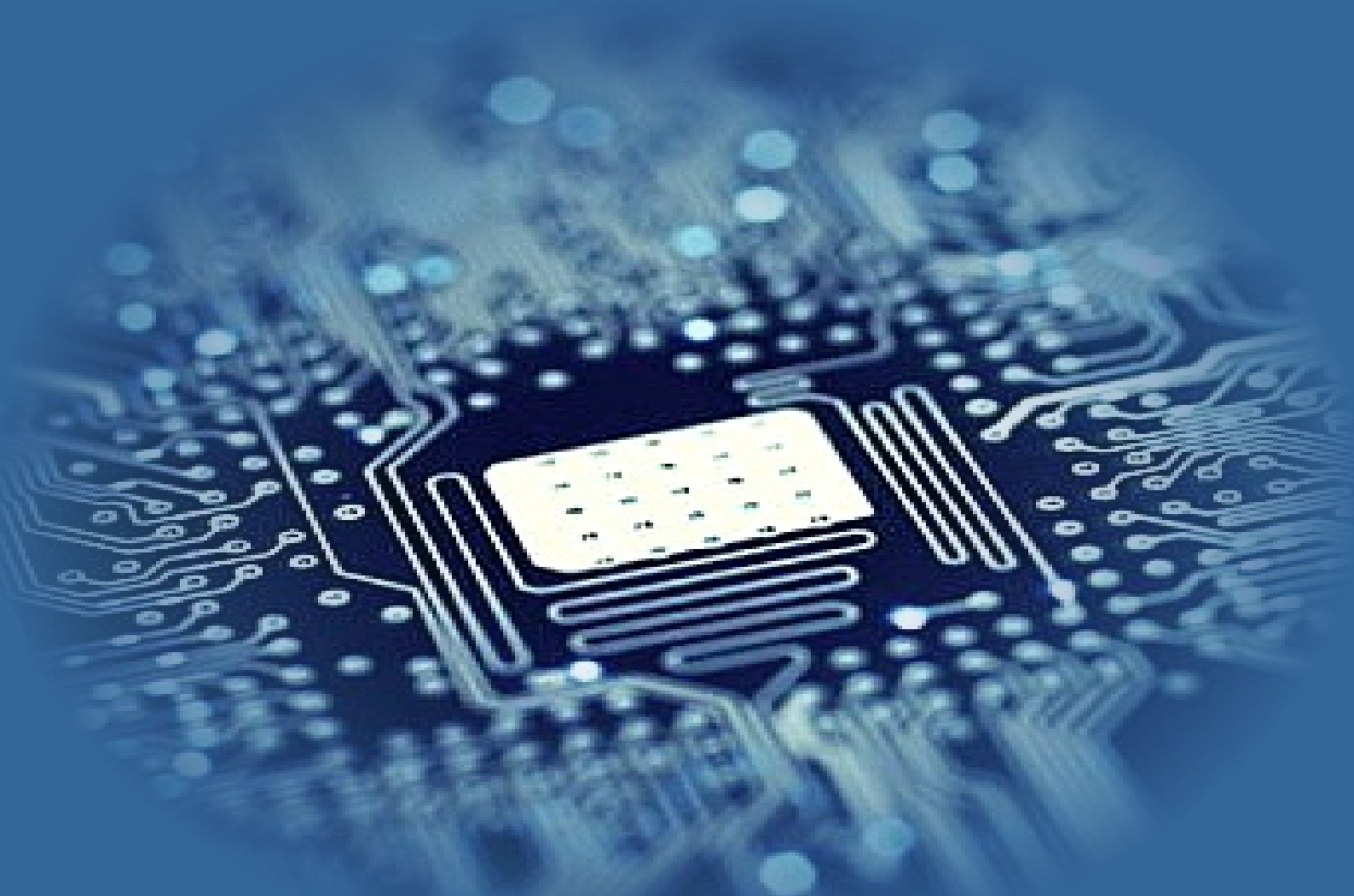


COMPUTER MODELLING AND NEW TECHNOLOGIES

2015
VOLUME 19 NO 4

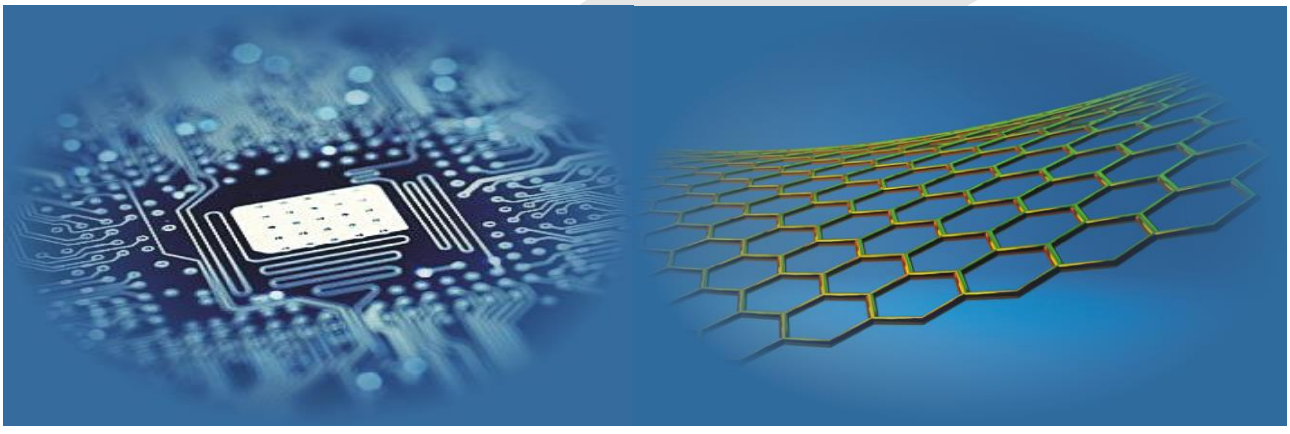
ISSN 1407-5806 ISSN 1407-5814 on-line

Latvian Transport Development and Education Association

Computer Modelling and New Technologies

2015 Volume 19 No 4

ISSN 1407-5806, ISSN 1407-5814 *(On-line: www.cmnt.lv)*



Riga – 2015

Journal topics:	**Publisher**	**Supporting Organizations**
• mathematical and computer modelling • computer and information technologies • natural and engineering sciences • operation research and decision making • nanoscience and nanotechnologies • innovative education	Latvian Transport Development and Education Association	Latvian Academy of Sciences Latvian Operations Research Society Transport and Telecommunication Institute, Latvia Fraunhofer Institute for Factory Operation and Automation IFF, Germany International IT University, Kazakhstan

Articles should be submitted in **English**. All articles are reviewed.

EDITORIAL CORRESPONDENCE	**COMPUTER MODELLING AND NEW TECHNOLOGIES, 2015, Vol. 19, No.4** **ISSN 1407-5806, ISSN 1407-5814 (on-line: www.cmnt.lv)**
Latvian Transport Development and Education Association	**Scientific and research journal** **The journal is being published since 1996**
68 Graudu, office C105, LV-1058 Riga, Latvia **Phone: (+371) 29411640** E-mail: yu_shunin@inbox.lv http://www.cmnt.lv	The papers published in Journal 'Computer Modelling and New Technologies' are included in: **INSPEC,** www.theiet.org/resources/inspec/ **VINITI,** http://www2.viniti.ru/ **CAS Database** http://www.cas.org/ **EI Compendex**

Editors' Remarks

****

A Moments Indulgence

by Rabindranath Tagore

The sun of the first day
Put the question
To the new manifestation of life-
Who are you?
There was no answer.
Years passed by.

The last sun of the last day
Uttered the question
on the shore of the western sea
In the hush of evening-
Who are you?
No answer came again.

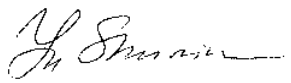
Rabindranath Tagore (1861-1941)♣

****

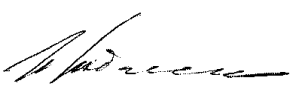
This 19th volume No.4 consists of four topical parts, namely, **Part A: Mathematical and Computer Modelling, Part B: Computer and Information Technologies, Part C: Operation Research and Decision Making and Part D: Nature Phenomena and Innovative Engineering.** These parts have a particular page numbering. References should include the symbols belonging to the part of the journal issue (A, B, C or D) and the pages of the paper quoted. (e.g.: ... **19**(4C) 77-89) We are planning to expand CMNT topics within the scope of its scientific interests.

Our journal policy is directed to fundamental and applied scientific researches, innovative technologies and industry, which is the fundamentals of the full-scale multi-disciplinary modelling and simulation. This edition is the continuation of our publishing activities. We hope our journal will be of interest for research community and professionals. We are open for collaboration both in the research field and publishing. We hope that the journal's contributors will consider collaboration with the Editorial Board as useful and constructive.

EDITORS



Yuri Shunin



Igor Kabashkin

♣ **Rabindranath Tagore (7 May 1861 – 7 August 1941),** was a Bengali poet, novelist, musician, painter and playwright who reshaped Bengali literature and music. As author of Gitanjali with its "profoundly sensitive, fresh and beautiful verse", he was the first non-European and the only Indian to be awarded the Nobel Prize for Literature in 1913. His poetry in translation was viewed as spiritual, and this together with his mesmerizing persona gave him a prophet-like aura in the west. His "elegant prose and magical poetry" still remain largely unknown outside the confines of Bengal.

Content A

The weakening of the energy flow of surface waves due to scattering by the roughness

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Received 1 May 2015, www.cmnt.lv

Abstract

The stream of elastic energy in a wave extending on a rough surface is calculated. For enough smooth surface attenuation of a superficial wave is defined by the transport time of a relaxation considering of non-essentially processes of scattering on a small corner.

Keywords: *energy flow, physics*

1 Introduction

In work [1] considered the spread of Rayleigh waves on a rough surface of an elastic isotropic half-space. The surface of the elastic medium assumed to be random, and the deviation of the random surface of the plane χ=0 was believed to be small compared with the length of spreading over the surface of the Rayleigh wave. Calculates the displacement vector of the medium averaged over the ensemble of random surfaces. Appeared attenuation τ was due to scattering Rayleigh waves into secondary Rayleigh waves and body waves. Similar problems have been considered earlier in work [2] and [3] by a different method. However, taking into account only the scattering of Rayleigh waves in the body waves. In some cases, the attenuation due to the excitation secondary Rayleigh waves, as shown in [1], is the main. Considered in [1] attenuation was calculated as the displacement pole averaged roughness of the Green's function of elasticity equations with appropriate boundary conditions. For this reason, the τ was determined by the scattering amplitude waves on the roughness and an increase in the correlation length of roughness *d* does not tend to zero.

On the other hand, an increase in *d* means an approximation to a perfectly flat surface, and in this case, the damping would be to decrease.

To answer this question in the present work calculated physical observable quantity - the energy flux density averaged over the rough. It is shown that in the limit of large *d* damping is determined by the transport time τ_{tr}, decreasing for large *d*. The reason for replacing the τ to τ_{tr} related to the fact that the scattering at zero angle does not contribute to attenuation. In the calculation of the flow along with the Green's function is required to consider vertex diagrams, which leads to the appearance. The problem is being solved is close to the problem of skin-effect on the rough surface [4]. Another example - the resistance of alloys [5].

The energy flux density $\mathbf{q}(x, s, t)$ in the sound wave determined based on the continuity equation

$$\frac{d\varepsilon(x,s,t)}{dt} = -div\,\mathbf{q}(x,s,t),$$

where the energy density is determined by the expression

$$\varepsilon = \rho c_t^2 u_{ik}^2 + \frac{\rho}{2}\left(c_l^2 - 2c_t^2\right)u_{jj}^2 + p_i\frac{u_i^2}{2}, \quad (1)$$

u_{ik} - strain tensor, S - a two-dimensional vector with coordinates *y,z*. Using the equations of motion

$$\ddot{u}_i = c_t^2\frac{\partial^2 u_i}{\partial x_j^2} + \left(c_l^2 - 2c_t^2\right)\frac{\partial^2 u_j}{\partial x_i \partial x_j}. \quad (2)$$

We obtain for $q(x,s,t)$ expression

$$q_j(x,s,t) = -\left[2\rho c_t^2 \dot{u}_i u_{ij} + \rho\left(c_l^2 - 2c_t^2\right)\dot{u}_j u_{ii}\right]. \quad (3)$$

From equation (2) and the boundary conditions

$$\sigma_{\alpha\beta}n_\beta = P_\alpha(x,s,t), \quad (4)$$

that must be done on a random surface $x = \xi(s)$,($\sigma_{\alpha\beta}$ - stress tensor), determined components of displacement $u_\alpha(x,s,t)$. We assume that the force $P_\alpha(x,s,t)$ is different from zero in a small area on the surface and calculate the flow at large distances from the point of excitation.

The solution of equations (2), decomposed in *t* and *s* as a Fourier integral, write in the form

$$u_\alpha(x,\mathbf{p},\omega) = \sum_\gamma u_\alpha^{(\gamma)}(\mathbf{p},\omega)C_\gamma(\mathbf{p},\omega)e^{ip_x^\gamma x}, \quad (5)$$

where $u_\alpha^{(\gamma)}(\mathbf{p},\omega)$ - own solution of the equations (2),

$$u_\alpha^{(\gamma)}(\mathbf{p},\omega) = \begin{pmatrix} p_x^{(x)} & ip_y & ip_z \\ -ip_y & -p_x^{(y)} & 0 \\ -ip_z & 0 & p_x^{(z)} \end{pmatrix}, \; p_x^{(\gamma)} = \sqrt{\frac{\omega^2}{c_\gamma^2} - p^2}. \quad (6)$$

The γ index of a column of a matrix (6) enumerates three independent decisions, the speed of spreading of c_γ coincides with the speed of transverse waves at $\gamma = y, z$ and with a speed of longitudinal waves of $\gamma = x$. $\mathbf{C}(\mathbf{p},\omega)$ vector is determined from the boundary condition (4), which, after decomposition in a Fourier integral and substituting (5) into (4) takes the form (drop the vector indices).

$$H^{(0)}(\mathbf{p},\omega)\mathbf{C}(\mathbf{p},\omega)+\int\frac{d^2q}{(2\pi)^2}\left[\mathbf{V}^{(1)}(\mathbf{p},\mathbf{q})+\mathbf{V}^{(2)}(\mathbf{p},\mathbf{q})\right]\mathbf{C}(\mathbf{q},\omega)=\mathbf{P}(\mathbf{p},\omega), \tag{7}$$

where

$$H^{(0)}_{\alpha\gamma}(\mathbf{p},\omega)=i\left(p_x^{(\gamma)}u_\alpha^{(\gamma)}(\mathbf{p},\omega)+p_\alpha u_x^{(\gamma)}(\mathbf{p},\omega)+\delta_{\alpha x}\left(\frac{c_l^2}{c_t^2}-2\right)p_\beta u_\beta^{(\gamma)}(\mathbf{p},\omega)\right)$$

$$\left.\begin{aligned}
&\mathbf{V}_\alpha^{(1)}(p,q)=\xi(\mathbf{p}-\mathbf{q})\Big[\delta_{\alpha\beta}(\mathbf{p}-\mathbf{q})\mathbf{q}u_\beta^{(\gamma)}(\mathbf{q},\omega)+(p-q)_\beta\,q_\alpha u_\beta^{(\gamma)}(\mathbf{q},\omega)+\\
&+\left(\frac{c_l^2}{c_t^2}-2\right)(p-q)_\alpha\,q_\beta u_\beta^{(\gamma)}(\mathbf{q},\omega)-q_x^{(\gamma)^2}u_\alpha^{(\gamma)}(\mathbf{q},\omega)+\\
&q_\alpha q_x^{(\gamma)}u_x^{(\gamma)}(\mathbf{q},\omega)+\left(\frac{c_l^2}{c_t^2}-2\right)\delta_{\alpha x}q_x^{(\gamma)}q_\beta u_\beta^{(\gamma)}(\mathbf{q},\omega)\Big],\\
&\mathbf{V}_{\alpha\gamma}^{(2)}(\mathbf{p},\mathbf{q})=i\int\frac{d^2q'}{(2\pi)^2}\xi(\mathbf{p}-\mathbf{q}-\mathbf{q}')\xi(\mathbf{q}')q_x^{(\gamma)}\Bigg[\left(qq'-\frac{q_x^{(\gamma)^2}}{2}\right)u_\alpha^{(\gamma)}(\mathbf{q},\omega)+\\
&+\left(q'_{\beta\delta}-\delta_{\beta x}\frac{q_x^{(\gamma)}}{2}\right)q_\alpha^{(\gamma)}u_\beta^{(\gamma)}(\mathbf{q},\omega)+\left(\frac{c_l^2}{c_t^2}-2\right)\left(q'_{\alpha\delta}-\delta_{\alpha x}\frac{q_x^{(\gamma)}}{2}\right)q_\beta^{(\gamma)}u_\beta^{(\gamma)}(\mathbf{q},\omega)\Bigg].
\end{aligned}\right\} \tag{8}$$

In the formulas (8) $p_{\alpha\delta}=0$ at $\alpha = x$, $p_\alpha = p_y$, p_z at $\alpha = y, z$. As in [1], we consider the amplitude of the roughness is small compared to the wavelength of sound ad, so the derivation of (7) the left side of the boundary condition (4) is decomposed by ~ ξ accurate to the second order.

To calculate the flow required substitute (5) into (3)

$$\begin{aligned}
q_s(x,\mathbf{p},\omega)=-\frac{\rho c_t^2}{(2\pi)^3}\int\omega' d\omega' d^2p'\Big\{(p-p')_{s'}\Big[&u_k^{(\gamma)}(\mathbf{p}',\omega')u_k^{(\beta)}(\mathbf{p}-\mathbf{p}',\omega-\omega')\delta_{s's}+\\
+u_{s'}^{(\gamma)}(p',\omega')u_s^{(\beta)}(\mathbf{p}-\mathbf{p}',\omega-\omega')+&\left(\frac{c_l^2}{c_t^2}-2\right)u_s^{(\gamma)}(\mathbf{p}',\omega')u_{s'}^{(\beta)}(\mathbf{p}-\mathbf{p}',\omega-\omega')\Big]+\\
+p_x^{(\beta)}(p-p')u_x^{(\gamma)}(\mathbf{p}',\omega')u_s^{(\beta)}(\mathbf{p}-\mathbf{p}',\omega-\omega')+&\\
+\left(\frac{c_l^2}{c_t^2}-2\right)p_x^{(\beta)}(p-p')u_s^{(\gamma)}(\mathbf{p}',\omega')u_x^{(\beta)}(\mathbf{p}-\mathbf{p}',\omega-\omega')\Big\}\times&\\
\times C_\gamma(\mathbf{p}',\omega')C_\beta(\mathbf{p}-\mathbf{p}',\omega-\omega')\exp\left\{i\left(p_x^{(\gamma)}(p')+p_x^{(\beta)}(p-p')\right)x\right\}&
\end{aligned}. \tag{9}$$

In the flow interesting us at large distances from the point of excitation term with $p_x^{(\beta)}(p-p')$ using conditions (4) can be reduced to the form containing $(p-p')_s$, then the expression (9) takes the form

$$\begin{aligned}
q_s(x,\mathbf{p},\omega)=-\frac{\rho c_t^2}{(2\pi)^3}\int\omega' d\omega' d^2p'(p-p')_{s'}C_\gamma(\mathbf{p}',\omega')C_\beta(\mathbf{p}-\mathbf{p}',\omega-\omega')\times&\\
\times T_{ss'}^{(\gamma\beta)}(\mathbf{p}',\omega',\mathbf{p}-\mathbf{p}',\omega-\omega')\exp\left\{i\left(p_x^{(\gamma)}(p')+p_x^{(\beta)}(p-p')\right)x\right\}&
\end{aligned}, \tag{10}$$

where

$$\begin{aligned}
T_{ss'}^{(\gamma\beta)}(\mathbf{p}',\omega',\mathbf{p}-\mathbf{p}',\omega-\omega')=&u_k^{(\gamma)}(\mathbf{p}',\omega')u_k^{(\beta)}(\mathbf{p}-\mathbf{p}',\omega-\omega')\delta_{s's}+\\
+u_{s'}^{(\gamma)}(\mathbf{p}',\omega')u_s^{(\beta)}(\mathbf{p}-\mathbf{p}',\omega-\omega')-&2u_s^{(\gamma)}(\mathbf{p}',\omega')u_{s'}^{(\beta)}(\mathbf{p}-\mathbf{p}',\omega-\omega')-.\\
-u_x^{(\gamma)}(\mathbf{p}',\omega')u_x^{(\beta)}(\mathbf{p}-\mathbf{p}',\omega-\omega')\delta_{s's}&
\end{aligned}$$

To calculate **C** need to solve the equation (7). Considering $\xi(s)$ small, we solve equation (7) iterations on $\mathbf{V}^{(1)}$ and $\mathbf{V}^{(2)}$.

In the zero approximation

$$\mathbf{C}^{(0)}(\mathbf{p},\omega) = H^{(0)-1}(\mathbf{p},\omega)P(\mathbf{p},\omega)$$

Substituting $\mathbf{C}^{(0)}(\mathbf{p},\omega)$ in (5), we obtain the solution on a perfectly flat surface

$$u_\alpha(x,\mathbf{p},\omega) = u_\alpha^{(\gamma)}(\mathbf{p},\omega)H_{\gamma\beta}^{(0)-1}(\mathbf{p},\omega)P_\beta(\mathbf{p},\omega)e^{ip_x^{(\gamma)}x}. \quad (11)$$

The poles of $u_\alpha(x,p,\omega)$ (11) defined from a condition

$$\det H^{(0)}(p,\omega) = \left(2p^2 - \frac{\omega^2}{c_t^2}\right)^2 + 4p^2 p_x^y p_x^x = 0$$

give the known spectrum of Rayleigh waves on the ideal surface

$$p = p_0(\omega) = \frac{\omega}{c_R}.$$

The time-averaged flow of energy density, determined by integrating (10) with respect to p multiplier $e^{i\mathbf{p}\mathbf{s}}$, must be calculated at $\omega = 0$. On the ideal surface the result of integration at large distances determined by the poles and branch points of the expression (11), as well as the saddle point exponent. Recent determine the contribution of body waves in the flow of energy. In the integration over the angle between p and s are two saddle points corresponding to the two directions of spreading. We find the contribution of the poles, i.e Rayleigh waves, in the flow of energy. Writing the inverse matrix $\mathbf{H}^{(0)-1}(\mathbf{p},\omega)$ as near the pole in the form of

$$\mathbf{H}_{\gamma\beta}^{(0)-1}(\mathbf{p},\omega) = \left(p^2 - p_0^2(\omega) + i\delta\right)^{-1} R_{\gamma\beta}(\mathbf{p}), \quad (12)$$

where $R_{\gamma\beta}(\mathbf{p})$ has no singularities, we obtain for the contribution of Rayleigh waves in the flow of energy the following estimate

$$q^{(s)}(0,\mathrm{s},0) \sim \frac{\rho}{s}\int d\omega' \omega'^3 p^2(\omega'). \quad (13)$$

The contribution of the saddle point $p_\gamma = \frac{\omega}{c_\gamma}\left(s\Big/\sqrt{(x^2+s^2)}\right)$, available in the integral modulo the *p*, is estimated as follows

$$q^s(x,\mathrm{s},0) \sim \frac{\rho c_t x^3}{(x^2+s^2)^{5/2}}\int d\omega' \omega'^3 p^2(\omega'). \quad (14)$$

It is easy to see that the input branch at large distances proportional $1\Big/(x^2+s^2)^{5/4}$, that is small compared to (14). Returning to the case of a rough surface on the n step iterations, we find

$$C^{(n)}(\mathbf{p},\omega) = -\int \frac{d^2q}{(2\pi)^2} H^{(0)-1}(\mathbf{p},\omega)\left[\mathbf{V}^{(1)}(\mathbf{p},\mathbf{q}) + \mathbf{V}^{(2)}(\mathbf{p},\mathbf{q})\right]C^{(n-1)}(\mathbf{p},\omega). \quad (15)$$

Substituting (15) into (10) and averaging over a rough, we see that there are two types of terms. In terms of the first type $C_\gamma(\mathbf{p}',\omega')C_\beta(\mathbf{p}-\mathbf{p}',\omega-\omega')$ average of the product into a product of averages. Calculate the average of $C_\gamma(\mathbf{p}',\omega')$, described in detail in [1], leads to the following result $\langle C_\gamma(p,\omega)\rangle = H_{\gamma\alpha}^{-1}(p,\omega)P_\alpha(p,\omega)$

$$H_{\gamma\alpha}(\mathbf{p},\omega) = H_{\gamma\alpha}^{(0)}(\mathbf{p},\omega) - \int \frac{d^2q}{(2\pi)^2}\left(\left\langle \mathbf{V}_{\gamma\beta}^{(1)}(\mathbf{p},\mathbf{q})H_{\beta\delta}^{(0)-1}(\mathbf{q},\omega)\mathbf{V}_{\delta\alpha}^{(1)}(\mathbf{q},\mathbf{p})\right\rangle + \left\langle \mathbf{V}_{\gamma\alpha}^{(2)}(\mathbf{p},\mathbf{p})\right\rangle\right). \quad (16)$$

Members with **V** change spectrum of Rayleigh waves. Near the pole H^{-1} can be represented in a form similar to (12)

$$\mathbf{H}^{-1}(\mathbf{p},\omega) = \left(p^2 - p_0^2(\omega) + i/\tau c_R\right)^{-1} R(\mathbf{p}). \quad (17)$$

Asymptotic expressions for $(\tau c_R)^{-1}$ are given in [1]. Note that formula (16) allows us to calculate the attenuation of a second order in the ξ/λ, in which it is determined by the binary correlation function

$$\left\langle V^{(1)}V^{(1)}\right\rangle \sim \xi_2 \sim \langle \xi(\mathbf{p})\xi(\mathrm{p}')\rangle = (2\pi)^2\delta(p+p')\xi_2(p)$$

Easy to see that while $\mathbf{V}^{(1)}$ defines as attenuation and the displacement the ownl frequencies, $\left\langle \mathbf{V}^{(2)}(\mathbf{p},\mathbf{p})\right\rangle$ - does not contribute to attenuation. For this reason, further $\left\langle \mathbf{V}^{(2)}(\mathbf{p},\mathbf{p})\right\rangle$ won't be considered.

Does not reduce to the product of the average expression of the second order in shown in Figure 1.

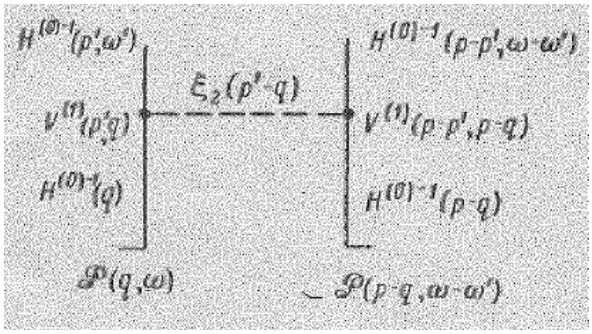

FIGURE 1 The diagram of the second order

Thin line begins with $H^{(0)-1}(\mathbf{p}',\omega')$ and ends with $P(\mathbf{q},\omega')$, or begins with $H^{(0)-1}(\mathbf{p}-\mathbf{p}',\omega-\omega')$ and ends with $P(\mathbf{p}-\mathbf{q},\omega-\omega')$, and the dotted line corresponds to the binary correlation function ξ_2, at the top there is a multiplier $\mathbf{V}^{(1)}$. Performing the summation of the iterative series for the average

$$\left\langle C_\gamma(\mathbf{p}',\omega')C^*_\beta(\mathbf{p}'-\mathbf{p},\omega'-\omega)(p'-p)_s\right\rangle \equiv \prod_{\gamma\beta s}(\mathbf{p}',\omega',\mathbf{p}'-\mathbf{p},\omega'-\omega)$$

in the ladder approximation we obtain the equation

$$\prod_{\gamma\beta s}(\mathbf{p}',\omega',\mathbf{p}'-\mathbf{p},\omega'-\omega) = H^{-1}_{\gamma\alpha}(\mathbf{p}',\omega')H^{-1*}_{\beta\delta}(\mathbf{p}'-\mathbf{p},\omega'-\omega)\times$$
$$\times\left[P_\alpha(\mathbf{p}',\omega')P^*_\delta(\mathbf{p}'-\mathbf{p},\omega'-\omega)\right](p'-p)_s + \quad . \qquad (18)$$
$$+\int\frac{d^2q}{(2\pi)^2}\left\langle \mathbf{V}^{(1)}_{\alpha\mu}(\mathbf{p}',\mathbf{q})\mathbf{V}^{(1)*}_{\delta\alpha}(\mathbf{p}'-\mathbf{p},\mathbf{q}-\mathbf{p})\right\rangle\prod_{\mu\alpha s}(\mathbf{q},\omega',\mathbf{q}-\mathbf{p},\omega'-\omega)$$

Later on we will be interested in the case when the correlation length d (an area in which ξ_2 significantly different from zero) is large in comparison with the characteristic length of Rayleigh waves. In deriving (18) we have neglected terms of order λ/d. The time-averaged flow $\mathbf{q}(x,\mathbf{p},\omega)$ at large distances is determined by p and ω, are small in comparison with the characteristic frequency and length of Rayleigh waves. For this reason, the integral

$$\int\frac{d^2t}{(2\pi)^2}\left\langle \mathbf{V}^{(1)}_{\alpha\mu}(\mathbf{p}',\mathbf{t})\mathbf{V}^{(1)*}_{\beta\nu}(\mathbf{p}'-\mathbf{p},\mathbf{t}-\mathbf{p})\right\rangle\prod_{\mu\nu s}(\mathbf{t},\omega',\mathbf{t}-\mathbf{p},\omega'-\omega) = p'_s\mathbf{K}_{\alpha\beta}(\omega,\omega'). \qquad (19)$$

We will calculate at small p and ω, p' corresponds to the length of the excited Rayleigh waves. To solve equation (18) multiply it by $\left\langle \mathbf{V}^{(1)}_{\alpha\gamma}(\mathbf{l},\mathbf{p}')\mathbf{V}^{(1)*}_{\delta\beta}(\mathbf{l}-\mathbf{p},\mathbf{p}'-\mathbf{p})\right\rangle$ and integrate over p'. We obtain

$$\mathbf{l}_s\mathbf{K}_{\alpha\delta}(\omega,\omega') = \int\frac{d^2p'}{(2\pi)^2}\left\langle \mathbf{V}^{(1)}_{\alpha\gamma}(\mathbf{l},\mathbf{p}')\mathbf{V}^{(1)*}_{\delta\beta}(\mathbf{l}-\mathbf{p},\mathbf{p}'-\mathbf{p},)\right\rangle\times$$
$$\times H^{-1}_{\gamma\mu}(\mathbf{p}',\omega')H^{-1*}_{\beta\gamma}(\mathbf{p}'-\mathbf{p},\omega'-\omega)\left[P_\mu(\mathbf{p}',\omega')P^*_\gamma(\mathbf{p}'-\mathbf{p},\omega'-\omega)+\mathbf{K}_{\mu\gamma}(\omega,\omega')\right]p'_s \qquad (20)$$

The character of the solutions of (20) is determined by which of the functions

$\xi_2(\mathbf{l}-\mathbf{p}')\sim\left\langle \mathbf{V}^{(1)}(\mathbf{l},\mathbf{p}')\mathbf{V}^{(1)*}(\mathbf{l}-\mathbf{p},\mathbf{p}'-\mathbf{p})\right\rangle$ or $H^{-1}(\mathbf{p}',\omega')H^{-1*}(\mathbf{p}'-\mathbf{p},\omega'-\omega)$ are in the integration over p' more acute. The first significantly changes at modification of the module in the range of $1/d$ order, and the second – in the range of $1/\tau c_R$. Appropriate intervals of the angle of the vector $\mathbf{p}'$: $1/dp_0(\omega')$ for $\xi_2(\mathbf{l}-\mathbf{p}')$ and $1/\sqrt{\tau c_R p}$ for $H^{-1}(\mathbf{p}',\omega')H^{-1*}(\mathbf{p}'-\mathbf{p},\omega'-\omega)$. Multiplying (20) on the scalar $\mathbf{l}$ and using (18) we see that the following limiting cases.

The correlation radius d is large in comparison with the τc_R. Integration with respect to the vector $\mathbf{p}'$ in (20) is performed using a sharp function $\xi_2(\mathbf{l}-\mathbf{p}')$, and pole denominators H^{-1} may be submitted at $\mathbf{p}'=\mathbf{l}$. In this we obtain

$$K_{\alpha\delta}(\omega,\omega') = i\pi b\left[\left\langle -\int M_{\alpha\mu}M^*_{\delta\gamma}\cos\theta' d\theta'\right\rangle P_\mu P^*_\gamma + \left\langle -\int M_{\alpha\mu}M^*_{\delta\gamma}\cos\theta' d\theta'\right\rangle K_{\mu\gamma}(\omega,\omega')\right]. \qquad (22)$$

Solving (22), we find

$$K_{\mu\gamma}(\omega,\omega') = \left[\delta_{\mu\beta}\delta_{\nu\gamma} - i\pi b\left\langle -\int M_{\mu\beta}M^*_{\nu\gamma}\cos\theta' d\theta'\right\rangle\right]^{-1}\times\left\langle -\int M_{\beta\alpha}M^*_{\gamma\delta}\cos\theta' d\theta'\right\rangle i\pi b P_\alpha P^*_\delta .$$

Substituting the value $K_{\alpha\delta}$ of (22) into the expression for the polarized operator $\prod_{\gamma\beta s}$ (18), we obtain

$$\prod_{\gamma\beta s} = H^{-1}_{\gamma\alpha}H^{-1*}_{\beta\delta}p'_s\left\{P_\alpha P^*_\delta + \left[\delta_{\alpha\beta}\delta_{\delta\gamma} - i\pi b\left\langle -\int M_{\alpha\beta}M^*_{\delta\gamma}\cos\theta' d\theta'\right\rangle\right]^{-1}\times\ i\pi b\left\langle -\int M_{\beta\mu}M^*_{\nu\nu}\cos\theta' d\theta'\right\rangle P_\mu P^*_\gamma\right\}.$$

Presenting the inverse matrix as

case, used the ladder approximation is inapplicable because it omitted the derivation of (18) diagrams are large in parameter $(ap')^{-2}$

At lower values of the correlation length $d<\tau c_R$ integration modulo $\mathbf{p}$ performed using pole denominators, and the integration over the angle θ' - between $\mathbf{p}'$ and $\mathbf{l}$ and using the function ξ_2 on condition.

$$\frac{P}{(P_0(\omega')d)^2}\ll\frac{1}{\tau c_R}. \qquad (21)$$

Allocating polar as denominator $b\equiv\left(p\cos\theta+p_0(\omega)-i/\tau c_R\right)^{-1}$, where θ - a angle between $\mathbf{p}'$ and $\mathbf{l}$, and entering the matrix which does not have features $M_{\alpha\beta}(\mathbf{l},\mathbf{p}') = \dfrac{\mathbf{V}^{(1)}_{\alpha\delta}(\mathbf{l},\mathbf{p}')R_{\delta\beta}(\mathbf{p}')}{2p_0(\omega')}$,

$$\left[\delta_{\mu\beta}\delta_{\nu\gamma} - i\pi b\left\langle -\int M_{\mu\beta}M^{*}_{\nu\gamma}\cos\theta' d\theta'\right\rangle\right]^{-1} =$$
$$= \det\left[\delta_{\mu\beta}\delta_{\nu\gamma} - i\pi b\left\langle -\int M_{\mu\beta}M^{*}_{\nu\gamma}\cos\theta' d\theta'\right\rangle\right] N_{\mu\beta,\nu\gamma},$$

where $N_{\mu\beta,\nu\gamma}$ has no features, we find

$$\prod_{\gamma\beta s}(\mathbf{p}',\omega',\mathbf{p}'-\mathbf{p},\omega'-\omega) =$$
$$= H^{-1}_{\gamma\alpha}(\mathbf{p}',\omega')H^{-1*}_{\beta\delta}(\mathbf{p}'-\mathbf{p},\omega'-\omega)\,p'_s\left\{\frac{-p\cos\theta - p_0(\omega)+\dfrac{i}{\tau r_R}}{-p\cos\theta - p_0(\omega)+\dfrac{i}{\tau_{tr}c_R}}\right\}N_{\mu\alpha,\nu\delta}P_\mu P^{*}_\nu, \quad (23)$$

where

$$\frac{1}{\tau_{tr}} = \pi c_R\left\langle -\int Sp\mathbf{M}\,Sp\mathbf{M}^{*}(\cos\theta'-1)d\theta'\right\rangle$$

The last integral is determined by the range of angles $|\theta'| < 1/p_0(\omega')d$, and we obtain the following estimate

$$|\theta'| < 1/p_0(\omega')d\,. \quad (24)$$

From formula (24) we see that with increasing d time τ_{tr} increases. Asymptotic of the flow of energy in this case is given by

$$q(0,s,0) \sim \exp\left\{-\frac{s}{\tau_{tr}c_R}\right\}S^{-1}p\int\omega'^{3}|P(\omega')|^2 d\omega',$$
$$(\tau c_R)^{-1} < d^{-1} < \frac{p_0(\omega')}{\sqrt{\tau c_R p}}. \quad (25)$$

In the case of $p/(p_0(\omega')d)^2 \gg (\tau c_R)^{-1}$ estimate solution of equation (18) is given by the first term on the right side. In this case, damping is determined by the same order of magnitude as the displacement of the poles of the Green functions $H^{-1}(\mathbf{p},\omega)$. Corresponding asymptotic formulas are given in [1].

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Balanced geometric model for uplink power control in industrial wireless networks

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Received 1 May 2015, www.cmnt.lv

Abstract

Industrial networks now are trying to implement wireless technologies, following the tendencies in communication networks. This task is complicated because of the nature of the industrial environment. Wireless connections hardly achieve the same stable quality of service (QoS) parameters as traditional cable ones. Interference is one of the reasons for that and effective solutions should be developed for its reducing in order to maximize the throughput of the wireless media. Balanced geometric model, which reduces interferences between end-users and access points, is proposed. It is based on Nash Equilibrium Theory and gives opportunity to control the output power of wireless devices in optimal way. The use of vectors in the model helps to analyse in details, impacts between the neighbour points – their power and direction. At the end, there is a sample for using balanced geometric model in industrial network.

Keywords: interference, Open-loop, closed loop, uplink power, industrial networks

1 Introduction

The information translated into modern industrial networks is characterized by its multimedia nature. Unlike the industrial traffic in the past, today not only sensor data and commands into a symbol form are transmitted to the actuators. The transfer of entire files, sound, voice and video requires new approaches and policies for network management. The ultimate goals of such management aim maximum benefits from the transmission medium, providing a high level of security when transferring critical workflow data, adequate scaling of services in the terms of variable load and mobility endpoints.

Besides the multimedia nature of transmission, new challenges arise from the tendency to replace cable connections with wireless in the terminal segments of the industrial networks. Some of these problems are related to uplink power management in such a network.

2 Traffic management models in industrial networks. Priority based models. Equilibrium models

There exist different management models and approaches in industrial networks. One of them tolerates priority. The nature of industrial applications supports priority transition of some data compared to the other, due to their higher degree of significance for the industrial management processes. Usually this data requires to be transmitted into shorter time intervals (in real time) and is called critical data. However, not all data transmitted in industrial networks meet this characteristics and this implies the use of models that take into account these features. These are priority-based models.

Priorities in industrial networks, however, may be set not only according to the type of the transferred information. The criteria for priority may be also different sources of the information stream. For example, the video stream from the quality control system on the assembly line should be priority transferred, according to a video stream from the surveillance system cameras in the same production space. In both cases, the information is a streaming video, but surveillance systems allow recording and buffering of the data. The video-stream, from quality control cameras must be transmitted in real time in order to be avoided latencies and scrapping production as a result or mixing of standard products with substandard.

One stage in the management of such models is a current state analysis of the network - the count and the type of transfer requests, channel load (occupied bandwidth), participants in the communication process at the analyzed moment. As a result of the analysis, priorities shall be appointed and according to them, different bandwidth parts to the different participants are provided for a specific time intervals.

Priority management according to the type of end nodes is hampered to somewhat by the mobility of the these nodes in wireless industrial networks.

All these circumstances make priority network management difficult to implement. Although there are established protocols and technologies, like MPLS for example, that can be used for implementation of such policy, the efficient management of the whole system requires use of multi-level criteria for evaluation of the priorities. Comprehensive assessment of the information on these criteria can introduce additional delays and decrease network performance. On the other hand the complicated analysis requires expensive and complicated hardware platform.

In contrast of priority models, there exist another type that explore the principles of equality. These models are called equilibrium models and tolerate even distribution of communication resources between the various actors in the communication process. Basically, the application of equilibrium models is used in the field of economic analysis, but their application in the field of communications is also possible. They use the principles of "fair

play". The policy in this case is limited to ensuring equitable access to the channels for each of the end nodes.

In this case, time slots analysis is used. It is realized through equal time intervals ΔT. Within this period the current state of the network is get into account, reports are analyzed and specifically decision is taken in accordance with the accepted policy. End nodes are competitors for the network resources. From physical point of view, these resources are limited and therefore the occupation of a larger share of a single participant automatically takes shares of the other participants. However, in practice the communication process is not one-sided and involves information exchange between multiple participants. This excludes tolerating scenario where only one or a few end-nodes occupy the entire physical network capacity.

The main advantages of the equilibrium communication models are related to their significantly easier implementation, simplified computational logic and correspondingly lower cost of the hardware devices. Another advantage is driven by their higher performance boost. The simplified analysis shortens decision-making. It also allows pro-active management – it is sufficiently fast response to meet the requirements of industrial applications and at the same time adequate to the environment to such an extent as to provide the desired quality of service.

The equilibrium models are suitable for upload power control in industrial wireless networks with high density and for maintaining the interference in the network on minimum-eligible equilibrium levels.

3 Interference impact in the industrial wireless networks

The interference is a phenomenon that describes a complex influence of two or more waves with the same frequency at certain points. As a result of the interaction of these waves, in the tested points can be obtained attenuation or amplification of the waves. The interaction between two waves is easy to analyze, but many disturbing sources make the task considerably more complex.

In the context of wireless industrial networks this phenomenon is affecting the distribution of radio waves. The range of the wireless zones is vulnerable to internal and external interfering sources (Figure 1).

