Design of intelligent bus control terminal based on ARM9

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Abstract

With regard to urban increasing traffic congestion problems, an intelligent bus control terminal, which based on embedded system is studied and designed in this paper. It adopts AT91sam 9260 produced by ATMEL company as the processor, realizes positioning information access and completes network data transmission with peripheral GPS and GPRS module. Linux is selected as the operating system, and many advanced technologies such as the Linux interrupt handling and multithreading are used in software design process, which bring about high efficiency, less resource consumption, stability and reliability. At the same time, sites and the communication network configuration information are processed by configuration files treatment, convenience for system maintenance in case of modification of later stage circuit, giving full play to the characteristics of embedded system. Compared with similar products, this terminal has advantages with compact structure and low cost. This study provides reference value for the similar product development from software angle, and has great significance.

Key words: Intelligent bus; Positioning Information; Network; Embedded system

1 Introduction

Transportation is foundation for national economic development. With rapid growth in urban population and automobile reserve, traffic congestion problems are increasingly plagued major cities. ITS (Intelligent Transport Systems) provides a guideline in solution for traffic congestion problems. “The core idea of ITS is how to the use the high-tech to connect vehicle com road systemically for solving the congestion. It attaches importance to systematicness, timeliness, Interactive exchange of information and extensiveness of services, essentially different with the original traffic management [1].” An intelligent bus control terminal based on the embedded system is researched and developed in this paper. The terminal realizes automatically auto-stop function by receiving the vehicle location information and in the meanwhile reports vehicle location to control center by means of network data transmission function so that a scheduling command is sounded timely according to the road and location and traffic informatization is realized to improve efficiency and relieve traffic pressure

2 Construction of embedded terminal platform

Embedded system is just like a micro-computer system and the composition is subject to its mission necessary to finish. Therefore, the design of embedded systems is unique and sole. Intelligent terminal hardware of this paper is designed like Figure 1 [2].The relative typeS and parameters are:

CPU: at91sam9260
GPS: GR-89
GPRS: EM310
SDRAM: 64M
UART: RS232 for two items、RS485 for one item
FLASH: 4M Data Flash、256M NandFlash
LCD: Lattice 128x64
KB: 4x4 Key Board
AUDIO: Support 16 items, 44 KHz for sampling rates WA audio files
USB: 1 USB Hosts（2.0 Full Speed USB Device）
NET: 10/100Mbps Ethernet MAC

“The terminal, taking at91sam9260 as a key chip, connected with module GPS and GPRS through two 232 rings. GPS is in charge of receiving location information and transmitting it into the at91sam9260 for analyzing. The real-time vehicle latitude and longitude are obtained from at91sam9260 and will be displayed on the LCD screen. Bus drivers can select and control terminal functions through keyboard. When the bus enter and exit the station, at91sam9260 can automatically broadcast MP3 including stop information. At the same time, the information of entry and exit will be sent to the background control station through network GPRS[3].”

DBUG serial and network chip are used to realize NFS cross compiler and terminal control in the development phase. To reduce costs in the finished product, the two parts will be omitted.

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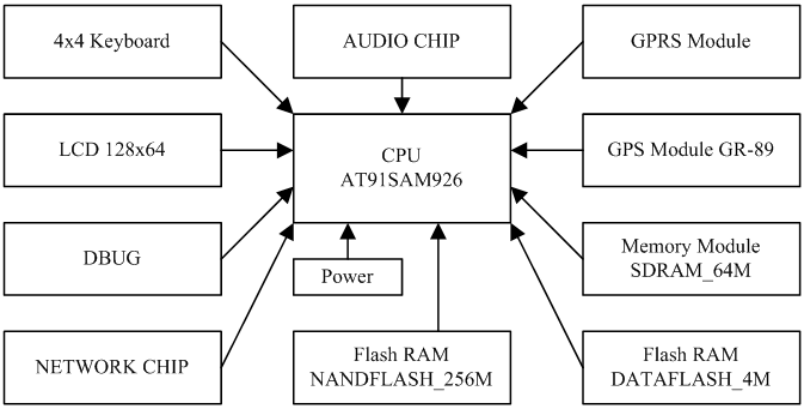

FIGURE 1 Terminal hardware structure

3 Software with embedded module

3.1 LINUX DEVICE DRIVER STRUCTURE

In the embedded system, both hardware and software can be considered as an entity so that the system can be divided into five layers. the bottom layer is hardware, the second layer is device driver, third is the operating system kernel, fourth is the system calls, and the fifth is application, from which the second , third, and forth are considered as a operating system. System calls, as an interface of operating system kernel, are specialized for application; while the device driver is the interface between operating system and hardware [4-5].

3.2 FOUR BY FOUR MATRIX KEYBOARD PRINCIPLE AND SOFTWARE DESIGN

"In embedded system, the principle of key hardware is relatively simple and can be realized as following, its pin at GPIO in processor is pulled high by a pull-up resistor, while the other end of resistor is connected with button and ground. When the button is pressed, it will produce low level at the interface processor. The low level will interrupt the CPU, which can be judged buttons by interruption."

