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Design of dangerous driving behavior warning system based on emotion recognition

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Abstract: In recent years, China's vehicle ownership has been increasing year by year, followed by more and more frequent traffic accidents. According to the statistics of traffic accidents at home and abroad, the main cause of traffic accidents is the dangerous driving behavior of drivers, which not only troubles other drivers, but also endangers the safety of pedestrians around the road. Therefore, this paper aimed at the three elements of human, vehicle and road, carried on the design of the early warning system. The purpose of the early warning system is to improve the driver's perception ability, so that the driver can make the right decision in the face of various road conditions during driving, so as to reduce the influence of anxiety on the driver's driving behavior.

Keywords: technology, algorithm model, driving behavior

1. INTRODUCTION

In recent years, domestic and foreign scholars have conducted in-depth research on drivers' emotional state and influencing factors, and achieved good results. Floyd first conducted psychological research on anxiety, and he believed that the occurrence of anxiety is due to the suppression of instinct [1]. Cattell divides these emotions into two categories: anxiety disorders are long-term in terms of duration, while state anxiety disorders are temporary; In terms of nature, anxiety is an inherent characteristic of individuals, while state anxiety is an emotion type [2]. Spielberg further points out that anxiety is a

disoriented awakening caused by the spontaneous nervous system, and its symptoms are anxiety and tension. Anxiety is a personality characteristic with certain behavioral characteristics [3].

Martin found that in many car driving modes, reducing speed can reduce the driver's perception of danger and impulsiveness. He believes this emotional state is caused by fear and anxiety. Panic occurs when the demands of the task at hand exceed the driver's perception, and anxiety can result from driver inattention when driving safely and at high speeds. The driver's stress response was detected by measuring the amplitude of skin electrical response [4].

The Amit study examined the driving behavior characteristics of 120 Israeli male drivers and assessed their anxiety levels using the "status-anxiety Scale". Regression results of four types of driver Behavior Scale (DBQ) -- error, error, general aggression and active aggression -- show that drivers with high anxiety have dangerous driving behaviors [5].Siamak through Manchester driving behavior questionnaire (DBQ) and Steven Spielberg state - anxiety rate table to test 168 drivers for anxiety levels and driving behavior (error, error, general and serious violation of) was studied, the relationship between found that anxiety level can significantly affect memory keep and processing, while driving distraction, Leading to dangerous driving behavior [6].

At the same time, some foreign scholars also discussed dangerous driving behaviors of drivers from the perspective of drivers: S. Helman took young male drivers as the research object and discussed the relationship between their dangerous driving behaviors on the road and traffic accidents [7]. Vinayak conducted a survey on motorists' views on highway speed limits in 2011 [8].

2. EMOTION RECOGNITION TECHNOLOGY AND ITS PRINCIPLE

At present, emotion recognition technology mainly uses voice, facial expression, body and physiological signals. Among them, emotion recognition by voice and facial expression are two mature technologies at present. So this paper mainly through the above two technologies to expand the discussion.

2.1 speech emotion recognition technology and principle: Speech emotion recognition technology is a kind of technology to judge a person's emotional state by using voice characteristics such as intonation, timbre and loudness. People in different emotional states have different expectations and therefore different tones. Since the 1980s, people have systematically studied the pronunciation and intonation, which is considered to be one of the most important means of human emotion expression. However, recognizing emotion from speech signals is a difficult task due to the large number of emotional-speech databases in which significant individual differences exist and specific speech content must be taken into account.

The main content of speech emotion recognition technology is to model the speech model, classify the existing speech features by emotion, and determine the appropriate parameters and weights. At present, the principle of pattern matching is adopted in most speech recognition systems. Figure 1 is a block diagram of a speech emotion recognition system.

So, to sum up, as in the vehicle intelligent terminal implementation instance of speech and emotion recognition technology, vehicle intelligent terminal receiver first acquisition and preprocessing the driver's voice and the surrounding environment, and then by an on-board wireless network transmission to the cloud server, the server to deal with the relevant data such as voice and emotion, finally through the vehicle intelligent terminal to realize voice information, And output it to voice and software interfaces.