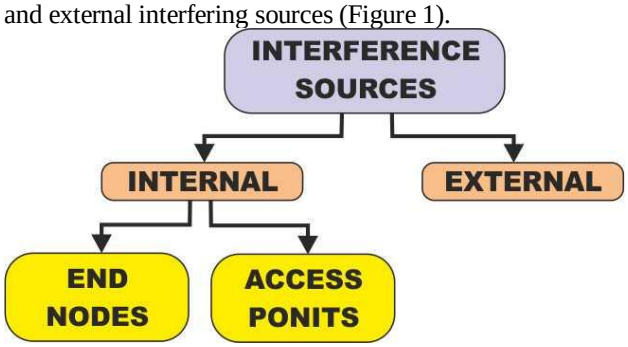

FIGURE 1 Classification of the interference sources in wireless industrial networks

External interfering sources are common in the industrial environment can be often observed in the industrial environment and their impact can be limited through a proper network planning, use of shields and / or directional antennas. Examples of such sources are powerful electromagnetic devices like transformers, contactors, electric motors, coils and others. The interference caused by these sources will not be dealt with in this report.

The other groups of interference impacts are internal for the network and can be divided into interference caused by near situated access points, working on the same or near frequencies and interference caused by end users into the area of the same access point. The accepted standards for wireless communication use bandwidth, divided into a separate channels. Each separate channel differs with a specific main carrier frequency and own frequency range (band). The standards allow partially overlapping bands of neighboring channels (Figure 2).

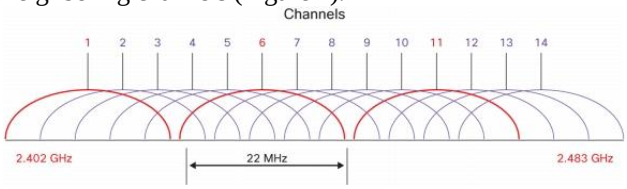

FIGURE 2 Channel bandwidths for 2.4GHz in the USA

This suggests the occurrence of interference in the adjacent access zones using adjacent frequency channels. The prevention against this type of interference includes administrative setting of distant frequency channels for the geographical neighboring access zones.

The interference between end users in a common zone arises due to the fact that they all use the same channel and respectively the same carrier frequency.

The end users, situated near the access point suffer less of interference impacts. Respectively the end users at the periphery of the zone are more vulnerable to an interference and at the same time, they are potentially more likely to generate similar impacts. The explanation for this is based on the amplitude of the signals at the points where end-users are positioned. The attenuation of radio signals for the used frequencies is realized on an exponential law.

End users situated near the access point receive significantly stronger signal from it and disturbing waves of other users are less likely to affect this link. In this situation, it is not necessary end devices to increase their output power in order to be connected to the access point. When end subscribers are placed on the periphery of the wireless zone, the signal from the access point is significantly weaker and more susceptible to interference impacts. In this case the end subscriber device tries to increase its uplink power in order to compensate for the attenuation of the signal caused by the long distance to the access point.

4 Known methods of preventing interfering influences

Bluetooth standard uses hopping carrier frequency in the defined frequency band (figure 3). The hopping frequency is changed automatically and synchronously, both in transmission and in the host side. This transmission method has been used since World War II, as the focus then was placed on the increased security of which provides. However, according to the subject matter of this paper, it may indicate the advantages in terms of safety from interference.

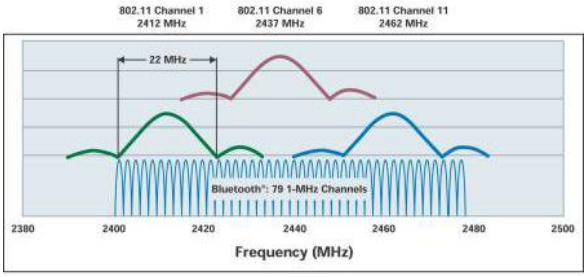

FIGURE 3 Hopping frequency channels in Bluetooth [16]

Hopping of the carrier frequency supposes that in occurrence of interference between two devices at a certain point, at the next moment the interference will be terminated due to the change of frequency in both interfering participants. The technology called Adaptive Frequency Hopping (AFH) relies on this principle, as it detects interfering devices, using different standards and protects them from setting the same carrier frequencies. There are used 79 frequencies with the interspace of 1 MHz. Bluetooth standard is used in the industrial wireless networks, but under certain conditions. Slower operating speeds and short-range distances mainly dictate its limited implementation.

Other method for minimizing the interference uses especially dedicated antennas for access points. When end users are static, their mutual influence can be suppressed by use of directional antennas. However, the access points often serve multiple subscribers distributed over a given territory, as some of them may be mobile. This limits the use of directional antennas. However, there exist antennas, constructed of multiple elements, as every one of them has a certain orientation. The antenna has an intelligent management and at work process can switch on and off some of its elements. The switching process is performed synchronously in time, according to which end subscriber communicates the access point at the given moment. So the antenna can effectively manage its beam.

5 Basic methods for uplink power control

One of the methods, specified by the standard organization 3GPP (3rd Generation Partnership Project), is known as Open Loop Power Control (OLPC) or also Fractional Power Control (FPC) [10, 13]. This method intends partial or full compensation of different values of SINR parameter for the subscribers with different allocation (Figure 4).

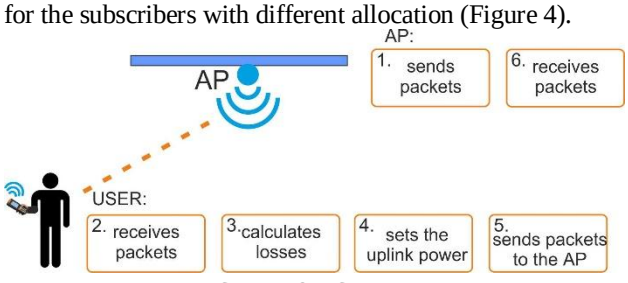

FIGURE 4 OLPC operation

In this method the end subscriber monitors the levels of the received signals and according to them determinates the necessary uplink output power on back direction. So the emitted signals can reliably reach the access point.

This method is called also "without feedback" because the access point does not have control over the output power of the end users. This method is not effective against interference and allows their appearance in a high density request environments. Due to this specification, it is not proper for uplink power control in a wireless industrial networks.

More reliable for implementation in this case is the other basic method known as Interference Based Power Control (IBPC). It uses the mechanism of Close Loop Power Control (CLPC) [2, 4, 7, 9, 13]. In this method, subscribers are not treated independently, but through management of uplink power on every subscriber it tries to increase the performance of the closed cells (serving access points) system as a whole. In other words it searches maximization of the total uplink throughput, through limiting the intercellular interference when it seeks a way to compensate the losses for the subscribers located in the border cell zones. [5,12]. The method is also known as "method for management and coordination with feedback", because the decision for uplink power is taken on basis of the received back into the access point signals.

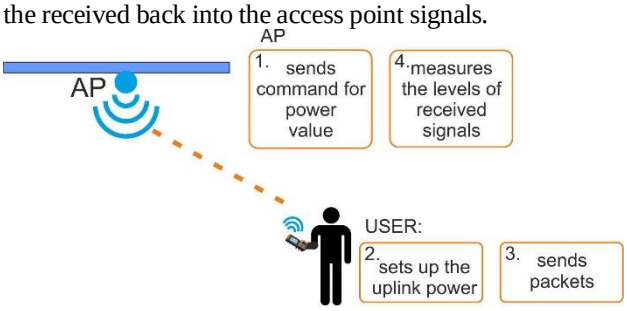

FIGURE 5 CLPC operation

The cycle shown on figure 5 repeats about 1000 times per second, which ensures precision and flexibility (short response time) of the mechanism. CLPC answers in a much higher degree of the requirements for high density industrial networks.

The methods for uplink power control, mentioned above use static analyses and do not represent reality from the point of the theory of service. Users constantly change their position and ongoing services requested. This requires development and research of dynamic uplink power management methods for wireless industrial networks and evaluation of the current density of service requests in base stations.

6 A vector model for equilibrium management of the interference

If it is necessary to analyze the interference between two access points, the factors affecting in this case would be:

- The output power of a signal for each of the points;
- Distance between the points;
- Direction of signal propagation.

The output power of a signal for each of the points is a function of the power sent from the final stage amplifier of the point transmitter and gain antenna used. On equal other circumstances, the dependence between output power and interference is directly proportional.

The distance between the two points in inverse proportion according to the interference.

In the theory of radio-wave signals except with its amplitude are described with its direction of propagation.

According to the topic of this paper, direction is detected to the geographical location of both access points (and the direction of transmission of their antennas, if they are directed).

These features show that for mathematical analysis, the most suitable geometric object to describe the interference is the vector. It also has size and direction, which adds greater visibility in the analysis.

For management of the energy estimation for uplink power in industrial environments is possible to use a relatively simple but effective approach based on a game theory. It aims by geometric (vector) analysis of the working environment to be achieved "Nash equilibrium" of interference between the separate zones. In his dissertation John Nash [11] explores situations of "game theory". According to this work, games can be divided into two main groups – cooperative and non-cooperative games. Non-cooperative games are those in which participants can make decisions only at its own discretion and interest, but by their actions a consequences arise for other players in the game. Nash considers a case with captured prisoners-accomplices, isolated from each other, which can confess their own and/or foreign wines and according to confessions made to get different sentences. According to the theory in terms of isolated interrogation, the lowest sentence prisoners will receive equal, if all plead guilty.

Brought in a field of high-density industrial networks, the Nash theory can be designed to interference influences. There are participants in the network connections. "The fault" or "confession" could be interpreted as own uplink transmit power to a particular participant and interference from other participants represent "punishment". In a case of inconsistency, each subscriber can emit high-power signal (not recognized wines), but afterwards the others will do the same. As a result, the total interference level will increase (greater penalty). According to the "Theory of Nash", the equilibrium of the system can be achieved, when participants limit their output power in such a manner, as they will generate minimal interference with each other. In this case there is a "non-cooperative game" because participants coordinate their uplink power only with access points. Every user suspects the interest of others, but only can take decisions on its own interest and shares the risk.

In this model are analyzed the interference impacts in the system, during equal time slots with an optimal duration and after that they are presented in a vector form. This form allows in real situations to receive, if necessary, a visual representation of the situation. The vectors coincide with the direction of the interference impacts, and according to the length indicate power of the influence. The ultimate goal is to achieve an equilibrium system in which interferences between separate zones are in a balance.

For example, the approach may be used for analysis of the interferences in the range of three adjacent access points in a high density industrial wireless network and customers located in them. On a figure 6 can be observed the mutual disposition of the analyzed wireless access points.

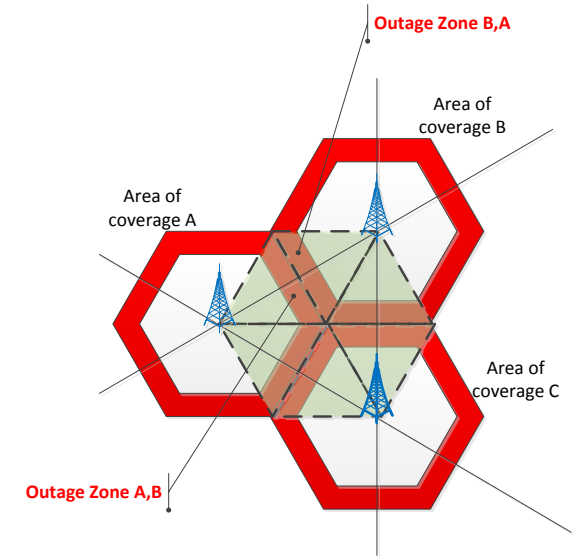

FIGURE 6 A part from wireless industrial network with three access points

Although the coverage zones are spherical in shape for the separate points, for the analysis purposes, on the figure they are presented as equilateral hexagons. On figure are marked the axes, on which interacts signals from the points, respectively on which will lie vectors. Highlighted in green area is the zone of interaction (interference). The border area of each cell is represented by a red line, as the subscribers located in this area generate significant interference in comparison with the others, located in the white access point area. As it was mentioned before in a point 3, as closer are users to the access point - the less power they need to support the communication and correspondingly feeble interference influences. This applies in the vector approach, visually distinguishing of the two types of subscribers identified by this criteria - near and peripheral situated.

If the scheme should represent interferences generated only between access points, ignoring for the moment influences from end users, the network will look like depicted in Figure 7.

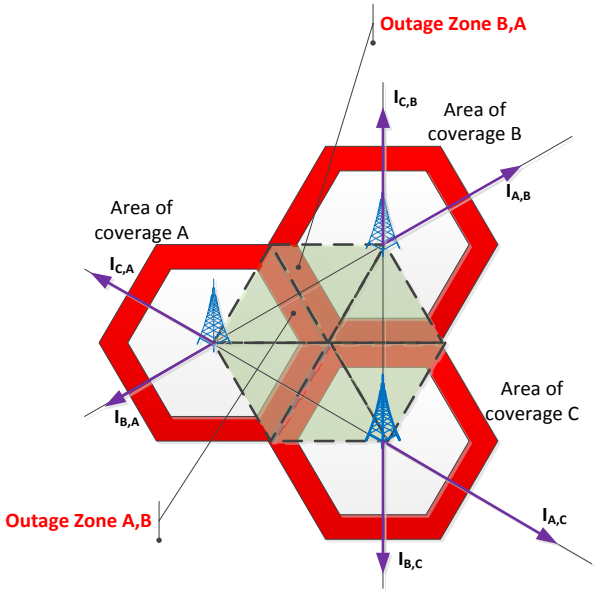

FIGURE 7 Interferences between access points

The vectors couple at each point represents interference in this place, generated by its neighbour access points. At this stage, it is easy to sum vector couples, but the results will not be credible if do not take into account the positions of subscribers, located in the separate areas (cells) of the access points.

On the figures above, the zone of interference influences (marked in green) is divided into triangles. They are important for the sectoral analysis caused of interference by customers. For example, the coverage area of point A has two sectors of influence (in a triangular form) – customers located in the north-positioned sector of figure, have an intensive influence on the access point B. Respectively customers located in the south-positioned sector of figure, have an intensive influence on the access point C.

Classification and grouping of customers according to their position is shown on Figure 8.

Having in mind the possibilities of mobility and transience of some subscribers is necessary for the analysis to take into account the relative values regarding the number of subscribers in the border areas of the sectors. The formula for obtaining this value is:

$$KI_{X,Y} = QXY_{out} / QXY_{all}, \quad (1)$$

where

$KI_{X,Y}$ - relative number of customers in the border area between cells X and Y, in the sector near by X.

QXY_{out} – absolute number of customers in the border area between cells X and Y, в in the sector near by X.

QXY_{all} – total number of clients in the sector with interfering influences of cell X to the side of cell Y.

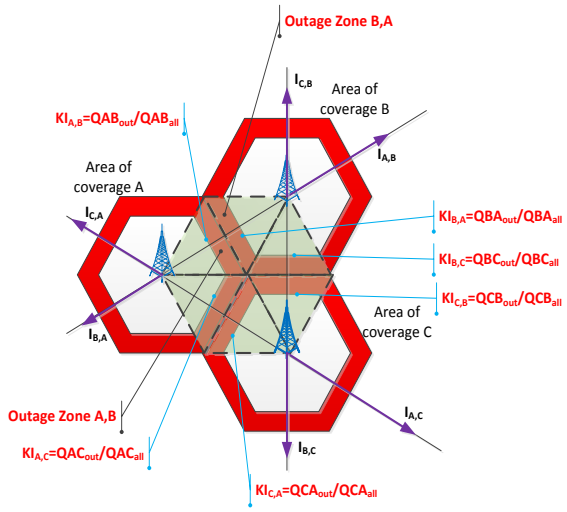

FIGURE 8 Differentiation of the clients according to their number and position

The total interference impact for individual areas (access points) and for the system at all are presented in Figure 9. The graphic analysis indicates, in the shown example, that it is necessary to increase the uplink power of cells B and C or to reduce the power of the A, in order to achieve equilibrium.

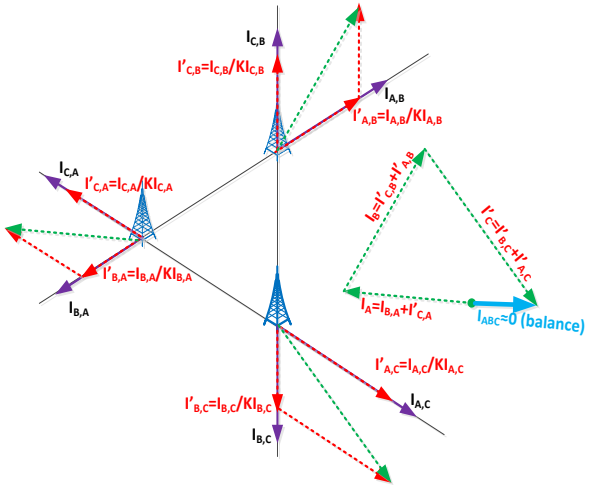

FIGURE 9 Sum of the interference for the explored zone

As it can be seen from the figure above, the relative interference impact for each of these cells can be calculated by the formula 2:

$$I'_{X,Y} = I_{X,Y} / \mathrm{K}I_{X,Y}, \quad (2)$$

where

$I'_{X,Y}$ - relatively interference influence of cell X upon cell Y.

$I_{X,Y}$ - Interference of the access point in cell X upon the access point in cell Y.

$\mathrm{K}I_{X,Y}$ - relative number of customers in the border area between cells X and Y, in the sector near by X.

After summing the vectors of the example was obtained triangle on the right side of the figure. The blue vector in the figure - I_ABC shows equilibrium by Nash. As more as this vector tends to zero, as much equilibrium system is and interference influences are balanced.

7 Scenarios in the case of interference imbalance

The reasons for an imbalance between the three points can be different. Mostly they are related to the mobility of subscribers, temporary occurrence of external interference, changing the density of requests, inadequate management, poor synchronization.

In order to apply the method, described in the previous paragraph, the access points should measure levels of interference and take decisions to achieve the minimization of the balance vector. The access points implement decisions by adjusting the uplink power, both for themselves and for the adjacent subscribers. Power of the subscribers can be set through a value of the coefficient α. It can vary in a range from 0 to 1 in a given step. For α=1, set capacity is the maximum possible, which can use the particular subscriber. Other management rule says that the coefficient α for anyone of the subscribers in every new time slot can be changed with only one step up or down.

In so established rules, one of the worst scenarios for behavior of the system is displayed in Figure 10.

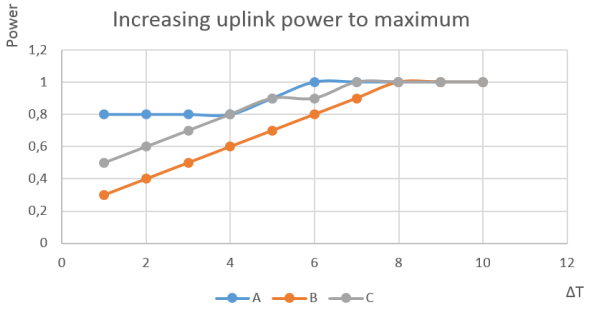

FIGURE 10 Mutual suppression

In this case, the separate access points (zones A, B and C) do not tend toward equilibrium and management in response to the increasing interference consists only in attempts for a compensatory rising of the output power. As a result, it can be observed exponential increasing of the interference and possibilities for blocking of the system. In industrial networks blocking is unacceptable and therefore, this type of control is considered as not applicable.

Another scenario is related with the inability for achieving balance, despite the possibilities of the system not only to increase the capacity of certain subscribers, but also to suppress those that generate excessive interference. Private case of this scenario can be observed on Figure 11.

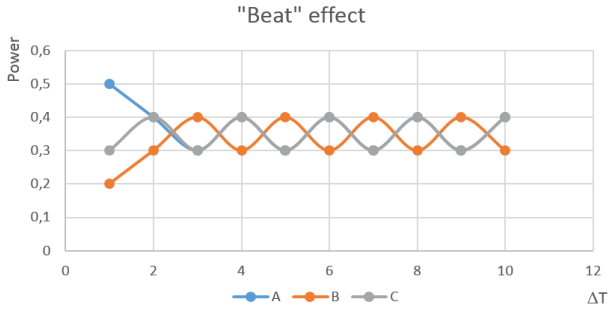

FIGURE 11 Inability to achieve balance

The figure shows pulse of power for the separate access points, two of which are in equilibrium with respect to each other (A and C), but the third is always unbalanced in relation to them (B).

The reasons this type of scenario to happen are limited mostly to incorrect selection of the length of a time slot ΔT.

At equilibrium (Figure 12) for the system shown on Figure 6, if we do not take into account external interferences and influences of the environment, the transmitted power from all three zones must be the same. The reason is that the access points are at the same distance and angle to each other.

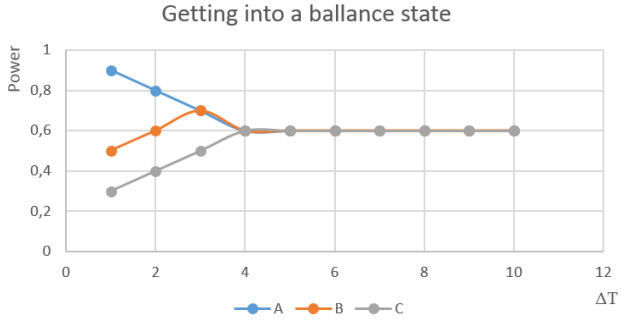

FIGURE 12 Achieving balance

In this situation, the balance vector $I_{ABC} = 0$ and the access points share equal the negative interference impact. The usage of the equilibrium vector model aims exactly such a situation.

8 An example of using the equilibrium vector model. Results obtained

The approach explained above, can be used for analysis of a particular example of wireless industrial network. The actual location of end devices of this example is depicted on Figure 13.

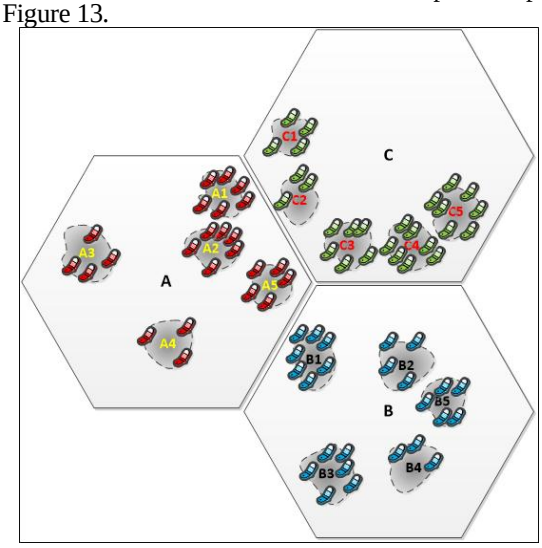

FIGURE 13 Placement of the end users in three separate areas at high density industrial network

Although, the end subscribers in the example are of different types (sensors and actuators), for the analyses purposes, they are drown the same way and only their color is different according to their belonging to a specific cell. The individual subscribers are grouped in a subgroups depending on their location in the cell (zone). The explanation of the figure is represented in a data form on Table 1.

TABLE 1

	A	B	C	Users in a Subgr.		
	X				**{GGIP}AB**	**{GGIP}AC**
A1	**308**	780	470	6	**948**	**1573**
A2	**148**	618	563	6	**575**	**631**
A3	**228**	935	917	4	**390**	**398**
A4	**210**	680	812	3	**371**	**310**
A5	**294**	480	458	5	**1225**	**1284**
		X			**{GGIP}BA**	**{GGIP}BC**
B1	451	266	624	7	**1651**	**1194**
B2	737	158	561	4	**343**	**451**
B3	676	211	881	6	**749**	**575**
B4	878	166	853	3	**227**	**234**
B5	826	162	667	5	**392**	**486**
			X		**{GGIP}CA**	**{GGIP}CB**
C1	536	854	283	4	**845**	**530**
C2	438	627	270	3	**740**	**517**
C3	530	471	269	6	**1218**	**1371**
C4	727	471	255	7	**982**	**1516**
C5	844	595	240	7	**796**	**1129**

The values in columns A, B and C represent the distances between the concrete subscriber groups and access points in the adjacent zones. In the both columns on the right is calculated the impact of every subgroup over the other cells. Visually represented, the results will look the following way:

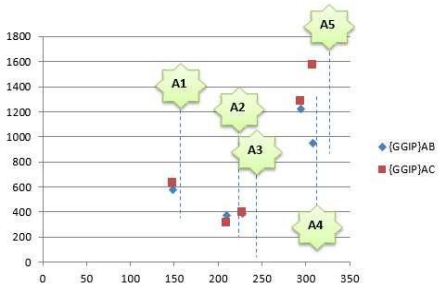

FIGURE 14 Influence of subgroups of zone A to the other subgroups

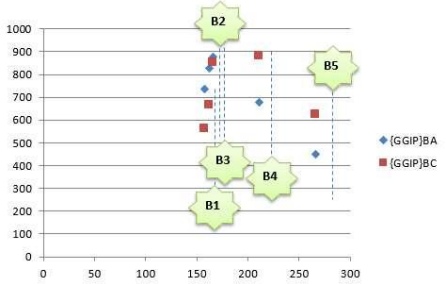

FIGURE 15 Influence of subgroups of zone B to the other subgroups

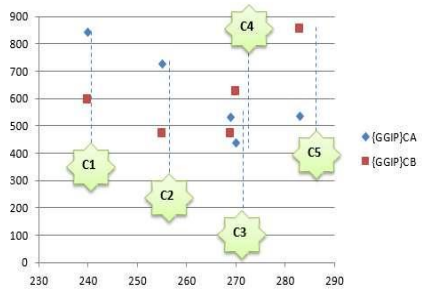

FIGURE 16 Influence of subgroups of zone C to the other subgroups

9 Conclusion

The analysis of the obtained results proves that every subgroup of subscribers generates higher interferences to the neighboring cells, when is situated on a maximum distance from its own base point (access point) and at the same time is maximum close to any of the neighbor access points.

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Authors' index

Mathematical and Computer Modelling

The weakening of the energy flow of surface waves due to scattering by the roughness

E I Urazakov

Computer Modelling & New Technologies 2015 ***19****(4A) 7-11*

The stream of elastic energy in a wave extending on a rough surface is calculated. For enough smooth surface attenuation of a superficial wave is defined by the transport time of a relaxation considering of non-essentially processes of scattering on a small corner.

Keywords: energy flow, physics

Balanced geometric model for uplink power control in industrial wireless networks

Teodor Kalushkov, Oleg Asenov

Computer Modelling & New Technologies 2015 ***19****(4A) 12-18*

Industrial networks now are trying to implement wireless technologies, following the tendencies in communication networks. This task is complicated because of the nature of the industrial environment. Wireless connections hardly achieve the same stable quality of service (QoS) parameters as traditional cable ones. Interference is one of the reasons for that and effective solutions should be developed for its reducing in order to maximize the throughput of the wireless media. Balanced geometric model, which reduces interferences between end-users and access points, is proposed. It is based on Nash Equilibrium Theory and gives opportunity to control the output power of wireless devices in optimal way. The use of vectors in the model helps to analyse in details, impacts between the neighbour points – their power and direction. At the end, there is a sample for using balanced geometric model in industrial network.

Keywords: interference, Open-loop, closed loop, uplink power, industrial networks

Content B

Design and evaluation of control system for ambient assisted living system based on voice and gestures recognition

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Received 1 May 2015, www.cmnt.lv

Abstract

This paper focuses on design and evaluation of control system for ambient assisted living system based on voice and gestures recognition by using Microsoft Kinect. Many modern and innovative applications use voice and gestures as input. These programs span a wide variety of genres, platforms and input technologies, from the touch screen of a smart phone to the full-motion, natural input of devices like the Kinect for Windows Sensor. There are some project's objectives: analyzing of existing voice and gestures recognition algorithms; development of a Kinect-based voice and gestures recognition system for better human-computer interaction; integration of the command system with other parts of AAL environment.

Keywords: smart-home, multi-agent systems, Kinect, voice recognition, gesture recognition, human-computer interaction, natural user interface

1 Introduction

Smart homes became available to ordinary users with the development of information technologies. Users can control the lighting in the house, heating, light switching and other functions via the PC and other devices [1]. With the escalating role of computers in ambient-assisted living systems, human computer interaction is becoming gradually more important part of it. The general believe is that with the progress in computing speed, communication technologies, and display techniques the existing HCI techniques may become a constraint in the effectual utilization of the existing information flow. The development of user interfaces influences the changes in the Human-Computer Interaction [2].

2 Definition of system requirements

Nowadays, the main aspect of the interaction between humans and computers shifts towards maximum simplification. Complex and cumbersome interaction devices are replaced by obvious and expressive means of interaction, which easily comes to the users with least cognitive burden like, hand gestures or voice commands. Potential buyers of such systems may be people with disabilities, for whom control with gestures and voice commands remain the only way to interact with AAL-system.

3 Potential problem solutions

For Kinect applications, it is essential to successfully and effectively communicate a person's intent in a natural way. Each home inhabitant "transforms" to natural "controller". This transformation is a core part of gesture\voice detection and recognition. Firstly, we will consider a gesture recognition. Wikipedia gives the following definition of "gesture" word: "A gesture is a form of non-verbal communication or non-vocal communication in which visible bodily actions communicate particular messages, either in place of, or in conjunction with, speech. Gestures include movement of the hands, face, or other parts of the body" [3]. There are two effective approaches to detect and recognize a meaning of gesture: heuristic and machine learning. What is the difference in these techniques? It has been described below (Table 1).

TABLE 1 Difference between heuristic and machine learning approach

Heuristic approach	Machine learning (ML) approach
Gesture is a coding problem	Gesture is a data problem
Quick to do simple gestures and poses	Signals which way not be easily human understandable
Code quickly becomes complex when trying to handle different environmental factors	Large recording and tagging efforts for production
	Machine learning can categorize behaviors that it has not seen before

We will use a machine learning approach and Kinect Visual Gesture Builder tool to detect and recognize user's gesture. Visual Gesture Builder allows us to detect appropriate gestures through data-driven model of machine learning. This means that gesture detection is turned into a task of content creation (data-problem). The process of creating a gesture detector consists of following steps:

1) Recording of raw\processed Kinect-clips with people while they perform the interested gestures. Raw clip-recordings can be created in Kinect Studio (Figure 1);

2) Converting of raw clips to processed clips.

3) Tagging all of the frames in the recordings that define a gesture.

4) Building of specific gesture-detector after tagging is complete, you can build the gesture detector.

5) Live preview of created gesture by using VgbView

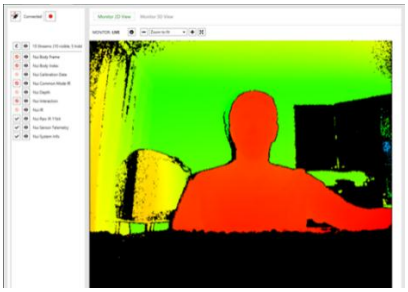

FIGURE 1 Microsoft Kinect Studio tool

Visual Gesture Builder has a couple of machine learning technologies for gesture recognition (Table 2).

TABLE 2 Difference between discrete and continuous gestures

Discrete gestures	Continuous gestures
Based on AdaBoost algorithm	Based on RFR algorithm
Boolean type of gesture. The gesture is either happening or not	Float type of gesture. There is always a signal
Complex gestures should be divided into several discrete gestures	Can be mapped to a single gesture or be used to combine multiple discrete gestures.
False positives can be decreased by using confidence value	Should be tied with a discrete gesture to determine context and decrease false positives

They can be grouped into two categories: discrete indicators and continuous indicators. A discrete indicator is a binary detector that determines if a person is performing a gesture and the confidence of the system in that gesture. A continuous indicator shows the progress of the person while performing a gesture. Let's create a gesture (for example, "Heart-attack gesture"). Firstly, we should to record all needed clips. There are two different types of clips that we can record: raw and processed clips. Raw files is preferable. Raw files take up more disk space. If Kinect happens to change some of underlying algorithms in generating depth or skeleton, our skeleton data might become invalid and we need to be able to regenerate that with the newest version of depth (by using KSConvert tool). We will use three types of streams to record necessary raw-clips. They are: Nui Raw IR 11 bit, Nui Sensor Telemetry and Nui System Info. Nui Raw IR 11 bit stream generates both depth, generates IR and body skeleton (Figure 2).

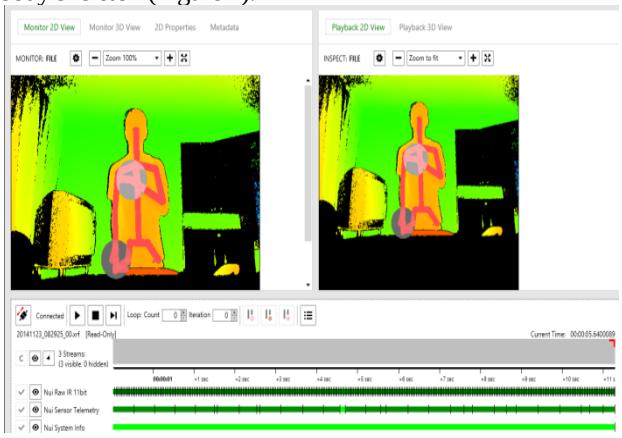

FIGURE 2 Recording process

The next step is to convert raw to processed clip (Figure 3). We will open the command line and convert our recorded clip by using KSConvert. Type the following command: *<Path to Kinect SDK folder>\Tools\KinectStudio\KSConvert.exe –source_filename.xrf – target_filename.xef.*

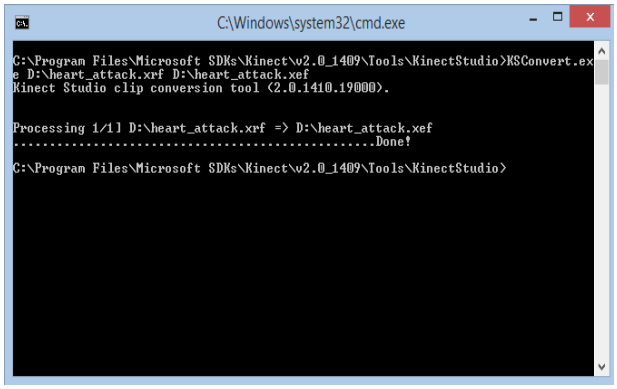

FIGURE 3 Converting process of raw clip

Now it is time to tag our frames. We are going to start VGB tool. Let's create a new solution that we will call "Heart_Attack". In next step, we have to start VGB Gesture Wizard. Follow the on-screen steps (Figure 4).

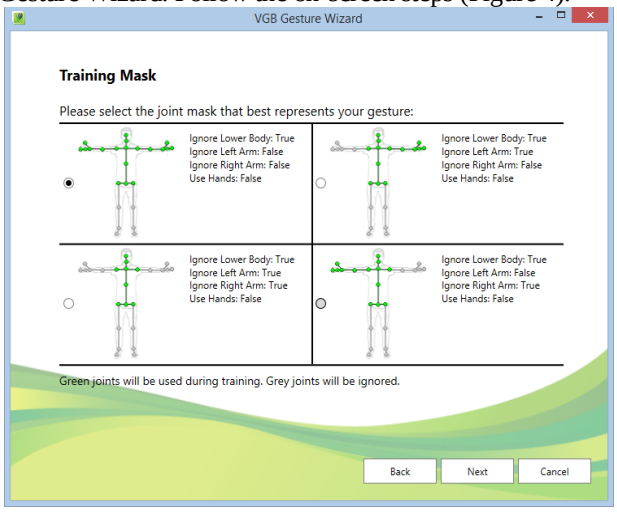

FIGURE 4 VGB Gesture Wizard

We have two projects within our solution now. So one that is called .a is actually our analysis\testing project. Any clips that we put here will be used to test gesture-detector with. All the clips that we put to another project (without a)

will be used for the actual detection of the gesture. It is usually good practice to split clips about 2\3 into training and leave 1\3 of them into testing. We can mark the time when gesture is happening as positive training example and other ones as negative by using "Gesture Tag" (Figure 5). Top blue lines show us positive tag-moments. Bottom lines show negative tagging.

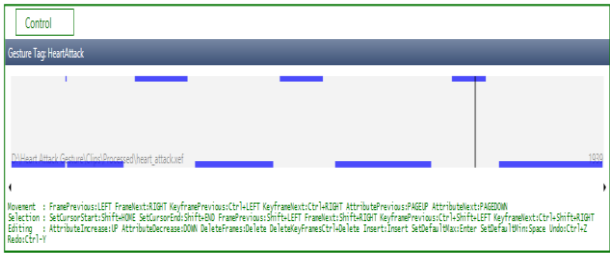

FIGURE 5 Gesture Tag bar with tagging information

There are some keyboard shortcuts that can facilitate the process of tagging (Table 3).

TABLE 3 VGB keyboard shortcuts

Shortcut	Appropriate action
Shift + Left Arrow / Shift + Right Arrow	Selects a range of frames to tag.
Enter	Sets the default maximum value
Delete	Deletes the selected range or a single frame
Ctrl + Left Arrow / Ctrl + Right Arrow	Moves the cursor to the previous or next frame.
Page Up / Page Down	Selects the previous/next attribute in the Tags grid as the active attribute.

Next step is to build and test our gesture. Figure 6 shows us a confident graph when user performs a gesture.

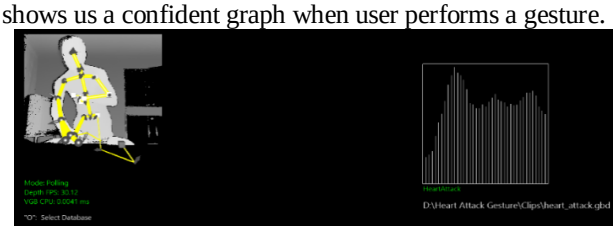

FIGURE 6 Gesture confidence graph

Secondly, we will consider a voice recognition. Speech recognition isn't new. But Kinect for Windows gives us additional benefits in speech recognition. One of the other features on the Kinect is the multi-array microphone with speech recognition. We have to install the following libraries to start work with speech recognition:

- Kinect for Windows Runtime Language Pack
- Microsoft Speech Platform SDK
- Microsoft Speech Platform Server Runtime

We have to create an enumeration. It will contain all voice commands that we will support in our program:

```
public enum VoiceCommand
{
  [Description("Unknown")]
  Unknown = 0,
  [Description("Measure the heart rate")]
  HeartRate = 1,
  [Description("Measure the breathing rate")]
  BreathingRate = 2,
  [Description("Measure the blood pressure")]
  BloodPressure = 3
}
```

Next step is to create a grammar file. We need some information about the Kinect and it's speech recognizer represented as a *RecognizerInfo*-object to do that. Usually computer has several *RecognizerInfo*-objects installed for each recording device. If we want to get the recognizer we need to loop that collection and get the first result where the additional info contains a Key/Value "*Kinect*" with a value "*True*". Next to that we want to specify our language pack '*en-US*' for commands in English. Let's create a method that returns the *RecognizerInfo* and call it *GetKinectRecognizer*:

```
private static RecognizerInfo GetKinectRecognizer()
{
foreach (RecognizerInfo recognizer in SpeechRecognitionEngine.InstalledRecognizers())
{
string value;
recognizer.AdditionalInfo.TryGetValue("Kinect", out value);
if ("True".Equals(value, StringComparison.OrdinalIgnoreCase) && "en-US".Equals(recognizer.Culture.Name, StringComparison.OrdinalIgnoreCase))
{
return recognizer;
}
}
return null;
}
```

To set up our grammar we will use the following properties:

1) SpeechRecognitionEngine will be used to build our grammar and start recognizing speech commands and listen to the corresponding events;

2) KinectAudioSource represents the audio from the Kinect microphone array;

3) A dictionary with voice commands and appropriate enumeration value.

```
private SpeechRecognitionEngine _recognizer;
private KinectAudioSource _audioSource;
private readonly Dictionary<string, object> _speechActions = new Dictionary<string, object>()
{
{"Measure the heart rate", VoiceCommand.HeartRate },
{"Measure the breathing rate", VoiceCommand.BreathingRate },
{"Measure the blood pressure", VoiceCommand.BloodPressure }
};
```

It is time to initialize a speech recognition. Let us create a new method called *InitializeSpeech*.

We will start with checking if a vocabulary is specified and if our sensor is still connected before we call our new method *GetKinectRecognizer*. Once we have a *RecognizerInfo* we will create a new *SpeechRecognizerEngine* based on the *ID* of our *RecognizerInfo*. Up next is creating a *Choices* object that will contain all the commands (keys) from our dictionary that will represent command options. Now we will pass our builder into a new Grammar object that we will load into our recognizer so he knows what he should be listening to. After we

hooked into the recognized & rejected events we can get the audio stream from our KinectSensor-object and link it to the recognizer. Last thing we need to do is tell the recognizer to start recognizing asynchronously and tell it to keep listening after a match by passing in RecognizeMode.Multiple.

```
    private void InitializeSpeech()
{
    if (_speechActions == null || _speechActions.Count == 0)
    throw new ArgumentException("A vocabulary is required.");
    if (_currentSensor.Status != KinectStatus.Connected)
    throw new Exception("Unable to initialize speech if sensor isn't connected.");
    RecognizerInfo info = GetKinectRecognizer();
    if (info == null)
    throw new Exception("There was a problem initializing Speech Recognition. May be Microsoft Speech SDK is not installed.");
    try
    {
    _recognizer = new SpeechRecognitionEngine(info.Id);
    if (_recognizer == null) throw new Exception();
    }
    catch (Exception ex)
    {
    throw new Exception("There was a problem initializing Speech Recognition. May be Microsoft Speech SDK is not installed.");
    }
    Choices cmds = new Choices();
    foreach (string key in _speechActions.Keys)
    cmds.Add(key);
    GrammarBuilder cmdBuilder = new GrammarBuilder { Culture = info.Culture };
    cmdBuilder.Append("Drone");
    cmdBuilder.Append(cmds);
    Grammar cmdGrammar = new Grammar(cmdBuilder);
    if (_currentSensor == null || _recognizer == null)
     return;
    _recognizer.LoadGrammar(cmdGrammar);
    _recognizer.SpeechRecognized += OnCommandRecognizedHandler;
    _recognizer.SpeechRecognitionRejected += OnCommandRejectedHandler;
    _audioSource = _currentSensor.AudioSource;
    _audioSource.BeamAngleMode = BeamAngleMode.Adaptive;
    Stream kinectStream = _audioSource.Start();
    _recognizer.SetInputToAudioStream(kinectStream, new SpeechAudioFormatInfo(EncodingFormat.Pcm, 16000, 16, 1, 32000, 2, null));
    _recognizer.RecognizeAsync(RecognizeMode.Multiple);
    }
```

When command has been recognized, it will be checked when the last command was recognized since it might occur that he recognizes some command multiple times or in a brief moment that will result into unwanted actions. Also we could check the correctness of recognized command by it's confidence-value.

