PAPER • **OPEN ACCESS**

The design research of an intelligent vehicle-mounted/maintenance alarm system based on image recognition technology

To cite this article: Hao yan *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **233** 032009

The design research of an intelligent vehicle-mounted/maintenance alarm system based on image recognition technology

Hao yan[1*], Xuetao Liu[1], Shuxin Lin[1], Hong Yang[1]

[1]School of Energy and Power Engineering WUT, Wuhan University of Technology, Wuhan, Hubei province, 430000, China

eusfsgs@vip.qq.com

Abstract: with the continuous progress of the society, in recent years, the image recognition technology has a rapid development, whose new application fields are expanding. The intelligent automotive electronic information system and traffic monitoring research based on image recognition have become a new means to solve some social problems. At present, cars have become a necessity for many families, but at the same time, it has also brought a series of social problems, for example, the elderly and children were locked in the car and suffocated by the tragedy is often reported. In order to prevent these accidents, this paper proposes an intelligent vehicle-mounted/maintenance alarm system based on image recognition. Using deep learning algorithm of system main control board as the carrier, the system connects the temperature, pressure and CO2 concentration sensor and camera equipment, with the aid of technologies such as 4G communication technology, image recognition, automatically monitoring in the car, when there were something abnormal, it would timely alarm to remind the owner, and start the ventilation system of emergency handling, in order to solve corresponding problems.

1. Introduction

With the increase of the popularity of private cars, more and more safety problems are caused more frequently by the use of cars. Among all the problems and phenomena, the problem of suffocation in the car is the most urgent and important. People sometimes rush to do things. In order to prevent children from getting lost and protect their safety, children will be locked in the car, in order to. People subconsciously think that this is the safest and most convenient way but ignore the problem of poor ventilation in the car, and this kind of unconscious factor, even become the main cause of children suffocating death.

As a non-contact, friendly biometric identification method, face recognition technology has great potential in the application of secret places, security monitoring, human-computer interaction and other fields. In the past 20 years, face recognition technology has received great attention and made significant progress [1]. intelligent vehicle electronic information system based on image recognition is mainly to realize the function of interaction of vehicles external environment and internal information, including vehicle adaptive navigation, obstacle detection, path identification, and fault analysis [2]. Combined with computer intelligence technology by camera or digital monitoring technology, an image recognition system for car safety monitoring was developed.

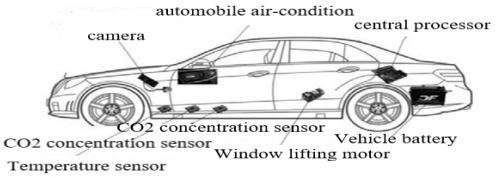

Figure 1 Concept diagram of the structure distribution of intelligent vehicle-mounted/maintenance alarm system

2. Structure design of intelligent vehicle-mounted/maintenance alarm system

Intelligent vehicle-mounted/maintenance alarm system is an alarm system that integrates many advantages such as automatic alarm, low requirements on the site environment, high safety and simple operation. At the same time, face recognition technology, image processing technology, full-duplex receiving wireless communication module and high-frequency wireless transmission technology are combined to meet the complex and diverse needs of the environment. When the system recognizes the vehicle flameout, equipped with an array of omni-directional camera, quickly identifying the existence of mankind by the human face recognition technology, the system will automatically checkout automobile inside condition. When the condition in the car meets the trigger condition, the high frequency wireless transmission technology is adopted to timely inform the owner of the danger in the prime time when it is the easiest to rescue the dangerous situation. If the car owner cannot get back to the parking place in time, the system will open the window after detecting the trigger condition, which greatly improves the safety.

The design goal of this system is to design an intelligent in-car monitoring system which is low cost and easy to disassemble and assemble, using deep learning algorithm of the system main control board as the carrier and connecting to temperature, pressure and CO2 concentration sensor and camera equipment, with the aid of technologies such as 4G communication technology, image recognition, in order to realize missing life in the car, and to achieve remote automatic alarm (when the system judges the life in the car is in danger).

Aiming at the potential risk factors of such accidents, the intelligent detection and warning system for missing life in the car designed in this work is an independent vehicle-mounted accessory, which is suitable for ordinary private cars on the market. When special circumstances occur, this system can detect the missing life in the car when the car locked, transmit the alarm information to the owner's mobile phone, and notify the nearest police duty guard at the same time, so as to achieve the fastest rescue effect.