In practice, that one key behavior is considered solely based on interrupt is inaccurate. All the button and touch screen have inherent problem, that is "jitter", the key is transferred from the first turn to stability that will go through a few milliseconds. During this process, "On - off "is very likely to take place many times. One hit to the keyboard maybe be considered many times if "jitter" is not eliminated

The keyboard structure is listed as Figure 2.

The method for eliminated "jitter" is as following, judging that the keyboard is pressed, and first mask all interrupts, and then enters the software delay (20ms) and judge the state of the keyboard. enter the process of determining the specific as following: transfer a row line into low level, in other ways, the others is in state of high level when one row line is transferred into low level.

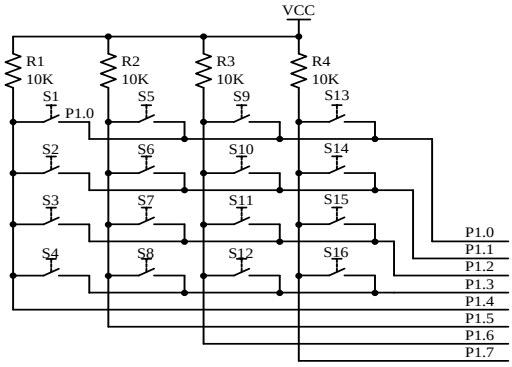

FIGURE 2 4 * 4 keyboard structure

If the button is still pressed, it can be concluded that the key is pressed. After confirming a key is pressed, you can press the button to After confirming one row line is in state of low level, other row's level state will be inspected. If one row is low, the button at crossing between this row and other row of low level is closed. Keyboard software design primarily is driven part. Keyboard Driver mainly includes pin initialization, Analysis of the key, the keyboard scan and elimination of "jitter". The working procedures of keyboard driver are listed as Figure 3.

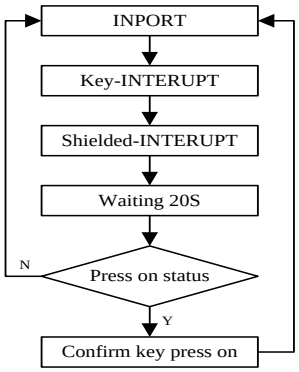

FIGURE 3 Keyboard-driven work flow chart

1) *Pin initialization:* MPU for intelligent terminal is the product of at91sis the am 9260 produced by atmel. In the Linux kernel, there are dedicated pins for chip initialization function. The main function of such function is to set a pin to an input or output pin. Through these

interfaces, the function set eight pins combining with at91sam9260;
at91_set_gpio_output(unsigned pin, int value);
at91_set_gpio_input(unsigned pin,int use_pullup);
at91_set_deglitch(unsigned pin,int is_on).

2) *Key analysis:* "In the key analysis subroutine, function at91_get_gpio_value (unsigned pin) is employed to get the current state of the input pin. The specific procedures is as following: The first step is that one of four output pins is set low and the other three pin is set high; the second step is to check the level of the four input pins circumstances one by one. If a pin is low at this time, you can determine the location of the keys. If the four input pin is high, then repeat the first step, but the first step of this time is to change the pin low for the next one, then the second step. This acation is repeated up to four times until a specific location is confirmed, This particular location in the function as a return value exists. Each key is in the program represents a value."

3.3 DESIGN FOR GPS SOFTWARE

The program first set a structure to store the GPS longitude and latitude Information:

```
typedef struct
{
    char longitude[12];
    char longitude_hs;
    char latitude[12];
    char latitude_hs; }GPS_POINT;
```

When the module works, the regular function----read(uart_fd， gpsbuf， 1024) working by serial port place the receiving information into string "gpsbuf". Then it will pass function LINUX to search for the part of "GPRMC". So that we can get a string like : $GPRMC, 121252.000, A, 3958.3032, N, 11629.6046, E, 15.15, 359.95, 070306, A*54. The next job is get the latitude and longitude of the string and fill them in the structure GPS_POINT .The whole GPS module data processing is shown as Figure 4, while the processing effect is explained by Figure 5.

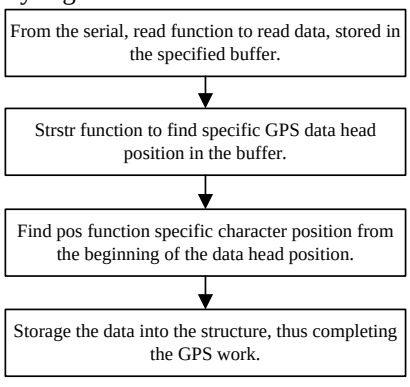

FIGURE 4 GPS module workflow

FIGURE 5 The effect of GPS data processing

3.4 DESIGN FOR MODULE GPRS

Module GPRS adopts EM310 made by Huawei company, which links MCU through the serial ports, GPRS is the focus of the entire software designas a result, To send AT order of controlling GPRS operation through serial ports in operation, Along with a AT order, there is a relative return value. Therefore, when we design a process, we should also consider another factor of receiving information from the serial ports to identify how to work of the modules.