4 System architecture

Microsoft Speech Platform and Microsoft Kinect v2 Visual Gesture Builder are the core parts of the system. The Microsoft Speech Platform SDK provides a comprehensive set of development tools for managing the Speech Platform Runtime in voice-enabled applications. Add the ability to recognize spoken words (speech recognition) and to generate synthesized speech [4]. The Kinect for Windows SDK includes a custom acoustical model that is optimized for the Kinect sensor's microphone array. The Kinect for Windows SDK provides the necessary infrastructure for managed applications to use the Kinect microphone with the Microsoft Speech APIs, which support the latest acoustical algorithms [5]. Microsoft Kinect VGB is a data-driven machine-learning solution for gesture detection, can be used efficiently to detect even complex gestures with very high accuracy. These technologies can make developers more productive and raise the quality of Kinect applications in terms of better voice\gesture detection and reduced latency.

5 Results

Voice recognition:

1) Single words are recognized and commands are predefined;

2) Only a developer can add new commands;

3) Users must learn the instructions and commands before start to use AAL's voice control system;

4) The ambient assisted living system will only be controlled by registered commands.

Gestures:

1) Gestures can be quickly prototyped and evaluated in semi-automatic mode;

2) High accuracy for detecting gestures can be achieved—even in cases where skeletal data is very noisy, such as sideways poses;

3) By tagging data appropriately, perceived latency can be made very low;

4) The run-time costs to CPU and memory are low;

5) The database size is independent of the amount of training data.

6 Conclusions

Nowadays a lot of attention is paid to multi-agent systems in smart-home environment that facilitate people's lives. Using traditional methods to create gesture and voice detectors for Kinect is not a trivial task to do robustly. Microsoft Speech Platform and Kinect VGB simplify this task, which can make developers more productive and raise the quality of Kinect applications in terms of better voice and gesture detection and reduced latency.

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Review of the current state of a problem of processing big data

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Received 1 May 2015, www.cmnt.lv

Abstract

The problem around the processing of large amount data sets is solved within the Big Data paradigm. Big data is important in many diverse areas, such as science, social media, enterprise and etc. This paper refers to various ways to store data to define the differences between traditional storage systems and current approaches to dealing with large data sets. Technologies such as MapReduce, NoSQL and processing of event streams in real time are discussed.

Keywords: Big Data, MapReduce, Hadoop, NoSQL, MongoDB

1 Introduction

As it is well known, IT- industry has it's own buzzwords - words that everyone usually hear, use them in their daily life, but only some of us really know what is hidden behind these words and how to use them correctly. Nowadays, one of the most well-known development in this field of study is «Big Data».

Big Data figures unusual size (capacity over traditional databases) or generated at an incredible rate, such as gathered from social networking providers. Big data is often unstructured - they cannot clearly fit into a predefined structure of the database. The main advantage of big data is that you can first collect and then analyze these data to obtain statistics, structure and relationships, without knowing in advance what to look for.

Big Data Analytics allows moving from traditional database queries to analyze what is happening, and to analyze the options for product development planning. It will be useful for large companies.

Hundreds of gigabytes/ terabytes/ megabytes of data are not valuable in themselves. Their main purpose is to help to understand the past and predict the future.

Three characteristics which define Big Data are volume, variety and velocity. They have created the need a new class of capabilities to augment the way things is done today to provide better line of site and controls over our existing knowledge domains and the ability to act them.

2 Big Data

Big Data information technology is a series of accesses, tools and modes for processing of structured and unstructured data and big amounts of the significant variously perceived by man for results that are effective in conditions of continuous growth, the distribution on multiple nodes computer network, formed in late 2000-s alternatives to traditional database management systems and solutions class of Business Intelligence. This series consist means massively parallel processing vaguely structured data, primarily decisions category NoSQL, algorithms MapReduce, software frameworks and libraries project Hadoop.

The concept of big data means working with the amount of information and varied composition, and quite often updated and located in different sources in order to increase strength, create new products and improve competitiveness. Consulting company Forrester gives brief statement: Big Data combines engineering and technology that extracts meaning from the data in the extreme limit of practicality.

3 Data capacity

In the next eight years, the number of data in the world will be 40 zetabytes, which is equivalent to 5200 gigabytes (GB) for each person on the planet, according to researches of IDC Digital Universe, published in December 2012. 40 zetabytes equivalent to 40 trillion GB, which is 57 times more than the number of grains of sand on the beaches on the entire surface of the Earth. According to forecasts, the amount of data in the world will double every two years until 2020 [1].

Most of the data that will be produced in the period from 2012 to 2020, will generate not people, but machines in interaction with each other and other data networks. These include, for example, intelligent sensors and devices which can communicate with external devices.

Analysts also expect that in the future most of the digital information to be stored in the cloud. If the cloud now accounts for about 5% of global IT expenses, by 2020 40% of all information in the digital universe will be "tied" to cloud systems. However, the cloud will be produced mainly handling and processing of the data, but directly stored in the cloud will only be 15% of the information [2].

4 Hadoop

Hadoop is a project of Apache Software Foundation, an open source set of tools, libraries, and software framework for the development and execution of distributed applications running on clusters of hundreds or thousands of nodes. It is used to implement search and contextual mechanisms of many heavily websites, including, for Yahoo! and Facebook. Developed in Java within the computing paradigm MapReduce, according to which an application is divided into big quantity of identical elementary tasks feasible on the cluster nodes and naturally reducible to the final result.

Hadoop is a framework with open source for creating and running distributed applications that process large amounts of data [3]. Distributed computing is a broad and multi-faceted region, but Hadoop has several important distinguishing features, namely:

• Availability: Hadoop running on large clusters assembled from standard equipment, or cloud computing, for example on the basis of service Elastic Compute Cloud (EC2), offered by Amazon;

• Reliability: as Hadoop to run on standard hardware, its architecture is designed to allow frequent failures. Most failures can be treated so that the characteristics of the cluster will gradually deteriorate;

• Scalability: Hadoop scales linearly, i.e. by increasing the amount of data is sufficient to add new nodes to the cluster;

• Simplicity: Hadoop allows a user to create quickly effectual parallel code.

As of 2014 the project consists of four modules - Hadoop Common (middleware software - a set of infrastructure software libraries and utilities used for other modules and related projects), HDFS (Distributed File System), YARN (system for scheduling and managing the cluster) and Hadoop MapReduce (programming platform and executing distributed MapReduce-computing), earlier in Hadoop includes a number of other projects, became independent projects within the Apache Software Foundation [4].

Hadoop MapReduce is a software framework for distributed computing program within the paradigm Map-Reduce. Application developer for Hadoop MapReduce is necessary to implement the core handler that on each compute node in the cluster will provide initial conversion pairs "key - value" pairs in the intermediate set of "key - value" (a class that implements the interface Mapper, called higher-order functions on Map), and handler, which reduces the intermediate set of pairs in the final, reduced set (convolution, a class that implements the interface Reducer). Frame passes the input convolution sorted conclusions from basic handlers, mixing consists of three phases - shuffle (shuffle, the selection for you output section), sort (sorting, grouping by key findings from distributors - sorting required in the case where different sets of atomic handlers return the same key, wherein the sorting rules in this phase can be defined programmatically and using any particular internal structure of the key) and actually reduce (convolution list) - get the result set. For some types of convolution processing is required and returns a frame in this case the set of sorted pairs received basic handlers.

Hadoop MapReduce job allows a user to create both basic handlers, and with contractions written without using Java: Hadoop utility streaming lest to use as base handlers and parcel of any executable file that runs the standard input-output operating system (e.g. utilities shell UNIX) There is also a SWIG-compatible application programming interface Hadoop pipes on C++. Also, in the Hadoop distributions include the implementation of various specific base handlers and convolutions, most typically used in distributed processing [5].

In the first versions of Hadoop MapReduce included scheduler (JobTracker), starting with version 2.0, this function was moved to YARN, and since this version module is implemented on top of Hadoop MapReduce YARN. Software interfaces for the most part retained, but no full backwards compatibility (e.g. to run programs written for earlier versions of API, to work in YARN generally require their modification or refactoring, and only under certain restrictions are possible options reverse binary compatibility).

5 NoSQL

The concept of NoSQL (Not Only SQL or No SQL) became famous from 2009. Then it was the development of web-based technologies and social services spurred many new approaches to the storage and processing of data. The developers of these applications are faced with the tasks for which traditional relational databases were either too expensive or are not productive enough. In addition, the rejection of universal popularizers "harvesting" (RDBMS) in favor of specialized steel making startups and those who have to work in scenarios so-called Big Data [6].

We must understand that NoSQL-solutions do not necessarily mean a change and a complete rejection of the DBMS. As usual, the tool must be selected by the task, and not vice versa. When people talk about NoSQL, typically list the following advantages.

Scalability. Horizontal scaling existing traditional database is usually time-consuming, expensive and effectt-ive only up to a certain level of challenge. At the same time, many NoSQL-based solutions designed to scale horizontally and do it "on the fly." Therefore, this procedure is usually simpler and more transparent in NoSQL, than in the DBMS.

Database performance on one node and not in the cluster is also an important parameter. For many tasks, such properties of traditional DBMS, both transactional isolation changes reliability within a single node or even the relational model is not always needed in full. Therefore, the rejection of these properties (all or some) allows NoSQL sometimes achieve better performance on one node than traditional solutions.

Reliable operation in circumstances where failure or network unavailability of iron - a common occurrence, is one of the many properties of solutions NoSQL. The main way to ensure it - it's replication. Replication itself is not a unique feature of NoSQL, but here, as when zooming, it plays an important role the efficiency and ease of making changes to an existing installation. Going to work in database replication mode - this is a simple task for most NoSQL-making.

Simplicity of administration and development is also an important argument in favor of NoSQL-technologies. A quantity of problems associated with scaling and replication, representing a significant challenge and requires extensive specialist expertise in traditional DBMS NoSQL in a matter of minutes. Setup and configuration tasks, the very use of NoSQL-making is usually much easier and less time-consuming than in the case with the DBMS.

Therefore NoSQL-systems have become the obvious choice for many startups, where the speed of the development and implementation is key.

In contrast to the relational model that preserves the logical business entity application to various physical tables to normalize, NoSQL storage with these entities operate as a cohesive objects, as shown in (Figure 1).

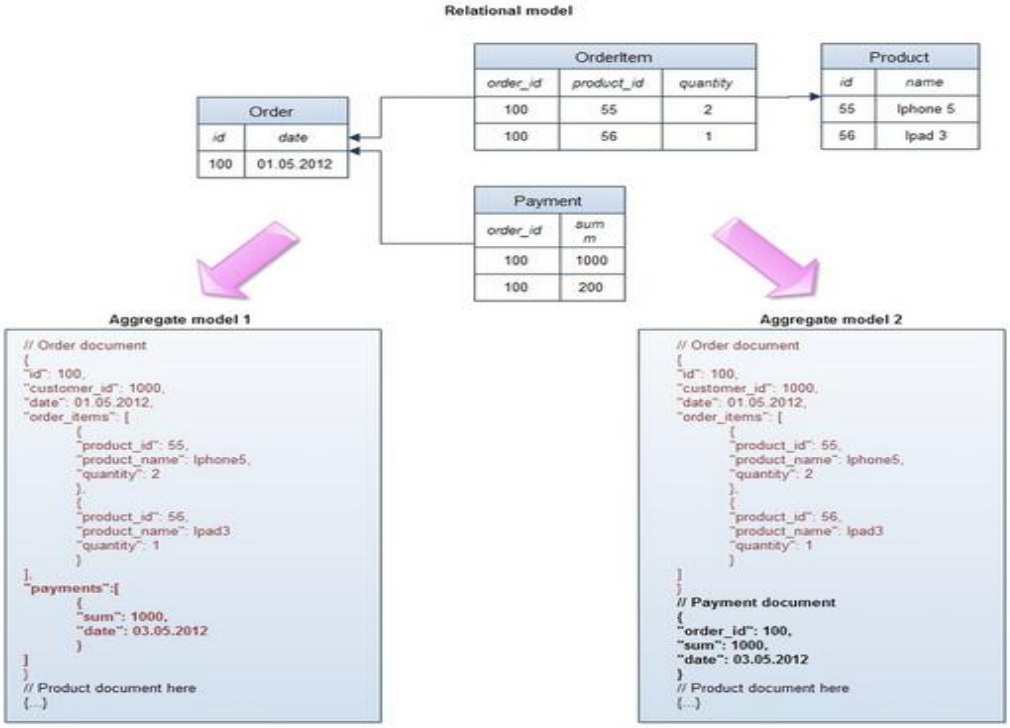

FIGURE 1 Aggregate model (sourse: Pramod J. Sadalage, Martin Fowler)

This example illustrates conceptual units for standard relational model of e-commerce "order - order item - payments - product." In both cases, the order is combined with the position of one entity, with each position keeps a link to the product and some of its attributes, such as name (such denormalization is necessary not to request the product to the extraction of the order - the main rule of distributed systems - at least "Join" between objects). In one aggregate payments combined with the order and are an integral part of the object, in the other - in a separate object. This demonstrates the main design rule data structure NoSQL databases - it must comply with the requirements and the application to be as optimized for the most frequent requests.

6 NoSQL vs SQL

NoSQL doesn't require schemas like SQL does meaning it can process information much quicker. With SQL, schemas (another word for categories) had to be predetermined before information was entered. That made dealing with unstructured information extremely difficult because companies never knew just what categories of information they would be dealing with. NoSQL doesn't require schemas so it can handle unstructured information easier and much quicker. Also, NoSQL can handle and process data in real-time. Something SQL doesn't do.

Another advantage to NoSQL computing is the scalability it provides. Unlike SQL, which tends to be very costly when trying to scale information and isn't nearly as flexible, NoSQL makes scaling information a breeze. Not only is it cheaper and easier, but it also promotes increased data gathering. With SQL companies had to be very selective in the information they gathered and how much of it they gathered. That placed restrictions on growth and revenue possibilities. Because of NoSQL's flexibility and scalability, it promotes data growth. That's good for businesses and it's good for the consumer.

NoSQL is also extremely valuable and important for cloud computing. One of the main reasons we've seen such a rise in big data's prominence in the mainstream is because of cloud computing. Cloud computing has drastically reduced the startup costs of big data by eliminating the need of costly infrastructure. That has increased its availability to both big and small business. Cloud computing has also made the entire process of big data, from the gathering stages to analyzing and implementing, easier for companies. Much of the process is now taken care of and monitored by the service providers. The increased availability of big data means that companies can better serve the general public [7].

7 MongoDB

MongoDB (from "humongous") is a cross-platform document-oriented database. Classified as a NoSQL database, MongoDB eschews the traditional table-based relational

database structure in favor of JSON-like documents with dynamic schemas (MongoDB calls the format BSON), making the integration of data in certain types of applications easier and faster.

MongoDB has a high read / write speed and scalability but safety and integrity of the data is not as good. Mongo has an excellent implementation of replication, which is fairly easy to install and set up or sharing (the ability to spread data across multiple servers), which is also quite easy to install.

The following Table 1 presents the various SQL terminology and concepts and the corresponding MongoDB terminology and concepts.

TABLE 1 SQL vs MongoDB terminologies

SQL Terms/Concepts	MongoDB Terms/Concepts
Database	database
Table	collection
Row	document or BSON document
Column	field
Index	index
table joins	embedded documents and linking
primary key	primary key
Specify any unique column or column combination as primary key.	In MongoDB, the primary key is automatically set to the _idfield.
aggregation (e.g. group by)	aggregation pipeline See the SQL to Aggregation Mapping Chart.

Figure 2 shows a sharp distinction between performance of MongoDB and MySQL [8]. Significantly low number of threads and records are represent low latency of MySQL with comparing to MongoDB, once number of threads and records amplifies the latency of MongoDB conversely decreases. This suggests that for large volumes if data is better to use MongoDB (Figure 2).

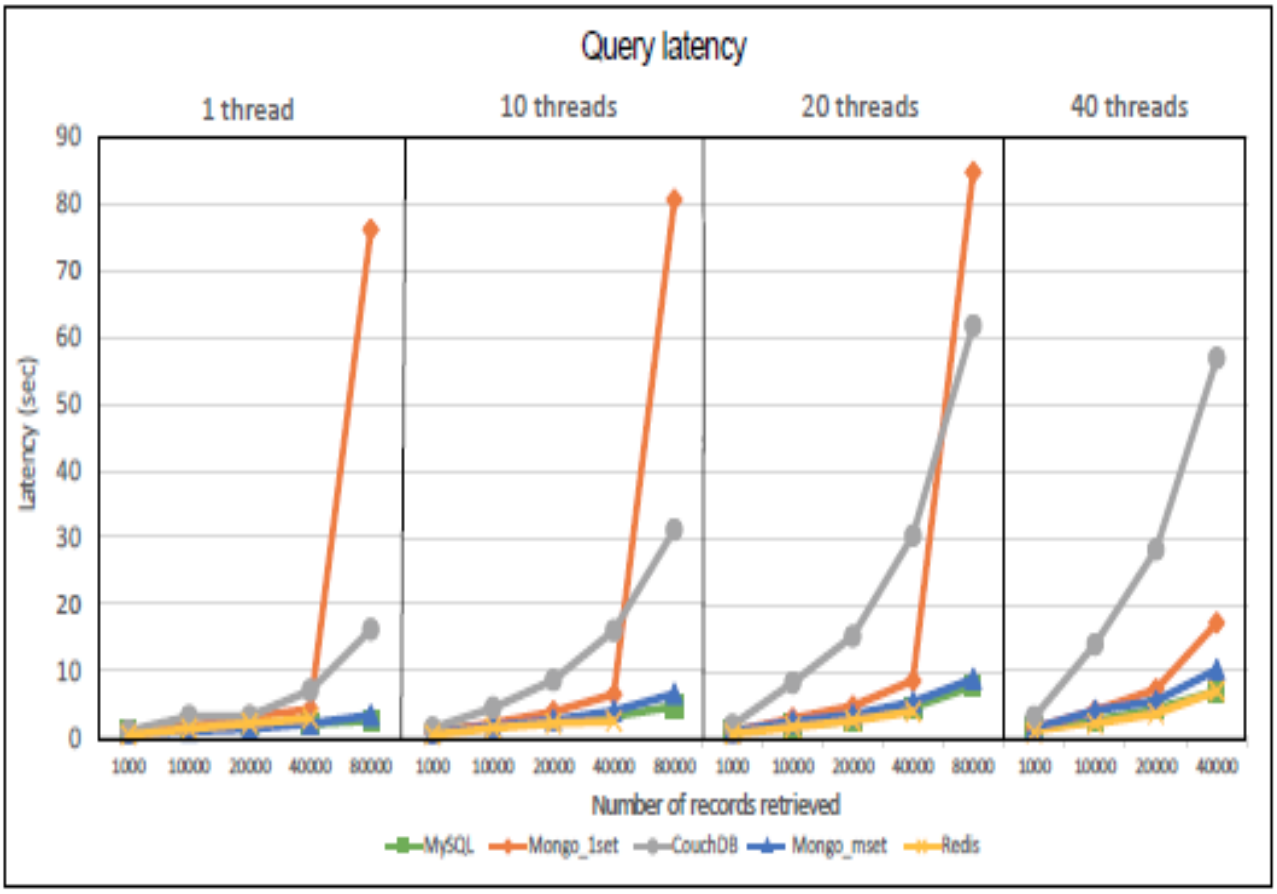

FIGURE 2 Performance of MongoDB and MySQL

8 Conclusion

In this paper problems which delivered big data before the relational DBMS were considered. We specified that that the relational database isn't capable to cope with quickly growing data streams. Also considered some approaches of processing of big data. We also specified that all instruments of processing of big data decide effectively the class of tasks.

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Simulations of the implementation of primary copy two-phase locking in distributed database systems

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Received 1 March 2015, www.cmnt.lv

Abstract

This paper considers algorithms for concurrency control in Distributed database (DDB) systems. Below are the simulating models of the implementation of two-phase locking (2PL) in DDB. From four types 2PL in DDB (Centralized 2PL, Primary copy 2PL, Distributed 2PL and voting 2PL) is viewed Primary copy 2PL, as this protocol is a "transitional" protocol of Centralized 2PL to the Distributed 2PL. The paper describes specifically the simulations of two-version 2PL and 2PL with integrated timestamp ordering mechanism. In concurrency control method 2PL may take place deadlocks of the transactions. Therefore, in the modelling algorithms described here are integrated algorithms for deadlock avoiding: two-version architecture of database and timestamp ordering strategy "wait-die". There are also presented, the results of the simulations of these two variants of the 2PL method at different scales of the networks for the transmission of data and at different intensities of inflow transactions. Modelling algorithms are developed by means of the system for simulation modelling GPSS World Personal Version.

Keywords: Simulation models, concurrency control, distributed transactions, 2PL, distributed database

1 Introduction

Concurrency control techniques are generally divided into: Locking, Timestamp ordering and Optimistic strategies - Validation check up. [1] In the last two methods were obtained a better retention of transactions in the system when it is saturated with conflicts (due to frequent rollbacks of transactions). Therefore, it is desirable to use the method of Two-phase locking (2PL). But emerging problems in its application require testing. One effective and inexpensive method for testing the operation of the various systems is the method of simulation. The basis of design are used presented and examined in [2] and [3] simulation algorithms, primary copy two-version 2PL and primary copy 2PL with built mechanism of Timestamping (TS) strategy "wait-die". In the modelling algorithms the data are subjected to incomplete replication (all data items have the same number of copies; the number of copies of the data item is smaller than the number of sites). The models were developed by means of the "classical" system modelling - GPSS World.

Since pessimistic protocols can arise deadlocks transactions, the problems arise to detect and resolve deadlocks. One way to avoid deadlocks is the use of data architecture with many versions in Distributed Database Management Systems (DDBMS). In [4] are presented and discussed algorithms with many versions for concurrency control in database management systems (DBMS), and in particular: Multi-version 2PL and Two-version 2PL. Since in the Multi-version 2PL there are problems with the management and conservation of the versions, to benefit of its advantages is desirable to limit the number of versions. So look Two-version Two-phase locking (2V2PL).

Besides algorithms with versions, were developed and protocols for concurrency control, which combine advantages of 2PL and Timestamping method. In the paper we consider the model of such an algorithm - Model of Primary copy 2PL with integrated mechanism of Timestamping - strategy "wait-die" (This method is described in [5] and some others).

2 Primary Copy 2V2PL Model

A protocol with two versions for two-phase locking is first proposed by Bayer in [6]. In 2V2PL protocol are only two versions of elements: 1 current version of the item and not more than one incomplete version. We use 3 types of locks, each lock is released at the end of the transaction: rl - (read lock) - established on the current version of the data item shortly before reading it; wl - (write lock) - sets before creating the new (incomplete) version of the item; cl - (commit lock) - established before the implementation of the last transaction of the transaction (usually before surgery commit) on each data item that it has recorded.

Advantages of the protocol: limit the number of older versions leads to reduction of volume of database (DB); does not require special storage structure versions; simple enough to implement a protocol.

Disadvantage: An organization of versions is advantageous especially for transactions that operation "reading". Problem: Not solved effectively the issue of transactions executed operation "record".

With the development and implementation of algorithms with many versions (MultiVersion Concurrency Control - MVCC) to solve many of the problems in algorithms with one version for concurrency control, but not all developed algorithms with versions are actively used in practice due to the problems of creating a DBMS with versions, namely: - Necessity of the construction of physical data organization, providing effective management of versions - Reporting: the expansion of the volume of DB adding versions; possible restrictions on the number

of versions, but in practice such a restriction is often lacking - the system simply delete old versions; - Need for reporting the versions in other components of the DBMS. In practice, the most frequently are used the protocols Read-Only MultiVersion and 2V2PL, because they, according to [4] are simple enough to implement and provide the user the advantages of most slurry conversion DBMS. In 2V2PL protocol it is solved the problem with the limitation of the number of versions.

The presented simulation models use 6 generated streams of transactions which imitate global transactions in DDB systems. They are all in parallel streams and their intensity λ is given in tr per sec (number of transactions per second). The structural scheme of a modelling algorithm for Primary copy 2PL of distributed transactions management in two-version architecture of data in Distributed DB (DDB) is shown in Figure 1.

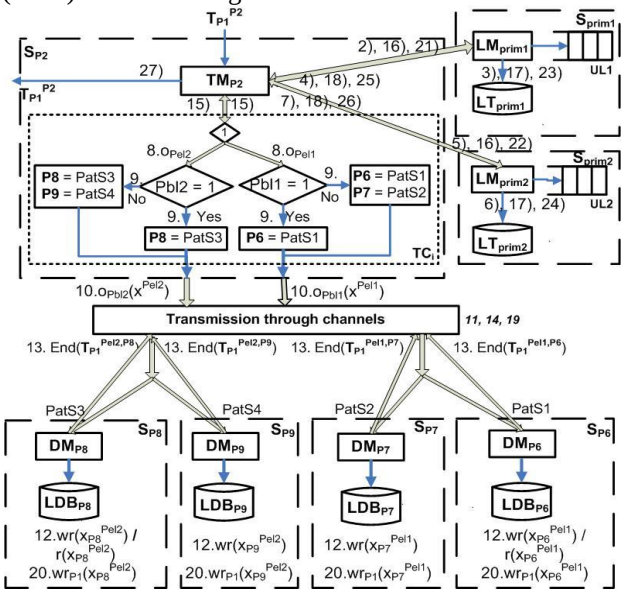

FIGURE 1 Scheme of Primary copy 2V2PL

The basic steps in the synthesized Primary Copy 2V2PL algorithm [2] are:

1. Transaction coordinator TC_{P2} splits global transaction T_{P1}^{P2} in two sub-transactions, T_{P1}^{Pel1} and T_{P1}^{Pel2}, for the process of the two elements *El1* and *El2* (operation 1 on Figure 1). These sub-transactions T_{P1}^{Pel1} (operation 2 on Figure 2) and T_{P1}^{Pel2} (operation 5 on Figure 1) are directed at lock managers LM_{prim1} and LM_{prim2}, to get the proper locks for the elements *El1* and *El2*.
2. If it is allowed for sub-transactions to lock the elements *El1* and *El2*, then the correspondent records are put in the lock tables LT_{prim1} and LT_{prim2} (operations 3 and 6 on Figure 1). Moreover the sub-transaction T_{P1}^{Pel2} waits for the acknowledgment of getting the locks of *El1* by T_{P1}^{Pel1} in S_{P2}. After that it is directed to the lock manager LM_{prim2} (operation 5 on Figure 1).
3. After given and granted locks (operations 4 and 7 on Figure 1), the transaction T_{P1}^{Pel1} splits in two sub-transactions $T_{P1}^{Pel1,P6}$ and $T_{P1}^{Pel1,P7}$ (operations 8 and 9). If the transaction T_{P1}^{Pel1} is required to read only the element *El1* then it doesn't split in two separate sub-transactions. Similarly, the transaction T_{P1}^{Pel2} splits in two-transactions $T_{P1}^{Pel2,P8}$ and $T_{P1}^{Pel2,P9}$ depending on where the copies of the data elements processed by the transaction T_{P1}^{P2} have been stored.
4. Sub-transactions $T_{P1}^{Pel1,P6}$ (and $T_{P1}^{Pel1,P7}$) and $T_{P1}^{Pel2,P8}$ (and $T_{P1}^{Pel2,P9}$) are directed to the corresponding data managers (operations 10 on Figure 1). After that they are transmitted in the network (operations 11 on Figure 1) to DM_{P6} (and DM_{P7}) and DM_{P8} (and DM_{P9}) If they have to be committed in a remote node.
5. Many operations read/write are committed in the sites-executors, where the corresponding data managers are included. The nodes PatS1 and PatS3 perform operations read/write over the first replica of *El1* and *El2*. It is shown in fig.1. The nodes PatS2 and PatS4 perform the operations write second replica of *El1* and *El2* (operations 12 on Figure 1 and Figure 2).
6. If the sites-executors don't match to the site – initiator of T_{P1}^{P2} after the sub-transactions have finished their actions in sites S_{P6}, S_{P7} and S_{P8}, S_{P9}, they are transmitted over the communication network to the transaction manager (operations 13 and 14 in Figure 1).
7. Transaction manager of T_{P1}^{P2} sends messages, which consists of requests for releasing the elements *El1* and *El2* (operations 16) to the correspondent lock manager, when it receives messages for ends of sub-transactions (operations 15 on Figure 1).
8. If a new version of El1 and/or El2 is created by the transaction then the requests for end of record and release of exclusive lock wl (operations 16 on Figure 1) are getting transformed to requests for certify lock cl. Moreover higher priority is given to them. There is existed a situation, in which the correspondent lock manager permits a record of certify lock of *El1* and/or *El2* (operations 17 on Figure 1) to be included in lock table, when acknowledge of certify lock (operations 18 on Figure 1) is received. In this common case, the sub-transactions T_{P1}^{Pel1} and/or T_{P1}^{Pel2} are sent through the network toward to the sites – executors to make uncommitted version of *El1* and/or *El2* a current one.
9. After fixing the results from sub-transaction processing in sites S_{P6}, S_{P7} and S_{P8}, S_{P9} $T_{P1}^{Pel1,P6}$ and/or $T_{P1}^{Pel1,P7}$ and $T_{P1}^{Pel2,P8}$ and/or $T_{P1}^{Pel2,P9}$, the transactions are sent through the communication network to the transaction manager (operations 20 on Figure 1).
10. Transaction manager of T_{P1}^{P2} sends messages to the corresponding lock manager when it gets the messages for the end of the sub-transactions. These messages contain requests to request a release for locks of the elements *El1* and *El2* (operations 21 and 22).
11. Sub-transactions T_{P1}^{Pel1} and T_{P1}^{Pel2} release locks of *El1* and *El2*. The records for these elements have been deleted from the lock tables (operations 23 and 24 on Figure 1). Afterwards, acknowledgments for the releasing of locks for *El1* and *El2* are sent to the manager of T_{P1}^{P2} (operations 25 and 26 on Figure 1).
12. Transaction T_{P1}^{P2} quits the system (operation 27 on

Figure 1) as soon as sub-transactions T_{P1}^{Pel1} and T_{P1}^{Pel2} finish their process.

3 Model of Primary copy 2PL with TS "wait-die

The method uses the so called timestamps (TS) of the transactions. There are two possible algorithms when transaction Ti wants to receive a lock of an element [5]:

1. "wait – die": If T_i is older (with smaller value of timestamp) than T_j, which has blocked the element then T_i waits for the release of the element in order to put the lock. If T_i has a greater timestamp than T_j, then T_i restarts.
2. "wound – wait": If T_i is younger (with greater timestamp value) than T_j, which has blocked the element, then T_i waits for the release of the element in order to put the lock. If T_i has a smaller timestamp than T_j, then T_i restarts.

In the Timestamp method the number of "superfluous" rollbacks is much smaller. Moreover the method is not very difficult to be realized, especially variant 1 „wait – cancel". Therefore we view one such realization of the Timestamp method in embedding in Primary copy 2PL algorithm for DDBMS.

The basic steps in the synthesized Primary Copy 2PL with TS model [3] are:

1. When the transaction T_{P1}^{P2} comes in the transaction manager TM_{P2} its length is checked (1 or 2 data elements will be processed) - operation 1 on Figure 1 and the transaction is prepared to be split (operations 8 on Fig. 2).
2. With the operations 9 values of the parameters of the sub-transactions are acquired – the numbers of the data managers DM_{P6}, (DM_{P7}), (DM_{P8} and DM_{P9}), where the sub-transactions $T_{P1}^{Pel1,P6}$, ($T_{P1}^{Pel1,P7}$), ($T_{P1}^{Pel2,P8}$ and $T_{P1}^{Pel2,P9}$) have to execute the operations of reading/recording of the copies of data elements *El1* and *El2*.
3. After the primary processing in the transaction coordinator TC_{P2} the requests for locking *El1* and *El2* are transmitted through the net to the corresponding primary lock managers LM_{prim1} and LM_{prim2} (operations 2 and 5).
4. LM_{prim1} and LM_{prim2} check in the lock tables LT_{prim1} and LT_{prim2} if the lock of El1 and El2 is allowed (operations 3 and 6 on Figure 2). If the lock of *El1* (and *El2*) is allowed, the corresponding record is put opposite the number of the element in LT_{prim1} (and LT_{prim2}).
5. The transaction receives confirmation messages about the lock of *El1* (operation 4) and if two data elements are being processed, TM_{P2}, through the transaction coordinator TC_{P2} sends the request for lock of *El2* to LM_{prim2} (operation 5 on Figure 2).
6. If the lock of the corresponding element is not possible, the number of the transaction is check if it is smaller than the number of the transaction which has put the lock:
   a. if the sub-transaction is not going to continue and is not going to restart, it waits the release of the element in user chain, whose number is the number of the element;
   b. if the sub-transaction has not received the lock of the element it restarts (operation 4/operation 7 is a restart operation). After it has arrived in TM_{P2}, the restarted lock request (operation 16 on Figure 2) is transmitted to LM_{prim1}/LM_{prim2} (the repeated (successful) attempt for lock element 1/element 2 is presented with operations 16, 17 and 18).
7. Transaction which has finished with the operation read/write releases the element in LT_{prim1} (and LT_{prim2}) – operations 21 and 22 on Figure 2. The requests for release of the lock of the elements are transmitted to the corresponding primary lock manager with operations 19 and 20.
8. After the release of the lock of an element, the transaction which is first in the waiting list heads to the lock manager. If it is a group of sub-transactions then they receive a shared lock of the element.
9. Receiving a confirmation for a lock of the elements of the GPSS transaction being allowed, a modelling global transaction splits. After that the sub-transactions are transmitted through the net to the data managers for executing the read/write operations (operations 10 and 11 on Figure 2).
10. The sub-transactions of T_{P1}^{P2} execute read/write in local databases LDB_{P6}, LDB_{P7}, LDB_{P8} and LDB_{P9} with the corresponding replicas of *El1* and *El2* (operations 12 on Figure 2). After that they are transmitted to the transaction manager TM_{P2} (operations 13 and 14). If a transaction renews a data element, the sub-transactions recording the corresponding copies wait for each other and get united (operations 15 on Figure 2), before a request for release of the lock of the element is sent to LM_{prim1} (and LM_{prim2}).
11. Transaction T_{P1}^{P2} quits the system (operation 25 on Figure 2) as soon as sub-transactions T_{P1}^{Pel1} and T_{P1}^{Pel2} finish their process (modelled with operations 23 and 24).
12. The transfer through the network to primary lock managers LM_{prim1} and LM_{prim2} and to the sites-executors, where are the data managers DM (operations 2, 4, 11, 14, 16, 18, 19, 21, 25 on Figure 1 and operations 2, 4, 11, 14, 16, 18, 19, 23 on Figure 2) is simulated with retention given by the matrix *MX$RAZST* for both models.

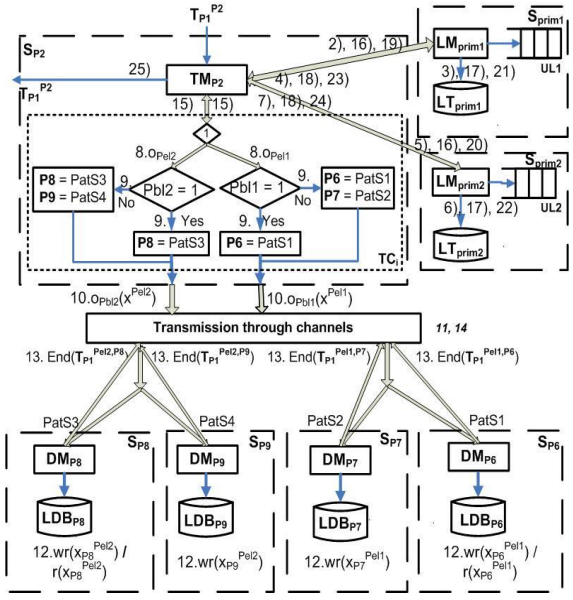

FIGURE 2 Scheme of Primary copy 2PL with TS "wait-die"

4 Matrices used in the modeling algorithms

In the synthesized simulation models mainly is used the matrix MX$LTA for modeling the lock table. Each row of the table corresponds to the data element from DDB. The matrix has the following columns:

- Type of the resulting lock the GPSS transaction blocked free data elements. This column, records the value parameter P$bl1 or P$bl2 of the same (depending on whether the element is the first or the second processed by transaction);
- Number the GPSS transaction, blocked free element. This column records the value the P1 parameter transaction, which placed the lock in the first column;
- Number of the site - initiator the GPSS transaction blocked first element (the value of parameter P2 of the transaction, borrowed the element in the lock table);
- Number of the GPSS transaction, received a shared lock element, blocked by another "reading" transaction before. This column records the value the P1 parameter of the transaction, whose request for "reading" is compatible with the shared lock set by the first column;
- Number of the GPSS transaction, received an interlock "record" elements blocked by "reading" transaction before. This column records the value the P1 parameter of the transaction, whose request for "record" is compatible with the shared lock, set by the first column 2V2PL modeling algorithm.

In the synthesized simulation models are used also and two matrices - *MX$RAZST* and *MX$RAZDEV* to set the mean and standard deviation of the retention time of he transactions in the transmission of messages between the nodes of the distributed database system modeled for communication costs.

5 Auxiliary variables and cells

In the simulation models primarily are used the following variables and cells serving as counters:

V$ElemN1 – in it are calculated random selection numbers of the first element that will process the transaction;

V$ElemN2 – in it are calculated the random selection of the numbers of the second element which will process the transaction. In the statements which calculates variable ElemN1 and the ElemN1 is involved and the random number generator RN2;

V$RAZRBL1/V$RAZRBL2 – in it is calculated the admissibility of the first/second lock element processed by the transaction. The value is the product of the parameter P$bl1/P$bl2 of the GPSS transaction requesting the lock and the value in the first column of the matrix LTA;

X$BROITR – total number of generated GPSS transactions during the modeling;

X$ZAVTR – total number of transactions leaving the model served.

6 Parameters of the GPSS transactions

P1 – Number of transaction. The value is a sum of System Numeric Attribute MP2 (The subtraction between the relative model time and the content of the second parameter of GPSS transaction) and the number of the site;

P2 – Number of the site, where the transaction is generated. The value is a number from 1 to <number of stream transactions>;

P$Nel – Length of the modeled transaction. The value of that parameter in the constructed models is 1 or 2 chosen by probability defined by the function FN$BrEl respectively 0.30 and 0.70. It is supposed that long transactions get in the system more frequently then short ones in that model;

P$El1/P$El2 – Number of the first/second element, which the generated transaction will read or write. The value is a random number and is uniformly distributed in the interval [1, NumEl];

P$bl1/P$bl2 – Type of the requested lock for the first/second element, which will be processed by the generated transaction;

P5 – Value 0, if the transaction is in 1st phase – occupation of the locks and value 1, if the transaction finishes its work and has to release the locks. In the future value 2 will be able to be appropriated to a transaction which will have to be restarted;

P$Prim1/P$Prim2 – Number of the primary site of the first/second element, which the generated transaction will read or write;

P6 and P7 – In them there are correspondingly recorded the number of the site, where it is the nearest copy of the data element and the number of the site, where it is the second replica of the first data element, processed by transaction. Correspondingly in parameters P8 and P9 we have the nearest copy of the second data element and the number of the recorded site, where it is the second replica of the second data element.

P$vr – This parameter is used in the model of 2PL with timestamping - P$vr = 1 in the case that the lock of the element is not possible and the number of the GPSS subtransaction is smaller than the number of the transaction, which set the lock, then, according to the timestamping mechanism strategy "wait-die" [5] if the subtransaction does not continue and does not restart, it waits for the release of the elements in the user chain, whose number is the number of elements.

7 Simulation Results

Our researches has been made for 2 replicas of the element, number of the incoming streams - 6 and number of the data elements in the global database - 50. Several parameters have been changed in order to obtain the whole picture of the states in which the chosen models went through.

The parameters and indexes of the simulations of the considered model are as follows: NumTr – general number of the generated transactions for the time of incoming modelling; FixTr – general number of the completed (committed) transactions for the same period; X=FixTr/Tn – throughput of the queuing system; Tn – time interval in which the system is being watched; Ps=FixTr/NumTr – probabilities for transaction service. The results are received in 6 streams of concurrent transactions with different intensity. The copies of the data elements are distributed evenly and random by 6 sites in the system. Service and rejection probabilities are calculated according to closely

associated formulas and the received values are different from those received through more detailed expressions.

Time modelling developed in the GPSS World algorithms is set in milliseconds. All streams transactions are received upon an exponential law with a variable at different studies with an average length of the interval. In all modelling algorithms we consider 6 streams generated by GPSS transactions modelling 6 sites in distributed database system, from which Poisson law shall go global transactions.

The diagram of Figure 3 presents the results of simulations of Throughput of Primary copy 2PL algorithms at the same intensities of input flows depending on the monitoring period (in seconds): The graph marked with a thin blue dashed line (2V2PL) and the graph indicated by a thick black line and square markers (2PL TSwd) – 6 streams, each with an average intensity 4,17 tr/s (minimum load - intensity cumulative flow 25 tr/s); The graph marked with thin black line and asterisks (2V2PL) and in the graph illustrated by dashed lines with triangular markers (2PL TSwd) - 6 streams, each with an intensity of 8,33 tr/s (average load - intensity of the aggregate stream 50 tr/s); The graph indicated by the thin dotted line (2V2PL) and the graph indicated by a thin blue line (2PL TSwd) - 6 streams of medium intensity 16,67 tr/s (maximum load - intensity of aggregate stream 100 tr/s).

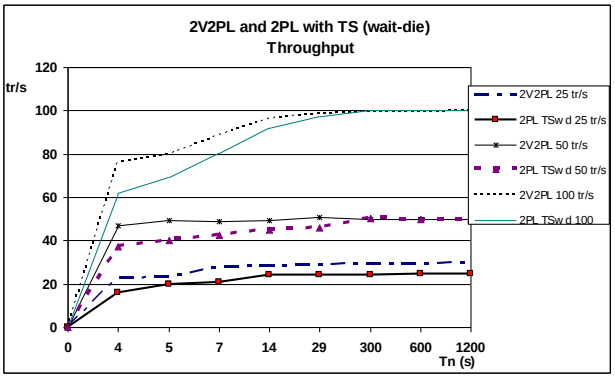

FIGURE 3 Throughput of the systems

The diagram in Figure 3 shows the Throughput for both models at three operating modes of load increased with the increase of the model during and after a certain time (5 minutes after the start of operation of the system); the occurrence of stationary mode reaches a maximum value and does not change with time.