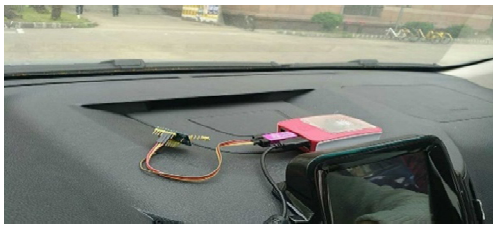

Figure 2 The core components of the early in-car missing life detection and warning system

3. The composition of vehicle condition detection module

The vehicle condition monitoring module can automatically monitor the current situation about padlock and the car seal, timely send text messages to remind the owner and start ventilation system for emergency treatment when the abnormal found, safeguard the real-time monitoring of the vehicle condition and provide enough key information to information processing and alarm module, so as to realize the early warning function of this system.

The vehicle condition detection module consists of the pressure sensitive sensor, AD conversion module, temperature sensor and CO2 concentration sensor.

(1) Pressure sensitive sensor: arranged in four windows grooves and near the door lock. Whether or not the sensor is squeezed by the window or door leads to the change of pressure value.

(2) AD conversion module: the pressure value generated by the door and window on the pressure sensitive sensor is converted into the voltage signal value, which is periodically output to the information processing and alarm module through the serial port.

(3) Temperature sensor and CO2 concentration sensor: these two sensors are arranged to measure the temperature and CO2 concentration of the environment inside the vehicle to serve as indicators of the severity of the environment inside the vehicle.Temperature and CO2 concentration will be periodically output to the information processing and alarm module through the serial port with voltage information.

(4) Finally, the information processing and alarm module will judge the current locking and sealing status and environmental severity of the car through the preset logic combined with various voltage values.

4. Structure of life detection module

4.1 Structure of life detection module

The life detection module mainly includes a camera monitoring device and an image recognition and processing device (Raspberry Pie) equipped with a deep learning personnel recognition module. Camera equipment realizes the car personnel image acquisition. The image recognition and processing equipment is equipped with the personnel image recognition module based on deep learning independently developed by the project, so as to process, analyze and judge the images collected by the personnel in the car.

4.2 Design of life detection module

(1) Workflow

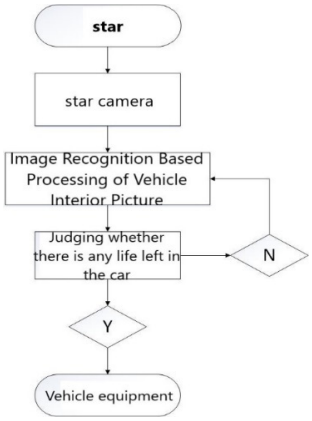

Figure 3 Flow chart of image recognition of life detection module

(2) Camera monitoring device

The camera monitoring device consists of two cameras installed in the car.

The function of the first camera is to periodically collect images of the driver to determine whether the driver is in the car or not, which can be used to judge whether there is a potential safety hazard for the stranded person in the car. If the driver's seat is unoccupied, the vehicle can be considered to be in a stop state, and there may be hidden dangers; otherwise, it is a safe state. The function of the second camera is to collect images of people in seats other than the driver's seat and monitor the in-car status in real time to see if there is any missing life.

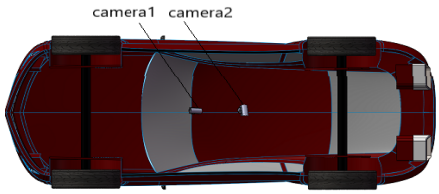

Figure 4 Image acquisition device

1) Camera 1 -- driver's seat camera: the first camera is located at the back of the top of the driver's seat, which is used to periodically collect images of the driver for recognition by image recognition processing equipment.

2) Camera 2 -- stranded personnel detection camera: the second camera is fixed on the top of the car directly above the front and rear seats. In this way, most areas of the car can be covered to avoid the situation that children or pets themselves are small in size and move to the bottom of the car without supervision, and are covered by seats or ornaments in the car and not correctly recognized. Its function is to collect the portrait of people in other seats except the driver's seat and wait for the recognition of image recognition processing equipment.

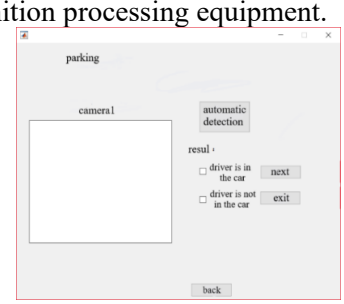

Figure 5 Interface of driver automatic detection status (Camera 1)

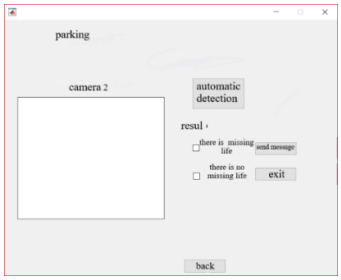

Figure 6 Interface of life judgment in the car (Camera 2)

(3) Vehicle personnel identification software based on deep learning

In order to process and analyze the images collected in the car by the camera, this project adopts the method of deep learning [3] to realize the detection of car personnel. The software can be divided into two stages: early training and later identification. In the early training process, a lot of image data was used to conduct sample training for personnel recognition software, so as to improve the accuracy of software image recognition as much as possible. In the later stage of identification, in-car experiments are mainly used to test whether the software meets the requirements of accurately identifying in-car personnel. See figure 7 for the design of the specific deep learning process.

