Research on the Management of Real-Time Driver Fatigue Detection System

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Abstract: Influenced by the rapid economic development, the living standard of Chinese people has improved greatly. More and more people start to buy cars as a means of transportation. The most important thing about driving an automobile is to ensure that the driver cannot be fatigued driving, which is an important factor to ensure the safety of the driver. Therefore, this paper carries out research on the real-time detection system of driver fatigue driving. In the research process, a single-chip microcomputer is designed as an important part of the system design and research. First, the fatigue driving real-time detection system is introduced. Secondly, the driver fatigue driving real-time detection system based on microcontroller application is designed and analyzed. It is hoped that the research in this paper can provide a reference for the functional design and hardware and software design of the driver fatigue real-time detection system.

Key words: single chip computer; driver fatigue; real-time detection system

1. Preface

With the rapid development of China's economy, automobiles have gone from being a luxury item in the past to a daily necessity for many families. However, with the sharp increase in the number of automobiles, traffic safety problems have become more and more prominent. Among them, driver fatigue is one of the main causes of traffic accidents. Therefore, how to effectively detect driver fatigue to ensure driving safety has become an urgent problem.

In order to solve this problem, some high-tech solutions have been put on the agenda. Among them, the driver fatigue detection system based on single-chip computer is a representative technology. Through a series of sensors and algorithms, this system is able to monitor the driver's physiological signals in real time, such as eyes, facial expressions, etc., so as to determine whether the driver is in a fatigue state.

In order to better promote and apply such systems, the Government, enterprises and scientific research institutions need to strengthen cooperation, increase investment and promote the research and development and innovation of relevant technologies. At the same time, publicity and education should also be strengthened to enhance drivers' safety awareness and self-protection ability.

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In summary, the driver fatigue detection system based on microcontroller is a high-tech product with broad application prospects. Its appearance and application are not only conducive to the protection of drivers' lives and the reduction of traffic accidents, but also conducive to the promotion of China's scientific and technological innovation and industrial development. Therefore, we should pay enough attention and support to actively promote and apply such systems to make greater contributions to the cause of traffic safety in China.

2. Fatigue Real-time Detection System

The real-time fatigue driving detection system, also known as the driver condition monitoring system, is a cutting-edge technology aimed at ensuring the safety of drivers' lives [1]. The core objective of the system is to monitor the physiological state of the driver in real time and determine whether he/she is fit to continue driving, so as to avoid traffic accidents caused by fatigue driving.

Data collection is the foundation of the entire system. It involves real-time collection of various physiological parameters of the driver, including but not limited to heart rate, blood pressure, body temperature, etc. [2][3] These data can reflect the physiological condition of the driver. These data can reflect the driver's physiological condition and provide basic data for subsequent judgment. In order to ensure the accuracy and reliability of the collected data, a filtering system is an essential part. This system pre-processes the raw data to eliminate possible outliers and noise to ensure the accuracy of subsequent analysis. Data analysis and comparison is the core of the entire system. By analyzing the physiological data collected and comparing it to preset normal values, it is possible to determine whether the driver is fit to continue driving. The key to this process is to set a reasonable threshold that ensures the safety of the driver but is not so sensitive as to lead to a misjudgment.

If the result of the validation data exceeds the threshold value, i.e. the driver's physical condition is judged to be unsuitable for further driving, the system will send a signal directly to the alarm device. Upon receipt of the signal, the alarm device will alert the driver in the form of sound, light, etc., and will even force the driver to stop if necessary to protect the safety of the driver and passengers.

In addition, the application of the system has many benefits. For example, it can improve road safety and reduce traffic accidents caused by fatigued driving; it can improve traffic efficiency and reduce delays caused by fatigued driving; and it can enhance our scientific and technological innovation strength and promote the research and development and innovation of related technologies.

However, there are some challenges and limitations in the application of such systems. For example, how to ensure the accuracy and real-time performance of data collection; how to set reasonable thresholds to ensure the accuracy of judgment; and how to reduce the cost of the system and make it popular.