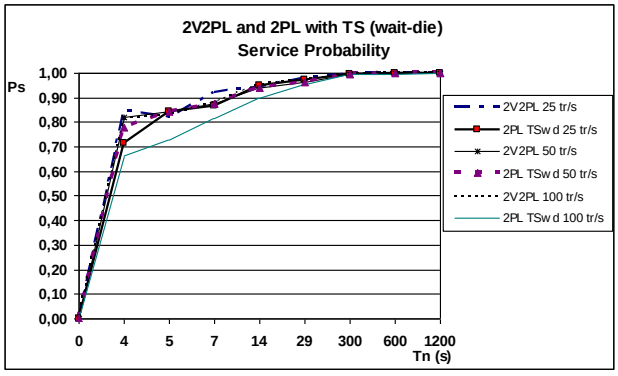

FIGURE 4 Service probabilities in the 2V2PL model and the 2PL with TS "wait-die" model

Service probability factor or completeness of service transactions serves to assess the dynamic properties of DDBMS. Figure 4 presents the results for the probability of service of distributed transactions at simulation algorithm Primary copy 2V2PL and Primary copy 2PL with an integrated mechanism of timestamping at the same intensities of inflows (as for Figure 3).

On Figure 5 graphically are given the values that are obtained for throughput by substituting the fixed in the receiving reports values of the cell X$ZAVTR. Intensity of inflows transactions are the same as the graphs of fig. 3, was changed only the matrix of distances MX$RAZST - the values in it are increased twice compared to models whose results are reported in the graphs of Figure 3.

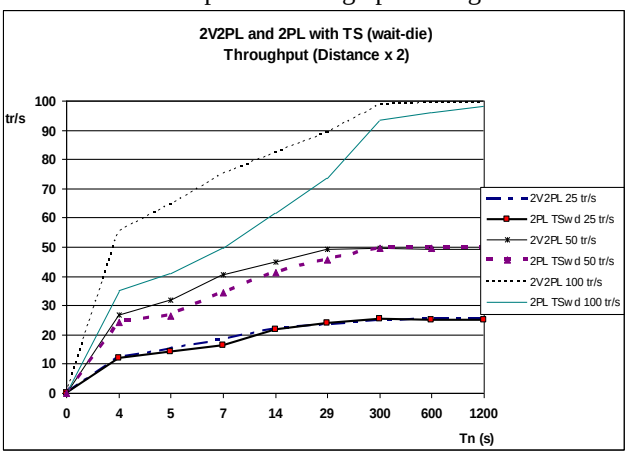

FIGURE 5 Throughput in the models at doubled distance between the sites in the system

From the graphs of Figure 5 it can be concluded that with the increase of the distance between sites in the system, the throughput graphs are "spaced apart" more. This is very evident in the graphs at maximum load of the system (intensity of inflow 100 tr/s).

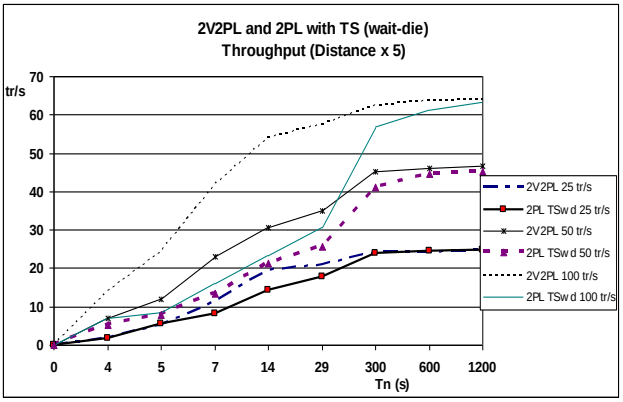

FIGURE 6 Throughput of the system (distance x 5)

By varying the values of cells in the matrix MX$RAZST (in the GPSS models) we can conduct research whether and how the gaps in the net, impact on Throughput, Service probability and other performance indicators of concurrency control algorithms.

For example, by five times, increasing the cell values of the matrix MX$RAZST are obtained the values of the throughput graphs on Figure 6 from the simulation reports of the Primary copy 2V2PL protocol and the Primary copy

2PL with timestamping "wait-die" at the same intensities of inflows as Figure 3.

By increasing the distance between sites in the system, except the increasing divergence of the graphs throughput, is observed slower occurrence of stationary mode. This is shown in the graph for the Primary copy 2PL with timestamping maximum intensity of the inflow transactions - graph, presented by blue line (*2PL TSwd 100 tr/s*) in Figure 7.

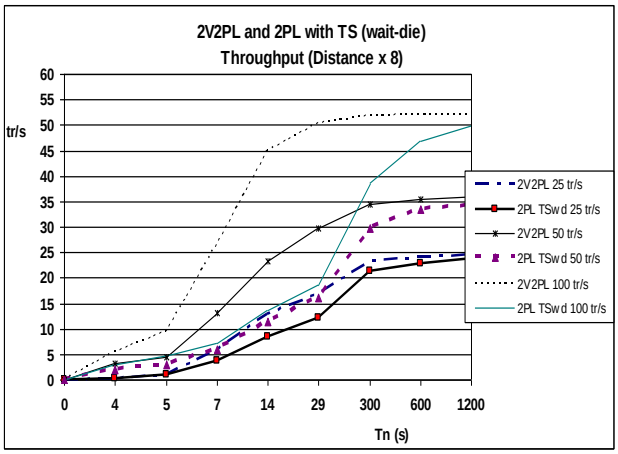

FIGURE 7 Throughput of the system (distance x 8)

Another indicator of the performance of concurrency control algorithms is Frequency distribution of Response time (RT) of transactions. Diagrams of Frequency distribution of RT are built automatically by the formulated in the GPSS model tables. On Figure 8 is demonstrated the histogram of Frequency distribution of RT in modeling Primary copy 2V2PL at the total intensity of the input streams 100 tr/s (maximum load on the system) and observation time 28.8 seconds. A histogram is generated automatically by GPSS World on table Response time distribution DATABLE, whose values are brought into the simulation report.

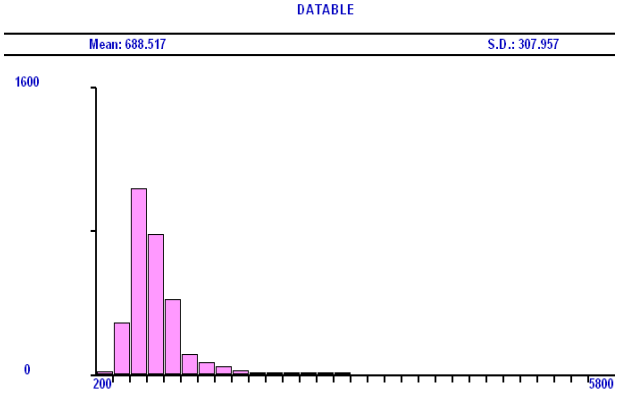

FIGURE 8 Frequency Distribution of RT in modelling Primary copy 2V2PL at λ = 100 tr/s

On fig. 9 is demonstrated the histogram of Frequency distribution of RT in modeling Centralized 2PL with timestamping (wait-die) at total intensity of the input streams 100 tr/s (maximum load on the system) and observation time 28,8 seconds (as in Figure 8).

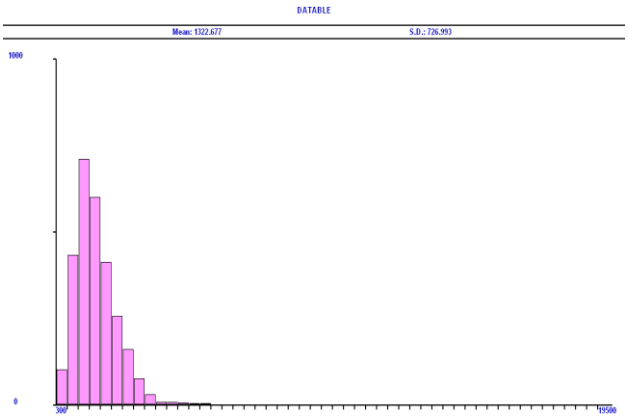

FIGURE 9 Frequency Distribution of RT in modelling Primary copy 2PL with TS (wait-die) at λ = 100 tr/s

The tables of Frequency distribution of RT besides that serve comparative analysis of concurrency control algorithms, serve also to assess the reliability of modeling algorithms by comparing with the template chart of Frequency distribution of RT [7].

Similarly, can be compared with the template graphics and charts for throughput of Figures 3, 5, 6, 7.

This approach may be useful in developing an information system for mobile learning [8].

8 Conclusions

The system of simulation GPSS World permits creation of effective simulation models of transaction concurrency control (in particular models of Two-phase locking of transactions in DDBMS with one-version and two-version architecture of replicated data.

Conducted simulations and the results confirm functionality of the modelling algorithms.

Simulation models allow definition the throughput ability of the distributed systems, the average service time of distributed transactions and other parameters on the basis of which the efficiency of the suggested algorithms could be defined.

The comparative analysis of the results of modelling of one-version and two-version Primary copy 2PL showed no deadlocks, while 2V2PL throughput is high and the response time is significantly lower than that of the one-version 2PL algorithm.

Acknowledgments

This paper is supported by the Project BG051PO00l-3.3.06-0003 “Building and steady development of PhD students, post-PhD and young scientists in the areas of the natural, technical and mathematical sciences”. The Project is realized by the financial support of the Operative Program “Development of the human resources” of the European social found of the European Union.

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Dialogue expert system at command line interface – DES – CLI Ryahovetz

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Received 1 May 2015, www.cmnt.lv

Abstract

The article describes the construction of a dialog expert system that supports the work of the system administrator. In its operation it uses the command line, which greatly improves its functionality and flexibility.

Keywords: Expert system, Command Line Interface - CLI, Data Hoard - DH, Logical Unit - LU, Dialogue Interface - DI

1 Introduction

We are witnessing continuous development of new information and communication technologies, continuous improvement of computers and the emergence of a variety of "smart" devices that facilitate everyday life.

Many commercial companies and existing open source communities compete in attracting more customers with a variety of innovative hardware and software developments. The race is to achieve simpler and easier to use devices and programs that guarantees them a larger share of the market. But despite the strong development of these technologies, we can not ignore the fact that all these decorated, aesthetically appealing and easy to use interfaces obscure the existing functionality of the products.

When additional flexibility and support are needed they do not always do well, and even violate the operating system on which they are installed.

2 Exposition

This is the place to mention the well known from the past command prompt, shortly called CLI, which reliably serves professionals in this area. For the inexperienced user it is difficult, but there are strong advantages for professionals compared to the graphic environments. Generally this environment is used actively and will be used actively at server level, especially in **UNIX** and **UNIX like** platforms and even in the **Windows** server platforms in all business environments, banks and others. It is not outdated, practically the command environment is the foundation and the GUI is the add-on, consuming additional resources, which the business at server level does not want, cuts and pays well to specialists to work exclusively on **CLI**. We must also mention, that, in many server platforms, it is even impossible to launch **GUI** because the architecture does not allow it: namely **"RISK Reduced instruction set computing"** which relies on productivity and security and they have not even written a graphical interface or if they have, it will strongly tend to the command view with the purpose of stability. Each layer adds extra risks to the security and potential crashes.

The table shows a part of the advantages and disadvantages of this type of environments.

TABLE 1 Advantages and disadvantages of CLI

Advantages	Disadvantages
Extremely stable and fast interface for communication with the operating system.	Extremely scary interface leading to total denial for working with such an environment
Extremely low consumption of system resources	Thorough knowledge of the particular operation system.
Full control over hardware resources and the operation system, having the rights needed.	Thorough knowledge of the commands and the ways to work with them.
Full control over the running processes, having the rights needed.	
Ability to perform complex tasks.	Often made mistakes by typing the different commands, arguments and compilation of strings of commands
Extremely fast communication, connection, transfer, configuration and control from one environment to another	High level of risk if there are unlimited rights, to delete significantly damage individual programs or even the operation system itself.
Easy possibility of scripting and automation of routine tasks.	The presence of large amounts of string information on the screen leads to confusion and missing valuable information. Especially if the operating person does not know how to retrieve it again.
Full control over standard streams stdin, stdout, stderr; opportunity for easy routing and localization in logs formatting for subsequent filtering and monitoring.	The need to work primarily with the keyboard and in very few and limited cases – with the mouse.

Certainly the topic on the advantages and disadvantages of one and the other environment is not limited to that described in Table 1.

The purpose of the described system is in three main directions:

1. To offer advices and expert solutions.
2. To assist the work with command interpreter with key information.
3. To teach itself and learn from the experience of the users.

3 Architecture Of The System

The system will consist on the principle of three-layer model with clearly identifiable modules. Namely **DH – Data Hoard**, **LU – Logical Unit** and **DI – Dialogue Interface**.

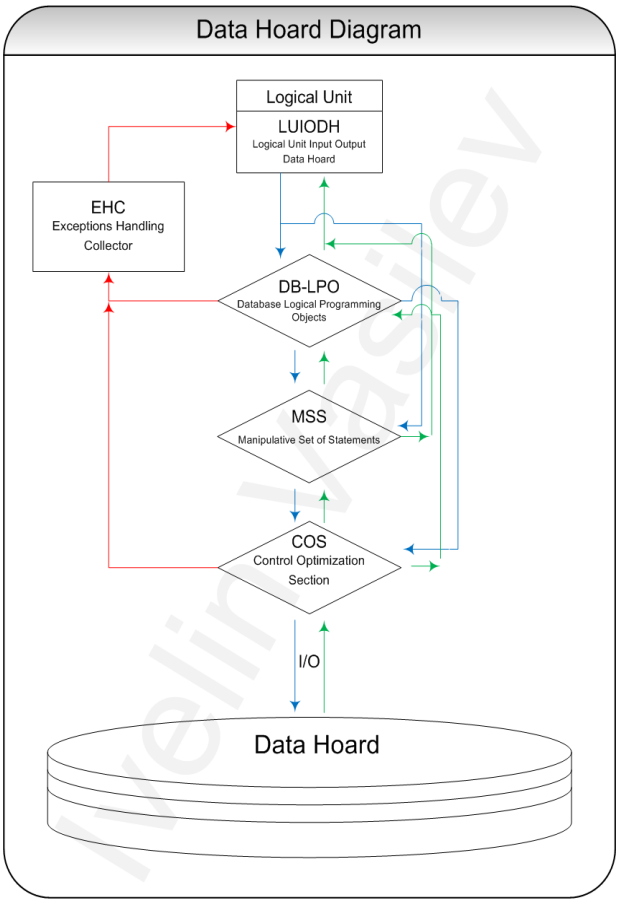

FIGURE 1 Module for storage and control of data

1) **DH - Data Hoard**. Module organizing storage of input - output data and control of information. This module can be divided into the following sub modules:
   - Physical database structure. A set of **DDL** statements creating the necessary set of relative tables providing space for storage of information.
   - **DB-LPO Database Logical Programming Objects**. Logic programming objects within the database. Each database offers its own language for writing and implementation of logic within the database for the purpose of fast operation, control and manipulation of input - output data. For example, ***Oracle PL/SQL, MySQL Stored Procedures, PostgreSQL PL/pgSQL and etc.***
   - **MSS – Manipulative Set of Statements.** Manipulative set of statements serving input – output data. A set of predefined and optimized DML queries and their routine call.
   - **EHC – Exceptions Handling Collector.** A segment for collecting and processing errors.
   - **COS Control Optimization Section**. A set of indexes, keys, triggers and others.
2) **LU – Logical Unit**. This module has the specific task to perform only and exclusively logical operations
   - **LUIODH (LU – I/O – DH) – Logical Unit Input Output Data Hoard**. Segment for interconnection with the **DH** module. The connection with the **DH** module must be made through a main duplex controller **LUIODH** for controlling the input – output data, divided into two simplex sub-controllers – one controlling and manipulating the input data **Logic Input Data LID** and one controlling and manipulating the output data **Logic Gets Data LGD**.
     a) **LID – Logic Input Data.** It can only receive data from its own main controller and communicate with the data hoard module **DH**. (**LUIODH → LID → DH**).
     b) **LGD – Logic Get Data.** It can only receive data from its own main controller and transmit them to the other main controller within the logical unit **LU**. (**LUIODH → LGD → LUIODI**)
   - **LUIODI (LU – I/O – DI) – Logical Unit Input Output Dialogue Interface**. Segment for interconnection with the **DI** module. Connection to and from the **DI** module is made similar to the segment before through one main duplex controller **(LU – I/O – DI) LUIODI** and two simplex sub-controllers **Logic Get Request LGR** and **Logic Response to Dialogue LRD.** Again there is a distribution, on which controller the data transfer to be performed.
     a) **LGR – Logic Get Request.** It can only receive data from its own main controller and transmit them to the other main controller within the logical unit **LU**. (**LUIODI → LGR → LUIODH**).
     b) **LRD – Logic Response to Dialogue.** This unit can only receive data from its own main controller and communicate with the dialog interface. (**LUIODI → LRD → DI**).
   - **SB – Scheduler Batches**: Segment for scheduled execution of routine tasks with the purpose of periodic processing of data with the purpose of updating, adding and modifying, reminding, triggering events and other.
   - **LEU – Logical Expert Unit**: Segment performing only complex logical operations. Connection to it is possible only through the two main controllers **LUIODI** and **LUIODH**.
3) **DI – Dialogue Interface.** Dialog interface for interconnection between end users and the system. This module has the main task to accept requests from

the end user and return the necessary information.

- **I-face - Input Interface.** Input interface receiving requests from users. The main task is to lightly check for the validity of the requests, arguments and parameters.

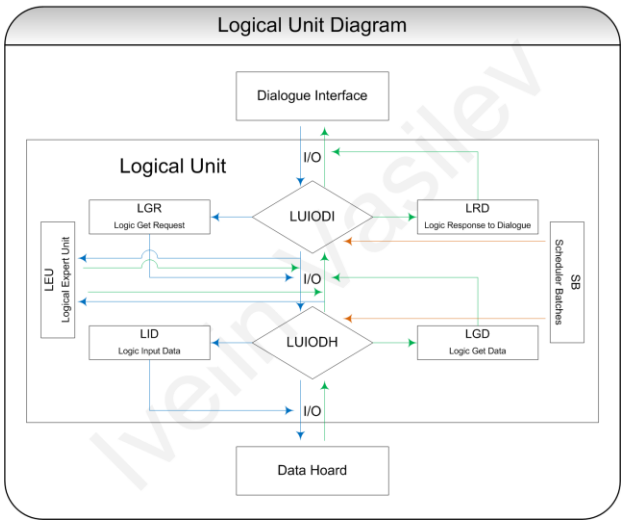

FIGURE 2 Logical unit

- **SU - Security Unit**. Security unit, which has the task to accept data from the **I-face** segment and make a thorough check in order to prevent blocking of the system due to improper or unauthorized use, attacks and others.

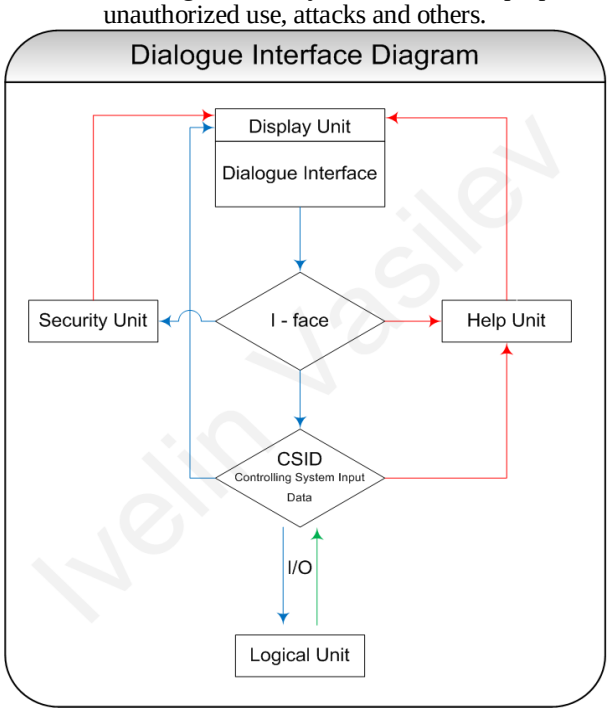

FIGURE 3 Dialog interface

- **HU - Help Unit.** In case of incorrect input data detected by **I-face** or **SU**, this unit is triggered to suggest or indicate the basic rules for using the system.
- **CSID - Controlling System of the Input Data**. Based on a single main controller that accepts requests passed by the **SU** unit and transmits them with almost no change to the logical unit **LU**.
- **DU - Display Unit.** Unit for presenting information to the end user by simply printing text on the screen or loading a set of templates for more complex queries.

4 Functioning Of The System

The operation of each system is based on the occurrence of certain events. In this system the events mainly occur from the dialog interface **DI** or **SB** segment for scheduled tasks.

We assume that an event has occurred from the dialog interface, ie a user has given a command to the system and expects a response. We assume that the command is correct and everything is fine at security level, it passes to the main controller of the dialog interface **"CSID"**. As described above, it turns with the information submitted, almost unchanged, to the logical unit **"LU"** to its main controller **"LUIODI"**. The controller is duplex, because it works both ways, it can receive and transmit, the task of the controller is to determine where the request came from and what is its purpose. In this case, for example, we have an incoming request from **"DI →LU"** and thus the data is passed on the simplex sub-controller **LGR** (logical unit receive data)

Received here, data are reviewed and according to the type of operation and type of data, logical operations can be triggered to transform data and interpret them in a form convenient for the next lowest module **"DH"**. After formatting the data if needed by more complex logic operations, then the main controller **"LUIODI"** turns to **"LEU"** for their implementation.

Data passed on this conveyor are ready to be put on the next main controller **"LUIODH"**, serving to connect to the module storing data. The task of this main module is to determine what operation is expected – retrieve information or input information. If the event is data entry, it passes on the sub-controller **LID** for input data. Its task is to check the input data for consistency, to ensure that data is not duplicated, whether the form consists with the one of the base and other routine operations. When you enter a large amount of data and if its nature allows, it can be formatted in several stacks and submitted asynchronously for faster performance, otherwise it is passed synchronously. In cases of data dependency, the asynchronous method fails and the synchronous transaction method is used. So prepared data is submitted for entry to the module **"DH"** and a record, change or deletion is performed.

Generally the implementation of the modification may be performed directly or may be passed through **"DB-LPO"** in need of further logical processing. The need of this logic at the lowest level is for achieving fast performance when processing large volumes of information and when it is necessary to perform multiple manipulations on the data in the database. This avoids unnecessary iterations with the **"LU"** logical segment.

In the optimization of the product, the most popular requests are implemented in the section **"MSS"** and are routinely invoked when matching events. The purpose of this segment is to avoid unnecessary accumulation of similar statements even if they are well optimized. The idea is one statement to be re-used as many times as possible and in need of change, either modification or

optimization, to affect the entire system. For additional control or its reduction, is used **"COS"** control optimization section of the module **"DH",** which creates, prohibits, permits or deletes a set of constants, triggers, indexes and other control-optimizing techniques within the selected database.

To explain the reverse action, we assume that an event to extract data from the system is invoked by the dialog interface. The request itself runs along the channel for input data until reaching the main controller **DH**. From there the necessary data are returned to the main controller **"LUIODH"**, which distributes things to happen on the channel for retrieving data **LGD**.

The logic controller takes the raw data and makes primary processing of data and then transmits the data to the controller **LUIODI**, which in turn distributes them to pass on the sub-controller **LRD**. This sub-controller accepts the semi-processed data and applies formatting methods and tools in order for data to be presented to the user in an appropriate and understandable format. In complex dialog templates, data is sliced into stacks and returned asynchronously to the dialog interface and loaded at the locations indicated on the template. In simple consoles the data is returned synchronously.

In the description until this point, we have not mentioned the element performing scheduled execution of routine tasks **SB - Scheduler Batches**. For the proper operation of the system, certain processes must be run in the background. Such tasks can be required to calculate data in a certain period of time or in case of reaching deadlines to apply some logic; to routinely extract data from third-party systems and update the system and to output data from the system and others.

This element's task is to create an event to one of the two main modules **LUIODI** or **LUIODH**. After the event is invoked, the control shall be taken by the respective controller and **"SB"** only marks that at the appointed time a process is started and the controller took the implementation. From here on, the corresponding controller takes care of the task until its implementation and thus registers the results in the base and logs information on occurred errors or successful implementation.

5 Interaction With Third-Party Programs

Every good software should offer an application programming interface for connection to third-party programs to itself, as well as support such interfaces for connection from itself to third-party programs. These are the so-called **API Application Programing Interface**. The need for such interfaces is required by many factors such as the following:

- Encapsulation and stability;
- Establish a strict protocol for communication;
- Simplified method for access to complex systems;
- Overcoming platform and other differences;
- Fast performance;
- Control over input – output data;

Application Programming Interface is the fourth independent module that can be turned off and on as needed and does not affect the operability of the system if it is not active. It can be regarded as an auxiliary or extension module for expanding the scope and functionality of the described here expert system. Its more detailed description is not under review here.

6 Conclusion

The described system solves everyday tasks of administration and management of different platforms. The quality of the resulting advices depends on the knowledge entered into the system base. Further development would be in the direction of adding new modules and increasing the relevancy of its recommendations.

7 Abbreviations

DML – Data Manipulation Language
DDL – Data Definition Language
CLI – Command Line Interface
GUI – Graphic User Interface
DH - Data Hoard
DB-LPO - Database Logical Programming Objects
MSS – Manipulative Set of Statements
EHC – Exceptions Handling Collector
COS - Control Optimization Section
LU – Logical Unit
LUIODH (LU – I/O – DH) – Logical Unit Input Output Data Hoard
LID – Logic Input Data
LGD – Logic Get Data
LUIODI (LU – I/O – DI) – Logical Unit Input Output Dialogue Interface
LGR – Logic Get Request
LRD – Logic Response to Dialogue
SB – Scheduler Batches
LEU – Logical Expert Unit
DI – Dialogue Interface
I-face - Input Interface
SU - Security Unit
HU - Help Unit
CSID - Controlling System of the Input Data
DU - Display Unit
API - Application Programing Interface

Acknowledgments

This development was funded by Project RD-08-306/12.03.2015 to Shumen University "Konstantin Preslavsky", Shumen, Bulgaria.

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Information and Computer Technologies

Content C

Development of a quantitative model of evaluation of maturity level of processes of software projects

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Received 01 March 2015, www.cmnt.lv

Abstract

The developed model allows for quantitative assess the maturity level of processes of software projects and to identify priority areas for the development of software project processes. The model was tested on 10 companies. Spent in the company survey allowed us to estimate the level of maturity, to collect data on deviations in time and the cost of the project and build the equation of dependence of deviation from the measured level of maturity. This equation can be used by companies to predict the variation of key indicators of the project when changing the maturity of software processes.

Keywords: quantitative model, maturity level, software projects, development of a quantitative model

1 Introduction

Maturity of project management can be distributed regarded as a tool for development the company through continuous improvement project management processes. For objective assessment of the company, other words, to assess the level of maturity developed

Various models, which are based on the task of measuring progress at the momentlevel of maturity and preparation of detailed recommendations on which areas of knowledge and phases of the project is necessary to improve the company's processes. Some models allow us to estimate the financial benefits of the transition to a higher maturity level of project.To assess the maturity of existing quantitative and qualitative methods, most of which are five levels: 1 – chaotic, 2 - informal, 3 - partial formalization, 4 - complete formalization, 5 - improvement. All models assess the level of maturity determine what processes need to be improved in the field of project, but in contrast to the qualitative, quantitative methods allow us to establish which areas of priority [1].

As part of the work performed are considered high-quality models: CMM1 (assesses the level of maturity for software developers); COBIT2 (an open standard for IT management); these models are based on the verification of the presence or absence of certain characteristics processes, but does not provide a quantitative assessment of the compliance procedure. In addition, the evaluation result is not reflected in the presence of higher-level process of maturity that is also an essential shortcoming qualitative model.

Despite its flaws, quality models allow us to estimate at what stage of development of is an organization at the moment, as well just analyzing what processes are at the lowest level, to understand what the requirements model should be provided in order to achieve higher level. However, with these models is difficult to determine the vector of development of software project in the company [2, 3].

2 Main content

The developed model has 5 levels of maturity. Each level used by organizational measures and describes the result of their impact on the project (Table 1). The model consists of questions relating to 8 software development knowledge areas: content, time, value, quality, human resources, communications, risk and procurement; and five project phasesInitiating a Project, Analyze, Execution, Control and Closing a Project. Questions contain 5 options where each option corresponds to a certain level of maturity from 1 to 5.

To calculate the final mark of maturity in the model used an average of the results of answers to all questions of each of the eight areas of knowledge and the five phases.

TABLE 1

Maturity Models	Description
Initial	The processes are usually ad hoc and chaotic. The organization usually does not provide a stable environment. Success in these organizations depends on the competence and heroics of the people in the organization and not on the use of proven processes.
Managed	The process discipline reflected by maturity level 2 helps to ensure that existing practices are retained during times of stress. When these practices are in place, projects are performed and managed according to their documented plans.
Defined	The processes are well characterized and understood, and are described in standards, procedures, tools, and methods. An organization has achieved all the specific and generic goals of the process areas assigned to maturity levels 2 and 3.
QuantitativelyManaged	The process performance are established and used as criteria in managing processes. Quantitative objectives are

	based on the needs of the customer, end users, organization, and process implementers. A quality and process performance is understood in statistical terms and are managed throughout the life of the processes.
Optimizing	The processes are continually improved based on a quantitative understanding of the common causes of variation inherent in processes.

3 Example of questions

Question 1.

Whether the project functions of the quality control requirements of the customer in the project objectives?

Answers:

1. The function of quality are not used
2. In managing customer requirements are used mapping customer requirements and objectives of the project.
3. In large projects the four-level model for small single-level.
4. The function of quality are used
5. After each project template quality function is updated.

Question 2.

Is there any quality assurance program of the project?

Answer:

1. Quality is not monitored
2. The quality is planned
3. The program is created only for large projects
4. There is a template programs and establishing procedures for its adaptation.
5. There is a template programs and establishing procedures for the adaptation, which is constantly being improved.

Question 3.

How do you monitor the cost of the software projects?

Answer:

1. The cost is not monitored.
2. Cost is controlled by a manager
3. On large software projects use control procedure cost of work performed.
4. There is a procedure for monitoring the value of work performed and analysis of control events.
5. There is a procedure for monitoring the value of work performed and analysis of control events.

TABLE 2

The range of mean scores	Assessment of the level of maturity
1 to 2	Low level
2 to 3,5	Middle level
3,5 to 5	High level

Depending on the qualitative assessment of a company can take the following actions:

TABLE 3

Maturity level	Recommendations
Low level	Create a list of processes. Document them and implement standards for their execution
Middle level	Spend the harmonization process execution to introduce a system of quantitative indicators
High level	You can invite Western companies to assess, but the pre-adapt their terminology to western terminology translation table or make one system to another system of terms

Analysis of the results showed that none of the companies surveyed did not reach the fifth level of maturity, but C9 and C10 companies meets the third and fourth level of maturity, which is also the highest, while the company C3 level of maturity in all fields of knowledge is the initial. Table 3 shows the results of the phases of the project, which correlate with the results of Table 2: C9 and C10 Companies also have a fairly high level of maturity phase, and the company C6 initial level. For other companies the level of maturity phase of the project is between the initial and the level of individual planning [4, 5].

TABLE 4 The result of evaluating the level of maturity (by the areas)

Area of expertise	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Content	1,34	1,58	1,00	2,57	2,91	1,53	1,53	1,53	3,53	3,49
Time	1,27	1,76	1,21	1,77	2,27	1,27	1,27	1,27	2,50	3,27
Value	1,29	1,33	1,29	1,69	2,29	1,29	1,29	1,29	3,29	3,29

Quality	1,00	1,23	1,00	2,00	2,85	1,00	1,00	1,00	3,00	2,00
Human resources	1,57	1,67	1,35	2,67	2,85	1,67	1,58	1,67	3,67	2,67
Communications	1,78	1,50	1,00	2,50	2,50	1,50	1,50	1,50	4,00	3,50
Risk	1,10	1,00	1,00	2,30	3,00	1,73	1,38	1,00	3,85	4,00
Procurement	1,24	1,00	1,00	1,88	2,00	1,68	1,00	1,00	1,00	3,00

TABLE 5 The result of evaluating the level of maturity (by the processes)

Processes	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
Initiating	1,72	1,58	1,00	2,32	2,32	1,00	1,58	2,00	3,00	3,30
Analyze	1,67	1,67	1,27	2,67	2,38	1,67	1,22	1,38	3,67	3,67
Execution	1,58	1,50	1,30	1,50	2,75	1,50	1,50	1,65	3,50	3,75
Control	1,40	1,60	1,38	2,00	2,00	1,00	1,32	2,00	3,50	3,68
Closing	1,64	1,00	1,00	2,00	2,48	1,00	1,78	1,30	4,00	3,83

4 Conclusion

The main purpose of the work described in this paper was to demonstrate the capability of automatic classification of maturity levels based upon some characteristics of the software engineering processes used by an organization. Thus, the developed quantitative model allows evaluating the level of process maturity, identifying areas for development management, to predict the success of the project. But any company would be interesting to assess their financial benefit from the transition to a higher level of maturity. And finally, the model can be used for passing information about particular aspects of the software engineering processes, both within and among software organizations.

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Polygraph method in psychological research of human emotions

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Received 01 March 2015, www.cmnt.lv

Abstract

The structure and characteristics of human emotional maturity have been studied. It was worked out a program (based on software "Sheriff 7" of polygraph "Barrier-14") for testing a peculiar personal characteristic of juveniles - deceitfulness. Earlier developed diagnostic methods were applied to measure the emotional maturity of a person. The correlation between the emotional maturity of juveniles and their deceitfulness was established using a polygraph method. It was revealed that the low level of emotional maturity corresponds to the weak abilities of juveniles to lie. A research of ethical and social values of contemporary juveniles was undertaken to determine the areas in which the deceitfulness is most pronounced.

Keywords: emotional maturity, hide deceitfulness, polygraphs «Barrier-14» («Sheriff 7» software)

1 Introduction

The emotional sphere of juveniles is a subject of numerous researches [1-6]. However this problem is insufficiently studied.

In this work we intend to consider the main factors that determine the level of emotional maturity and to show that this level is linked to the moral values of personality. In addition, we investigated the correlation between the emotional maturity and some specific psychological characteristics of juveniles, for example, such as deceitfulness. The last task is solved using a polygraph with original computer program. The use of the polygraph techniques allows a widening the possibilities of the psycho-diagnostics in modern psychological researches. In particular, using the polygraph technique we can use many indicators for revealing the presence or absence of deceit [7].

There are controversial approaches to the definition of different categories of lies and deception [6 - 9]. We define a deception as a half-truth that can lead to wrong conclusions in the real situation. The deception is simply essentially incomplete information. But the lie is a deliberate distortion of the true information.

There are different approaches to the problem of "emotional maturity", for example simultaneous consideration of emotional maturity and emotional competence [10] or emotional maturity as a manifestation of the social convention [11, 12]. According to the existing models, an emotional maturity is considered as some indicator of «the functioning person» [13]; emotionally mature person is a self-actualizing person [14]; emotionally mature person is represented as an authentic person, as a child or as an adult [15, 16]. Emotionally mature person is sometimes included in trans-personal structures [17, 18].

We proceed from the generalized characteristic of emotional maturity introduced by A. Chebykin and I. Pavlova [4]. They account the degree of the development of emotional sphere on the whole and the level of the adequacy of emotional response to social and cultural challenges. The main requirements to the emotional maturity are a controlled expression of emotions; an adequate perception of external factors, a deep understanding of the origin of owns emotions and emotions of the people around and the use of emotions for the effective communication, a high social sensitivity.

In this work we used a questionnaire «Diagnostics of emotional maturity» worked out by A. Chebykin [4].

One of our tasks was to investigate which values are preferable for students, what are the motivators for their actions and behavior, what do they strike for and what they hide. Than we expected also to clarify how the emotional maturity level of the person influences on the specific psychological characteristics of students. To reach this aim the following tasks were formulated:

1. To determine the hierarchy of moral and ethical values of contemporary juveniles.

2 To develop a program for a polygraph research of deceitfulness of individual in the adolescence.

3 To investigate the correlation between the peculiarities of emotional maturity and the data of deceitfulness of students.

For students the attitude to the educational process should be the most important moral value that would have prevailed in needs, interests and social expectations.

2 The social-morality ideals of students

In this experiment 308 students participated, including 223 girls and 85 boys. The students were asked to answer the appropriate questions. They had to rank six categories of values that were offered. The obtained results are presented in Table 1.

TABLE 1 Prioritization of students' values

Preferable values	% of students
Family	27%
Future employment and income	22%
Friends and communication	17%
Studying	14%
Health	12%
Adherence to social standards	8%

3 Results of polygraph research of the tendency to deception among students

As a rule the deceitfulness is manifested in spheres of values that are the most important for a person [8]. We have performed a polygraph test accounting the necessary rules which include, for example: precise statement, maximum of briefness (simple grammatical structure); convenient for pronunciation, correctness in meaning. The test should have only one subject matter, take into account intellectual and education level of a person, and others. Seven physiological parameters (photo-plethysmogram, galvanic skin response, upper breathing, lower breathing, pressure deviation recorder, the resistance to testing, automatic evaluation of person`s tension during an hour) are measured by polygraph «Barrier-14». Registration and data handling program «Sheriff 7» has an interface and based on operating systems Windows 98SE, ME, NT 2000, XP. The program allows a sight control of the testing procedure, archiving the test results, performing the comprehensive analysis. During the survey the assessment of the person's characteristics is carried using the polygraph data shown in Figure 1.

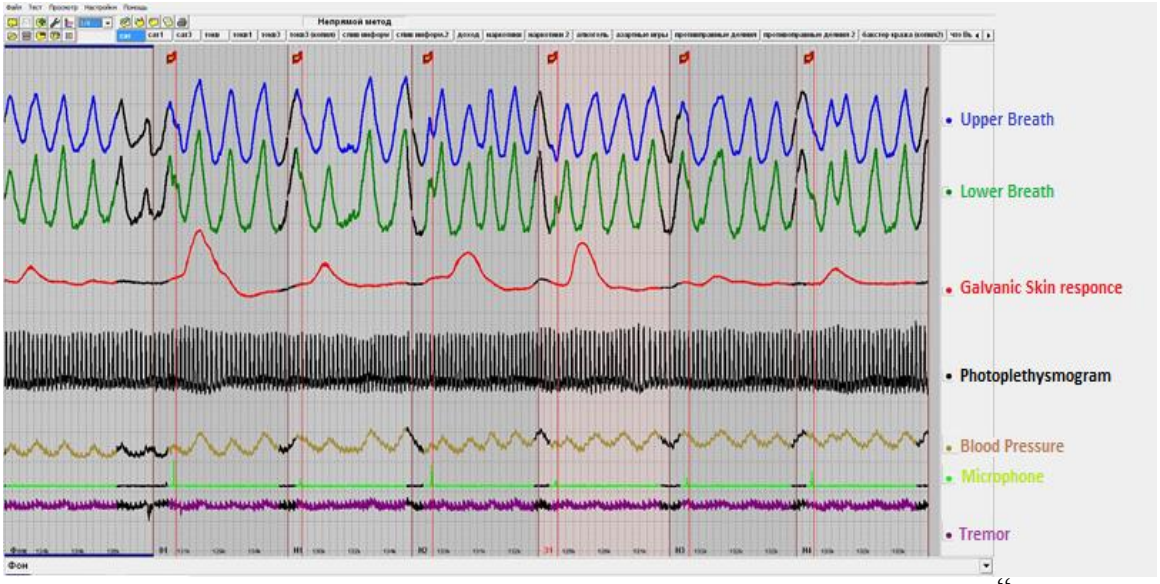

FIGURE 1 Illustration of registration of the physiological parameters with the polygraph "Barrier -14 "

The polygraph survey consists of eight test units and 122 questions. 51 questions were focused on deceit detection in the spheres of main values (Table 1) of juveniles.

The polygraph study covered 30 students including 22 girls and 8 boys 19-22 years old. The expert analysis of the obtained data was carried out. According to polygraph survey method we appropriated numerical values to obtained final results.

4 Correlation between the indicators of an emotional maturity and the polygraph results

The results showed the correlation between the indicators of an emotional maturity and the polygraph data are presented in Figure 2. We have implemented statistical analysis using average values, mode and median estimations, Pearson's (r) coefficients. We used also Student's t-test. As a result the following results were obtained:

- Correlation parameters between an emotional maturity level and the hide deceitfulness: $r=0,7$, $p<0,01$. It means that the higher level of emotional maturity leads to the higher level of the hide deceitfulness and vice versa;
- Correlation parameters between the level of emotional self-regulation and the level of the hide deceitfulness: $r=0,639$, $p<0,01$. It means that the higher level of emotional self-regulation corresponds to the higher level of the hide deceitfulness and vice versa;
- Correlation parameters between the level of empathy and the level of the hide deceitfulness level: $r=0,625$, $p<0,01$. It means that the higher empathy level leads to the higher hide deceitfulness vice versa.

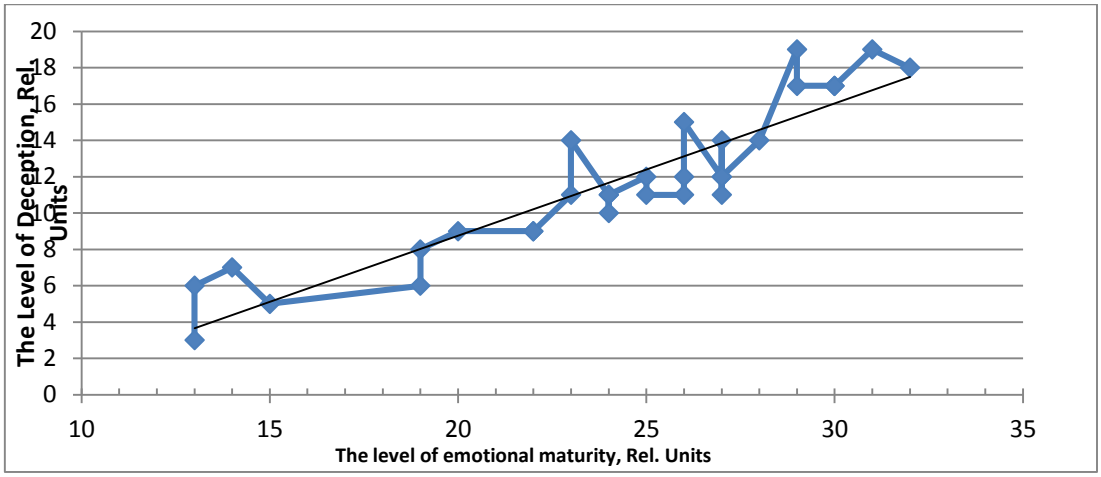

FIGURE 2 Correlation between the level of emotional maturity and the level of deception

Our results showed that a significant basis for diagnosis of deceitfulness is both high average indicators of self-regulation and empathy. This is in consistent with the work [6].

