Research on Driver Fatigue Early Warning Method Based on ARM

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Abstract：Fatigue driving is one of the important reasons of road traffic accidents，fatigue driving is refers to the driver in a long time continuous driving or physical fatigue condition，and then come into being physiological and psychological function disorder. In order to overcome the limitation of single sensor in the fatigue test， aimed at the requirements of monitoring on the fatigue driving， this article designed an driver fatigue monitor system based ARM926EJ-S as a controller， it is used to determine the driver′s fatigue and reduce the traffic acc ident. On the basis of fully considering the source correlation and complementary， it adopts the method of multi-source information fusion；by monitoring the pulse， heart rate， temperature of the human body， steering wheel grip strength to realized the fatigue level. The system of graphical interface adopts UCGUI. Finally，testing the main function modules of early warning system， the feasibility of the proposed early warning system is verified fusion.

Key words：vehicle active safety；physiological status；fatigue driving；multi-source information

1　Introduction

With the rapid increase of motor vehicle quantities and the road mileage increased year by year，a large number of traffic accidents caused the world huge property losses and casualties. Each year 600000 deaths and economic losses of about ＄12.5 billion caused by traffic accidents in the global，57% of these accidents is related to fatigue driving. Fatigue driving is the reaction levels drop after a period of time， and leads to can′t normal driving，When driver is fatigue， its psychological state will also has a variety of changes， such as vision loss and causing distraction， slow in reacting， stiff action and arrhythmia. Therefore， the accurate monitoring of driver′s fatigue state and implement effective early warning is of great significance to avoid fatigue driving effectively.

2　The software design

UCOS-III operating system transplant. In order to facilitate transplantation， UCOS-III most of the code is written in C， when it needs transplantation， it still needs to be written in C language and

assembly language code. When it related to processing hardware such as CPU registers operation code, it only can be written in assembly language. Transplanting UCOS-III mainly needs to write or modify the three kinds of CPU type kernel files: (os_cpu. h、os_cpu_c. c、os_cpu_a. asm), Os_cpu.h header file contains macros and functions related to the processor prototype statement; Os_cpu_a.asm file contains all the assembly language functions; Os_cpu_c. c contains the underlying operating functions, it is the core part of the system. UCGUI is a graphical support for embedded application software, it can work in multitasking system environment.

3　Hardware design

At present there are many researches about the early-warning system of fatigue driving, but there's no a method was accepted by everyone, The main reason that although each method in one area is persuasive and operability, But it haven't reached the requirements of vehicle, real-time, objective, system with DSP kernel. The information data has high processing speed and good control performance of the 32-bit ARM processor ARM926EJ-S as a controller. The 3.5 inch LCD screen with the small size, low power consumption as the human-computer interaction interface, Figure 1 is system hardware structure diagram.
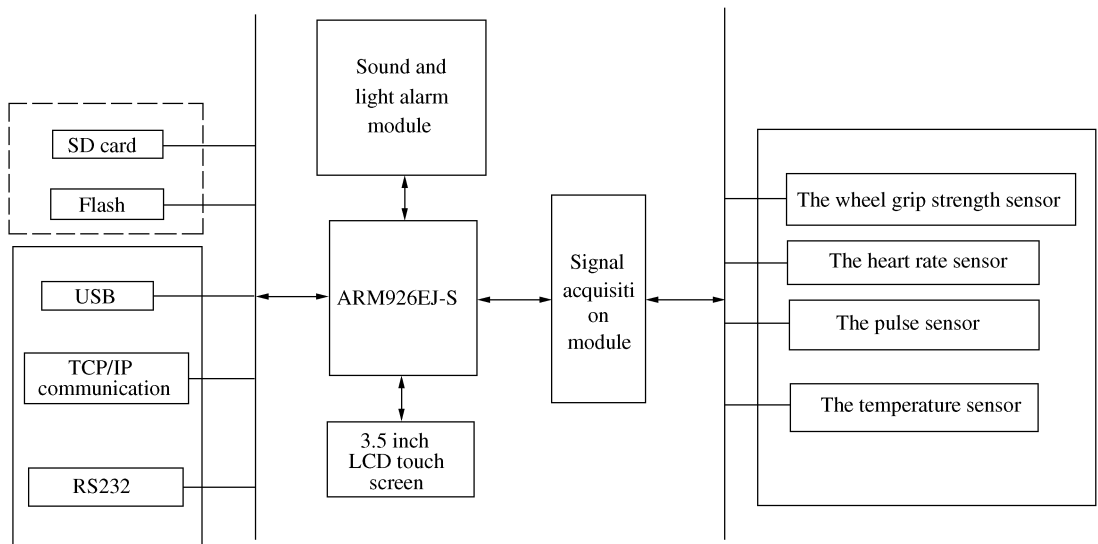