In the process, we designed a structure; each AT command corresponds to a structure. Structure members "* string" on behalf of AT command itself, "timeout" on behalf of waiting for instructions to return the time value, if this value is exceeded, the serial receiving end do not receive return information, it will automatically exit, and the next one command sent. "Flag" is used to denote this command to be sent there to return value 1 indicates, 0 means no.

4 Application implementation

4.1 THE BASIC PRINCIPLES FOR AUTOMATIC STOP

In terms of vehicles, the latitude and longitude of station sites are fixed, while the latitude and longitude of vehicles are changeable along with their movements. Thus, we can constantly acquire vehicles' location from GPS in the process of vehicles' operation. What's more, GPS also can figure out the next stop's longitude and latitude and acquire the distance between two stops. When the distance is less than a certain figure and decrease much more, it can be judged as vehicles' entry. In the meanwhile, it triggers the playback of audio files function. When the distance is more than a certain figure with upper trend, it can be identified as vehicles' exit. The automatic stop's working chart is shown like Figure 6.

4.2 GPRS NETWORK DATA TRANSMISSION

When the vehicles enter stop stations, the system will automatically announce to stop, and generate log files which are transmitted into control center through network GPRS. To access the system, first enter module GPRS networks through GPRS, access the GPRS network is mainly used by the AT command module which providing implementations. Vehicles terminal and control center server can communicate through socket network programming in system Linux [6].

The whole process works as two telephones and telephone lines works as a GPRS network and they are the basis for data transfer. the two "telephone "located in vehicle-vehicle intelligent terminal and control center, through the socket network complete the "Dial." After the connection is successful, it can be "talk" and data transmission [8-10].

After GPRS network is connected, a data can be transferred by socket programming.

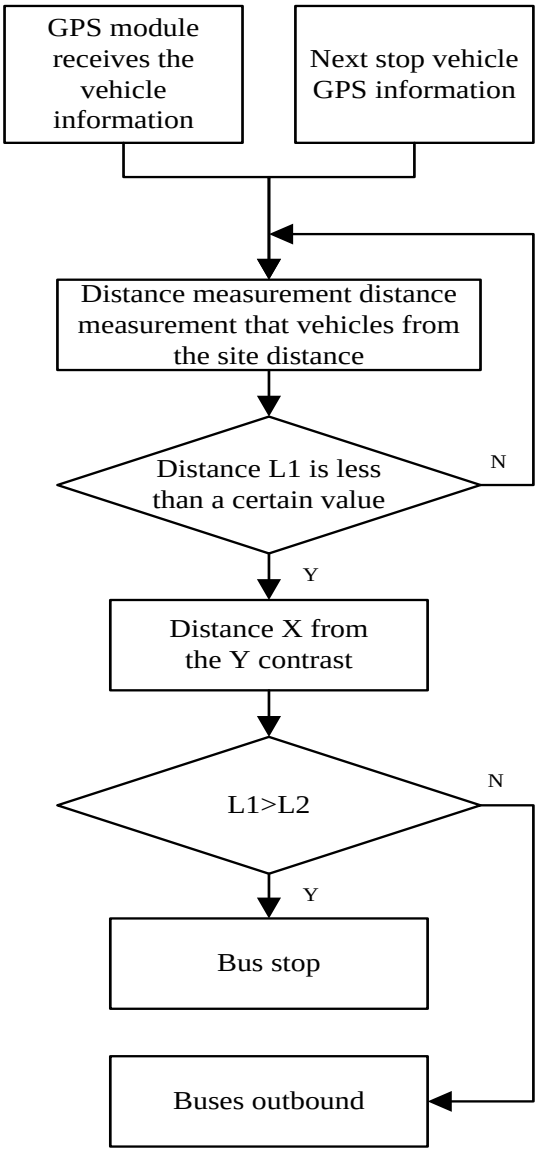

FIGURE 6. Automatic stop work flow chart

As two sides of data transmission, vehicles' intelligent terminal and server near vehicles' control center should be completed before data transmission and reception, which includes:

4.2.1 Preparation for server

1) Adjusting function socket ( ), establishing socket objective, and specifying communication protocol.
2) Adjusting function bind (), creating socket objective and bind one interface.
3) Adjusting function listen ( ), having socket objective heard and set the hearing queue size.

4.2.2 Preparation for vehicles' intelligent terminal

1) Adjusting function connect ( ), and sending requests from server.
2) When server hears such requests, receiving requests of function accept() are adjusted.

4.2.3 Data transmission and reception

1) Data send is finished by write () or send() in the server, while data reception is conducted by read() or recv () in the vehicles' intelligent terminal. Likewise, vehicles' intelligent terminal can adopt the same way to send data and receives by server.
2) After communication, the two sides adjust function close() or shutdown() to close socket objective.

5 Conclusion

Based on present status and problems of urban traffic management, the paper puts forward a theory of control terminal embedded system to enhance the operating efficiency of bus transportation. Moreover, the paper comes up with an effective way to manage traffic accidents. Namely, based on embedded platform hardware and all kinds of module's driver and application with at91sam9260, through' GPS positioning device, realizes real-time track, location, and two-way communication between bus and dispatch room. It is an intelligent management. The above design can provide manager with scientific dispatch information at any time, any road line, and any car for basis.

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