5 Conclusions

1. The most important values for modern juveniles are linked to family, further employment and income as well as friends and communication.

2. The important components of emotional maturity are the emotional self-regulation and empathy.

3. Polygraph study of the correlation between the level of the emotional maturity and the hide deceitfulness showed that the higher level of emotional maturity corresponds to the higher level of hide deceitfulness and also that the higher level of emotional self-regulation corresponds to the higher level of the hide deceitfulness.

4. A significant basis for diagnosis of deceitfulness is both high average indicators of self-regulation and empathy.

Acknowledgments

Author would like to acknowledge Academician, Profesor Olexiy Chebykin and Profesor Arnold Kiv for useful discussions.

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Multi-criteria decision-making model based on the level of doubt for information and training system

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Received 01 March 2015, www.cmnt.lv

Abstract

The urgency of developing information and training system based on multicriteria decision-making model is due to both scientific purposes better understanding of the information processes of learning and practical objectives to create more effective information and training systems, the implementation of which contributes to the quality of distance learning. The transition to this technology involves the use of new teaching methods, approaches, principles of organization of the learning process, including on the basis of information and training systems. Therefore, in this paper concerns the problem-oriented learning management based on multicriteria decision-making model that takes into account the level of doubt the user. The proposed method of measuring the level of doubt the user gives a clearer and more "transparent situational picture" for a more objective decision-making. Also, the method makes it possible to reduce the probability of guessing the correct answer, which increases the objectivity of knowledge in diagnostic systems for process control training on remote technology.

Keywords: multicriteria, distance learning, doubt

1 Introduction

Currently, the requirements for the quality of education (qualification level: knowledge, skills, worldview, mind and senses, abilities, personality and character) university students requires sophisticated testing methods to detect the level of knowledge, taking into account the social and psychological features of the student in order to effectively manage learning process.

The solution to this problem is possible:

- Firstly by the integration of all types and methods of testing and validation of knowledge (as well as checking ability, skills and outlook);
- Secondly, by automating the testing process, testing the knowledge and skill level (ie, quality);
- A third way to achieve maximum objectivity of evaluation of knowledge.

Therefore, in this paper address the latter problem is focused on maximizing an objective measurement of the level of knowledge. The possibility of solving this problem is to multicriterion approach, which measures the number of correct answers given by doubt.

Model development of a teaching element is constructed by the user when working with the system on the basis of personal identification properties. As a result, tracking personal properties in the system is generated for each user's image, which can be used to control the learning process according to the parameters in Table 1.

Based on multicriteria evaluation model of knowledge can identify key features for organizing and managing the automated process of training in information and training system. These include: (Savchenko Y.Y., 2012)

- Level of knowledge - the level of current results of the users.
- Level of difficulty - fixed characteristics prescribed settings teacher.
- Level of response - time estimates the user's actions in response to any impact.
- Level of confidence - probability characteristic inversely proportional to the level of doubt.

TABLE 1 Performance training for each educational element

№	Designation	Characteristic
1.	K_0	The beginner level of knowledge of educational elements
2.	K	The achieved level of knowledge of EE
3.	C	% doubt the level of knowledge
4.	S	Degree of difficulty of EE
5.	I	Intensity of using of EE
6.	P	Periodically of using of EE
7.	T	Spending of time on the development of EE
8.	H	Number of steps of learning
9.	D	Information handwriting user
10.	O	Percentage of errors when checking the EE
11.	V	Weight of training element
12.	R	Mode of operation of ITS

The level of doubt the user is latent parameter measurements, i.e. not directly measured. Level doubt plays an important role in the assessment of knowledge, because it takes into account the psychological characteristics of human behavior. At the level of latent doubt includes the following parameters: length of time the decision-making; periodicity; intensity; response to the outrage; reaction to the decision-making; artificially created situation; questionable actions of the user and others. For the measurement of these parameters are necessary quantitative characteristics: number of missed transactions; number of unconfirmed information; interrupts logical chain et al. To account for the level of doubt, the user is offered the following method

(Vinogradov G.P., Kuznetsov V.N., 2011).

The essence of the method is to confirm the doubts of the decision, by comparing it with the decision of this type. Defined latency parameter of this model uses the following quantitative characteristics: themes, complexity, and decision.

Testing formulated from x-issues. All questions are divided into x t-groups on specific topics. Each question has only one answer. In the entire test questions are divided into x of the n-levels of complexity. Each question has its own level of difficulty. The share issues by level of complexity must satisfy the following condition: for n=3 easy - 50%, average - 30%, complex - 20%. Each difficulty level corresponds to the weighting factor F (F_{max} - the most difficult, Fmax-1 - less complex, etc.) (Serbin V.V., 2013).

Questioned all questions that were answered correctly for all levels, except the first one. Doubt in answering the question level F, is calculated from the responses to the questions on the same topic (i.e., the same group), which is below the level of complexity of the complexity of this issue (Serbin V., 2010).

$$S_F = \sum_{i=1}^{m} k_i W_i ,$$

where m – number of difficulty levels below the one for which the calculation is carried out,

$$m = F - 1 ,$$

F – weighting factor of the current level of complexity;
k_i – weight ratio of doubt on the question below current levels

$$k_i = -\frac{i - m - 1}{\sum_{j=1}^{m} j} .$$

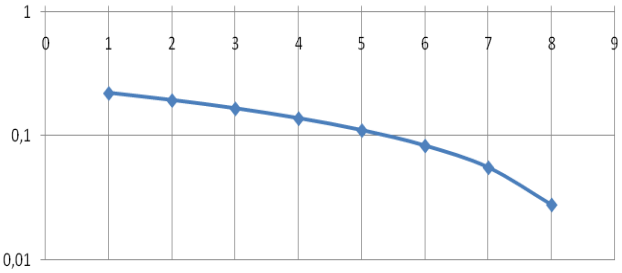

FIGURE 1 A plot of the weight coefficient Ki doubt on the current level of complexity of the issue (logarithmic)

W_i – total weight of the doubt question the i-th level,

$$W_i = \frac{1}{g} \sum_{l=1}^{g} V_i ,$$

where g – the number of questions the i-th level of complexity on the same topic as a question, for which the calculation is being doubt;
V_i – decision (answer the question)

$$V_i = \begin{cases} 1 - in\ \ case\ \ correct\ \ answer \\ 0 - in\ \ case\ \ incorrect\ \ answer \end{cases}$$

Assuming that the test in question may be several levels of complexity, there is a need to find a mean-value level of each question:

$$S_s = \frac{\sqrt{\sum_{t=1}^{q} S_{Ft}^2}}{q} .$$

Total factor characterizing the degree of doubt is:

$$S = \sum_{F=2}^{F_{\max}} f_{F-1} \cdot S_s ,$$

where S_F – doubt in response to the question of F difficulty, f_F – weight ratio doubt in response to the question of F difficulty:

$$f_F = \frac{F}{\sum_{j=1}^{m} j} ,$$

where F_{max} – maximum weight at the highest level. (Serbin V., 2013)

2 Results

The schema of multicriterial decisions making model shown in Figure 2:

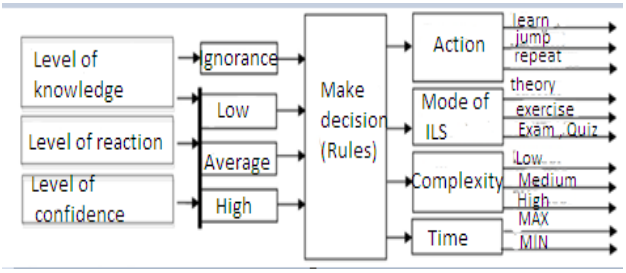

FIGURE 2 Multicriterial decisions making model

Decision making educational element (action, mode of operation, complexity, time) on the basis of the current state of the educational element is achieved on the basis of the truth table of decision-making in accordance with Table 2.

TABLE 2 The current state of the educational element and decision

State			**Decision of EE**			
Knowledge	Reaction	Confidence	Complexity	Time	Action	Mode
Z0	RA	UA	A	max	jump	theory
Z0	RA	UB	A	max	learn	theory
Z0	RA	UC	A	max	learn	theory
Z0	RB	UA	A	-	learn	theory
Z0	RB	UB	A	-	learn	theory
Z0	RB	UC	A	-	learn	theory
Z0	RC	UA	A	min	learn	theory
Z0	RC	UB	A	min	learn	theory
Z0	RC	UC	A	min	learn	theory
ZA	RA	UA	A	max	repeat	Exercise
ZA	RA	UB	B	max	repeat	-
ZA	RA	UC	B	max	jump	Exam, Quiz
ZA	RB	UA	A	-	repeat	Exercise
ZA	RB	UB	B	-	repeat	-
ZA	RB	UC	B	-	jump	Exam, Quiz
ZA	RC	UA	A	min	repeat	Exercise
ZA	RC	UB	B	min	repeat	-
ZA	RC	UC	B	min	jump	Exam, Quiz
ZB	RA	UA	A	max	repeat	Exercise
ZB	RA	UB	B	max	repeat	-
ZB	RA	UC	C	max	jump	Exam, Quiz
ZB	RB	UA	A	-	repeat	Exercise
ZB	RB	UB	B	-	repeat	-
ZB	RB	UC	C	-	jump	Exam, Quiz
ZB	RC	UA	A	min	repeat	Exercise
ZB	RC	UB	B	min	repeat	-
ZB	RC	UC	C	min	jump	Exam, Quiz
ZC	RA	UA	B	max	repeat	Exercise
ZC	RA	UB	B	max	repeat	-
ZC	RA	UC	C	max	jump	Exam, Quiz
ZC	RB	UA	B	-	repeat	Exercise
ZC	RB	UB	B	-	repeat	-
ZC	RB	UC	C	-	jump	Exam, Quiz
ZC	RC	UA	B	min	repeat	Exercise
ZC	RC	UB	B	min	repeat	-
ZC	RC	UC	C	min	jump	Exam, Quiz

The metric scale measuring the state of the educational element:

1. Ignorance (0%-49%) Z0
2. Low level of knowledge (50%-74%) ZA
3. The average level of knowledge (75%-89%) ZB
4. The high level of knowledge (90% -100%) ZC
5. Low level of reaction (0% -74%) RA
6. The average level of reaction (75% -89%) RB
7. The high level of reaction (90% -100%) RC
8. Low level of confidence (0% -74%) UA
9. The average level of confidence (75% -89%) UB
10. The high level of confidence (90% -100%) UC

The organization of the learning process in information-learning system based on a measure of doubt for control need rules, which formed the knowledge base.

Rules:

1. If (REs knowledge - ignorance and reaction - low, average or high and confidence - low, average or high) THEN (complexity - low, the learning mode - the theory, the effect of educational elements - learn).
2. IF (REs knowledge - ignorance, low, average or high and reaction - low and confidence - low, average or high), time (time - MAX).
3. IF (REs knowledge - ignorance, low, average or high and the reaction - high and confidence - low, average or high), time (time - MIN).
4. If (level of knowledge of UE - low. Medium or high and reaction - low, average or high and confidence - high) THEN (action educational element -Jump).
5. If (knowledge UE – low, average or high and reaction - low, average or high and confidence - low or average) THEN (action educational element - Repeat).
6. If (knowledge UE – low, average or high and reaction - low, average or high and confidence - Low) THEN (training mode - Exercise).
7. If (knowledge UE – low, average or high and reaction - low, average or high and confidence - high) THEN (training mode – Exam, Quiz).
8. If (knowledge UE - low or average and reaction - low, average or high and confidence - Low) THEN (difficulty - Low).
9. If (knowledge UE - low and reaction - low, average or high and confidence - average or high) THEN (difficulty - average).
10. If (the level of knowledge of UE - average and reaction - low, average or high and confidence - average) THEN (difficulty - average).
11. If (the level of knowledge of UE - average or high and reaction - low, average or high and confidence - high) THEN (complexity - high).
12. IF (knowledge UE - high and reaction - low, average or high and confidence - low or average) THEN (difficulty - average).

5 Conclusions

In this paper, decision making model was created on the basis of measuring the level of doubt the user to control the learning process. The proposed idea makes it possible to reduce the probability of guessing the correct answer for a more objective assessment of knowledge and adapt the learning process on the basis of the knowledge base.

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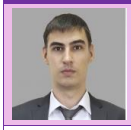

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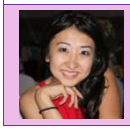

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Hot spot and development trend of domestic information science

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Received 01 March 2015, www.cmnt.lv

Abstract

Fundamental approach to literature metrology were introduced in this paper to make a statistical analysis on the thesis of library and information science during the period of the 11th Five-Year Plan of China with academic focus on CNKI, CSSCI collections, citation frequency, productive authors and authorities. With academic defects and deficiencies summarized from the statistical study, this paper aimed at making recommendations and references for the disciplinary development planning of library and information science, faculty construction and talent cultivation, as well as relative researching concerns.

Keywords: bibliometric studies, library information science, disciplinary development, statistical analysis

1 Introduction

The institutions of library and information science provided a key basis for academic studies and talents cultivation of this specific discipline in our country. Some knowledge of the research condition of this discipline could be gained from a statistic study of its publications, which could also help to grasp its educational trend and make recommendations and reference for the disciplinary development planning of library and information science, faculty construction and talent cultivation orientation, as well as some researching and teaching concerns etc.

2 Statistic foundations and methods

2.1 STATISTIC OBJECTS, DATA RANGE AND ANALYTICAL ITEMS

Notes: (1) The Information & Resource Research Center of Wuhan University, the Research Center for Chinese Science Evaluation and the Research & Evaluation Center for Chinese Social Science of Nanjing University couldn't be strictly distinguished and many authors have double identities, so publications of these two universities and three research institutions would be counted separately. (2) The literature & information center of Chinese Academy of Sciences doesn't belong to the teaching and research institution, while Yunnan University only has the doctor station of archive sciences, which don't belong to the research objective of the present thesis and would not be statistically analyzed.

Statistic objects: there were 12 universities in our countries having the doctor station of library & information science and archive management (see Table 1). In this paper, the Renmin University of China was less than Renmin University; Shanghai Branch of Nanjing Political College was less than Shanghai Branch; Central China Normal University was less than Huazhong Normal University.

TABLE 1 The universities and colleges with doctor stations of library & information science and archive management

The first level doctor station of library & information science and archive management	The Pecking university Wuhan University Nanjing University Renmin University	
The second level doctor station	library& information science	Nankai University Jilin University Literature & Information Center of Chinese Academy of Sciences
	library& archive science	Shanghai Branch
	library science	Zhongshan University
	information science	Huazhong Normal University
	archive science	Yunnan University

The data was collected from the papers published during 2006 to 2010 from the paper research of China Academic Journal Network Publishing Database of CNKI. The due date is August 15, 2011.

The statistic analytic items included, first, the statistical analysis of publications under the category of CNKI information & technology; second, the statistical analysis of publications under the category of CNKI library & information and digital library; third, the statistics of publications from Journal of Library Science in China and Journal of Information Studies; forth, the statistical analysis of documents published in the CSSCI journals; fifth, the statistical analysis of references; sixth, the statistical analysis of prolific authors and experts.

2.2 RESEARCH STRATEGIES AND STATISTICAL METHODS

The publication statistics was conducted under the category of information of technology, information of library and digital library of CNKI as search port. The time scope was from 2006-01-01 to 2010-12-31. The standard title of colleges and institutions having the specific disciplines were fuzzy research under restricted conditions, such as Department of Information Resources Management of Business School of Nankai University and School of Information Resources Management and School of Archives of Renmin University of China. Titles of other departments and institutions are supplementary search under restricted conditions, such as Business School and Department of Information Management of Nankai University etc. Cases like non-first author, non-academic paper and repeated publications of one paper will be excluded after comparison. The CSSCI literatures are categorized according to different degree. The search portal is library & information and the research matching condition is consistent with the CNKI publication research.

All the publications from the twelve departments and institutions are statistically analyzed according to the CNKI research results. 1. Artificial statistics are made for the papers published in Journal of Library Science in China and Journal of Information Studies through the annual general contents of the two journals. 2. The number of papers written by on-the-job doctors and postgraduates are artificially calculated based on the author affiliation, such as Lu Yibao, the Department of Information Management of Nanjing University and the library of Huaiyin Normal University.

Summary methods: 1) publications from the three research institutions of Wuhan University and Nanjing University are incorporated into corresponding schools and departments for summarization 2) All the statistics are arranged in descending order.

2.3 PUBLICATIONS STATISTICS AND ANALYSIS

2.3.1 Statistics and analysis of publications under the category of information & technology, CNKI

The cross penetration of library & information discipline and its relevant subjects demonstrated in academic papers in current days. On the one hand, the modernization of library & information and archives becomes inevitable, and this subject has closely interrelated with computer science and network theory, becoming a key domain of research. On the other hand, in the era of new media, the science of library & information and archives are penetrating with the field of press and publication, providing a cross domain of this subject. This thesis will not statistically analyze the interpenetration of library & information subject and other subjects in the respect of academic papers.

The total number of papers from Wuhan University is in approximately 34% of the overall statistics (2423/7074). Expect for the archive, under which Wuhan University ranks the forth, other categories are all led by it. In addition, its cross-field development also proceeds in a balanced way.

A careful review of the category of computer & software and computer application in CNKI reveals that the papers are all about the application of computer in the work concerning library & information and archives, which could be seen as the modernization of library & information and archive. The total number of this category is just second to the library & information, implying that this aspect of research is attached great importance by the universities, and reflecting the enhancement and development trend of modernized research of library & information and archive in our country from one side. The number of this kind of paper in Renmin University, Huazhong Normal University and Shanghai Branch is even greater than that of library & information; the paper of this category in Jilin University also accounts for 39% (152/389), all displaying a strong sense of research modernization.

2.3.2 Classification and statistical analysis of publications under the category of library & information and digital library

The established search strategies are employed for the category of information & technology, library & information and digital library. Since there is no further classify-cation for this category in CNKI, we couldn't categorize and analyze all papers, and as a result, this thesis saves and prints the searching results with the layout provided by CNKI. All the papers are artificially classified according to the chart three based on the topic to discuss.

The designing of the classification and its contents refers to the traditional classification method of the library & information and the fundamental ideas of literatures combined with the paper themes of nine departments.

The research condition of each institution during the 11th Five-year-Plan of China. The papers of different sorts are of balanced quantity, indicating that the general research of library & information focuses on comprehensiveness.

The number of papers published by Wuhan University assumes the absolute advantage, contributing 1/3 of the entire number (1216/3238). And these publications cover each area of library & information studies, highlighting its leading position in the research and talents cultivation of this field in our country. For the introductory papers, there are some words of high frequency like intellectual management, intellectual property, information security, vulnerable group etc., and in addition, many researching results are also impressing in the aspect of metric analysis and evaluation, digital library theories, ancient book studies and modern library history.

Among the overall publications in Nanjing University, there are 35% (203/574) of these papers are about metrics and evaluation, which is a high proportion showing that the Research and Evaluation Center of Chinese Social Science in Nanjing University plays a key role in the education and research of library & information filed in this university. Besides, there are also many works of book reviews with both high quality and quantity in the field of library policies, information processing of digital library, reading therapy in reading theories and so on.

3 Other statistic analysis

3.1 STATISTICS ANALYSIS OF CSSCI LITERATURES

CSSCI collection is an important index to evaluate the quality of journal papers in the field of social science of our

country. If the publication quantity of the two journals reflects the ability of publication on high level journals as a "point" of quality measurement, the literatures included in CSSCI could indicate the comparison of quality from "side". For the absolute number compared with the chart four, other orderings almost stay the same except for a tiny change for Jilin University and the Central China Normal University. As for the relative number, every university assumes a high collection proportion of CSSCI-all of them (except a little lower proportion for Shanghai Branch) have the proportion over 80%, and some even higher than 90% like Nankai University, Jilin University, Pecking University and Renmin University. And nearly 1/3 of the papers in this field collected by CSSCI every year come from these universities, showing the evident advantage of the quality of publications from schools and universities with doctoral stations.

3.2 STATISTICS ANALYSIS OF PAPERS WITH HIGH CITATION RATE

From the perspective of thesis topic, we could find the highlight of library & information research during the 11th Five-Year-Plan of China, among which there are 3 articles concerning the role of library in the harmonious society, written by several senior scholars. These articles reflect a strong sense of times, thus receiving much attention from the scholars and are cited with high frequency. These are 6 articles about methods and evaluation of service theories such as library intellectual service, personalized service, and general service and so on, thus we can see that library serving the society, which is spoken highly of, has received a lot attention and emphasis from the academic field during the period of 11th Five-Year-Plan. The researchers have deepened it to various levels. The construction of other information principles and systems all have great guiding value on the macro level as well as classic reference value. In addition, there are many other research highlights like intellectual management, intellectual map, business out-sourcing, database construction, search engine etc., which share a common feature of research cutting-edge. Therefore, these articles have a rate of citation. Under the impact of half-life pattern of paper citation, the twenty articles are all published prior to the year 2008. And it is impossible to list the quality papers released after 2008 based on the present citation rate.

3.3 STATISTICAL ANALYSIS OF PROLIFIC AUTHORS

There are 46 authors who have published over 10 papers. In the team of prolific authors, there are 15 out of 46 people from Wuhan University, accounting for 33% of the total number, nine from Pecking University, seven from Nanjing University, six from Zhongshan University, five from Nankai University, two from Jilin University, one from Central China Normal University, one from Shanghai Branch and Renmin University has 12 authors having published over 10 papers of archive science, which will not be listed here one by one. We could see some familiar names, which there are totally 38 acknowledged scholars in the field of library & information in our country. For several decades, they have contributed to the prosperity of our library & information business through diligent research and constant writings.

3.4 ANALYSIS OF DOMINANT EXPERTS

Based on the results of publication classification results, a specialist distribution chart is made with references of relevant information of these authors. And reflects that Wuhan University performs well both in the field occupied by specialists and the structure of teaching & research group. Nanjing University doesn't have many dominant experts, but they are middle-aged backbones who are energetic. From the overall point of view, the distribution of experts in the field of library & information science is not balanced in disciplinary field and structure of region and age. And the problems are prominent in several aspects.

4 Comments

4.1 STRENGTHENING THE MACRO PLANNING OF DISCIPLINE CONSTRUCTION

The science of library & information and archive science share some common ground, for both of them belong to the class-one discipline. On the macro-level, equal importance should be attached to the development of the three class-two disciplines. For instance, Pecking University should value both the library science and information science, and the same applies for Nanjing University in the field of library science and archive science. The construction of key class-two disciplines could only be supported with stronger momentum when they are developed in coordination.

4.2 STRENGTHENING THE CONSTRUCTION OF TEACHING & RESEARCH FACULTY

The phenomenon can't be ignored that there is an aging trend in dominant experts in the area of library & information science. The problem of seniority in academic research still persists in the field of library & information in our country, which gives priority to authors instead of articles. Some schools and departments even make teachers writing papers for others, hindering the development of young talents. Each university should give priority to the level construction of teaching & research faculty. Some effective measures are required to cultivate the new researchers with various approaches such as to study abroad, to fund the scientific research, to offer academic rewards etc. so as to favor the youth, or some schools and departments will lack new qualified successors. For many institutions with a lack of dominant experts, the disciplinary construction will be hard to develop and it is even likely that there will be no successors.

The science of library & information contains the creation of information and knowledge. There is little human-oriented content in communication & evaluation, selection & interview, organization & description, reserve & retrieval, saving, analysis, interpretation, appraisal, composition, transmission and management [5]. This phenomenon could rather be understood as a kind of defection than the transformation of library & information research. The research orientation of dominant experts from

institutions with doctoral stations to a large extent leads the direction of domestic research on library & information. With technological development in present days, people – oriented awareness as well as service-oriented research on readers should be enhanced.

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Comparison of measured by results of the test system used e-learning in Konstantin Preslavsky University of Shumen through practical tasks

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Received 01 March 2015, www.cmnt.lv

Abstract

In the work are discussed, analysed and compared acquired ratings from students trained in Shumen University used alongside the traditional way of teaching and platform implemented at the university e-learning. Compared the results obtained by assessing the practical task with those achieved in the electronic ultimate test.

Keywords: practical use of systems for e-learning, analysis of the results in the evaluation of practical tasks and solve computer test

1 Introduction

Changes taking place in higher education in the Republic of Bulgaria to improve the quality of training required than classical methods of training and use of information and communication technologies that transform traditional learning in electronic or remote. An example is the mass introduction of training based on the implementation of projects under the grant BG051PO001-4.3.04 "Development of electronic forms of distance learning in higher education" under the Operational Programme "Human Resources", funded the European Social Fund of the European Union.

This project was also implemented in Shumen University, as a result of which was fully prepared technological, resource and methodological support of the training process. Were prepared trainers developed multimedia textbooks, electronic modules, presentations, tests to check the knowledge of different disciplines and comprehensive distance learning courses, which were used for e-learning supporting basic education students.

2 Basic information about the unit "word" included in different course

The module "word" is included in the various training programs for compulsory and optional subjects for student's specialists and non-specialists for students studying at the University of Shumen.

Electronic materials for the module I developed in detail it is provided with - an electronic textbook divided into chapters containing multiple slides, sample task and practical test.

Modern information technologies penetrate not only in all levels of information, but in any workplace. Appear software to automate various activities. They provide opportunities for all professionals to form the most diverse way their documents with text, tables and graphics. One of the most common applications of computer systems is the ability to process a text known as computerized text. It is actively used in small office in conducting business correspondence, in preparation of presentation documents, accounts, reports, flyers, and more. The main goal of the study module is enrichment already acquired knowledge, skills and competencies for fruitful and successful work, as well as developing specific professional word processing techniques.

The aim of the training course of this module is to help students acquire knowledge and practical skills for word. These hours are a worthwhile investment in the future competitiveness of each employee whose employment is directly or indirectly linked to the preparation and operation of representative and official documents, reports, correspondence, etc. Increase the office culture and professional competence.

3 Scheme for assessing knowledge of trainees in module "word"

The evaluation of the acquired and strengthened the knowledge, skills and competencies in the use of a word processor is selected to be a two-component based on practical problem solving and test [4]. To use the fullest possible advantages offered by e-learning platform Moodle e-learning materials unless provided for practical training is also provided on the basis of this platform is to carry out the assessment of knowledge acquired through the test, and its detailed analysis.

Practical assignment: practical task is related to the solution of various problems that students are engaged in training in the discipline. This is the way to show in practice what they have learned and you know how to apply their knowledge in practice.

Development of a practical task within no more than 2 hours, the student must base on the assigned model to be able to transform it into an electronic version, under the rules for entering information, editing, formatting and data insertion and setting specific word elements as specified in the original.

The formation of the final practical assessment is based interpretation of accumulated point score - the maximum score consists of 100 points, which is formed on the basis

of the performance of each individual condition of practical assignment. Table 1 provides a scheme used to transform the experience point scores in evaluation of the six-point system used in the Republic of Bulgaria.

TABLE 1 Scheme for the transformation of point scores in assessing the practical task

from 0 to 30	Weak 2
from 31 to 50	Average 3
from 51 to 70	Good 4
from 71 to 85	Very good 5
from 86 to 100	Excellent 6

Test: The test is designed to assess the knowledge acquired and reinforced the students on issues and specifics of working with a word processing program.

The test used to check the acquired knowledge is gated - multiple choice, including 30 questions. Each question has five possible answers. Only one of the answers is correct. Its system is set each time the output responses of a matter should be arranged randomly five answers. The questions included in this test of the student selected at random from the database containing double issues with accompanying answers.

When solving specific test question, if answered correctly will be awarded 1 point, while incorrect answer 0 points. The test scores of the student is obtained as the sum of all true answered questions from the test. Maximum test score that can get a student deciding electronic test is 30.

We e-learning in Shumen University for the courses are given any instructions to solve the test, and the transformation of accumulated test scores in the final evaluation (Table 2).

TABLE 2 Scheme for the transformation of point scores in evaluation of test

from 0 to 10	Weak 2
from 11 to 17	Average 3
from 18 to 24	Good 4
from 25 to 27	Very good 5
from 28 to 30	Excellent 6

The formation of final assessment on the module "word" of students is based on estimates obtained test and practical task, as an average.

The focus of this article is to compare the results of the tests using the system for e-learning in Shumen University and evaluation through practical task raises interest method of assessment of the achievement test results and comparability of results.

Assessment "Average 3" The student knows the basic theoretical concepts, but allows inaccuracies in the performance of a specific task does not use the full capabilities of the program, make mistakes and omissions in performing practical tasks.

Evaluation "Good 4" The student knows the basic theoretical concepts, know-how and enjoy the possibilities of the program, but in the performance of a specific task does not use its full capacity. Prevents serious errors in solving practical problems.

Evaluation "Very good 5" The student knows the basic theoretical concepts, able to work and exploit the opportunities in the execution of a specific task. Do not make mistakes in carrying out practical tasks.

Assessment "Excellent 6" The student knows the basic theoretical concepts, able to work with the program and use its full potential in the performance of a specific task. Rational use and purpose capabilities of existing hardware, demonstrate responsible attitude and in the performance of specific tasks. Do not make mistakes in carrying out practical tasks.

4 Experimental results comparable results practical task

The aim of the experiment is to answer the questions:

1. How students learn academic material - theoretically?
2. Assessment of test and real commensurate is the assessment of the practical task?

For the realization of the experiment to test and practical testing of students in the same module of relevant discipline are examined results of 13 students who have studied previous semester module.

Students were informed in advance about the way of forming their final assessment modules involved in the formation of their final assessment of the respective academic discipline. This gives reason to expect that the results of both the practical and the test examination should overlap and be close to each other.

Expectations for overlapping evaluations of both tests are justified. The achieved results are given in Table 3 and Figure 1.

TABLE 3 Results for the testing of practical job by test

Practical task		**Test result**	
Points	Rating	Points	Rating
65	**4**	18	**4**
31	**3**	11	**3**
19	**2**	9	**2**
73	**5**	25	**5**
52	**4**	13	**3**
35	**3**	11	**3**
83	**5**	11	**3**
90	**6**	20	**4**
83	**5**	18	**4**
91	**6**	26	**5**
96	**6**	28	**6**
100	**6**	29	**6**
69	**4**	20	**4**

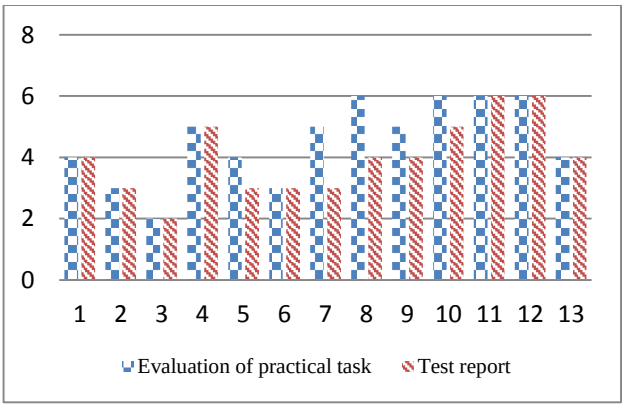

FIGURE 1 Results for the testing of practical job by test

6 Conclusions

Figure 1 shows that from the experiment over 60% of the students tested their results overlap completely, whether held or practical test. In the results, in which there are differences between the resulting assessment of the practical task of making this test reveals that the results achieved in the test examination are lower than those of the practical task, which:

- on the one hand say that students experiencing difficulty to present their theoretical knowledge;
- on the other hand says that test used to check the acquired and learned knowledge is reliable and gives a realistic assessment of students' knowledge.

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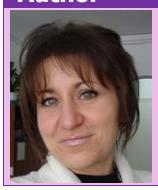

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Mobile technologies and electronic governance

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Received 17 March 2015, www.cmnt.lv

Abstract

This paper looks at some of the problems of electronic governance in the Republic of Bulgaria. It also provides a summary of the advantages and disadvantages of providing e-services in the e-health sector. An optimized algorithm is then drawn up, upon which a model with vein code biometric identification for web-based systems is applied in the process of providing e-services in the healthcare sector. This model provides a much higher level of authenticity in data processing in comparison with the traditional customer service procedure. A comparative analysis is built upon the various criteria of mobile websites and applications, where the choice of mobile application analysis is well-founded. The major stages of mobile application development are traced and a preliminary research on their precision and convenience is carried out.

Keywords: e-Government, e-services, biometric identification, mobile applications

1 Introduction

According to the e-Governance law (EGL): "**Art. 8, Par. 1** Within the scope of *electronic administrative services* fall those administrative services provided to citizens and organizations by the administrative bodies, the services provided by people to whom public service provision has been assigned, as well as the public services requested and/or provided distantly *by means of electronic devices"* [1].

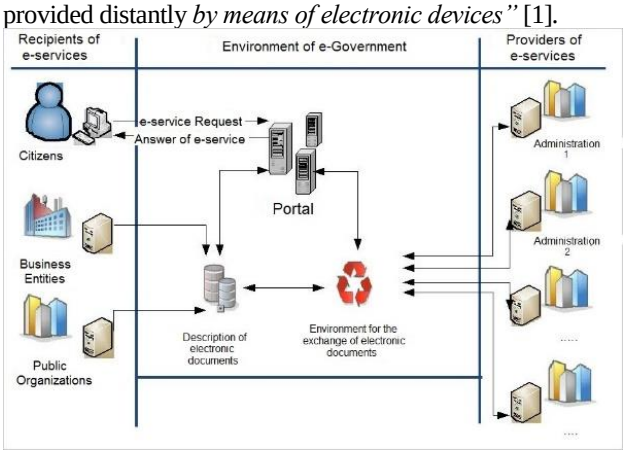

FIGURE 1 Infrastructure of unified information environment for electronic governance

It is necessary that the *administrative e-services* be delivered in a user-friendly and accessible interactive form, also for persons with disabilities. Access to e-services is based on the entitlement of each natural or legal person to all services accessible to this user category.

Key element in the *e-service provision* by means of a unified information environment (Figure 1) is the possibility for persons and organizations to access the information inserted for review at any time and from any location [3].

Figure 1 illustrates the basic components in the unified information environment infrastructure:

- *The recipients of e-services*, citizens and an organization who after confirming their identity in the unified information environment get limited access to the requested e-services;
- *Unified information environment:* – supports single portal for access to e-services; – Provides integrated interdepartmental e-services related to consolidated transactions to databases of more than one department, directorate or administration;
- *E-service providers* – information systems of the administration or of organizations which by virtue of normative act had outsourced part of the functions and activities inherent in the administration.

The providers of e-services manage the actual processing of requests for e-services, the portal and the environment being mainly responsible for the accessibility of services and the protection of information, as well as the individual access to confidential information through relevant identification of requesters.

Prior to the final identification by means of identity confirmation saved on electronic storage device, identity check with view of providing access to information within the e-governance environment can be fulfilled as follows:

Comparing between the names of the requester in the application form and the holder of the electronic signature certificate;

Check in the administration responsible for the citizen registration, whether the unique identifier of the applicant indicated in the application form corresponds to the name of a citizen holding this name;

Subject to identity check are all citizens who had claimed circumstances and possess a unique identifier;

Check of the identity of organizations is based on the respective organization registry books.

The single identification is binding if the citizen, respectively the organization had indicated a unique identifier.

After indicating the unique identifier, the e-service environment recognizes the identifier itself, not the actual service requester. The basic issue remains unresolved. If a third party acquires or becomes aware of the content of the unique identifier, that person may act as the citizen or the organization in front of the unified information environment

and get access to information and services to which he/she is not entitled.

Key priority areas of the electronic governance are the "Safety", the "Healthcare", the "Finance and Tax Policy" [2], the three of them containing confidential information for the citizens and organizations access to which could be obtained through the e-services portal, the information could be "downloaded" only and solely upon submission of universal electronic identifier. In the sector "Finance and Tax Policy" the electronic signature is sufficient proof for the provider of certified services of the reliability of information provided by citizens and organizations, but in the reverse processing, security matters are not the responsibility of the information provider. According to the law, the person submitting the tax declaration bears responsibility for the data inserted but, if a third party could access the e-service portal or could otherwise access the aforementioned tax declaration, this counts as severe security failure. The two key characteristics of the information are its reliability and protection. With the essential help of the electronic governance portal the administration will receive more and faster information electronically, since it is expected that both the citizens and all organizations will be facilitated in issuing this type of information by authenticating its content with an electronic certificate.

From a technological point of view, an important aspect in the development of electronic governance is the placement of the two properties of information, authenticity and protection, on an equal footing of importance. At this stage the problem with the provision of authentic information is to a great extent solved, however, the problems of providing reliable electronic identity are still pressing.

2 Special features and flaws of providing electronic services in the e-healthcare sector

The Healthcare sector has priority over other sectors in terms of the need for providing electronic services. In this area a considerable progress in terms of operation information processing has been achieved with the introduction of contemporary Information and Communication Technologies (ICT). What is special about the sector is that its work is related to the provision of a special type of electronic services called electronic attendance services. An example of this kind of service is drawing money from ATM. The service is a typical e-service in itself, but the presence of the certificate holder and the authentication of their identity at the institution providing the service are key features for the healthcare sector.

In the "Healthcare" sector, patient identification plays a key role in terms of service provision and the reliability of information with the electronic method.

A main disadvantage of the instantaneous way of obtaining information is the lack of certainty in the identity validation of consumers. In the process at present, one could not otherwise be sure, than relying on the conscientiousness of general practitioners or chemists, if the patient had actually attended the general practitioner and if this particular patient had fulfilled the prescribed recipe at the pharmacy. These kinds of issues relating to identity confirmation in the delivery of information through e-services are even more conspicuous when the e-service provided results in the money transfer.

It is possible in practice, false records to be gathered on the basis of which payments are fulfilled without any guarantee whatever on the true identity of the beneficiary of the health or the e-service provided.

The application of biometric identification, in this case, is one of the possible solutions to objectify the process of inserting reliable information in the key fields of the database used.

This study is based on the algorithm of processing clinical pathways by way of tracking the patient's "route" from the general practitioner to the specialist.

Other major characteristic is the possibility of adding two additional factors for identification – time and location – in the course of identity confirmation and completion of key fields.

The technology of biometric identification implies the addition of information about the time and place of identification, which in itself solves the problem of the meaning of steps in the process of information services, i.e. it is obvious that at a given hour and date the prescription has been issued in favour of the patient who, in one's own turn, had "personally" attended one's general practitioner and after the elapse of a good time span this same patient was "actually" at the pharmacy, was identified biometrically and fulfilled the prescription.

The purpose of the optimization of the existing algorithm is turning the information processing into an objective process via a biometric identification technology, as well as to reduce the paper work related to the information processing and accounting of the process.

3 Optimized model of a web-based system for e-service provision in the healthcare sector with application of biometric identification through vein code

A new version of the base algorithm for data processing of clinical pathways is presented. The application of the optimized model aims at making the process of clinical pathway data processing more objective, by integrating a biometric identification technology. The new version marks the possibility for biometric identification to be applied as factual evidence for attendance, as well as for confirmation of the actual clinical pathway implementation.

Thus, only with the introduction of an effective enough method of biometric identification which does not entail significant information and communication resources, a number of problems had been solved and this is a precondition for further improvement in the quality of the e-service provision. Assuming that such an identification model has already been introduced and that each general practitioner and pharmacy, each inlet and outlet in the "clinical pathway" is equipped with devices and relevant program "shell" for biometric identification, then all paper recipes and medical referrals to a professional or clinical pathway could be removed. A paper authentication would not be necessary to prove that a certain person had obtained a prescription or an actual medical referral to professionals or that this same patient had "benefited" from the services and budget by virtue of the clinical pathway.

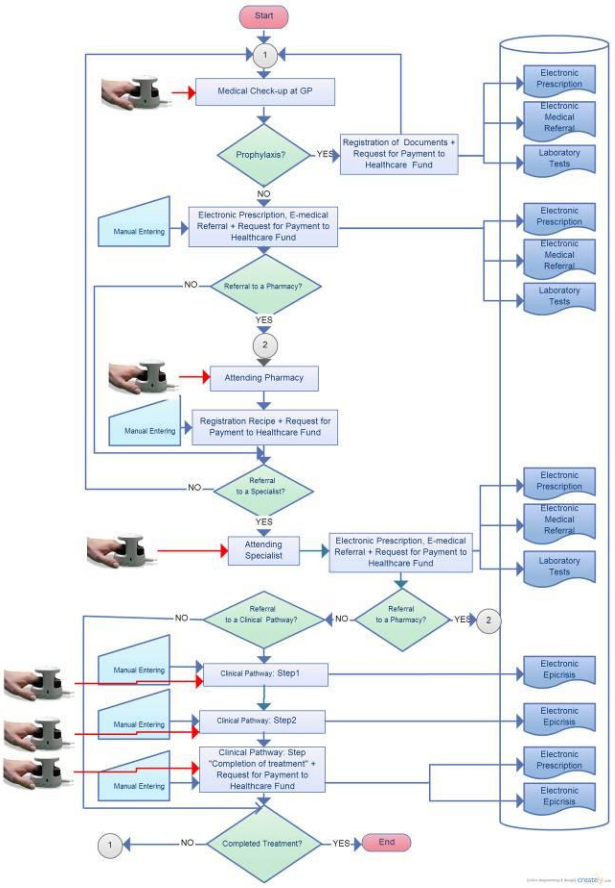

FIGURE 2 An optimized algorithm for information processing in the "clinical pathway" range in Bulgaria

Only with the application of this simple and feasible method of biometric identification could, on the one hand, *the authenticity of the user be guaranteed*, and on the other, arise opportunities for optimization and addition of new electronic services and *paper accounting be reduced*. Third, this *reduces significantly the amount of information* inserted by all operators in the information provision service, particularly those from pharmacies, and creates *opportunity for real-time processing*.

This optimized model of the "clinical pathway" information processing algorithm (Figure 2) ensures greater degree of authenticity of the data inserted compared to the traditional user service approach.

Authentication of patient availability at each step of the process is made by means of unique vein-code biometric identification of a single or several fingers. Card issuance or the application of complex identification technology is not required, the only thing to do being inserting your finger into an attester terminal and letting a vein identifier (vein ID) to be recorded.

All documents are electronically made and the next stage follows only if the vein code has been successfully detected. The registered vein code allows for spatial and temporal tracking of the patient in the process as well as his/her "physical" participation in the process. Generation of documents is not possible in the case of absence or fictive presence where valid registration of the unique finger vein code is not available.