Figure 1　System hardware structure diagram

Car driver fatigue early warning system for embedded hardware mainly includes ARM926EJ-S core processor, a 3.5-inch LCD touch screen, data storage

module, data communication interface module, information collection module, sensor module and alarm device. LCD touch screen based on the system

of the monitoring results shows that the current driver in a sober, mild or severe fatigue, fatigue; and LCD touch screen is human-computer interaction interface of the driver and early warning system. The driver turned on or off using LCD touch screen early warning system for fatigue monitoring function, it can also view the current own pulse, heart rate, body temperature and other physical information.

The main functions of the system: the micro pulse sensor pick up drivers pulse signal; a serial port communicated with tiny heart rate sensor acquires drivers' heart rate signal; the infrared temperature sensor acquires driver temperature signal; the thin film pressure sensor acquires driver steering wheel grip; System collected the human body physiological signal data and preprocessed, then it displayed parameters on the LCD panel, at the same time the data are stored in the storage module of the system. Figure 2 is system structure diagram.
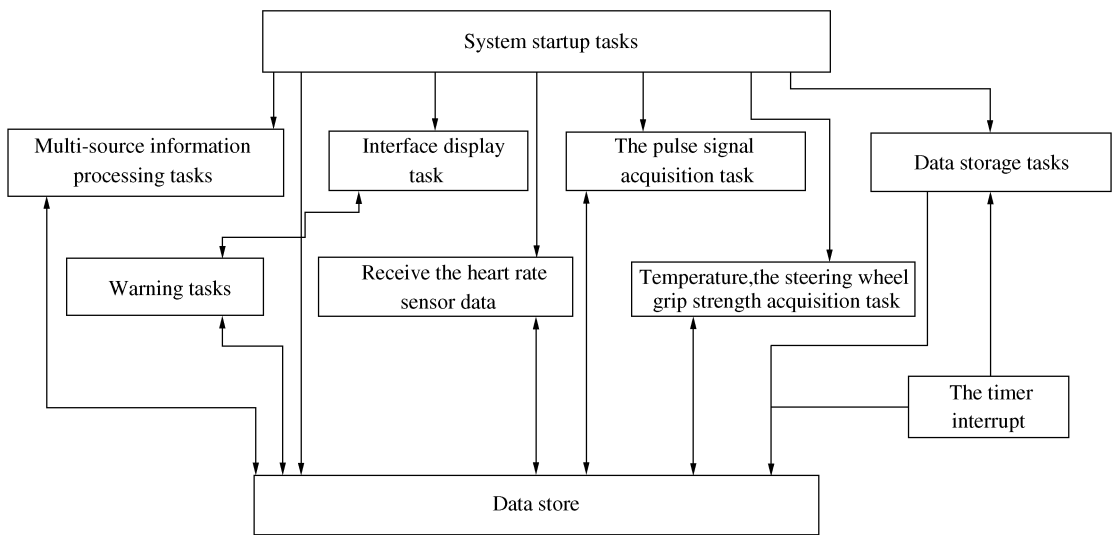

Figure 2   System structure diagram

4   The realization of fatigue criterion

When programming in the embedded software, reasonable distribution of the embedded system application task is a very important content, The reasonable design of the task will enable software have efficient code quality.

Otherwise, it will complicated the software code. The reasonable design will simplify the writing of the operating system, and the demand for system resources will be minimum.

