

# Ambient Assisted living systems and platforms

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## 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].

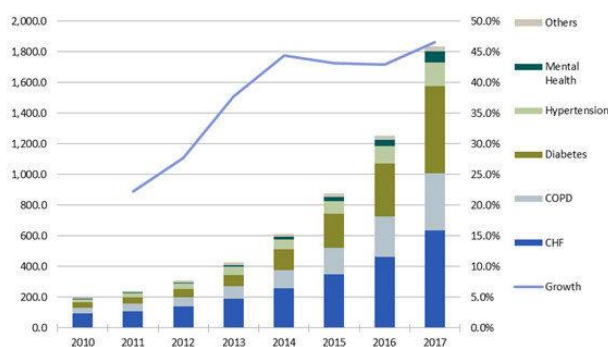


FIGURE 1 World Telehealth Patients (thousands) By Disease [1]

### 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)

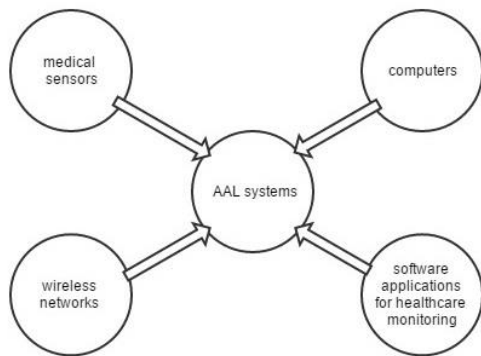


FIGURE 2 Ecosystem of AAL

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 Symbian. 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)

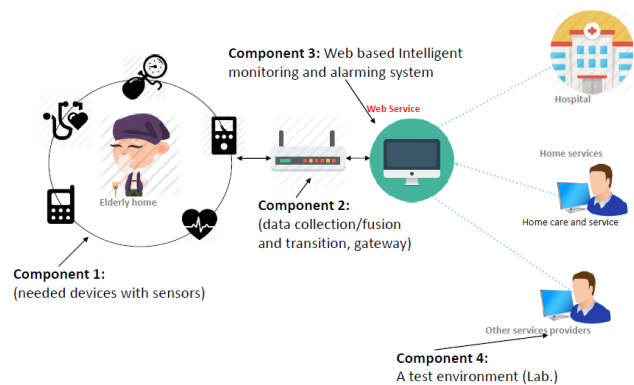


FIGURE 3 Relationship of project components

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, <a href="http://www.aaluis.eu/">http://www.aaluis.eu/</a>  | 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, <a href="http://www.aal-europe.eu/projects/amica/">http://www.aal-europe.eu/projects/amica/</a> | 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, <a href="http://www.aal-alfa.eu/">http://www.aal-alfa.eu/</a>  | 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, <a href="http://www.goldui.eu">http://www.goldui.eu</a>  | N/A   | ISO/IEC 40500, ISO/IEC 18036, ISO 9241-151 | Windows XP/Vista/7/8, Linux, Android | PHP, Java, JavaScript, PostgreSQL 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, PostgreSQL     | 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, PostgreSQL, .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, <a href="http://www.nacodeal.eu/en/">http://www.nacodeal.eu/en/</a>  | N/A   | N/A  | Windows XP/Vista/7/, Linux           | N/A                                   | REST                         | 1000  |
| 11 | PAMAP—Physical Activity Monitoring for Ageing People, <a href="http://www.pamap.org">www.pamap.org</a>   | 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), <a href="http://www.remote-project.eu/">http://www.remote-project.eu/</a> | 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, <a href="http://tuki.vtt.fi/smarttouch/www/?info=intro">http://tuki.vtt.fi/smarttouch/www/?info=intro</a>                                | Weight-scale, Glucose Meter, Blood Pressure   | N/A  | Windows XP                           | C#                                    | SOAP, .NET                   | N/A   |
| 14 | SOFTCARE, <a href="http://www.softcare-project.eu/overall.php">http://www.softcare-project.eu/overall.php</a>  | N/A   | N/A  | Windows XP/Vista/7/8                 | Java, C                               | SOAP                         | 500   |
| 15 | TemRas: Telemmedizinisches 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 <a href="http://opencareproject.wikispaces.com/home">http://opencareproject.wikispaces.com/home</a>   | 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.

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