4 Advantages of mobile applications

Mobile websites use HTML protocol and work with related websites as well as any general website. They are less integrated to the device hardware in terms of applications though the HTML protocol is a universal Internet protocol adapted to any browser. Some users prefer to access mobile websites from a tablet or a smartphone being satisfied because in this way they need no further installation but only the Internet address of the website. An additional application is not necessary because all the information required from the mobile website is available in several touches of the screen. Specialized applications, in turn, offer a more complete package of services. They are installed on devices and are much better integrated to already installed or to user selected applications. When creating an application, the website owners may require from developers the embedding of features that work equally well on any OS. Thus, the user is satisfied and keeps on using the website.

The specialized mobile applications provide much better tracking of usage, usage duration, specific position in the application and access to profiles on the social networks Facebook, Twitter, Google+, LinkedIn. In-App subscriptions and premium versions without ads are possible. The specialized applications compared to mobile websites use less system resources whereas providing more functions.

Comparing mobile website to mobile application considering the following criteria:

Accessibility

– A mobile website is immediately accessible to users through the browser which all mobile devices are nowadays adapted to use.

– The applications shall be installed by the user to be able to see the website content.

Scope

– Mobile websites have a broader scope, because they are available for different platforms and easy sharing among users.

– The application functionality is limited to the operation system for which they are designed.

Update

– A mobile website is much more dynamic in terms of flexibility for updating the content. The mobile website design or content could be changed by making corrections in the code, the update being immediately visible.

– The update of a mobile application requires dissemination of the available updates to the users, as the application update shall be made on every type of device.

Searchability

– The mobile websites are easy to find via Google or Bing search engines.

– The applications' visibility is limited to a great degree within the specific App Store of the specific OS (WP, Android, iOS).

Compatibility

– A mobile website is accessible to users with different mobile devices. Its URL could be easily integrated into other mobile technologies, such as SMS, QRcodes and NFC (Near Field Communication).

– The Apps require development of specific version for different types of devices.

Website Sharing

– The mobile websites could be easily shared in

developer to user and user to user manner.

– The applications could also be easily shared by means of multiple related online services but they are not always multi-platform.

Duration of availability

– The mobile websites are available as long as the main website exists.

– The majority of Apps have short life unless they are constantly maintained by developers. This maintenance is closely connected to the constant update and monitoring of the new versions of operation systems so that outdatedness and the risk of user mobile device's inability to access to the selected mobile application could be avoided.

Costs

– The mobile websites are cheaper because the Application stores are free of charge.

– Investments with mobile applications are not limited to their initial start-up. Proper support and development of an application (update, testing, compatibility issues and continuous development) is much more expensive.

Despite the obvious advantages of mobile websites, applications are quite popular due some special characteristics, making the use of a single application the better option:

– *Interactivity* – this index makes the use a single application the more suitable choice than the website.

– *Power* – as applications are directly linked to the operating system, they can use its available resources.

– *Personalization* – if the target consumers want to personalize a given service in accordance with their preferences, the contemporary applications provide a suitable method of doing so.

– *Offline maintenance* – if when a specific service is needed but there is no access to the internet, the mobile website becomes unreliable, while a single application can provide offline access whatever the circumstances.

5 Stages in the development and testing of mobile applications

This section looks at the creation and usage of two mobile applications for access to the centralized system. The functionality of the first application is realized by conventional access, with a consecutive pair: "name : password", and the "M-Zdrave.apk" mobile application is used to create a virtual channel that connects a biometric sensor, working with Windows XP operating system, with the mobile device of the consumer via QR code.

The creation of each mobile application for Android OS goes through the following sequence of ***stages***:

- S1: Development of the conceptual design – formulating the initial requirements for the application.

- S2: Context-based design – research on the user needs and requirements in terms of the operative working environment.

- S3: User Environment Design (UED) – introduction of the system functions and their organizing in a user friendly way. At this stage, the settings of the application working environment are made; also, adding and adjustment of the PHP framework and libraries.

- S4: Development – writing, editing, testing and correcting the source code.

- S5: Mobile App testing. Corrections of the source code follow, subsequently implementation and testing.

- S6: Introduction of the developed application. At this stage, the implementation is under way. A preliminary research on the applications is conducted.

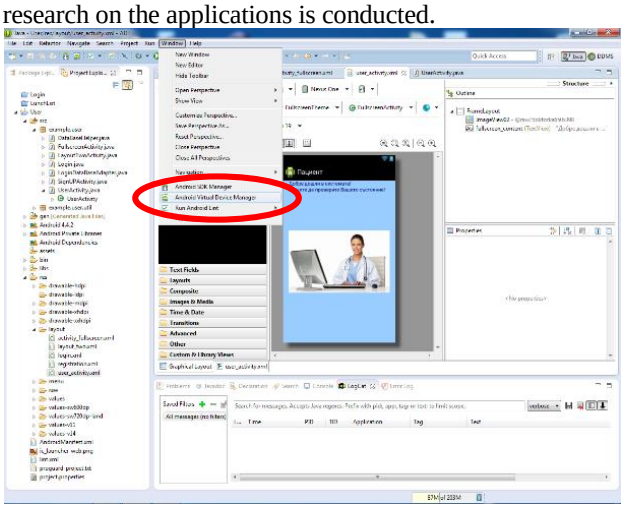

FIGURE 3 Menu for work with virtual device manager Android SDK

The applications are developed with Eclipse IDE (Integrated Development Environment) and Android SDK (Software Development Kit). Eclipse IDE is an open code programming environment [7]. Android SDK is a free-of-charge toolkit creating applications for Android mobile operating system [5]. The programming environment maintains the testing of developed applications with the help of a virtual device, simulated and adjusted in "Android Virtual Device Manager" mode (Figure 3).

Figure 4 – a visualization of an instant of the functionality and the proper behaviour check of the mobile application "M-Zdrave.apk", test conducted on the virtual device "5554: LG4", simulating work with Nexus 4 device in Google – screen size 4.7 inch, resolution 768 x 1280: xhdpi, SD Card 1 GiB and RAM 768 MiB, emulation of both device cameras.

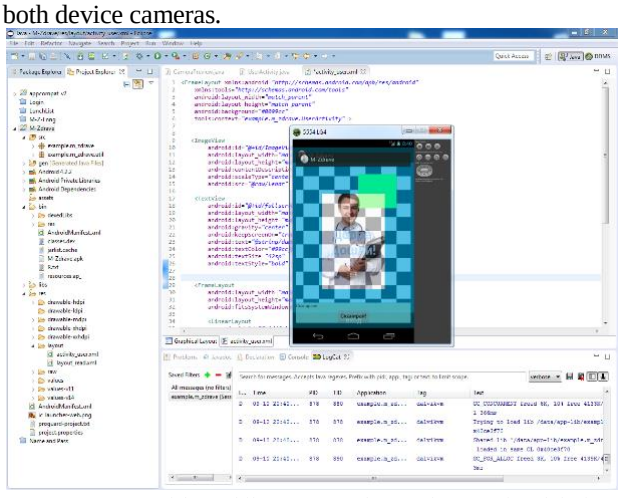

FIGURE 4 Test of the mobile App "M-Zdrave.apk" on a virtual device

The actual feel of comfort, applicability or difficulties on the part of the consumer when working with this application are impossible to define with the help of a virtual device, whose interface is managed from the keyboard and mouse of the computer system. The purpose of this operational mode is mostly to detect code errors or an unpredicted

unexpected behaviour of the mobile application. What is important is the impression gained from the end result of the actual handling of the user interface by touching the screen of the device and by working with its main functional keys, rather than the choice of elements made by pointing with a mouse or using a keyboard, as is the management and user dialogue of a virtual devise.

Prior to the introduction stage, it is necessary to test the application functionality using various mobile devices with Android operating system, including those ones different versions of the platform.

The functioning of the mobile application "***M-Zdrave.apk***" has been studied and tested in practice – on different devices and different versions of the mobile operation system – *Gingerbread, Jelly Bean and KitKat.* The results from the preliminary study of the application's proper behaviour and user friendly interface are shown in Table 1.

TABLE 1 Functionality of the mobile application "M-Zdrave.apk"

OS Android Version	Samsung devices	Screen characteristics		M-Zdrave.apk	
		Size	Resolution	Login (sec.)	Convenience
2.3.7. *Gingerbread*	S5300 Galaxy Pocket	2.80"	240 x 320	-	-
4.1.2. *Jelly Bean*	I8260 Galaxy Core	4.30"	480 x 800	4.2	+
4.3. *Jelly Bean*	I9250 Galaxy Nexus	4.65"	720 x 1280	3.1	+
4.4.2. *KitKat*	I9505 Galaxy S4	4.99"	1080 x 1920	2.5	+

6 Comparative technology analysis and methods for identification with remote access

The proposed model is a result of the detailed research and analytical study of the existing legal algorithm for processing clinical pathways in the healthcare sector in Bulgaria. A series of counselling has been conducted with medical staff working as general practitioners. The analysis is based on the tracking the patient "route" from the general practitioner to the medical professional. An optimized model of the algorithm for clinical pathway information processing is being suggested which ensures much greater authenticity of the data provided. Patient availability at every stage of the process is verified through unique finger vein code method of identification.

TABLE 2 Mobile applications – comparative analysis

OS Android Version	Reg_patient.apk		M-Zdrave.apk	
	Time to login with password	Convenience	Login time with QR code (sec.)	Convenience
2.3.7. Gingerbread	42	-	-	-
4.1.2. Jelly Bean	23	-	4.2	+
4.3. Jelly Bean	19	-	3.1	+
4.4.2. KitKat	21	-	2.5	+

Comparing the mobile application functioning. The idea behind comparing two applications with different mechanism of functioning is to highlight the advantages of the identification model using biometric terminal. This model is applied to get access to a requested database of a centralized system that fulfils biometric control of its users.

Table 2 illustrates a resume of the rates of the comparison drawn as a result of the work and experience of users having different versions of Android operation system.

7 Advantages and disadvantages of the identification model

The mobile applications are hereby compared so as to highlight the advantages of the identification model with M2SYS biometric reader [6]. After the testing and analysis of the precision of the personal mobile applications have been carried out, some of the main advantages and disadvantages of working with the biometric identification system for centralized database access of the e-healthcare sector and of mobile device control access have been summed up.

Advantages:

- The registration of the vein-code allows for patient control in the process in terms of "time and location" as well as control of the user "real attendance" during the process.
- The developed application makes the processing of information within clinical pathways impartial through applying the biometric identification technology and reduces the volume of "paper work" by information processing and accounting.
- Registration of an electronic health status file according to this model enhances the medical service efficiency:
- Gives reliable information to the medical professional about all past diseases and treatments prescribed;
- Reduces the service administration time.

Disadvantages of the presented model:

- Entails Internet connection.
- Requires the availability of a well-working biometric sensor. For registration of the finger vein biometric in the database, a proper interaction with the software governing the specialized biometric registration hardware is required.
- The medical healthcare service for children under-age is not regulated and therefore, it could not be provided only on the basis of the proposed identification model.
- The use of the system is difficult when serving immobile patients.

8 Conclusions

This paper provides a research of a model for biometric identification in the public informational system and a secondary control access from a mobile device. It traces the major stages in the development of mobile applications for a web-based system with centralized database, biometric control and mobile device access, as well as its compatibility when working and gaining access from various devices. Preliminary study of the proper behaviour and user-friendly work of the mobile applications has been carried out.

The designed system is subject to further developments with view to solve the disadvantages of the present model. The development of mobile applications for various operation systems is under way, which will be user-friendly, reliable and will bring user satisfaction when making inquiries to the information service system in the healthcare sector.

Acknowledgments

This work was supported by a grant from the project №09-590-13/10.04.2013, Integrated electronic services for the citizens and the business of St.Ciryl and St.Methodius University of Veliko Turnovo, Bulgaria.

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[7] https://eclipse.org/downloads

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Mobile sites as a part of the digital model of modern daily newspapers

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Received 3 March 2015, www.cmnt.lv

Abstract

Changes in the sphere of conventional printed publications have been acquiring global dimensions. Is there any future for the printed newspapers? Problems of the daily newspapers transition from paper to digital bearers are discussed in the present paper. A model of the future digital newspaper is presented here. The mobiles sites of Bulgarian newspapers and magazines are viewed in the paper. The advantages of the mobile platforms through smart phone access are presented here. The sites have been viewed in the aspect of the necessity of "New digital model of the modern newspaper." An analysis of their utility in the point of view of readers and news publishers has been made.

Keywords: Digital model, mobile sites, news, newspapers, magazines

1 Introduction

Smart mobile phones are multifunctional devices. Their sales in recent years have surpassed personal computers in sales. [1]. Many people use their phones in their free time – for quick access to news and news sites. The advantages and disadvantages of the mobile sites compared to desktop at access by mobile phones are presented in the paper.

Predictions for the death of the printed media have appeared since the origin and rise of radio. Later at the emergence of the new exciting media – the television, almost all analyzers were convinced that it would bring the end of newspapers. As it is well known all these predictions have failed to come true – just the opposite – radio and television are not competitors fighting for influence any more but they are becoming partners for development.

The emergence and quick development of Internet have become medium for the appearance of new electronic media. They present news quicker than paper newspapers. This has become the reason for publishers and editors to ask questions about the future of newspapers and to make pessimistic prognosis. Is there any future for newspapers?

2 The necessity of a Mobile platform

For the convenience of the owners of mobile devices some news media offer possibility for quick access to a lighter content of their site through a smart phone. With such an access the users are automatically redirected to the mobile platform of the corresponding media and in this way they get quickness of loading and save traffic data.

3 Advantages of the mobile versions of sites at smart phone access

The content is as close to the user as possible. Speed of loading and work in the site. Friendly interface in compliance with the small size of the smart phone. Easier navigation in the site, reading and sharing information. All menus and panels for navigation are in compliance with censor navigation and the small area of the screen. Full compatibility with all mobile operation systems [2] and browsers for them. Lack of Flash elements in the mobile platform [3]. The use of Flash elements (SWF - Shockwave Flash or Small Web File) in internet pages enriches its content and presentation but makes difficult the access to them especially through portable devices. Another basic disadvantage of SWF-files is that they require very quick internet connection and generate huge traffic. At the same time they take a lot of resources and weight down maximally the processor which leads to high energy consumption and so to quick exhaustion of the batteries of the mobile devices [3]. Not all modern mobile operation systems support functionally Flash elements in their browsers [2].

4 Digital model of modern daily newspaper

The author of the present research has more than 15 years experience in printed news media. There is a practical experience gathered for their creation, expansion and development, and observation of their crises, problems and successes. In our opinion internet is not a thread but a new transition medium for the printed news media. Their future is clear – in order to survive they have to benefit from all digital forms which have been offered by the new technologies. Let us not stop only to the availability of electronic site [4]. It is only one form of existence in the digital era. The others are:

1. Availability of a mobile version of the site for quick access through smart phone and tablet;
2. A mobile application working under the three most widespread operation systems for smart phones and tablets - Android, iOS, Windows phone;
3. Concluded agreements with providers of electronic books and distribution of the newspaper as an electronic interactive document in all readers of electronic books and sites for distribution of electronic sites;

4. Strong presence in social networks and looking for feedback with readers through them and if possible the online users to be able also to be its numerous reporters.

5. Availability of digital archive with a new structure and possibility for searching. In order the site of the media to be successful, in our opinion, it needs deeper and fuller temporary archive in which the technologies for semantic web at supporting digital archive to be applied.

A common web based platform is in the basis of this new digital model. It contains two bases of data – one information reference and an advertising one containing all advertisements of the daily newspaper. The new digital transformations of the news media (desktop site, mobile site, mobile application for smart phones and tablets, and digital format for electronic books) get information from the main web based platform (Figure 1).

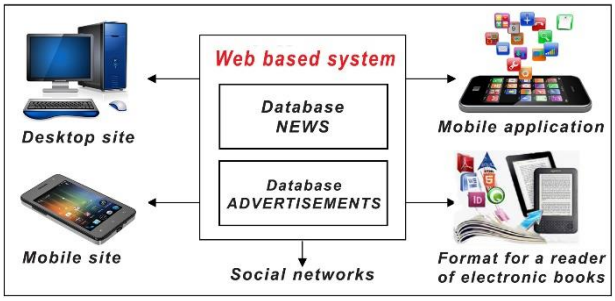

FIGURE 1 New digital model of a web based platform

Here is the model of the newspaper of the future presented by Ivan Mihalev: "The business model of the quality newspaper in the epoch of internet practically combines three different business models corresponding to the different platforms for content distribution – paper newspaper, online issue and a mobile version. They function united by a common denominator – the brand of the media. It is a guarantee for the quality of the content and it is the grounds of the confidence in information which the audience has. Common multimedia editorial offices which are usually in a common integrated newsroom are responsible for the production and distribution of content. The correct positioning of the messages which is a function of the good communication between the structure departments, preliminary coordination between the editors of the corresponding platforms as well as the constant engagement of the journalist teams is of great importance."

To this opinion we can also add the role of the electronic readers and tablets and the prognosis for them on economicarticles.eu: "They open a new business niche for the newspapers. iPad, Kindle, Sony, Toshiba and many others are already producing good platforms and alternatives of the paper newspapers. One of the advertisement accents of Kindle is namely you to be able to read the morning newspapere on it and if you open the site of iPad, you can see first the issue of The New York Times. The competition between the devices themselves is very strong and the prices are constantly falling down. In a year or two it will be one of the main ways of reading newspapers in our country and the one who starts preparing now will win." [5].

The necessity of this channel for transferring of information is shown in the report of Aleksei Pustovalov "Printed issues or web? Leading USA magazines in the struggle for popularity" [6].

The advantages of the electronic bearer according to Ivan Bunkov, publisher of "New life" and the chairman of Bulgarian association of regional media are:

– actuality and possibility for actualization of information each minute;

– 24-hour access to the issue;

– accessibility from each point connected to the world web on the planet;

– volume – it is difficult for the reader to keep and to have access to 10-old archive of the printed issue but they can easily get access to each article in the electronic archive;

– quick search and finding of information;

– possibility to illustrate events by rich picture materials, sound and even video – thus the reader gets comprehensive and pictorial information for the events".

5 Mobile and desktop version of sites of Bulgarian printed media

In the present research we will discuss the sites of leading national and regional newspapers and magazines.

5.1 THE "TRUD" NEWSPAPER

The newspaper has a full desktop site. The navigation in it is convenient and intuitive. A quick access is secured to materials of a certain sphere by departments and falling menus. The author articles are clearly distinguished from the advertising and reference information. There is a browser available. The registered readers can comment the articles on the site. You can access that by your social webs profile.

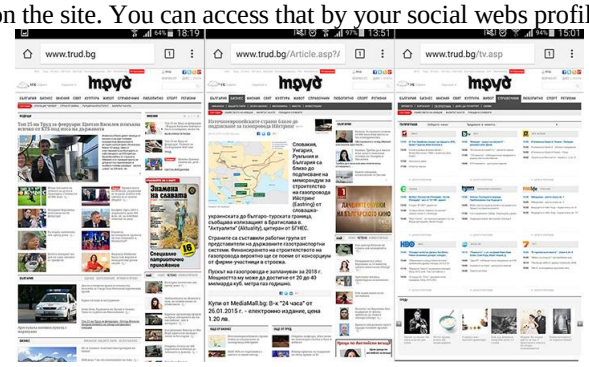

FIGURE 2 Potentials of the desktop version of the "Trud" newspaper

At accessing the site through a smart phone the mobile version is not always loaded. At the end of the page there is a reference to after turning up the whole information. Difficulties are mainly created by falling menus under the head of the media. On fig 2 the opening page (left), view of open news and access to information are presented (Figure 2).

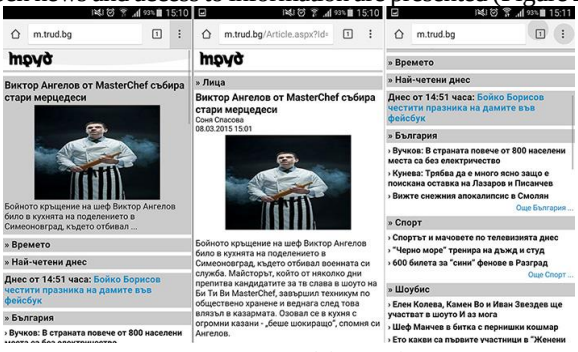

FIGURE 3 Mobile version of the "Trud" newspaper

The mobile site loads with a picture the leading news and in the form of a list the features and the news of them. (Figure 3). The quick loading with information and convenient navigation by touching are the advantages of the site. The disadvantages are: lack of searching machine and connection with the social media. The second makes the access to the sections with the comments impossible – reading of existing and adding new. Lack of access to multimedia content – picture gallery and video information. There is only one picture to a given news and often it is not resized correctly and is loaded disproportionately.

Because of all these disadvantages we could not define the interface as "user friendly" according to modern graphic standards.

The opening page of the site (left), a view of open news and an access to other news and sections are presented on Figure 3.

5.2 THE "CAPITAL" NEWSPAPER

The weekly newspaper "Capital" offers a modern desktop site with a lot of possibilities. It is the only one of all the media reviewed to offer possibilities for reading in the version of an electronic book. This is the most convenient format for the owners of Kindle and other eBook devices and tablets. The access to this format is paid (Figure 4).

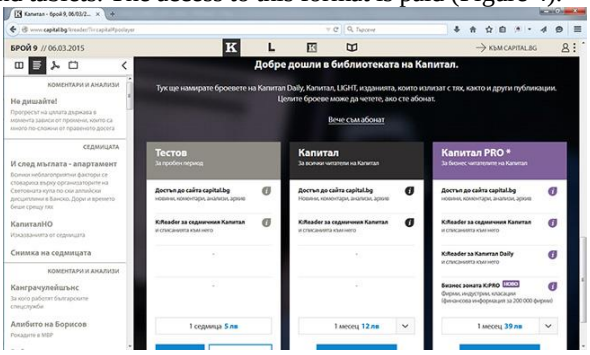

FIGURE 4 Paid section of "Capital"

The navigation by desktop browser is convenient and pleasant. At accessing through smartphone the mobile version is loaded as there is a reference available in to the full version of the site. (Figure 5).

In the mobile version of "Capital" all the opportunities of the desktop one are available. Quick and convenient access to features and news references is offered. Each piece of news is presented by a picture. There is a connection with the social webs. All the comments are accessible and one can add new ones a social web profile. Everything is easy only by one touch.

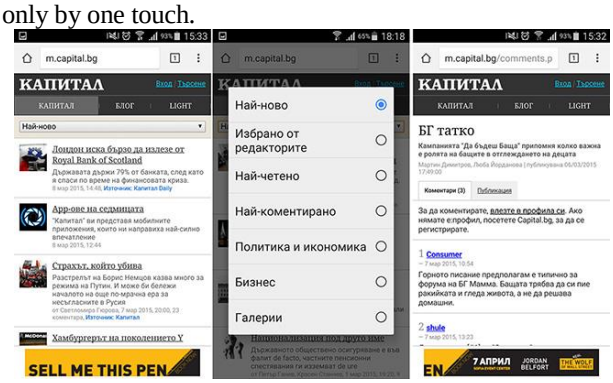

FIGURE 5 A mobile version of "Capital" newspaper

On the opening page a link to Blog of the newspaper is put and also to "Capital LIGHT" application.

On Figure 5 the first page (left) is presented, the convenient menu for choosing a feature and the comments after the article.

Definitely the mobile site of "Capital" is functional and can be used as a pattern in developing the news site.

5.3 THE "HICOMM" MAGAZINE

Accessing it through a desktop browser the site of the magazine is overloaded (Figure 6). The advertisement elements "eat" the news content. The involuntary activation of an advertisement banner is the desired effect at the designing of the site.

FIGURE 6 "the captured"by advertisements page of HiComm"

At loading from a smart phone it is automatically directed to the mobile version of the site. It is light and quick. The navigation is convenient and intuitive. There is access available to social webs and writing of comments.

On the first page there are references to the most important sections of the site: "News", "Test", "HiEnd", "Accents", "Analysis". A search margin is at the right upper corner next to the logo. Own searching browser is used.

Each piece of news is depicted by a picture. When there are more pictures there is a link added to them in the "Gallery" section. The pictures are looked through easily and conveniently in it.

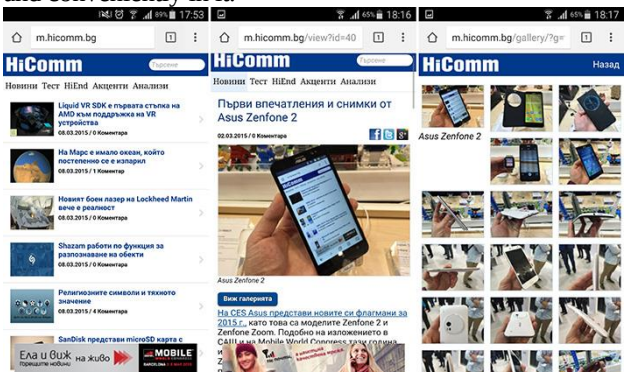

FIGURE 7 A mobile version of "HiComm" magazine

As a whole the mobile version of the "HiComm" magazine is well designed and realized in an exceptional "user friendly" style.

On Figure 7 the opening screen is presented (left) loaded news and an open gallery to the news.

5.4 "CHERNOMORSKI FAR"

The present research would be complete if we do not include the regional media in it. We will discuss the exclusively ambition joint project of two Burgas newspapers with a common publisher. Since 2014 the daily "Chernomorski far" and the weekly "Factor" have a common site. The name - "Information Agency "Far" shows that it is a new separate electronic project. Each hour news are published with the ambition the site to become the information agency of the region. Is this the future of the newspapers?

FIGURE 8 the first page of "Chernomorski Far"

At the first loading through a desktop browser the page of "Chernomorski far" seems overloaded by advertisement. While scrolling it becomes evident that the banners are crowded only at the upper part of the site. The news materials are divided in theme features and are clearly distinguished from the advertisements. The navigation in the site is convenient and logical. There is also own searching device.

Each piece of news from the site can be shared in the social webs. Registration or profile is not required in order to write comments. In this case the comments are limited to 600 symbols.

Accessing through a smart phone the browser automatically directs to the mobile version of the site. The same has a user friendly interface and convenient navigation. The opportunities of the desktop version are present in the mobile one too. There is an easy access to the categories in the site and to the searching device on the title page. Users can read and add comments.

Each visitor can regulate the size of the letters in the main text of the news. Each piece of news is accompanied by a picture. We could not find news with more than one picture.

The site offers reference information and the weather forecast is being updated in real time.

Though the mobile site is convenient enough there is a link in it to the full desktop version.

The opening page of the site (left) is presented on Figure 9, the list with categories and news and open to be read news are also presented.

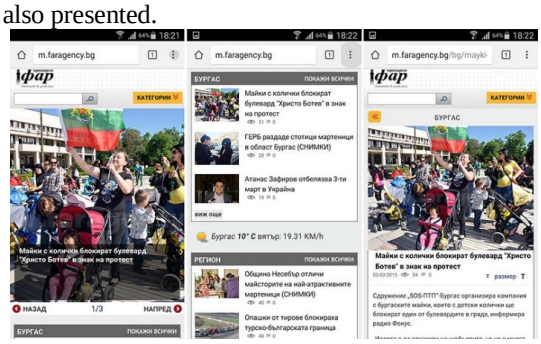

FIGURE 9 "Mobile version of "Chernomorski far"

6 Conclusions

We have to conclude that in XXI century newspapers have to be transferred to new modern digital bearers of information. A new digital model of the newspaper in the epoch of internet in which the website of the media is only one of the forms of the newspaper of the future has been presented in the paper. The others are the mobile version of the site, the application for smart phones, and strong presence in the social network, a version of the issue formatted for electronic books. Though the mobile devices are being equipped with more and more powerful processors and their browsers are becoming more and more compatible with the desktop systems we consider the necessity of mobile versions of on-line issues of the newspapers of Bulgaria. A lighter version which is in compliance with the size of the smart phone offers an easy and convenient interface. Traffic and time for loading and reading the news are saved. The entire customer experience is much better at access to the site through the mobile platform than through the desktop version.

Acknowledgments

The research is financed by Project „Developing a web portal of the electronic periodicals of University of Veliko Tarnovo "St. st. Cyril and Methodius", Bulgaria.

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Implementation of a course in "artificial intelligence and expert systems" on top of a distance-learning platform

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Received 01 March 2015, www.cmnt.lv

Abstract

In the current paper, presented is animplementation of a distance-learning course on the subject of "Artificial Intelligence and Expert Systems" for students pursuing bachelor's degree in the field of "Informatics and Information Technologies". The distance-learning platform used by the university is based on Moodle. The teaching materials are in the form of lectures, promoting discussions. For verification of the knowledge gained by the students, tests and analysis of the results are performed.

Keywords: distance learning platform, distance learning, course, test, discipline

1 Introduction

Distance-learning is becoming one of the most popular ways for offering courses in higher education institutions today [3, 4].

Experience shows that courses developed under the project BG051PO001-4.3.04-0020 "Modernization of the Distance Learning Center in *Konstantin Preslavsky* University of Shumen using electronic teaching methods" are well accepted among students and help increasing their results [6].

This is an introductory course in the field of artificial intelligence systems, which is thought under the "Informatics and Information Technologies" major in the university [5, 6]. For its implementation, a platform is used based on a Learning Management System (LMS) – Moodle [8].

2 Distance-learning course internals

The course content is divided into two modules. In the first one are included: basic terminology in artificial intelligence, intelligent agents, algorithms for solving tasks using unsupervised and heuristic search, tasks for satisfying limitations, modeling of games and planning.

The second module describes the models for representing knowledge, expert systems, methods of communication, social models: neural networks and genetic algorithms and tools for creating artificial intelligence systems.

The content is in line with the standards set by the top education institutions in the field of artificial intelligence [5]. Some of the study materials used are the books of P. Jackson and S. Russell [9], D. Luger [7], I. Bratko[1] and others, cited at the end of the current paper [2, 10, 11].

The home page of the course presents its structure (Figure 1) and contains a brief introduction of the content along with the keywords and terms.

The course can be found on the university's distance-learning center's page [5] and is delivered to both full-time and part-time students.

FIGURE 1 Introduction to the course "Artificial Intelligence and expert systems"

It is worthy to note the importance of carefully choosing the keywords, thus allowing the students to quickly get into the terminology of the subject and clearly understand the content of the course. This is a guarantee for getting their attention and successfully adopting new knowledge.

The main part of the course is presented in the form of lectures, backed up with examples in various forms – graphics, text, etc. (Figure 2).

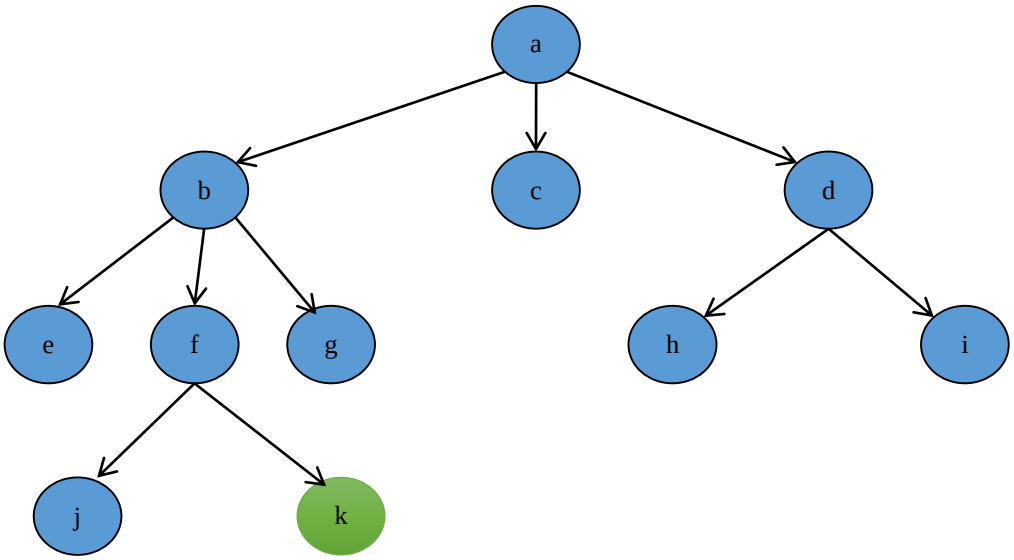

FIGURE 2 Part of the lecture course

One example for state space graph State1
State$_1$= [N_1, A_1, S_1,G_1],
N_1 = [a,b,c,d,e,f,g,h,I,j,k],
A_1 = [a,b; a,c; a,d; d,h; d,i; b,e; b,f; b,g; f,j; f,k],
S_1 = [a],
G_1 = [k],
where operators (arcs) are separated by - ; (semicolon).

Lectures are constructed in a way that they contain the information in a clear and concise manner. Important element for the good understanding are the examples given, that present possible interpretations of the discussed problems.

The test for assessing student's knowledge consists of 50 questions related to various parts of the course content. The platform allows randomizing the order of appearance of the questions. This provides relatively objective assessment of the student's knowledge. Below are shown some of the results from a test that has been conducted.

12 students have participated in the test, each having 51 answer attempts and maximum time of 60 minutes.

	Име / Фамилия	Идентификатор	Започнат	Завършен	Продължил	Оценяване/50	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	#12
	Петър Енев	1250136101	1 декември 2014, 09:48	1 декември 2014, 10:34	45 мин. 31 сек	29	--/1	--/1	--/1	1/1	1/1	1/1	1/1	0/1	0/1	1/1	1/1	1/1
	Нуртен Салиева	1250136102	1 декември 2014, 09:47	1 декември 2014, 10:36	49 мин. 1 сек	31	--/1	--/1	--/1	1/1	1/1	1/1	1/1	0/1	0/1	1/1	1/1	1/1
	Илхан Юсеин	1250136103	1 декември 2014, 09:49	1 декември 2014, 10:35	46 мин.	32	--/1	--/1	--/1	1/1	1/1	1/1	1/1	0/1	0/1	1/1	1/1	1/1
	Мехмед Асан	1250136106	1 декември 2014, 09:49	1 декември 2014, 10:35	46 мин. 5 сек	36	--/1	--/1	--/1	1/1	1/1	1/1	1/1	1/1	0/1	1/1	1/1	1/1
	Мая Георгиева	1250136109	1 декември 2014, 09:46	1 декември 2014, 10:36	49 мин. 56 сек	30	--/1	--/1	--/1	1/1	1/1	1/1	1/1	0/1	0/1	1/1	1/1	1/1
	Васко Михайлов	1250136110	1 декември 2014, 09:49	1 декември 2014, 10:35	45 мин. 36 сек	33	--/1	--/1	--/1	1/1	1/1	1/1	0/1	0/1	1/1	1/1	0/1	1/1
	Камен Петков	1250136117	1 декември 2014, 09:48	1 декември 2014, 10:39	51 мин. 27 сек	29	--/1	--/1	--/1	1/1	1/1	1/1	1/1	1/1	0/1	0/1	1/1	0/1

FIGURE 3 The results of the final test of the course

The system provides possibilities for detailed analysis of the answers: from each participant and from the group as a whole, thus allowing to identify common mistakes and weaknesses in the teaching process. In the table below is shown an example of analytical data for one of the test questions for a group that has taken it.

TABLE 1 Part of the table of elements of the analysis

Question	Answers	Score	Number of responses / total number of attempts	% answers
What are meta-knowledge?	Knowledge about relationships between objects and facts	0	13 / 51	35%
	Knowledge for knowledge itself	1	30 / 51	59%
	Knowledge of objects and facts	0	3 / 51	6%

On the next figure, statistics is shown for the correct answers of 12 students that have taken the test.

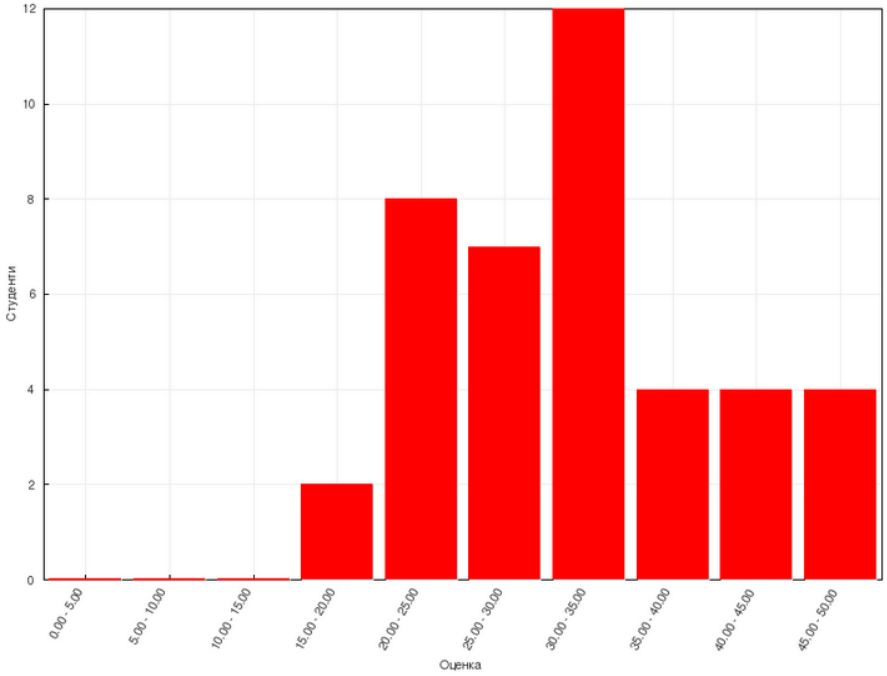

FIGURE 5 Analytical data on the results of the final test

The analysis allows assessing the results of the teaching process for a given subject and identifying ways for improvement, related both to the content and to the way it is taught.

The capabilities of the distance-learning platform are standard and allow importing and exporting data from external files as well as using graphics, sound and animations for most appropriate representation of key indicators used when teaching and examination.

3 Conclusion

The presented realization of a course for distance-learning does not pretend for uniqueness. The results prove the effectiveness of the chosen methodology of teaching and can be used for the development of a more complex distance learning system in the university.

The course can be of use for full-time or part-time students with various majors, pursuing a degree in a related field. It can be of interest to any specialty that need to provide fundamentals in the field of artificial intelligence.

As a direction for improvement can be pointed better adapting the course materials and content for mobile devices. This could help increase the number of targeted students and their interest in the field.

Acknowledgments

This development was funded by Project RD-08-306/12.03.2015 to Shumen University "Konstantin Preslavsky", Shumen, Bulgaria.

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Nature, meanings, and elements of the marketing strategy

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Received 01 March 2015, www.cmnt.lv

Abstract

A review was made, considering the views of 10 leading foreign and Bulgarian authors regarding the nature and elements of the marketing strategy. Based on the different approaches, the meaning of the marketing strategy and its efficient application, a new vision is represented regarding the nature of the marketing strategy, methods for consistency, and combination of elements, and their content.

Keywords: marketing strategy, elements of the marketing strategy

Introduction

The marketing strategy is a result from the corporative strategy of the organization and assists its realization through specific methods, activities, and instruments, oriented towards provision of services for the organization's target groups.

1 Nature of the marketing strategy

The definition of the market strategy's nature is extremely important for its correspondent development, application, and efficiency. There are great number of different definitions of prominent scientists and practicians in the scope of the marketing area.

The present review represents views for the nature of the marketing strategy, according to Phillip Kotler, Armin Zeiler, J. Evans and B. Bermann, W. Pride and O. Pharrel, Richard Lewki, Michael Porter, Bruce Henderson, R. Kervin, V. Mahajan, R. Varadarajan, N. Krusteva and I. Petrova, Galina Mladenova.

The analysis of the cited definitions shows that the strategy is defined as a combination of approaches and methods, means or a plan for action, description or ways of combination, formula for competitive business. In summary, the strategy is a way towards the right direction. Undoubtedly, it has the nature of a plan, and in this sense, it can be viewed as a complex of purposeful activities.

The common in all definitions is that the desired result is the realization of the organization's aims through the elements of the marketing mix, which is the formula for success. A precondition for effectiveness is the satisfaction of needs and preferences, the feeling for the products as your own. Since the product cannot satisfy all preferences, the knowledge for leading criteria and decision making while purchasing an item are crucial. In the contemporary marketing paradigm of relationships, the main differentiating approach is the spirituality.

Based on analysis on the leading contemporary theories, the following newly summarized definition is suggested: The marketing strategy is a planned complex of purposeful activities, containing the elements of the marketing mix, according to the market possibilities and resources of the organization, assisting for the achievement of differentiated competitive advantage, through which the marketing aim is achieved.

2 Elements of the marketing strategy

The marketing strategy consists of several key elements, needed for its successful application. The correspondence and conditions between them play an important role during the efficient realization of the marketing aims.

The marketing strategy is developed on the grounds of thorough analysis that characterizes its component parts. Although the components are reviewed separately, it is important that their two – way effect and their reciprocal action to each other will be taken into account.

Reasonably, there is a model suggested, regarding the consistency of the following structure elements of the marketing strategy:

- Analysis of the market and target groups;
- Main aims;
- Key competitive advantages and market challenges;
- Marketing mix;
- Innovations;
- Activities and tasks;
- Strategic marketing budget;

3 Conclusions

The clear and correct definition of the marketing strategy and its elements is crucial for the efficiency and practicality of the organization and community.

First element: Market and target group analysis.

The market choice and users identification are among the main marketing substances. Each undertaken marketing activity is inevitably connected with these two determinants.

The marketing choice for certain market depends generally on the users towards which the business is targeted, specifically their needs, necessitates and desires. [11]

From marketing point of view, "the market of certain products is combination from real and potential users, who have similar needs, different preferences and purchasing

power“ [11].

Considering the nature of the market, it can be summarized that the deep understanding of the conditions and perspectives for developing of the said market is essential for the developing and realization of the marketing strategies. The market analysis cooperates for the determination of the company's focus within the frames of the target market.

During the preparation of the organization's developing strategy (marketing strategy), important aspect of the said preparation is the target group identification. In the present market situation with well-differentiated and versatile target market, it is very important that all future marketing initiatives are in correspondence with the users. Through correct identification of the target groups, the organization strives to meet the needs of the customers better than the competitors do. The realization of the market analysis could be impossible without the application of target marketing initiatives and segmentation.

Regarding the construction of target market and market segments identification, it is necessary for the company to undertake measure in correspondence with the concept – target marketing. The target marketing expresses the decisions of certain company to differentiate the different user groups that form its market and to develop products and market mixes for the chosen target markets. The target market initiatives become increasingly popular for the finding of new market possibilities.