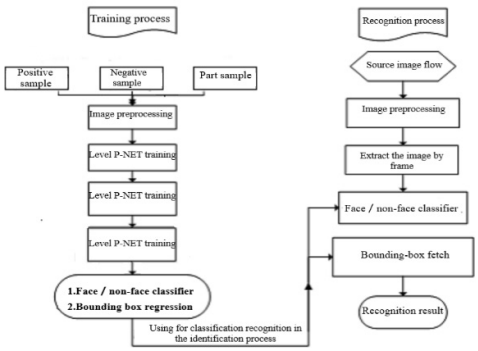

Figure 7 Flow chart of image deep learning

(4) Image recognition and processing equipment

The system installs the self-developed deep learning image recognition software in the Raspberry Pie as the image recognition processing equipment. It can accurately identify images from both cameras. Image recognition and processing equ ipment has undergone a large number of sample training, with a large database to ensure the accuracy of recognition. The logical value of the recognition result is output to the information processing and alarm module through the serial port. In order to check the working condition and practical effect of image recognition and processing equipment, the project carried out field test.

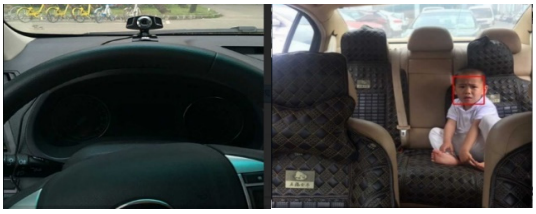

Figure 8 Experimental diagram of image acquisition device

As can be seen from figure 8, in the test, this image recognition software can accurately capture children's facial images for comparison with the database. If there are people in the car and abnormal living environment indicators are detected in the car, such as excessively high temperature and excessively high concentration of harmful gas, the system will immediately carry out emergency treatment, such as alarming, adjusting the environment and sending SMS of warning indicators [4]. Alarm includes automatic alarm and remote alarm. Adjusting the environmental index includes starting the ventilation system and other emergency treatment methods. Design of life detection module

The information processing and alarm module is the control center of the whole system. The data transmitted by the vehicle condition monitoring module and the life detection module will be analyzed and processed by the information processing and alarm module [5], and all data will be logically processed by the information processing and alarm module to achieve the purpose of intelligent processing of data information and judgment.

Figure 9 Display diagram of SMS warning

5. Conclusion

In recent years, with the increasing popularity of private cars, suffocation incidents are common. However, image recognition technology can be comprehensively applied in computer intelligence, GPS, data communication, mechanical control, sensing and other technologies to realize vehicle monitoring, positioning, anti-theft, vehicle internal and external information interaction, fault and obstacle detection and other functions [6], and achieve very effective results.

At present, the domestic market for vehicle missing life detection system is in a blank. However, with the opening of the two-child policy in China, the number of children in China has increased significantly, and the number of cars is also increasing year by year. Therefore, the market demand for intelligent detection and warning system for missing life in cars is real and growing rapidly.

The system, composed of image recognition technology and 4G wireless communication, has the advantages of simple operation and strong anti-interference ability. It can effectively avoid the occurrence of casualties caused by children being locked in the car by mistake and has certain social effects.

Reference

[1] Liping Yang, Xiaohua Gu. Relative gradient histogram feature description for face recognition [J]. Optical Precision Engineering, 2014, 22 (1): 152-159.
[2] Qingtian Geng. Research on Key Technologies of Intelligent Transportation System Based on Image Recognition Theory [D]. Jilin University, 2016.
[3] Shuqiang Jiang, Weiqing Min, Shuhui Wang. Overview and Prospect of image recognition technology for intelligent interaction [J]. Computer research and development, 2016, 53 (1): 113-122.
[4] Yuquan Zhang. Design of Intelligent Anti-collision Alarm System for Automobile [D]. Hebei University of Science and Technology, 2013.
[5] Yan Long. Video Information Processing Technology and Application in Intelligent Community [D]. Jimei University, 2016.
[6] Qiang Zhang, Jiafeng Li, Li Zhuo. Overview of Vehicle Recognition Technology [J]. Journal of Beijing University of Technology, 2018 (3).