5   D-S set of legal evidence

D-S evidence theory was first put forward by Dempster, development by Shafer is an imprecise theory, as well as an extension of the Bayes method, it does not require any prior information and conditional probability. In Bayes experiment, when the goal incompatible and there is no uncertainty measure, D-S evidence theory and Bayes method will

produce the same results. fusion algorithm is shown in Figure 3, In a multiple sensor information fusion system, each sensor provides a set of objective evidence, and establishes the corresponding quality distribution function, in this way, each sensor can be seen as a body of evidence. Under the same criterion system, let the different rules of evidence use D-S to merge, so we can form a new body of evidence, and calculating the verisimilitude of evidence body, finally it determines the decision rules and the fatigue level.
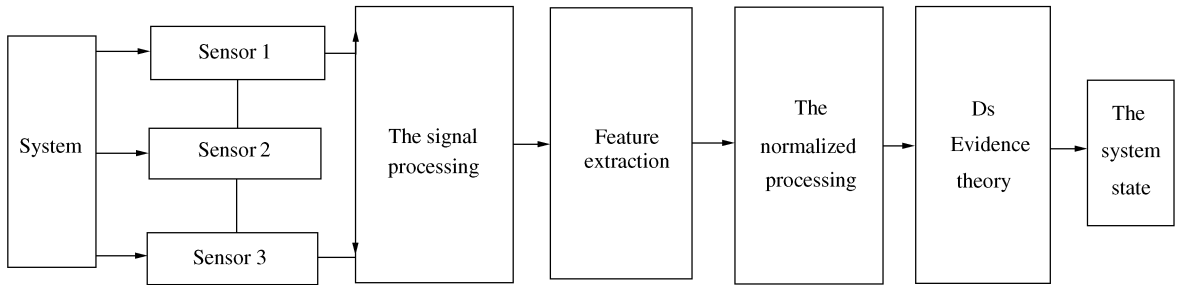

Figure 3   Figure of multi-source information fusion process

6   The graphical interface design

The interface of embedded fatigue early warning system is real-time display driver′s physiological signal data. The LCD display interface of this system as shown in Figure 4, the interface is mainly shows that the pulse, body temperature, heart rate, the size of the steering wheel grip strength and driver′s current state of fatigue. Detailed display design is as follows: the upper right corner displays real-time of current date and time; the above screen shows that early warning system of the title " Driver Fatigue Monitor System"; the central of screen shows the "Pluse", " Temperature", " Heart rate" and " Grip" real-time data; Below display screen is fatigue State information. When the driver in the waking state, the green light on the board up and fatigue status appear two green signals; When the driver is in a state of slight fatigue, the yellow light on the onboard, fatigue status is displayed at the same time adding the two yellow signals to remind the driver in slight fatigue; When the driver is in a severe fatigue, the red light flashing on the board and alarm speakers, and fatigue state shows two red signals to warn that driver has been in a state of severe fatigue, measures must be taken to terminate the fatigue driving.
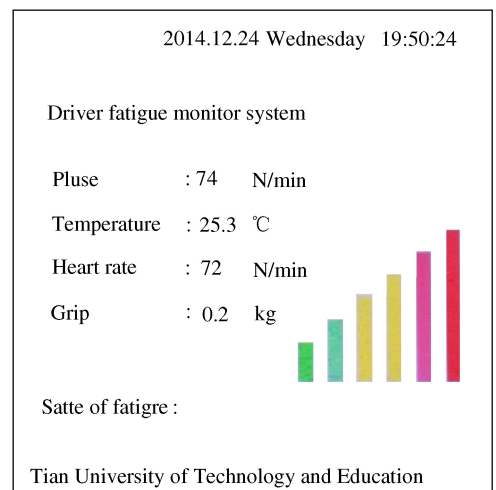

Figure 4   Warning system display interface

7　Conclusion

With the method of multi-source information fusion, this paper mainly completed the development of car driver fatigue early warning system based on embedded structure, it choosed the ARM STM32F407 processor with DSP computation capability and combined with multitasking ability UCOS-III real-time operating system to realize the function of early warning system; then, according to the fatigue early warning system for the actual functional requirements, it designed main tasks of system, and introduced the working process of the tasks; finally early warning system for graphic display interface is designed.

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