Kotler suggest three main steps for the conduction of target marketing:

- Identification and description of the different buyer groups, that is, application of market segmentation;
- Choosing of one or more market segmentations, that is, determination of the target markets;
- Market positioning [12].

From the following sequence must be noted that the decisions connected with the specified steps for target marketing are closely related and are strongly interdependent. Due to this reason, the three decisions connected with the target marketing must be reviewed as a system of interconnected and interdependent elements.

The results from the market analysis and the user evaluation represent several segments that can guide the company, to be of interest for it and to meet its requirements. It is necessary for the company to make decisions regarding the number and type of the segments towards which it will concentrate its efforts. It is narrower, more clearly expressed than the relevant market and covers only the segments on which the company has chosen to purposefully influence. It is suggested that the market and target groups' analysis is represented as complex process connected with research of the market segments, their extent, scope and attractiveness. At this point, it is necessary that certain activities are undertaken, connected with the evaluation of the existing markets, aiming to determine the strategic priorities of the company, as well as estimation of the development of the product markets and determination of their attractiveness with regards to the business aims of the given company.

With this first key element of the marketing strategy is conducted the market segmentation which results into differentiation of certain user groups which form the base market. There are actions that are overlapped and connected with the determination of the size of the market segment through certain methodology, chosen by the organization. The target market must be in correspondence with the resource capabilities of the company, as well as to be evaluated as remunerative. The segment must give perspectives, comparable to the company's business aims.

In summary, the following conclusion can be drawn: the activities connected with identification of the existing and potential clients and their needs can be considered as founding and crucial for the formation of the marketing strategy, and for the future of the organization. The disregard of this substantial stage or the incorrect differentiation of the user groups is risky and can lead to incorrect segmentation, product failure or in the worst case – company failure.

Second element: Main aims.

Specifying the marketing aim, which will be achieved through the marketing strategy and creating realistic aims against the chosen target market are the main elements for the good marketing strategy. The specified aims for the target markets and segments must be in correspondence with the organizational and marketing aims of the company, as well as to give clarity regarding the business achievements using the chosen strategy, the desired market position towards which the company is focused, realizing the strategy.

In order for the aim to be effective it must be: (1) put in hierarchical order, so it can guide the business from the big to the specific aims; (2) determined in quantitative way; (3) realistic (4) and consistent [12].

In order for the first condition to be realized, the following conclusion must be drawn, overlapping the concept that both marketing aims and target groups aims must be set and consistent "from top to the bottom", that is, from the organization's leadership towards the lower managerial levels. Thus, the formation and application of the marketing strategy will have purposeful orientation towards the achievement of the corporate aims, therefore the main condition will be realized, that is, the sub – aims are identified and cooperate for the realization of the main aim. Regarding the conduction of the second condition, it is necessary that the aims are clear and quantitatively formed, that is, to have neutral and valuable nature. The reality is the next condition for effectiveness of the aim. Each aim must be formed in such way that is achievable and in correspondence with the organization's possibilities. The achievable aim can be interpreted as equivalent of the realistic aim, because the realistic aim it in its essence the achievable one. All aims of the organization must be consistently formed and achieved. Sticking to one, more clear and more consistent view of the aim that must be achieved, the organization will be more consistent in its choice of resources for conduction of the selected activities. The consistency in the actions cooperates for their conduction step by step in a way which is more effective than the work without direction or targeting multiple directions. The earned and kept users, the maximization of the profits and minimization of the expenses can be determined as the main aims of each marketing strategy. Besides, there is the winning of reputation of the company within the frames of the existing community and specifically in the target market.

The identity is a substantial condition – it is at the base of the favorable understanding of the organizations' suggestions.

Another important aim n the strategy is the provision of quality and consistency in the service of the target market.

In summary, based on the identification of the aims against the target market, that must be achieved, can be determined what type of strategy must be chosen and what tactical actions must be undertaken for its achievement.

Third element: key competitive advantages and market challenges.

On this stage, the organization must undertake certain actions regarding the knowledge and research of its competitors, in order to offer the user more benefit than its competitors do.

In order for the competitive advantages of the company to be outlined, the application of the so-called competitive analysis is necessary. In order to obtain the competitive advantages, the companies must have long – term information regarding their competitors, so they can foresee their future reactions and the business behavior of the competitive companies as a whole. According to Michael Potter, the competitive analysis must give answer to three questions: What affects the competitor? What does he make? What could he perform in the future? [6] As a result from the presented sequence, one can summarize that the same is the ground for the identification of the key competitive advantages of the company, as well as precondition for important strategic decision. The detailed and analytical answer to the given questions cooperates as practical as possible for the conduction of competitive analysis, helping the preparation of competitive profile. The knowledge regarding the competitors cooperates for the foresight of their future activities and this helps the company when it comes to positively differentiate its suggestion from the competitors' suggestions and to gain advantage. The realized and distinguished competitive advantage will allow the organization to gain greater restitution. If there is not any competitive advantage, the existence of the company is not economically justified – this advantage is the reason that the company exist and develops it.

There is a competitive advantage at hand, when the restitution of the organization's market activities exceeds the average amount for the given branch. The advantages arises from these product and service characteristics which made it better than the competitors' advantage.

It must be summarized that the competitor's advantages can be the main aim of the company, as well as result of the applied marketing strategy.

The dynamic is one of the main factors that must be taken into account when crating competitive advantages. This is a result from the idea that the competitive advantages are considered as a variable quantity. If a given circumstances insures the presence of certain advantage, this means that it will do so in the future as well. Multiple factors affect the changeability. The competitive advantages in the current market conditions are characterized with greater instability in comparison with past periods. The continuingly changeable market environment involves recording and actualization of the changes in the competitive behavior and structure, the changes in the user behavior and the changes in the elements of the marketing environment that surrounds the organizations. When analyzing these values, the company will bring out those factors, elements and circumstance that can insure the competitive advantages. In this sense, the dynamic in a certain environment can lead to great risk situations for the company and the so – called market challenges.

The formation of the marketing strategy in the current market conditions requires developing of scenarios for managing with the future challenges. It is necessary that the following matter a re taken into account: markets, needs, and necessities of the users, distribution channels, competitors and their suggestion – all of these things must be considered as dynamic quantities, affected by strong fluctuations and requiring attention.

As a result from the analysis of the process of preparation of the competitive organization's advantages shall be summarized with the following conclusion: the successful marketing strategy requires, in turbulent organizations, stipulated actions for changes and adaptation, meeting the market challenges, provoked by the environment. The main direction for finding the market challenges is the analysis of the elements of the surrounding marketing environment. The analysis of the necessity of researching the surrounding marketing environment allow us to summarize the following:

The due analysis of the surrounded environment is based on its dynamic. The environment includes different elements – events and circumstance affecting the object of management that is the organization. The periodical analysis and the identification of the changes in the environment and its components is precondition for the establishment of the key competitive advantages and market challenges. In the current marketing conditions, one can observe continuous fundamental changes in all of the environment components (changes in the demographic characteristics of the users, the models of the user behavior, economical and technological changes, etc), whose analysis gives possibilities for winning competitive advantages, as well as challenges with the organizations must learn to cope.

Fourth element: marketing mix.

During the process of marketing strategy creation, the main role is played by the elements of the marketing mix. Without developed marketing mix it would not be possible to form and follow certain strategy. The structural elements of the mix are the base for creation of successful marketing strategy.

MacCarthy classifies these instruments in four general groups, which he calls the "four P" of the marketing: (product, price, placement, promotion). Each component requires conduction of specific activities. These elements are classified to the controllable factors of the surrounding marketing environment and are object of the organizational management which can affect multipolar, complex and dynamic on the own products search.

During the formation of individual marketing mix it is necessary for the company to specify what is the strategic role of each compound elements, how the activities connected with the elements will be divided and which element will be with priority effect, that is, which of the elements will have lead role in the realization of the marketing strategy.

The marketing strategy, to a greater extent, consists in the creation and maintenance of the most suitable for the

organization marketing mix, that is, it ensures the best choice for the successful application in the complex of main characteristics of the elements. Some authors widen the mix to "seven P", adding the physical presence, uniforms, furniture, atmosphere and processes. The number of the "Ps" in the marketing is constantly increasing, but all these additional elements can be found in the main four elements. It is crucial that they are properly combined regarding the satisfaction of the needs of the targeted market. Expressing his statements regarding the increasing number of elements in the complex, Alexander Rapiev states that: "The marketing complex of the company – that is all that is related with the client" [13].

Based on the presented statements regarding the elements of the marketing mix, the following summarization can be made: the marketing mix and its elements are the main instrument for formation and realization of the marketing aims and strategies. Through this main substance in the marketing literature are created approaches and mechanism for strategies conduction.

The controllable quantities that form the mix allow the organization to change the activities connected with the elements in correspondence with the dynamically changing market environment, as well as the components are important for the formation of the marketing strategy, thus they can be reviewed as tactical means for conduction of the company's aims. The concept "mix" accentuates the possibility for coordination and synchronization of the decision and action connects with the elements. The achievement of the company's marketing aims requires coordination of the action connected with all elements of the mix.

Fifth element: Innovations.

The innovations are at the base of the development and growth of given company and the aim of each business is development, prosperity and high profits. Due to this reason, it is suggested that the innovations are reviewed as compounds element of the marketing strategy.

"Innovation means the introduction of some new or significantly improved detailed product (item or service) or production process, new method of marketing or new organizational method in the business practice, organization of work places or external connections which creates market advantages and increase the competitiveness of the companies" [14].

In the present days, one of the most valuable resources for the companies that will provide them with competitive advantages is the ability to turn the change into way of work and then gain profits from it. The innovations are main engine of the economic of each country. As an element of the marketing strategy, they must be reviewed in different direction according to the object in which they are realized, namely: products, processes, markets (marketing) and organizational – managerial innovations.

The strategic thinking and planning of the intellectual, information and human potential become even more important for the successful business activities and the company's development. As a result, the following conclusion can be made: the innovations as an element of the marketing strategy represent a process of using knowledge or certain information for the creation and introduction of something new and useful. The innovations as an element of the marketing strategy are powerful means for gaining strategic advantage over the competitors. Exceptionally great and even greater is the role of the innovations for the companies, because the innovations helps the production of new organizational products and increase the manufacturing process. Therefore, the innovations are becoming even greater permanent competitive power.

When putting the innovations at the base of the successful marketing strategy of a given company, it must be taken into account that the concept of innovation does not necessarily mean discovery, invention, etc., but process which can gain the organization added value or innovation with added value. With this type of innovation, the company can upgrade and add in such a way, that certain process is organized in new way and with new benefits. The most suitable type of innovations for the small and medium business companies are the so – called "kaizen" innovations, which in Japanese means continuous small improvements in different directions. They do not accentuate the discovery, but usually change something small and gather already known matters in new configuration which results to something new with new benefit for the users.

The innovation during the formation of the marketing strategy must be in correspondence with the priorities of the organization, also the introduction of the innovations prolonging the process of formation of the marketing strategy and the presence of changes that must be taken into account and managed.

Sixth element: Activities and tasks.

This stage can be reviewed as etalon, which differentiate in its essence aiding activities and tasks for the realization of the marketing strategy. This element is substantial for the preparation of the marketing strategy, specific process, requiring attention to the details. The realization of the strategy represents a combination of intertwined activities realized according to preliminary stipulated standards and agenda. This is finalizing, crucial element from the process of strategic planning, which must follow the setting of the aims and the development of measures and activities for their achievement. At this stage it is necessary that certain actions are specified, against the previous elements of the marketing strategy and periods for conduction are stipulated, which will help the achievement of the main aims. The determination of the main tasks for conduction of the elements and their realization cooperates for more effective conduction of the events for the actual realization of the marketing strategy.

The activities and tasks for conduction of the marketing strategy must be formed in such way that their conduction will cooperate for creation of key competitive advantages and effective marketing strategy.

Seventh element. Strategic budget.

This substantial element of the marketing strategy answers the question: "How much the project realization will cost?" Through preparation of current budget estimations, the organization can estimate whether or not the realization of certain marketing strategy can be conduction or it is necessary for the organization to undertake certain actions for reducing and cutting down the expenses.

The budget is record of chosen approach of a budget articles. For example, in the budget for the cash flow are included those budget articles which affect the cash flow, and in the profit and expenses budget record are included the transactions which

affect the profits and expenses of the organization.

As a result from the presented information, one can draw the following conclusion: the strategic budget is a written project, financial plan for project activities. It reduces all quantities of the organization in measurable quantities, determines the needed resources and the expected restitution within the frames of certain period of time.

The strategic budget is not just a list for all expenses, included in the conduction of the marketing strategy. It can answer the question are the expenses justifies against the estimated results?

As a results from the analysis the following summarized definition is suggested: the nature of the strategic budget is brought to the summarization of all planned actions and tasks for preparation and conduction of the marketing strategy and reviewing them as specific expenses, compared against the profits from the realized strategy.

In summary of the presented elements that are substantial for the marketing strategy, the following conclusion can be drawn: the marketing strategy is complex of activities, considered as strategic and their conduction which predetermines the quality of the company's marketing strategy, effective conduction of the marketing aims and successful business as a whole.

In the current economical conditions, substantial role has the effective management of the organizational resources. The budgeting is the instrument for good financial planning, control and realization of a given strategic project. The ability for orientation in the fluctuations between the budgets and the actual indexes is precondition for duly identification of the problems and undertaking of certain actions, which must be adequate and correspondent to the changes in the planning process.

Acknowledgments

This development was funded by Project RD /29.03..2015 "Competitiveness of the company" to Shumen University "Konstantin Preslavsky", Shumen, Bulgaria.

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Operation Research and Decision Making

Development of a quantitative model of evaluation of maturity level of processes of software projects

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Computer Modelling & New Technologies 2015 ***19****(4C) 7-9*

The developed model allows for quantitative assess the maturity level of processes of software projects and to identify priority areas for the development of software project processes. The model was tested on 10 companies. Spent in the company survey allowed us to estimate the level of maturity, to collect data on deviations in time and the cost of the project and build the equation of dependence of deviation from the measured level of maturity. This equation can be used by companies to predict the variation of key indicators of the project when changing the maturity of software processes.

Keywords: quantitative model, maturity level, software projects, development of a quantitative model

Polygraph method in psychological research of human emotions

Olena Kosyanova

Computer Modelling & New Technologies 2015 ***19****(4C) 10-12*

The structure and characteristics of human emotional maturity have been studied. It was worked out a program (based on software “Sheriff 7” of polygraph “Barrier-14”) for testing a peculiar personal characteristic of juveniles - deceitfulness. Earlier developed diagnostic methods were applied to measure the emotional maturity of a person. The correlation between the emotional maturity of juveniles and their deceitfulness was established using a polygraph method. It was revealed that the low level of emotional maturity corresponds to the weak abilities of juveniles to lie. A research of ethical and social values of contemporary juveniles was undertaken to determine the areas in which the deceitfulness is most pronounced.

Keywords: emotional maturity, hide deceitfulness, polygraphs «Barrier-14» («Sheriff 7» software)

Multi-criteria decision-making model based on the level of doubt for information and training system

V Serbin, A Syrymbayeva, K Tolebayeva

Computer Modelling & New Technologies 2015 ***19****(4C) 13-16*

The urgency of developing information and training system based on multicriteria decision-making model is due to both scientific purposes better understanding of the information processes of learning and practical objectives to create more effective information and training systems, the implementation of which contributes to the quality of distance learning. The transition to this technology involves the use of new teaching methods, approaches, principles of organization of the learning process, including on the basis of information and training systems. Therefore, in this paper concerns the problem-oriented learning management based on multicriteria decision-making model that takes into account the level of doubt the user. The proposed method of measuring the level of doubt the user gives a clearer and more "transparent situational picture" for a more objective decision-making. Also, the method makes it possible to reduce the probability of guessing the correct answer, which increases the objectivity of knowledge in diagnostic systems for process control training on remote technology.

Keywords: multicriteria, distance learning, doubt

Hot spot and development trend of domestic information science

Liying Lin

Computer Modelling & New Technologies 2015 ***19****(4C) 17-20*

Fundamental approach to literature metrology were introduced in this paper to make a statistical analysis on the thesis of library and information science during the period of the 11th Five-Year Plan of China with academic focus on CNKI, CSSCI collections, citation frequency, productive authors and authorities. With academic defects and deficiencies summarized from the statistical study, this paper aimed at making recommendations and references for the disciplinary development planning of library and information science, faculty construction and talent cultivation, as well as relative researching concerns.

Keywords: bibliometric studies, library information science, disciplinary development, statistical analysis

Comparison of measured by results of the test system used e-learning in Konstantin Preslavsky University of Shumen through practical tasks

Boryana Hr Uzunova–Dimitrova

Computer Modelling & New Technologies 2015 ***19****(4C) 21-23*

In the work are discussed, analysed and compared acquired ratings from students trained in Shumen University used alongside the traditional way of teaching and platform implemented at the university e-learning. Compared the results obtained by assessing the practical task with those achieved in the electronic ultimate test.

Keywords: practical use of systems for e-learning, analysis of the results in the evaluation of practical tasks and solve computer test

Mobile technologies and electronic governance

Milena Stefanova

Computer Modelling & New Technologies 2015 ***19****(4C) 24-29*

This paper looks at some of the problems of electronic governance in the Republic of Bulgaria. It also provides a summary of the advantages and disadvantages of providing e-services in the e-health sector. An optimized algorithm is then drawn up, upon which a model with vein code biometric identification for web-based systems is applied in the process of providing e-services in the healthcare sector. This model provides a much higher level of authenticity in data processing in comparison with the traditional customer service procedure. A comparative analysis is built upon the various criteria of mobile websites and applications, where the choice of mobile application analysis is well-founded. The major stages of mobile application development are traced and a preliminary research on their precision and convenience is carried out.

Keywords: e-Government, e-services, biometric identification, mobile applications

Mobile sites as a part of the digital model of modern daily newspapers

Tihomir Stefanov

Computer Modelling & New Technologies 2015 ***19****(4C) 30-33*

Changes in the sphere of conventional printed publications have been acquiring global dimensions. Is there any future for the printed newspapers? Problems of the daily newspapers transition from paper to digital bearers are discussed in the present paper. A model of the future digital newspaper is presented here. The mobiles sites of Bulgarian newspapers and magazines are viewed in the paper. The advantages of the mobile platforms through smart phone access are presented here. The sites have been viewed in the aspect of the necessity of "New digital model of the modern newspaper." An analysis of their utility in the point of view of readers and news publishers has been made.

Keywords: Digital model, mobile sites, news, newspapers, magazines

Implementation of a course in "artificial intelligence and expert systems" on top of a distance-learning platform

Nayden V Nenkov

Computer Modelling & New Technologies 2015 ***19****(4C) 34-36*

In the current paper, presented is animplementation of a distance-learning course on the subject of "Artificial Intelligence and Expert Systems" for students pursuing bachelor's degree in the field of "Informatics and Information Technologies". The distance-learning platform used by the university is based on Moodle. The teaching materials are in the form of lectures, promoting discussions. For verification of the knowledge gained by the students, tests and analysis of the results are performed.

Keywords: distance learning platform, distance learning, course, test, discipline

Nature, meanings, and elements of the marketing strategy

Trufka Dimitrova, Margita Yanкova

Computer Modelling & New Technologies 2015 ***19****(4C) 37-41*

A review was made, considering the views of 10 leading foreign and Bulgarian authors regarding the nature and elements of the marketing strategy. Based on the different approaches, the meaning of the marketing strategy and its efficient application, a new vision is represented regarding the nature of the marketing strategy, methods for consistency, and combination of elements, and their content.

Keywords: marketing strategy, elements of the marketing strategy

Content D

Ambient Assisted living systems and platforms

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Received 01 March 2015, www.cmnt.lv

Abstract

In accordance with the modern concept of "smart home", we see the emergence of a new component - Ambient Assisted Living, which can be translated as "living environment". The basic idea of is that all the human environment should facilitate his life. Ambient Assisted Living (or AAL) is a multi-disciplinary field, exploiting ICT in Healthcare and telehealth systems to resist the effects of growing elderly population. There is a huge potential and prospects of development of ambient assisted living systems and platforms. Also, there is affected aspects of AAL systems, usage of contemporary AAL systems and platform and its architecture.

Keywords: Ambient Assisted Living, smart house, personal health monitoring, healthcare IT, telehealth; medical sensors, health monitoring; interoperability, usability; security and privacy

1 Introduction

The growth of such areas as microelectronics, information technology, telecommunications infrastructure, as well as the rapid increase in the number of elderly people in Europe and progress in medicine may affect the formation of what we now call the concept of "smart home".

In accordance with the modern concept of "smart home", we see the increasing number of connected components in a person's environment such as heating, ventilation, air conditioning, lighting, opportunities for recreation and entertainment, telecommunications equipment, security systems and fire fighting, as well as quite a new component - Ambient Assisted Living, which can be translated as "living environment". The basic idea of is that the entire human environment should facilitate his life.

2 Overview of the study area

2.1 AMBIENT ASSISTED LIVING (AAL) SYSTEMS

Ambient Assisted Living (or AAL) is a multi-disciplinary field, exploiting ICT in Healthcare and telehealth systems to resist the effects of growing elderly population.

The primary goal of AAL is to extend the time which elderly people can live independently in their preferred environment using ICT for personal healthcare.

Targeted needs of AAL are individual elderly person, their families and caretakers (not healthcare institutions), e.g., safety, security, social access, medical and emergency services, infotainment, etc.

2.2 HUGE POTENTIAL OF AAL SYSTEMS

AAL systems have a huge potential in development in the provision of health care services, health monitoring with the help of ICT.

AAL systems are used in the field of telemedicine. According to the statistics provided in the report of InMedica (which is the research group in the market of medical devices) [1]: about 1.8 million patients worldwide will monitor their health with the help of telemedicine systems. (Figure 1) [1].

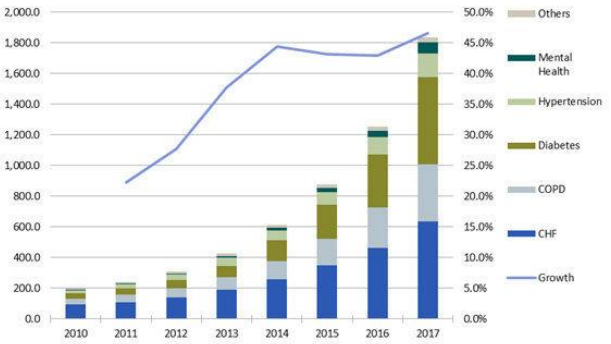

FIGURE 1 World Telehealth Patients (thousands) By Disease [1]

2.3 THE REASONS OF AAL SYSTEMS POTENTIAL

Such high stable growth caused by the reasons that give AAL systems such a huge potential.

Firstly, society is in need from healthcare receivers, because of the increasing percentage of aged society, growth of the quality expectation from citizens, mobility – people and diseases.

Secondly, technology push provides development of AAL systems: the growth of ICT – Internet access, wireless networks and 3G, the stable development of biomedical technology.

Thirdly, globalization aspect reflect to the potential of AAL systems: interoperability, integrity, and accessibility are provided through standard specifications (standardized protocols, data models) and diversity.

2.4 ECOSYSTEM OF AAL

AAL systems consist of medical sensors, computer (or other device), network, software (such as mobile applications and databases, which is connected to a mobile application to

exchange data), and used to provide services in the field of improving the quality of life. (Figure 2)

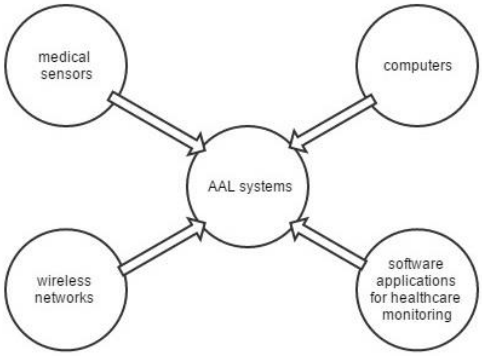

FIGURE 2 Ecosystem of AAL

Usually, the sensors are connected to the application via a gateway to transmit medical data to the monitoring system of the patient.

Many of the available sensors, used to monitor the level of blood sugar, blood pressure and heart rate transmission, can also transmit vital data for health monitoring systems. Therefore, the use of such systems, the medical specialist can monitor the patient's general condition remotely.

2.5 ASPECTS OF AAL SYSTEMS

In order to produce high quality systems, it is important to consider various aspects of AAL systems. The main requirements are to achieve interoperability of medical sensors and their integration (in many studies mentioned the importance of this aspect), usability (means ease of use), security, privacy, data protection and accuracy of the data. However, existing systems of nowadays industry do not consider all aspects of AAL systems.

3 Adopting relevant technology

3.1 USAGE OF CONTEMPORARY AAL SYSTEMS AND PLATFORMS

According to an emailed-based survey to analyze the real world usage of contemporary AAL systems and platforms [2], 62 correspondents were contacted, of which 40 responded. 16 of the 40 correspondents communicated the required information about users, technologies, supported devices, platforms, standards, and cost. Based on 16 positive responses, shown in Table 1, we can conclude that, mainly, the medical devices used in AAL systems and platforms are blood pressure, glucometer, pulse oximeter, fall detector, and weight scale sensors [3]. Also, there is the use of heart-rate monitor, dehydration sensor, subcutaneous pump, intraoral device, and electronic stethoscope.

The Operating System being used are Windows, Linux, Android, and Symbion. The major programming languages are Java, C#, C++, PHP, and Python.

HTTP, SOAP, and RESTful protocols are employed as the communication among distributed architectures. Networking is consisted of WiFi, Ethernet, ZigBee and Bluetooth. The cost of platforms ranges from EUR 500 to EUR 20,000. (Table 1)

3.2 AAL SYSTEMS ARCHITECTURE

There are 4 components, consisting of AAL systems architecture [4]. The first component is a need analysis to identify required devices, ICT context aware smart products, sensor, and sensor data collection, mobile devices and fusion. The second component is standards and sensor network integration, transition to Web (gateway). The third component is design Database and Web architecture, design intelligent monitoring and alarming system. The fourth component is the test environment: build up laboratory to test integration, interoperability, reliability, and security of the ICT devices and communication (Figure 3)

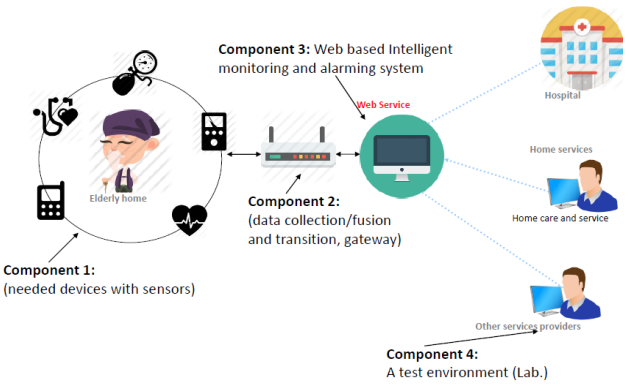

FIGURE 3 Relationship of project components

TABLE 1 Data showing usage of contemporary AAL platform and systems [2]

#	Project Title/Description/ URL	Medical Devices Supported	Standards	Operating systems	Programming Languages	Service Model	Cost/system /user (EUR)
1	AALuis—Ambient Assisted Living user interfaces, http://www.aaluis.eu/	N/A	ISO/IEC, 29341-x (UPnP Device Architecture)	Windows, Linux, Mac OS X, Android	Java, ECMA Script, XSLT	N/A	N/A
2	AMICA—Autonomy, Motivation & Individual Self-Management for COPD patients, http://www.aal-europe.eu/projects/amica/	N/A	HL7, X.509, Bluetooth LE/Continua, ISO 13485, ISO 60601-1-4, ISO 62304, ISO 9241	Windows XP/Vista/7/8, Android	C#, C++, Java, WSDL	SOAP, .NET	990/Year

3	AAL-ALFA: Active Living for Alzheimer-patients, http://www.aal-alfa.eu/	N/A	N/A	Android 4.1	Java	N/A	N/A
4	HELP: Home-based Empowered Living for Parkinson's disease Patients	Blood pressure, Parkinson sensor, Subcutaneous pump, Intraoral device	Zigbee Health Profiles, IEEE 11073	Windows Mobile, Android	C++, Java	OSGi	3500
5	GoldUI: Adaptive embedded human interfaces designed for older people, http://www.goldui.eu	N/A	ISO/IEC 40500, ISO/IEC 18036, ISO 9241-151	Windows XP/Vista/7/8, Linux, Android	PHP, Java, JavaScript,Postgre SQL	SaaS	N/A
6	WayFiS: Way Finding for Seniors	N/A	ISO 20282, ISO/IEC 27002, ISO 17267:2009	Windows XP/Vista/7, Linux, Android	PHP, Java, JavaScript, Postgre SQL	SaaS	N/A
7	MyGuardian: A Pervasive Guardian for Elderly with Mild Cognitive Impairments	N/A	ISO 6709:20, ISO 20282, ISO/IEC 27002	Windows XP/Vista/7, Linux, Android	PHP, Java, Postgre SQL, .NET	SaaS	N/A
8	HOMER—Home Event Recognition System	Continua Health certified devices	ISO/IEEE 11073-10471	Windows XP/Vista/7/8, Linux	Java	OSGi REST Web Socket, JSON	N/A
9	HOPE—smart home for elderly people	Pulse counter, Fall detector, Panic-Button	HL7	Windows XP/Vista/7/8	C++, VB.net, Java, C#	N/A	N/A
10	NACODEAL: NAtural COmmunication DEvice For Assisted Living, http://www.nacodeal.eu/en/	N/A	N/A	Windows XP/Vista/7/, Linux	N/A	REST	1000
11	PAMAP—Physical Activity Monitoring for Ageing People, www.pamap.org	Heart rate monitor	HL7	Windows, Linux	C++, Java	SOAP	N/A
12	REMOTE (Remote health and social care for independent living of isolated elderly with chronic conditions), http://www.remote-project.eu/	Zephyr bio harness, Dehydration sensor, Blood pressure device, weight scale	HTTP, SOAP	SymbionOS	Java, LWUI, JADE	SOAP	30–35
13	SmartTouch: Interaction as simple as touch, http://ttuki.vtt.fi/smarttouch/www/?info=intro	Weight-scale, Glucose Meter, Blood Pressure	N/A	Windows XP	C#	SOAP, .NET	N/A
14	SOFTCARE, http://www.softcare-project.eu/overall.php	N/A	N/A	Windows XP/Vista/7/8	Java, C	SOAP	500
15	TemRas: Telemedizinisches Rettungsassistenzsystem, Telemedical Rescue Assistance System	Monitor/Defibrillator for Emergency Medical Services (Philips HeartStart MRx), Electronic Stethoscope (3M-Littmann E3200)	HL7	Windows 7/2008 Server, GNU/Linux	Java, Python, C#	AMQP, FTP	20
16	OpenCare Platform @ Sekoia http://opencareproject.wikispaces.com/home	Blood Pressure, Glucometer, Pulse-Oximeter, Weight-scale and other Continua certified devices.	HL7	Windows	C#	SOAP, REST	N/A

4 Conclusions

There is high and stable growth of usage of ambient assisted living systems due to society needs, technology push and globalization.

In order to produce high quality systems, it is important

to consider various aspects of AAL systems, such as interoperability, usability, security, privacy, data protection and accuracy. However, current AAL solutions do not consider all the essential aspects of AAL systems.

Furthermore, we see that ambient assisted living systems and platforms open lots of perspectives and opportunities. Firstly, AAL systems can make a better healthcare by resolving communication problems between healthcare providers and healthcare receivers and even among different healthcare institutions. Consequently, this may contribute the increase of healthcare co-operation and team work in tele-medicine, tele-experts diagnose, consulting and operation. Also, there is the growth of interoperability among healthcare community and shareability of healthcare knowledge.

Acknowledgement

This work is the part of the Master dissertation project called "Development of client-server system based on the Android mobile platform for monitoring the cardiovascular system of the patient" at International University of Information Technology, Almaty, Kazakhstan.

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Automating the process of resetting the carrier phase of the mudflow to the downstream reach of Medeo dam

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Received 01 March 2015, www.cmnt.lv

Abstract

The carried-out analysis of catastrophic mudflow in Medeo tract in 1973 showed that the abnormal operation of the dam spillways was associated with several deficiencies in the mud dam's construction and unexplored process of deposition of the solid phase of the carrier medium mudflow mass trapped in the mudflow storage reservoir. Subsequent completion and modernization of spillways was made taking into account the effects of the mudflow in 1973 and now they do not structurally allow catastrophic mud flow cram the mudflow storage reservoir. The article presents a method of controlled dumping the treated fraction from the solid one of of carrying water phase of the forecast catastrophic mudflow through modernized spillways of Medeo mud dam. The proposed approach allows protection from flooding the social-culture objects of Medeo tract through optimal work of spillway that controlled using computer model of automated dam's control and safety system.

Keywords: swirl shaft spillway, hard mudflow phase, hydro technical constructions (HTC), automated control and safety systems

1 Introduction

Nowadays Medeo dam spillways have construction, which consider the deficiency that exposed in 1973 after a catastrophic mudflow. However, in practice, the spillways of the second stage dispose only possibility of overflow from the dam's crest. The factor of existing firm phase during dumping surface water of carrying phase of mudflow mass is left out of consideration. During mudflow mass' "choking" the underlying portals of spillway's headrace tunnels, the overhead spillway portals from short period of time can get out to maximum consumption over 30m3/s. This can cause uncontrolled dumping to the downstream reach of carrying mudflow phase with large solids in the form of rocks, trees residues, etc.

This hypothetical scenario during passage of catastrophic mudflow in Medeo tract can have a number of unacceptable consequences:

- Riverbed of Small Almaty River in the lower reach has a capacity not above than 5m3/s, but high capacity leads to flooding well developed social and cultural infrastructure of Medeo tract situated along the riverbed;
- Big stones and especially granite fragments can lead to strong abrasive destruction of concrete wall of swirl spillway and lead to "choking" a toe basin, which can lead to the full breakdown of spillway dam;
- Mudflow "Choking" of the construction spillway elements, even with successful scenario of surface water release from mudflow storage reservoir, is a negative factor, which related with costly reconstruction works as it did after mudflow in 1973.

The mudslide process in Medeo tract cannot be full-scale modeled. Therefore, the most relevant is a computer modeling with using mathematical tool of computational fluid dynamics of multiphase environment, also using 3D graphical simulation modeling methods [1].

Theoretical analysis of complex hydraulic processes in entrance channel, swirl circular spillway, cushion pool and discharge tunnel requires the plotting theoretical models of moving heterogeneous mixtures of multiphase medium mechanical science [2].

The swirl water flow of dispose masses in spillway is an enhance separation phase process. For swirl shaft spillway the solid phase, in the form of sand and small stones, deviate to concrete surface of spillway by influence of centrifugal forces. It can lead to quick abrasion of concrete embedding and changing geometrical parameters.

As known, Medeo dam spillways have maximum capacity about 30 m3/s, which can fix up with surface water release of mudflow storage reservoir during several days. The main characteristic of these spillways is absence of seals and other control elements of consumption overflow characteristics. The Small Almaty River riverbed was formed by yearly average hydraulically regime of this river. It allows to leave out flow quantity over 5 m3/s without serious negative social-economic consequences in Medeo. The surface water release of mudflow water reservoir, with flow quantity over 30 m3/s during several days, can lead to flooding a number of important sporting and cultural constructions in the lower reach of Small Almaty River.

The purpose of this research is improve the level of controllability of hydro technical constructions (HTC) and spillway work optimization, for safety water release of surface water of mudflow storage reservoir on downstream reach water dam.

2 Overview of the study area

Flat metal hydraulic valves mounted on the front of the receiver portal spillway, eliminate many disadvantages. Their design is shown in Figure 1, and as you can see, they do not require large material costs [3].

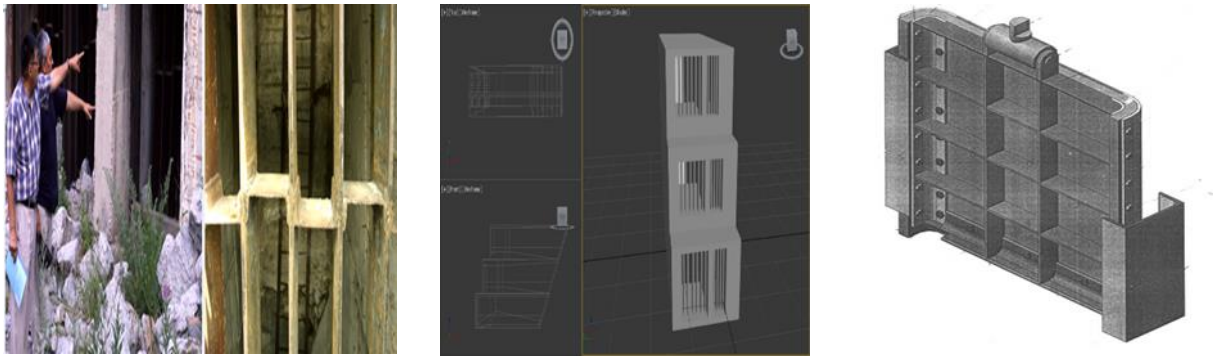

FIGURE 1 Receiving portal, its 3D model and spillway design flat metal gate

Such spillway improvement allows solving some kind of hydraulic problems of Medeo dam spillways:

- Mudflow mass "chocking" of the input portals;
- Decreasing bad influence of "bombing" by massive stones of concrete spillway wall;
- Decreasing influence of sand and small stones to the carrying flow and to the geometrical parameters of Medeo spillway dam (Figure 2).

The better scenario of this situation, after mudflow passing in Medeo and its holding in mudflow storage reservoir, is defecating the mudflow masses during two – three days. In this case, the mudflow storage reservoir can be like large sinker, which should prepare high layer of carrying mass to emergency closing stage - process of surface water release through spillways dam in downstream reach.

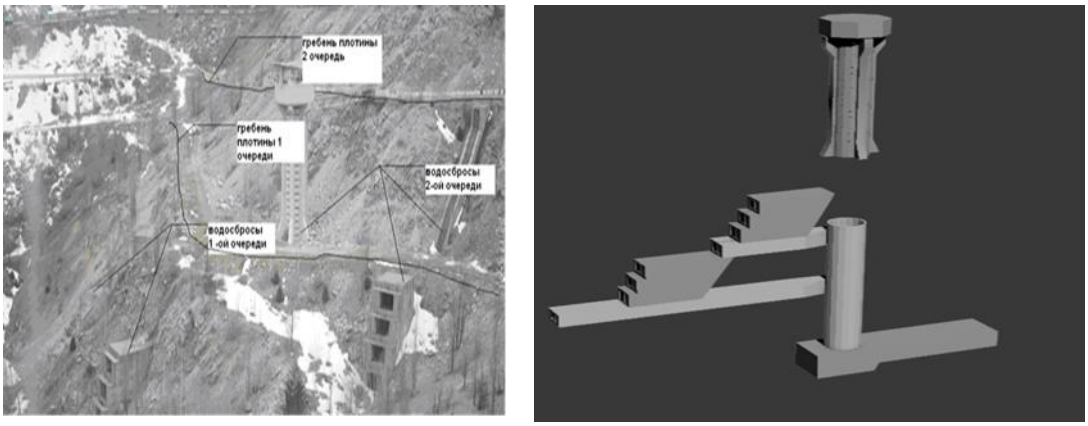

FIGURE 2 Antimudflow Medeo dam and 3D model of spillway construction elements

The process of firm phase separation from carrying environment represents a complex process of impulse and energy exchange in some continuum of entire medium that includes liquid and solid phase.

For quantitative time estimation of coarse particles of firm phase, there is proposed the following methodic of the calculation safety time of settling the carrying masses of mudflow storage reservoir and most probable solid particulate size, which will be thrown off Medeo dam spillway.

There is estimated safety technology of clarified surface water release of mudflow storage reservoir during catastrophic mudflow contains from following steps:

1) Mudflow moves at high speed along Small Almaty riverbed and near input of mudflow storage reservoir; so, because of sudden expansion of "live" canal the flow speed significantly reduced.

2) This effect ensures project impact force on the body of the dam, with a capacity up to 12 million cubic meters, which is equivalent to more than two volume mudflow mass of 1973 year.

3) Input portals of mudflow dam is realize circulation motion in closed space of mudflow storage reservoir. It should be good for firm phase equitability in overall total of mudflow mass.

4) Finishing the circulation flow motion in mudflow storage reservoir is an initial time point of gravitational process of firm phase disposition.

5) The settling time is calculated by the algorithm that created via a computer interface, which ensures deficiency solid particles, from 1mm diameter and above, in surface discharge water.

3 Adopting relevant technology

The gravitational settling is considered in hydromechanics like complex process of separation the heterogeneous stationary systems, in which main factors are the gravitational forces, force of Archimedes and force of sticky, interfacial interaction (force of fraction between particles and carrying phase, during high concentration of solid particles).

During low concentration of firm phase, the computation is carried out in the case of absence of mutual influence particles to each other, and it represents the Stock's task in classical view.

Stock formula shows laminar condition of spherical form of solid particle affected by gravity force, Archimedes force and resistance force of medium:

$$\mathrm{Re} < 2;\ \xi = \frac{24}{\mathrm{Re}};\quad \mathrm{W_{oc}} = \frac{\mathrm{d_ч^2}\left(\rho_ч - \rho_{cp}\right)g}{18\mu_{cp}}, \qquad (1)$$

where ξ – coefficient of medium resistance;

$\mathrm{Re} = \frac{\mathrm{W_{oc}}\rho_{cp}\mathrm{d_ч}}{\mu_{cp}}$.

While flow turbulence, under the action of inertia forces, occurs the boundary layer separation for moving the solid spherical particles, which leads to a turbulence flow to solid body. The deposition rate in the transition mode calculated by the semi empirical formula of Allen:

$$2 < \mathrm{Re} < 500;\ \xi = \frac{18.5}{Re^{0.6}};\ \mathrm{W_{oc}} = 0{,}78\frac{\mathrm{d}^{\,0.43}\left(\rho_ч - \rho_{cp}\right)^{0{,}715}}{\rho_{cp}^{0{,}285}\mu_{cp}^{0{,}43}}. \qquad (2)$$

In the automodeling mode of gravity force, significantly override from viscose friction. Calculation is doing by I. Newton formula:

$$\mathrm{Re} > 500;\quad \xi = 0.44;\quad W_{oc} = 5.46\sqrt{\frac{d_ч(\rho_ч - \rho_{cp})g}{\rho_{cp}}}. \qquad (3)$$

Lyaschenko's approach is more general algorithm, which is used for generality mode of particle flow and its form. This approach was the basis of computer interface algorithm. It is also a part of the planned in program Flow Vision, MasterScada module of automated control system, of technological process (ACS TP) "Clarification of surface water of mudflow storage reservoir" [4-8].