In order to address these issues, governments, enterprises and research institutions need to strengthen cooperation, increase investment and promote research and development and innovation in related technologies. At the same time, it is also necessary to strengthen publicity and education to improve drivers' safety awareness and self-protection ability. The

driver fatigue detection system based on monolithic computer is a high-tech product with broad application prospects. Its appearance and application not only help to protect the life safety of drivers and reduce the occurrence of traffic accidents, but also help to promote the scientific and technological innovation and industrial development in China. Therefore, we should pay enough attention and support to actively promote and apply this kind of system, so as to make a greater contribution to the cause of traffic safety in China. Specific system design application diagram, as shown in Figure 1:

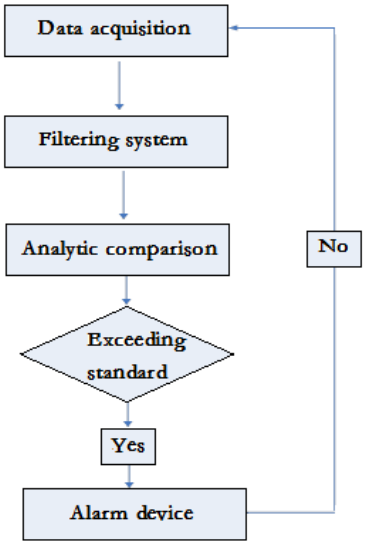

Fig.1 Driver fatigue detection system

3. System design

The selection of hardware and software as well as the functional design are crucial aspects in the design of a real-time driver fatigue detection system. These factors directly affect the performance, accuracy and reliability of the system. Therefore, we need to carefully consider and select the most suitable hardware and software, and carry out detailed functional design.

Hardware selection is the basis of system design [4]. Previous studies have shown that the use of a high-performance microcontroller as the main controller can efficiently process the physiological data collected in real time [5]. In addition, choosing the right sensors is crucial in order to accurately collect physiological data from the driver [6]. We need to select hardware devices that can collect and process data quickly and accurately. Since we need to monitor the driver's physiological data in real time, we suggest using a high-performance microcontroller as the main controller. In addition, in order to accurately collect the driver's physiological data, we need to choose suitable sensors, such as ECG sensors and pulse sensors. These sensors can monitor the driver's physiological condition in real time and transmit the data to the main controller for processing. Software selection is also a very important aspect. We need to choose a programming language that is easy to develop and has good stability and scalability. C is a good choice because it has the advantages of high efficiency, good portability, and

strong ability to operate on hardware. Next is the functional design. The real-time driver fatigue driving detection system needs to have a variety of functions to ensure that it can accurately determine the driver's fatigue state and provide timely warning. Specifically, these functions include data acquisition and transmission, data processing and analysis, display and control, early warning and intervention, storage and backup. These functions collaborate with each other to accomplish the task of real-time monitoring and early warning of driver fatigue.

Through careful selection of hardware and software and detailed functional design, we can build an efficient, accurate and reliable real-time driver fatigue driving detection system. This system can effectively prevent traffic accidents caused by fatigued driving, improve road safety, and provide drivers with a better driving experience.

3.1 Selection of System Hardware and Software

(1) Selection of chips and sensors

Hardware Selection of Fatigue Real-time Detection System involves the use of a 16-bit MCS-96 single-chip computer. This chip, originally designed for high-speed positioning control systems, is capable of issuing timely instructions to the system and controlling its operation. Furthermore, it effectively links with the external control transmission system [7].

In this study, the chosen sensor is the DCMC-932, strategically positioned around the steering wheel in the practical system design. This sensor is employed to measure the driver's pulse beat signal, which is then amplified and transmitted through a filter to the digital display instrument. The final displayed data results are monitored and measured to determine whether the driver's fatigue status exceeds the standard. Through this process, the driver's fatigue state can be identified during the monitoring and measurement of fatigue levels, helping in assessing whether the driver is fatigued. In the event of fatigue driving, the system will promptly relay this information to the alarm device, alerting and reminding the driver.

(2) Software selection

To ensure the effective functionality of the system detection application, the software functions of the system application are meticulously designed. It is through this specific design that we can enhance the software, making timely improvements to the assembly language within the system application. Simultaneously, during the design of the system's assembly language, there is a focus on timely enhancements to the measurement of data parameters and information numbers. The design and application of the software contribute significantly to the secure operation of the data system applications [8].

3.2 Functional Design

(1) Data acquisition function

Data acquisition function is a specialized design based on sensors. The design of the data acquisition function involves the sensing of the sensor to the pulse, providing timely feedback to the Data Display Center, effective data analysis, and judgment by the alarm device. The design of the data acquisition function is crucial, and it is necessary to incorporate it into the overall system design [9]. Under normal conditions, common sensor data acquisition includes quartz crystal and piezoelectric ceramics.

(2) Data display and control function

The design of the data display and control function is a specialized electronic module designed for displaying data. In the application of this function, the number of beats per minute of the driver is displayed on the data display instrument by the control element. In this study, the data display instrument is installed next to the driver's rearview mirror, and the key is set next to the steering wheel pressure ceramic sensor[10]. Only in this way can it be driven by its sensors, showing the result of data transmission in time. The application of this transmission mode reduces the time consumed by data transmission to the CPU.

