Design and Research of an Embedded Vehicle Intelligent Alarm Control System Based on Image Recognition Technology

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Abstract. With the continuous development of the society, cars have become a must-have for many families, but at the same time, they have brought about a series of social problems such as the tragedy of the elderly and children locked in the car being suffocated that is often seen in newspapers. In order to prevent these accidents, we analyzed the cause of the accident and invented the embedded vehicle intelligent alarm system, which can automatically monitor the situation inside the vehicle. When an abnormality is found, danger signal processing and alarm can be performed in time. At the same time, text message is promptly sent to the owner, and the corresponding emergency treatment measures such as starting the ventilation system are started so as to alarm and get rescue in time.

1. Preface
The present systematic in-vehicle intelligent detection and early warning system in China has not been fully developed, and there are no measures that can be taken. However, various safety accidents occur frequently. An emergency cannot be discovered and alerted in time, which leads to a tragic accident. Therefore, a comprehensive vehicle-embedded safety auxiliary alarm processing device that can solve the problem of car suffocation is particularly urgent. The design research of an embedded vehicle intelligent alarm control system based on image recognition technology is an emergency measure that effectively carries out information processing and alarm and performs timely automatic ventilation according to the actual situation in the event of accidents based on the detection of the living body and the state of the vehicle.

2. Working Method of Embedded Car Intelligent Alarm Control System
The system mainly includes four modules: life detection module, vehicle state detection module, information processing and alarm module and vehicle automatic ventilation device. When life monitoring and early warning system is turned on, the four modules start to operate, collect data, and coordinate.

The life detection module and the vehicle condition monitoring module collect the information in the vehicle, and transmit the signal to the information processing module and the alarm module. After the Raspberry Pi accepts the information and combines the information collected from the other two modules, it determines whether to alarm or not according to predetermined logic. When the alarm logic is met, vehicle ventilation is started to avoid suffocation accidents.
Figure 1. The flow chart of life detection control is missing in the car

3. Design of Information Processing and Alarm Module and Vehicle Automatic Ventilator

3.1. Information processing and alarm module
The life detection system performs real-time processing on the acquired image in the vehicle based on image recognition technology. After analysis, the life detection module outputs the logic value of the judgment result to the information processing and alarm system through the serial port.

3.1.1. Function of information processing and alarm module
The information processing and alarm module logically analyzes the data transmitted by other hardware by collecting the processed image information of the life detection system in the vehicle. When the trigger condition is met, it sends the alarm command to the alarm unit and activates the alarm system to send alarm signal to the vehicle owner (target alarm object), and at the same time, sends signal to on-board automatic ventilator when the environment inside the vehicle is abnormal after Raspberry Pi comprehensively processes data using the data fusion algorithm when the predetermined logic is met.

3.1.2. Composition of information processing and alarm module
The information processing and alarm module includes the Raspberry Pi and the 4G communication module. The Raspberry Pi is mainly responsible for comprehensive processing of the various data of the system. When the predetermined alarm logic is satisfied, it transmits the alarm command to the 4G communication module and sends alarm through 4G network.
3.1.3. Design of information processing and alarm module
Raspberry Pi is not only the carrier of image recognition software but the center of final information processing. After Raspberry Pi comprehensively processes the information, it can be transmit the information to the owner through the corresponding arithmetic logic.

(1) Raspberry Pi selection
We chose the latest 3rd generation B+ Raspberry Pi as the core processor. It has 1 GB of memory, which is enough to store a large image database of our training process. Its CPU responses faster, meeting the high efficiency and short-term requirements for the safety monitoring of the living body in the vehicle;

![Raspberry Pi chip](image)

Figure 2. Raspberry pie chip

(2) Function design of Raspberry Pi
It combines the information collected from the other two modules to determine whether to send alarm according to predetermined logic. Its alarm logic is:

1) Bad driving behavior reminder
   1. The logic corresponding to the data output by the vehicle state detection module shows that the vehicle is running.
   2. Driver behavior monitoring module monitors the time for driver’s eyes to remove the road surface or close.
   3. If 1 and 2 are met, then a corresponding reminder based on the driving state is initiated.
   4. If 1 and 2 are not met, then continue to judge the next set of data.
2) Safety alarm for missing life inside the car
   1. The logic corresponding to the data output by the vehicle state detection module shows that the vehicle is in a stagnant state and e is locked and sealed inside the vehicle.
   2. The life detection module detects that the driver’s seat is unmanned while other seats are manned.
   3. If 1 and 2 are met, and the temperature and CO2 concentration inside the vehicle reach the set value, the alarm will start immediately; otherwise the alarm will be delayed.
   4. If 1 and 2 are not met, continue to judge the next set of data.
The 4G communication technology used in this module (simultaneously compatible with 3G and 2G communication technologies) can effectively send alarm signals to target alarm personnel quickly, accurately and efficiently. 4G mobile communication technology is a relatively mature wireless network technology. Its advantages are low information transmission cost and reliable alarming system because the wireless transmission of multiple base stations reduces the information transmission delay so situation of no signal or weak signal seldom appears.

3.2. Design of vehicle automatic ventilator
Vehicle condition monitoring module in the vehicle can discover the current lock and seal situation of the car, temperature change and gas composition in the car in time. When an abnormality is found, message can be promptly sent to remind the owner, and ventilation system is started for emergency treatment.

The ventilator can automatically open the window 5-10 cm wide, which solves the problem of suffocation that may occur in the car, and ensures the safety of the car at the same time.

3.2.1. Design of electric lift window
The electric lift window consists of a DC motor, a worm gear, a hoisting wheel, a shifting gear, a support arm, a window slide, a pulley, a rubber strip, etc., as shown in the figure. The working mode is as follows: firstly, the automatic control module controls the rotation of the DC motor, and drives the worm gear; the hoisting wheel and the shifting gear moves the window support arm so that the window glass can move up and down along the window slide and slightly open the car window to exchange air inside the car and avoid car suffocation accidents.
(1) DC motor: When designing the window, we take into consideration its use inside the car. Therefore, the motor should have little noise, small size and weak electromagnetic interference. At the same time, DC motor ensures the normal operation of the electric glass lifter, so the motor should also have a high degree of protection, while having good water tightness, durability, vibration resistance, heat resistance and other properties. The DC motor is shown in Figure 8.

(2) Worm gear speed reducer: DC motor rotates too fast during operation, and cannot be directly applied to electric lift window. For this purpose, a worm gear reducer is needed to reduce the rotation speed of motor to a reasonable range so as to drive the electric lift window.

(3) Hoisting wheel: The hoisting wheel is a mechanical device capable of converting a curved motion into a linear one. Its rotation is driven by the movement of the motor. Since the car window moves in a linear vertical manner, a hoisting wheel equipped with a conversion gear is required to realize the straight running of the window. The hoisting wheel is as shown in Figure 9.

(4) Control device: The system controls the movement of window by converting DC motor through the MCU. When MCU receives the control signal converted by the data fusion module, it controls the turning and running time of the motor through a preset algorithm, thereby controlling the opening and closing time and the opening degree of the window.
4. Conclusion:
In recent years, with the increasing popularity of private cars, car suffocation also becomes more common. The image recognition technology can be comprehensively applied in computer intelligence, GPS, data communication, mechanical control, sensing and other technologies to achieve effective functions such as vehicle monitoring, positioning, anti-theft, information interaction inside and outside the vehicle, and fault and obstacle detection.

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