A generalized block diagram is shown in Figure 3.

There is more complicated calculation algorithm of settling firm phase speed in case of mutual particle collision, because of high concentration.

In continuum model, these forces take in consideration in the viscosity coefficient by Boussinesq. However, for practical measurements these approach less appropriate. The important finding of these calculations is increasing energy flow losses that related with impulse interchangement between particles and carrying phase.

The increasing of resistance coefficient at high concentration of firm phase leads to decrease by twice the settling speed. For higher-precision necessary to get semi-empirical form:

$$\mathrm{W}=\mathrm{f}\,(\mathrm{Wc.oc},\ \mathrm{Соб}), \qquad (4)$$

where W – speed of hindered settling, m/s; C – volume concentration of liquid mudflow phase.

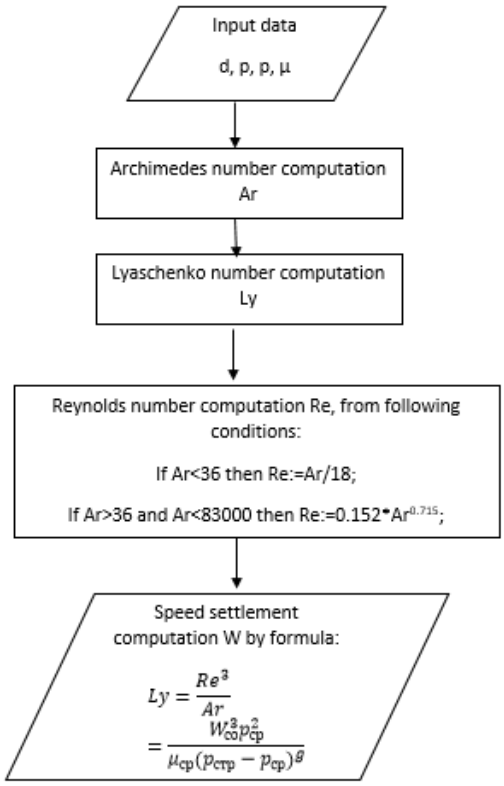

FIGURE 3 Block scheme of speed settling calculation of solid particles in case of concentration firm phase before 10%

Graphical method of calculating the deposition rate of particles is implemented in a heterogeneous mixture which released in Lyaschenko's nomogram that is shown in Figure 4.

In the case of deposition particles rate calculation with irregularly share, there is introduced φ coefficient, which is directly proportional the particle area and inversely proportional the spherical particles area with similar volume.

Described algorithms underlie the basis of the projected automated control system and safety dispose process of clarified water of Medeo dam's mudflow.

For carrying out a manual mode of the control process of surface water release of mudflow storage reservoir there is used the hybrid control technological process scheme. It is based on remote video monitoring of mudflow storage reservoir and inclined drop in downstream water. Using the SCADA-system there was engineered the hierarchy of control objects for developed automated control system of technological process named "Spillway" (Figure 5).

These lists of OPC-Server configuration allow interaction with video monitoring, estimation sensors of the clarified settling of carrying phase in mudflow storage reservoir, and kinematical flow parameters in spillway construction elements that depending on regulated servomechanisms position of ACS TP.

The proposed configuration of ACS TP shows characteristics of high-speed process of clarified surface water release of mudflow storage reservoir through Medeo dam spillways constructions.

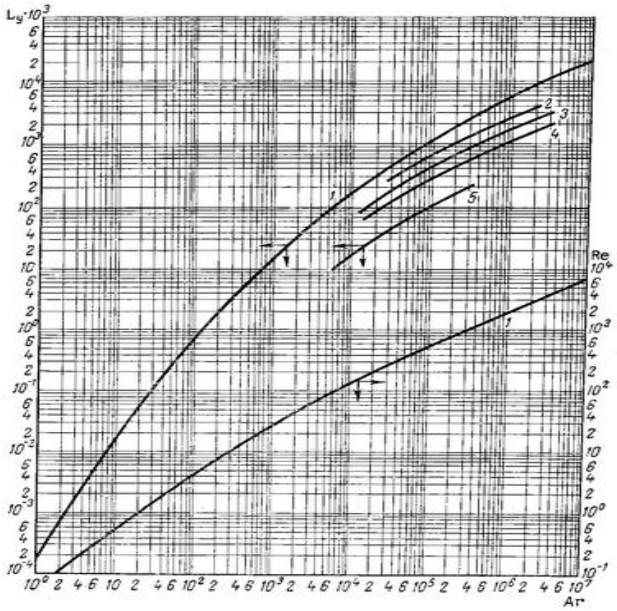

FIGURE 4 Semi-empirical depences of Ly and R parameters by Ar for settling particles in stationary medium:
1 and 6 – spherical particles; 2 – round; 3 – angular; 4 – extended; 5 – sheetlike

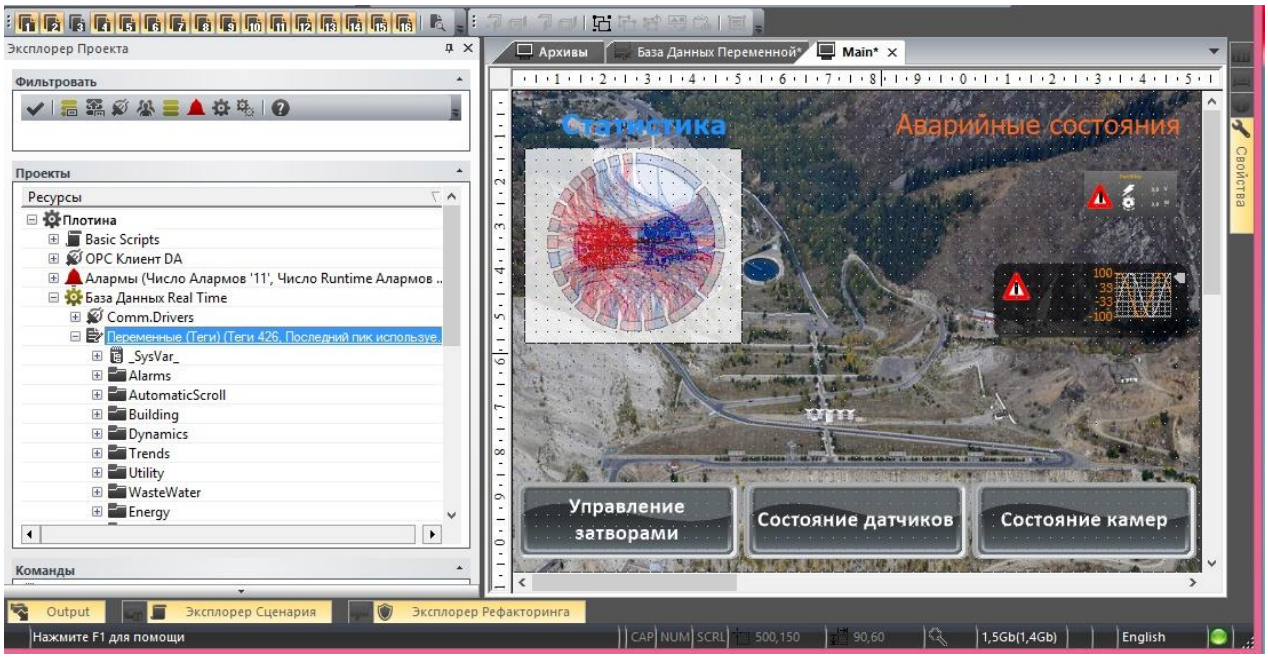

FIGURE 5 Configuration settings of OPS-Server of ACS TP “Spillways”

4 Conclusion

So, the heterogeneous mudflow mass moving in Medeo dam spillway is a complex movement of multiphase environment, which consists from water, stones, clay, rocky soil, etc. Addition of the effective viscosity by Boussinesq coefficient allows reducing problem of moving mudflow to simplified Navier-Stokes equations. In this case the concentration of solid phase where viscosity of carried phase is considered on 10-30 percentage upper water viscosity.

It allows take into account the influence of solid phase to changing of water flow in spillway shaft. Severe abrasion wear of shaft concrete surface related with presence in carried environment the split granite, stones, gravel and sand can lead to divergence geometrical parameters of HTC and initiation some of risks for spillway.

Operating experience spillways in mode of surface water release of catastrophic mudslide in 1973 showed that there was a "blockage" spillway shafts and "draining" of mudflow storage reservoir carried out through the top of the dam only after 3-4 days, after delivery of powerful pumps and spillway setting up. During this time, the firm phase had time to settle to the bottom of mudflow storage reservoir, and a pump is pump out the water with low concentration of sand.

The proposed method of surface water release via Medeo dam spillway allows continuous increasing the

escape water quantity mass up 3-5m3/s. This will provide secure mode of surface water release of mudflow that stopped in mudflow storage reservoir for 3-4 days after mudflow avalanching.

Conducted research changes the conceptual approach to Medeo dam spillway exploitation. This requires regulated metal settle seals and updating existing directory materials by exploitation intake portals of Medeo dam spillways.

The use of automated control system with regulated seals and appropriate sensor during surface water seals of carried environment of Medeo mudflow storage reservoir, allows increasing security of Medeo dam and keeping unique nature boundary.

Acknowledgement

The work was done by support of grant financing of scientific-technical programs and Science Committee projects of Education and Science Department of Kazakhstan, grant # 1602/ГФ3, 2013-2015.

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A Novel CPG controller of robotic fish: based on body wave function

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Received 01 March 2015, www.cmnt.lv

Abstract

The biomimetic robotic fish shows great potential of surveying of resource, military reconnaissance, the monitoring of water environment and so on, so the biomimetic robotic fish is a hot issue with great challenges. Although the current CPG controller of generating sine signals can also control the movement of robotic fish, but this kind of controller needs many parameters.According to the fish body wave function proposed by Lighthill we design a new CPG controller. This controller can efficiently reduce the parameters of controlling robotic fish movement and realize the simulation of the fish body wave curve. In order to test the feasibility and effectiveness of the CPG controller. We realized the virtual reality simulation and test it in a three joints of robotic fish.

Keywords: CPG, fish body function, biomimetic robotic fish

1 Introduction

Through million years of natural selection, fish show their capacity of high efficiently swimming, disturbing environment lightly and excellent mobility and performance underwater. This ability is great for underwater robots to complete surveying of resource, military reconnaissance, the monitoring of water environment task, and attract researchers's strong interest and enthusiasm [1, 2]. In order to imitate fish special capacity of motion underwater, we need to realize the coordinated control of robotic fish motion and this is a hot and difficult issue for robotic fish research.

In recent years with the development of CPG (central pattern generator) neural network, many researchers designned CPG controllers and apply them in the various robots. CPG is a kind of bionic method, and it is a basic component of vertebrate and invertebrate motor nerve loop [3, 4]. The major feature of CPG as a kind of locomotion system is the capability of producing coordinated patterns of rhythmic activity without any rhythmic inputs from sensory feedback or high_level control signals. High_level control signals can also conduct CPG controller and CPG controller has the advantages of simple structure and strong adaptability [3, 4]. This feature is especially suitable for controlling robotic locomotion, so these have been a number of robots using CPG controllers for controlling, such as legged robots [5-7], amphibian robots [8-10] and underwater robots [11], etc.

In the literature [11] Wang proposed a kind of CPG controller based on sine wave, and this controller can effectively control the robotic fish's motions. However, the parameters are too many, so controlling fish is hard. What's more, it cannot simulate the natural fish swimming body curve well. In order to realize the simulation of the fish body wave function and simplify the control of robotic fish, we design a new CPG controller based on the fish body function proposed by Lighthill [12, 13]. The CPG controller can control the robotic fish locomotion in a straight line using just only four parameters (literature [11] needs 2N+1 variable, N is the joint number of the robotic fish). In the literature we will introduce the establishment of CPG controller through dispersing fish body wave function and test the CPG controller's feasibility and effectiveness through simulation and an actual three joints robotic fish.

2 Fish body function

In 1960s, Lighthill proposed the fish body wave function according to the study of fish swimming wave curve [12, 13]. The function as follows:

$$y_{body}(x,t) = (c_1 x + c_2 x^2)\sin(kx + wt). \quad (1)$$

y_{body} denotes the offset from the axis of fish body and is a function of the fish body axial position x and time t; c_1 and c_2 is the first gain and second gain of the amplitude; k is the body wave number ($k = 2\pi/\lambda$, λ is the wavelength of the fish body wave). w is the fish body wave frequency ($w = 2\pi f = 2\pi/T$). In one moment the curve which the function presents is called fish body wave. As shown in Figure 2-1.

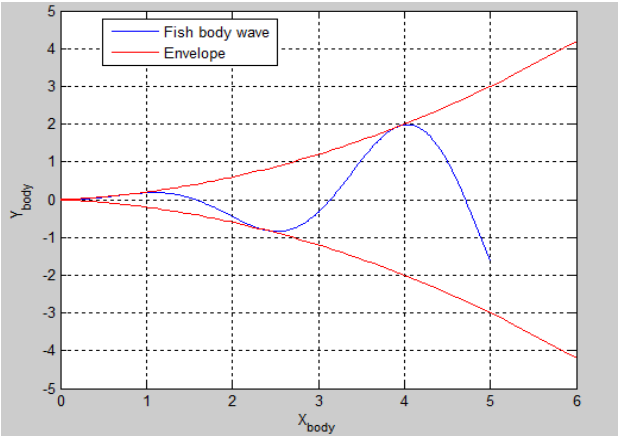

FIGURE 2-1 The diagram of fish body wave

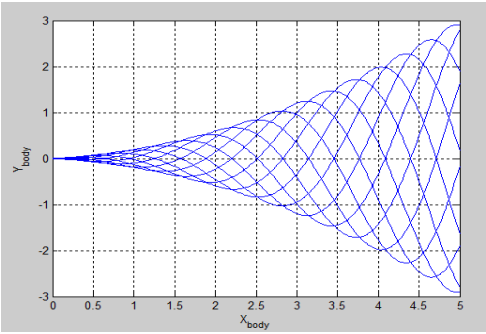

FIGURE 2-2 The diagram of discrete fish body wave

In fact, different fish swimming presents completely different shapes and the waveform they present may be only a part of overlap. For example, eel fish propagates from head to tail when swimming, but Carangidae fish is only part of the tail.basing on the different shape and size of fish, we should choose different parameters (c_1, c_2, k, w) .

In order to use biomimetic robotic fish to simulate the real wave when fish swimming presents, we need to do two things: (1) the discrete fish body wave in time; (2) fitting the fish body wave in space, that is to say, the fish body is comprised by many same length rod [14]. The more times of the discrete fish body wave in time,the more accurately control the robotic fish;The more ideal fit in space,the more accurately reflect the characteristics of fish swimming.

Supposing the robotic fish swimming locomotion is divided averagely into *M* equal parts in a period, then the variable of time is

$$wt_i = i * \frac{2\pi}{M}; i = 0,1..M-1 .$$

The fish body function at the moment is:

$$y_{body}(x,i) = (c_1 x + c_2 x^2)\sin(kx + \frac{2\pi}{M} i) . \quad (2)$$

If *M*=10, the discrete fish body wave present as Figure 2-2.

3 CPG controller based on fish body function

In most vertebrates even including of a part of invertebrates, controlling limbs and body to produce rhythmic motions, such as breathing, the beating of heat,swimming, is produced by CPG neural circuits.Taking into account that the fish body swing is a typical rhythmic locomotion,we can design a CPG controller to control robotic movement by the frequencies and amplitudes of fish body swing.

3.1 CPG CONTROLLER

In order to make the robotic fish body swing curve more similar to the fish body function, the common method is making the top of joints falling in the fish body wave curve, generally calling this kind of method "endpoint location method" [15]. This method is to solve the problem of finding appropriate joint angle φ_{ij} to make the end of each joint falling in the fish body wave curve, which requires each endpoint of joint satisfying the following conditions:

$$(x_{i.j} - x_{i,j-1})^2 + (y_{i,j} - y_{i,j-1})^2 = l_j^2 , \quad (3)$$

$$y_{i,j} = (c_1 x_{i.j} + c_2 x_{i.j}{}^2)\sin\left(kx_{i.j} + \frac{2\pi}{M} i\right) . \quad (4)$$

In the function, (x_{ij}, y_{ij}) denote the coordinate value of the j endpoint at the i moment, and $x_{i,0} = 0, y_{i,0} = 0;\ 1 \le j \le N;\ 1 \le i \le M-1$. N denotes the number of rods composing of the fish body. M denotes the discrete number in a period of the fish swimming action. So we use the iterative method to calculate the required rotational angle of each joint at each moment. Composing the angle list can also control the robotic fish's locomotion [15, 16]. But this method needs new angle list when we change the robotic fish locomotion,and it needs a large amount of calculation.So we design a new CPG controller in the paper which can solve the troubles.

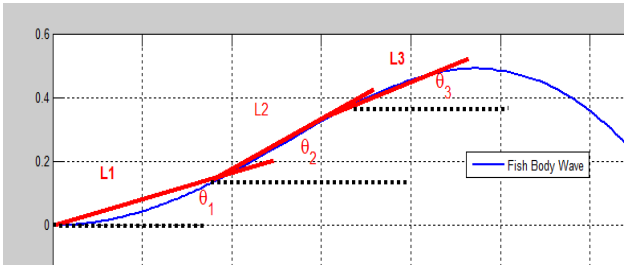

FIGURE 3-1 The diagram of joints falling in the fish body wave curve

The fish body wave function curve makes us know the fish body waveform when swimming and the Equations (3) and (4) require the robotic fish to meet the two Equations when swimming. So we design a new CPG controller to meet the requires.The i rod (i.e.oscillator) at the t moment meets the equations as following:

$$\theta_{0,i}(t) = \alpha_i\left[\alpha_i(\theta_{0,i} - \theta_{0,i}(t)) - 2\theta_{0,i}(t)\right], \quad (5)$$

$$x_i(t) = x_{i-1}(t) + L_i \cdot \cos(\theta_i(t-1)) , \quad (6)$$

$$y_i(t) = (c_1 x_i(t) + c_2 x_i(t)^2)\sin(kx_i(t) + wt) , \quad (7)$$

$$\theta_i(t) = \theta_{0,i}(t) + \arcsin\left(\frac{y_i(t) - y_{i-1}(t)}{L_i}\right) - \theta_{i-1}(t) . \quad (8)$$

$\theta_{0,i}(t)$ denotes the offset of the i rod when time is t; $x_i(t)$ denotes the abscissa of the i rod when time is t; $y_i(t)$ denotes the ordinate of the i rod when time is t; $\theta_i(t)$ denotes the rotation angle relative to the previous joint and the first joint rotation angle is relative to the horizontal axis; $\theta_{0,i}$ denotes the offset of rotation angle set at the first beginning; L_i denotes the length of the i rod. Just as Figure 3-1 showing.

Equation (5) denotes a critically damped second order linear system, and the output $\theta_{0,i}(t)$ asymptotically and monotonically converges to the input $\theta_{0,i}$. In Equation (6) $\theta_i(t-1)$ denotes a rotation angle from the previous action, an approximate quantity, used to replace the rotation angle $\theta_i(t)$. $x_{i-1}(t)$ denotes the sum of the front (i-1) rod(oscillator) abscissa. Equation (7) is used to calculate the ordinate of the rod (i.e.oscillator) by the fish body wave

function. Equation (8) is used to calculate the rotation angle of each joint to control the robotic fish locomotion. The schematic diagram of the CPG controller is just showing as Figure 3-2. c_1 and c_2 is from the fish body wave function, and they is mainly used to control the the amplitude of the oscillator. k is mainly used to control the phase difference. $\theta_{0,i}$ is the set offset used to control the direction.

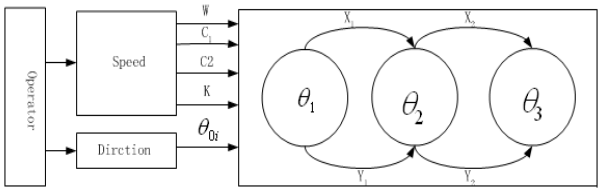

FIGURE 3-2 The diagram of locomotion control architecture

3.2 SPEED CONTROLLER

The locomotion speed of the robotic fish (only discuss swimming forwards in the section) is influenced by the frequency w, amplitude, phase difference and the surrounding environment.if we take all factors into account, it is very hard to control the speed. Through a lot of experiments we discovered that when the other parameters are fixed,the speed increases with the frequency w. When fixing the other parameters, increasing the value of C1 and C2 can make the amplitude increase and swim faster.But the two ways are restricted by the steering gear and the length of rods, and the corresponding relationship between them is nonlinear.

3.3 DIRECTION CONTROLLER

Direction controller used to control the direction of robotic fish is related to the offset $\theta_{0,j}$ of the oscillator. The different offsets of oscillators cause different direction of robotic fish swimming. We set $\theta_{0,1} = \theta_{0,2} = \theta_0$ and $\theta_{0,N} = 0$ to control the amplitudes of oscillators. θ_0 is the only variable to control the direction.Setting $\theta_{0,N} = 0$ is used to obtain enough driving force through robotic fish body swing. Now we set $\theta_0 > 0$ to control robotic fish move left, and $\theta_0 < 0$ is corresponding right.

4 Experimental tests

In order to test the effectiveness of the CPG controller based on fish body wave function, firstly we carried on the simulation experiment and then realized the CPG controller in the three joint robotic fish.

4.1 SIMULATION EXPERIMENTS

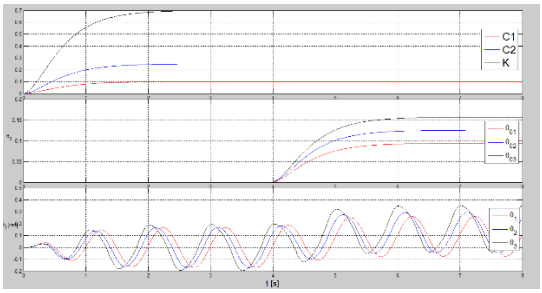

FIGURE 4-1 The waveform of output signal

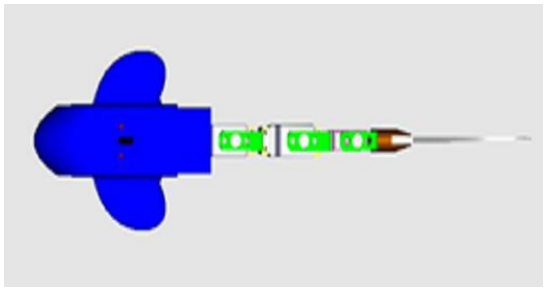

FIGURE 4-2 The three joints fish of virtual simulation

In Figure 4-1, C1 and C2 denote the coefficient of the fish body function envelope. K denotes the body wave number, that is to say, the ratio of length of the fish body swing to the length of fish body. In order to make the output signal θ_i more smooth,we use the critically damped second order linear system of Equation (7) to gradually increase to the ideal value C1, C2 and K. θ_{01}, θ_{02} and θ_{03} denote the set values of the offset angle.and also are used the critically damped second order linear system to increase to set valve. θ_i is the output rotating angle of the joint.The abscissa denotes the time t, and the unit is second. In Figure 4-1, we know the initial offset angle is zero, and the plus_minus amplitudes of the output signal θ_i are same, that is to say, the robotic fish is swimming straightly. θ_i increase from 0 to the maximum value smoothly, and that can meet the requirements of mechanics.When the time t is 4s, we set different offset angles,so the output signal θ_i increases smoothly. The enclosed area of the curve of output signal θ_i and abscissa axis is a positive value, meaning that the robotic fish swim towards a direction, which can be used to control the robotic fish direction. Virtual three joints fish can be driving by the rhythm signal generated by the CPG controller, just as Figure 4-2 showing.

4.2 ROBOTIC FISH

In this paper, the robotic fish is a three joints robotic fish made by the Intelligent Control Laboratory in Peking University. The robotic fish generates power by the tail swing, and change the amplitude and frequency of the tail swing to control the robotic fish locomotion (as shown Figure 4-3). The head and pectoral fins are streamlined to reduce the resistance of the water effectively. The tail is made up of three independent steering gear to provide the power for the robotic fish. The caudal fin is made of flexible rubber, presenting crescent.

FIGURE 4-3 Robotic fish

The robotic fish swims in a pool. There is a camera above the pool to capture the robotic fish and send data to a

computer. And we can control the robotic fish by the compute sending commands to the robotic fish through the wireless. Through the experiments we corroborate that the CPG controller can effectively control the speed and direction of robotic fish swimming. Now the straight speed of the robotic fish can reach 37.8cm/s, which is 0.84 times the length of the fish body. The speed is a little slow, and next we will optimize the parameters to improve the speed of robotic fish.

FIGURE 4-4The robotic fish is swimming forward

FIGURE 4-5 The robotic fish is turning left

5 Conclusions

CPG controller basing on neural networks can generate rhythm signals to control the robotic fish locomotion.In the paper we designed a new CPG controller based on the fish body wave function to control the robotic fish locomotion.The experimental results show that this CPG controller can control the robotic fish, at the same time reduce the number of parameters and controlling becomes more simple and effective.What's more, this method can realize more simply and smoothly switching in different locomotion modes.

Acknowledgment

The study gained favor with the innovation experimental base of information technology, China University of Geosciences, Beijing. We are grateful for its support.

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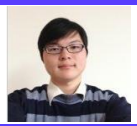

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Software environment to teach programming of robots

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Received 01 March 2015, www.cmnt.lv

Abstract

This article discusses the issue of selection of suitable software environment for programming the robots needed for university studies. Educational robots are two types of Lego Mindstorms NTX2 and Lego Mindstorms EV3.

Keywords: robot, software environment, programming languages, Lego Mindstorms, sensors

1 Introduction

The practical applications of artificial intelligence robots as more "conquer" the world with their possibilities to be used in many fields of people's lives. The interest on these derives from their opportunities to relieve replacing them when performing routine and / or dangerous activities.

This requires the search for suitable forms and means for organization and conduct of training in universities. Curricula should offer opportunities for acquiring technologies and tools for development and Robots control.

Subject of this report is the choice of suitable software environment in training on robot programming in the course "Artificial Intelligence". There are a lot of of hardware platforms - robots for training and environments for their programming.

Our university has two models of the robot Lego Mindstorms NTX and EVE. Choosing the right software training on "Robots" from the course "Artificial Intelligence" is an important issue for the effective and organized process of teaching. It depends on the interest and successful absorption of knowledge in the field from the training students.

2 Programming environments for robots

The article examines environments for programming the robots that are available and correspond to the objectives of the course "Artificial Intelligence". It's explored a variety of software environments, but limited part on them are subject to the description.

2.1. HARDWARE FEATURES ON THE TRAINING ROBOTS

Before being characterize the software environments for programming the robots need to review their hardware peculiarities.

Table 1 shows the hardware features of robots used in the teaching of "Artificial Intelligence".

TABLE 1 Hardware features of LEGO robots

FEATURES	ROBOTS	
	EV3	NXT
Display	Monochrome LCD 178 x 128 pixels	Monochrome LCD 100 x 64 pixels
CPU	300 MHz Texas Instruments Sitara AM1808 (ARM9 core)	48 MHz AtmelAT91SAM7S256 (ARM7TDMI core)
Memory	64 MB RAM 16 MB Flash microSDHC Slot	64 KB RAM 256 KB Flash
USB ports	YES	NOT
Wi-Fi	Optional dongle via the USB port	NOT
Bluetooth	YES	YES
Link to Apple devices	YES	NOT

Lego Mindstorms NXT 2.0 (Figure 1) is the second of Lego Mindstorms LEGO series from 2009 [4]. The kit comprises a plurality of parts including a new sensor which can detect the colors. Lego Mindstorms EV3 (Figure 2) is a third-generation robots Series LEGO Mindstorms. It is the successor of the second generation robot Lego Mindstorms NXT 2.0 [3]. In the "EV" is the definition of "evolution" series of NXT. "3" refers to the fact that this is the third generation of Lego Brick. EV3 has better performance compared with the previous model NTX 2.0, which can be seen in Table 1.

Robot kits include a multitude of parts [1, 2], through which they can assemble different configurations. Electric motors are available to allow their smooth movement. They possess various sensors that can be programmed for implementing the complex algorithms. These are: Color sensor - the sensor for detecting color 6 different shades: blue, green, red, yellow, white, black; Light sensor - light sensor recognizing light levels. (Included in the first version, but in 2.0, replaced with a color sensor.); Touch sensor - is a button that through which the robot senses touch him; Ultrasonic sensor - ultrasonic sensor for measurement of

distances by ultrasonic waves; Sound sensor - this "hearing" the robot capable of measuring the volume, but cannot record real sounds; Compass sensor - used to detect direction with integrated calibrator to reduce interference from objects with magnetic properties; Accelerometer sensor - serves to monitor the direction of movement of the surface and can be measured force of gravity; RFID - radiosenzor communication between several robots; Rotation sensor - rotation sensor measures the direction of rotation; Bluetooth - used for wireless communication with other devices such as access to written to a computer or other device and program data

FIGURE 1 Lego NTX

FIGURE 2 Lego Mindstorms EV3

2.2 PROGRAMMING SOFTWARE FOR ROBOTS

Have been developed a variety of languages and environments for programming robots. Only a small part of them are the subject of the article and are mainly related to robots series Lego. The opportunities for programming via the control unit of robots called "smart brick" are limited, especially for NTX 2.0. Elementary commands can be created by this block. In complex programs need to be developed on a PC and transferred for execution via the USB port in that block.

The choice of a suitable environment for programming could be done using the generalized characteristics shown in Table 2. The table shows some of the environments in which it is possible to train students for programming of different types of robots, including the series Lego Mindstorms. At the end are shown links to more sources of information for other media included in the exhibition.

TABLE 1 Environments for programming robots

Software environment	**Characteristic**						
	Platform	**Interface**	**Integration**	**Training**	**Convenience of use**	**Price**	**Additional information**
actor-lab	Mac OS / MS Windows	graphic	unknown	easy	excellent	free	
NXT-G	Mac OS / MS Windows	graphic	unknown	easy	excellent	Included in the kit	Provides a kit
LabVIEW Toolkit	Mac OS / MS Windows / UNIX	graphic	National Instruments LabVIEW visual programming language (G code)	hard	excellent	There are no data	
Lego::NXT	Mac OS / MS Windows	graphic	unknown	easy	excellent	Included in the kit	API offers between Perl and NXT
ROBOTC	MS Windows	graphic text	language C	medium hard	medium	1 year license - $49	Includes built-in debugger, code templates mat. / Triglyceride. Built-in functions and sample programs.
RoboMind	Mac OS / MS Windows /	Text editor and	The software of Lego	easy	excellent	1 account - 10 € (offline) and 5 €	Using simple scripting

	LINUX	graphics in general IDE	Mindstorms NTX and EV3			(online students)	language similar to C / C ++ and JavaScript
MATLAB and Simulink	Mac OS / MS Windows / LINUX	Text and graphics	Variety of options	a moderate hard	excellent	a paid	Many control facilities over USB ports robots
Microsoft Robotics Developer Studio (Microsoft RDS, MRDS)	MS Windows	Graphical interface, web interface and language for 3D simulation	Visual programming language for Microsoft Visual Programming Language, a link to the C # and more. .NET Languages.	medium hard	excellent	he paid version and a free academic	Environment controls and simulation of robots for academic, amateur or professional development.

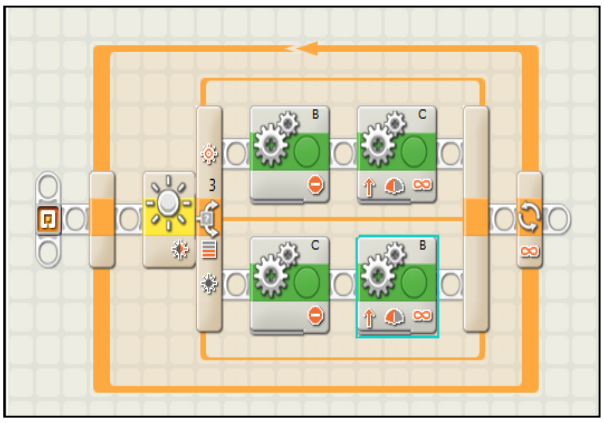

FIGURE 3 Program NXT-G

```
define SpeedSlow 50
#define SpeedFast 100
int SV;
task main() {
int Threshold1=600;
long t;
// It will set the sensor
SetSensorType(IN_3, IN_TYPE_LIGHT_ACTIVE);
SetSensorMode(IN_3, IN_MODE_RAW);
while (true)  {
// Reads the value of the light sensor
SV = SensorRaw(IN_3);
// Check whether we are on the black line
if (SV < Threshold1) {
//Looming on the motor A to move quickly and motor B to
move slowly, causing rotation of the robot..
OnFwd(OUT_A, SpeedFast);
OnFwd(OUT_B, SpeedSlow);
}
else {
//Set of motor B to move quickly and motor A to move slowly,
causing rotation of the robot.
OnFwd(OUT_A, SpeedSlow);
OnFwd(OUT_B, SpeedFast);
}
}
return
```

FIGURE 4 Program to pursue a line through

The programming can be shown by a classic task in which the robot is to soak line [5, 7].

Figure 3 shows the implementation of the programming language - NXT-G, and the next Figure 4 decision of NXC. The workflow can be described with the following steps:

1. The robot rotates in one direction while the light sensor does not detect the black line.

2. The robot begins to rotate in the other direction until the light sensor no longer detects the black line.

Colored in yellow block checks the value of the light sensor and performs two green blocks. Green blocks drive motor (movement), either stop them or place. Language Not eXactly C - NXC requires some experience with programming and is quite powerful (Figure 4).

Microsoft releases free tool Robotics Developer Studio (RDS) [6] for programming and modeling the behavior of robots. RDS supports some of the most popular robotic platforms, including iRobot Create, LEGO Mindstorms, EV3, Coro Wareand Parallax. The product, which contains a visual programming interface and three-dimensional simulator is intended for amateurs and for researchers and developers.Previously, there were three versions of the product - Free with limited functionality, commercial and educational institutions. 2007 RDS is downloaded half a million times. Assessment of the corporation, the package is used by 60,000 active users and the free version is called to increase this number. Microsoft Robotics Developer Studio (MRDS) [6] provides integrated .NET (Microsoft .NET Framework is a platform that provides a programming model, a set of classes and execution environment written especially for her program code) environment for developing, designing, implementing and debugging applications and robotics. MRDS makes work with software problems present in robotics as coordination, monitoring, configuration, deployment and reuse. There are high on Visual Programming Language (VPL), which uses a programming model based control of the flow of data in a graphical environment. VPL is suitable for programming at the same time in parallel or distributed processing scenarios.

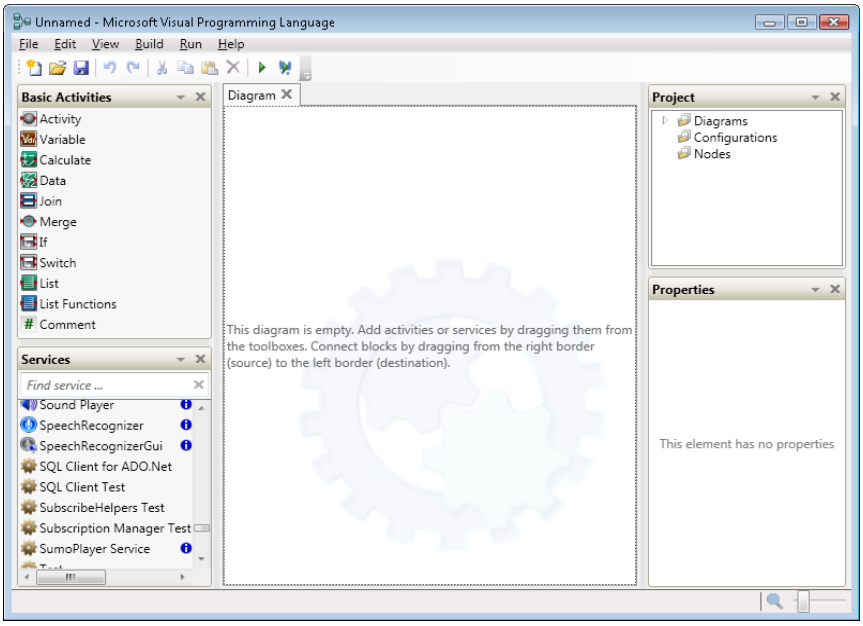

FIGURE 5 View of the main window of VPL

Window of VPL (Figure 5) shows the menu bar and toolbar commands and access to the central part of the scheme, and several tabs, including toolbars that display a list of built-in data and services available (pre-written code which performs functions) that can be used in the project; the current contents of the project (diagrams and configuration files), and a section to edit the properties of selected items. When developing applications using drag-n-drop elements.

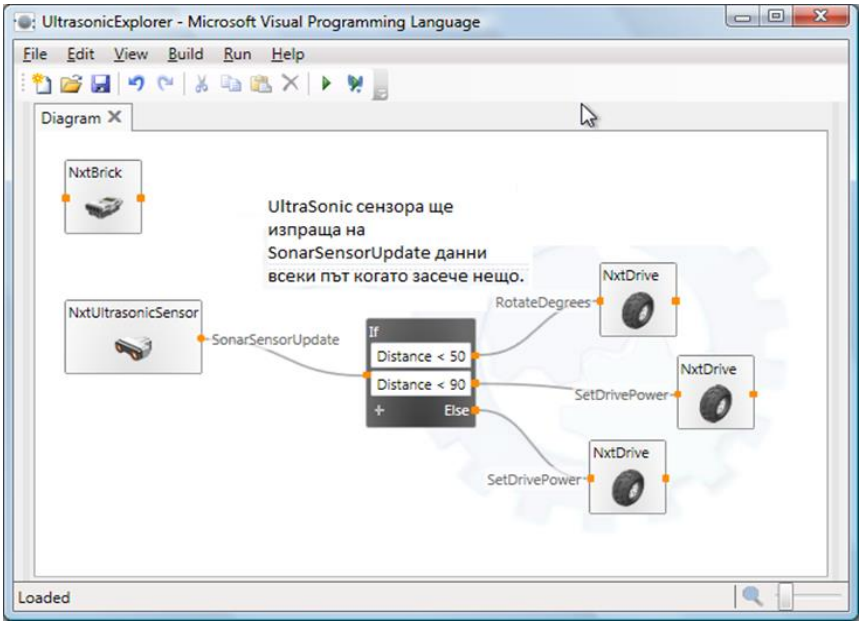

FIGURE 6 Sample program implementation of VPL

It is possible to add a new activity by double-clicking the item from the menu. Retention mouse over any item in the toolbar will display information related to a given element. If the element also includes an icon "I" (information), i.e. provides additional information.

Robots series LEGO MINDSTORMS, using Bluetooth and USB communication between PC and NXT. Robots can build different configurations. MRDS supports both existing hardware and in simulation with great ease to program the included Microsoft Visual Language. Figure 6 shows an example fragment of program implementation.

3 Conclusion

Of the the analysis it can be confirmed that the environment NTX-G is suitable for introduction to the programming of robots in the course "Artificial Intelligence". It has built-in intelligent block of the series robots Lego. Very helpful tool for further study of the programming of robots is Microsoft Robotics Developer Studio (MRDS). Along with the ability

to easily learn and use, friendly interface, MRDS has much greater opportunities for integration with the .NET platform and languages: C / C ++, C # and more. This would give students the hands of a powerful tool for modeling and programming of a serious and significant practical projects. This environment can be successfully used not only for series LEGO® MINDSTORMS® NXT robots and EV3, but also with many other models.

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Acknowledgments

This development was funded by Project RD-08-306/12.03.2015 to Shumen University "Konstantin Preslavsky", Shumen, Bulgaria.

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Nature Phenomena and Innovative Engineering

Ambient Assisted living systems and platforms

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Computer Modelling & New Technologies 2015 ***19****(4D) 7-10*

In accordance with the modern concept of "smart home", we see the emergence of a new component - Ambient Assisted Living, which can be translated as "living environment". The basic idea of is that all the human environment should facilitate his life. Ambient Assisted Living (or AAL) is a multi-disciplinary field, exploiting ICT in Healthcare and telehealth systems to resist the effects of growing elderly population. There is a huge potential and prospects of development of ambient assisted living systems and platforms. Also, there is affected aspects of AAL systems, usage of contemporary AAL systems and platform and its architecture.

Keywords: Ambient Assisted Living, smart house, personal health monitoring, healthcare IT, telehealth; medical sensors, health monitoring, interoperability, usability, security and privacy

Automating the process of resetting the carrier phase of the mudflow to the downstream reach of Medeo dam

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Computer Modelling & New Technologies 2015 ***19****(4D) 11-15*

The carried-out analysis of catastrophic mudflow in Medeo tract in 1973 showed that the abnormal operation of the dam spillways was associated with several deficiencies in the mud dam's construction and unexplored process of deposition of the solid phase of the carrier medium mudflow mass trapped in the mudflow storage reservoir. Subsequent completion and modernization of spillways was made taking into account the effects of the mudflow in 1973 and now they do not structurally allow catastrophic mud flow cram the mudflow storage reservoir. The article presents a method of controlled dumping the treated fraction from the solid one of of carrying water phase of the forecast catastrophic mudflow through modernized spillways of Medeo mud dam. The proposed approach allows protection from flooding the social-culture objects of Medeo tract through optimal work of spillway that controlled using computer model of automated dam's control and safety system.

Keywords: swirl shaft spillway, hard mudflow phase, hydro technical constructions (HTC), automated control and safety systems

A Novel CPG controller of robotic fish: based on body wave function

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Computer Modelling & New Technologies 2015 ***19****(4D) 16-19*

The biomimetic robotic fish shows great potential of surveying of resource, military reconnaissance, the monitoring of water environment and so on, so the biomimetic robotic fish is a hot issue with great challenges. Although the current CPG controller of generating sine signals can also control the movement of robotic fish, but this kind of controller needs many parameters.According to the fish body wave function proposed by Lighthill we design a new CPG controller. This controller can efficiently reduce the parameters of controlling robotic fish movement and realize the simulation of the fish body wave curve. In order to test the feasibility and effectiveness of the CPG controller. We realized the virtual reality simulation and test it in a three joints of robotic fish.

Keywords: CPG, fish body function, biomimetic robotic fish

Software environment to teach programming of robots

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Computer Modelling & New Technologies 2015 ***19****(4D) 20-24*

This article discusses the issue of selection of suitable software environment for programming the robots needed for university studies. Educational robots are two types of Lego Mindstorms NTX2 and Lego Mindstorms EV3.

Keywords: robot, software environment, programming languages, Lego Mindstorms, sensors