(3) Design of filter module

The design of the filter module is a specialized study on data interference. In the transmission of actual data, influenced by transport mediation, deviations may occur in the data. In such cases, the data needs to be specially filtered. In the selected N numerical analysis and processing, there is an ability to measure the square of the difference. The measured difference data results show that specialized programming data will be aggregated. The specific programming data is shown in Figure 2:

```
DSAV2CLR 20H          ; Clear register 20H
CLR 22H               ; Clear register 22H (cumulative sum)
CLR 24H               ; Clear register 24H (maximum)
LD 26H, #FFFFH        ; Load register 26H with initial minimum value
LDB 1CH, #8           ; Load register B with 8 for loop counter
DSA21:
    CMP 24H, AH       ; Compare maximum with current value
    JCD SA22          ; Jump if current value is greater
    LD 24H, AH        ; Update maximum
SA22:
    CMP 26H, AH       ; Compare minimum with current value
    NHD SA23          ; Jump if current value is not less
    LD 26H, AH        ; Update minimum
SA23:
    ADD 20H, AH       ; Add current value to accumulation
    ADDC 22H, 0       ; Add carry bit to cumulative sum
    DNZ 1CH, DSA21    ; Decrement loop counter, loop if not zero
SUBB 20H, 24H         ; Subtract maximum from accumulation
```

Fig.2 Data Display Programming of Filter Module

(4) Design of data analysis module

In the analysis of data, to ensure the stability of data transmission, special analysis and comparison of data are required. Only in this way can we analyze and compare the data, handling relevant data display elements in a timely manner. Typically, it begins with data entry, followed by judgment, and the ultimate display appears on the data alarm instrument. The specific data operation flow is illustrated in Figure 3.

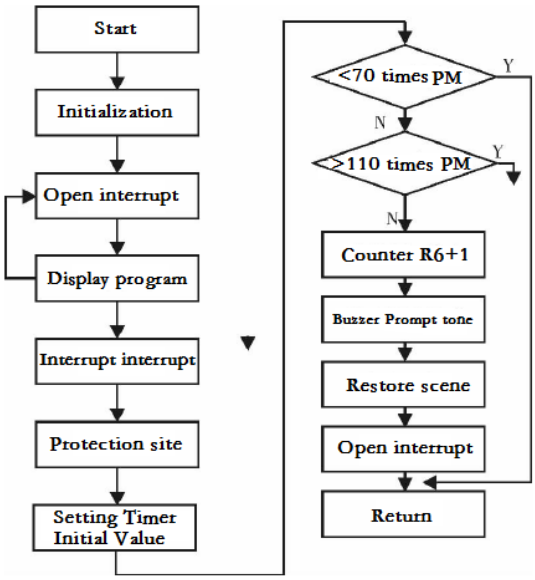

Fig.3 Data analysis module program operation

5) Design of early warning module

In the integration of data acquisition and the analysis and comparison of a series of system applications, it is essential to analyze the early warning device designed for the system. The analysis and design of the early warning device include the development of a special function for data analog sound display. Through the application of 8254 Timer Simulation Technology, it can provide timely feedback for the alarm sound. The specific sound data display model is illustrated in Figure 4.

```
MOV AL, 10110111010B ; Load binary value into AL register

OUT 43h, AL ; Output the contents of the AL register to port 43h

MOV DX, 12h10101100010110B ;Load hexadecimal value into DX register
```

Fig.4 Specific sound data display model

4. Conclusion

In summary, the design of a real-time driver fatigue detection system requires careful attention to both its core functions and meticulous consideration of its software and hardware components. The safety of the system is intricately linked to these design factors. The data acquisition function serves as the foundation of the entire system. It is tasked with collecting

various physiological parameters of the driver, such as heart rate, blood pressure, body temperature, etc., providing a true reflection of the driver's physiological condition. Similarly, the data display and control function play a pivotal role. The system must present the collected data to the user in an easily understandable manner, while also offering a control interface for user customization based on real-time conditions. The filtering module's function, on the other hand, is to ensure the accuracy and reliability of the data. This module excludes outliers and noise, thus safeguarding the precision of data analysis. At the core of the system is the data analysis module. Responsible for in-depth analysis of the collected data and comparison with preset normal values, the accuracy of this module directly influences the assessment of the driver's physical condition. Equally crucial is the design of the early warning module. When data analysis reveals that the driver's physical condition may not be conducive to continued driving, the early warning module activates immediately. It alerts the driver through sound, light, etc., and can even enforce a stop if necessary, prioritizing safety. For a microcontroller-based driver fatigue real-time detection system to be effective, it must encompass these five functions, ensuring accuracy and safety in its application. Such a comprehensive system design not only effectively prevents traffic accidents resulting from fatigue driving but also enhances transportation efficiency while promoting technological innovation and industrial development.

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