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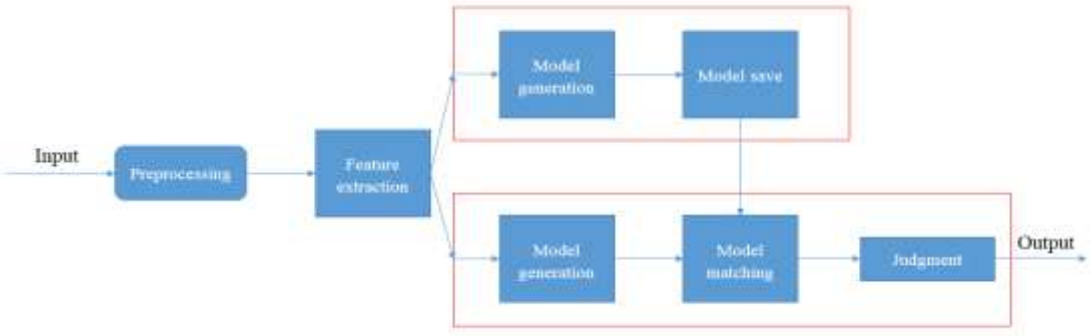

Figure 1: Block diagram of speech emotion recognition system

2.2. Facial recognition technology and principle: The study of facial features began in the 19th century, when changes in facial features were studied in relation to emotions. Ever since Darwin posited that the human face is innate, psychologists have been interested in understanding it. Until the 1970s, experts believed that human facial expressions included joy, surprise, sadness, anger, fear and anxiety. Since the 1980s, psychologists from all over the world have been studying facial expressions.Facial emotion recognition technology is a technology that can judge personal emotions by changes in facial expressions. Facial emotion recognition technology is developed based on face recognition technology. Therefore, the recognition of facial emotional features is also based on facial features. These features are part of the facial contour and sensory shape.

A specific principle of facial emotion recognition technology is that, given a continuous picture of facial activity, it is the basis for the dynamic judgment of facial expression in a period of time, and the facial representation changes dynamically with time. Face detection is mainly accomplished through face camera interaction. The data monitors the facial state of the people in the picture, captures the changes of eyebrows, eyes, nose and mouth, and detects emotions through the algorithm model. The basic schematic diagram of the technology is shown below.

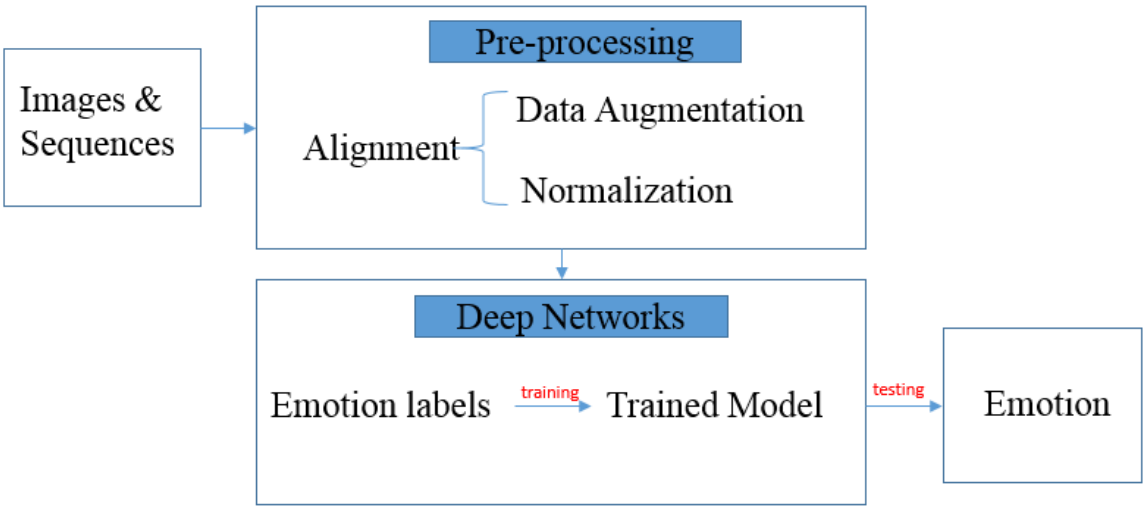

Figure 2: Schematic diagram of facial emotion recognition technology

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Therefore, the development of facial emotion recognition technology in vehicle intelligent terminal can be summarized as the above points. Vehicle intelligent terminal of on-board camera driver facial information collection, such as eyebrows, eyes, nose and mouth, the change of information, such as the face after pretreatment by on-board wireless communication network is sent to the cloud service terminals, facial emotion recognition by the service terminal, and finally by the vehicle intelligent terminal for feedback results by voice or software interface display.

2.3. Body emotion recognition technology and principle: Body emotion recognition technology is based on body movement, posture, posture, range of motion and data characteristics and other factors to identify emotions. Although the study of body expressions is relatively late and less than that of facial expressions, in fact, body expressions and facial expressions can be very good at conveying people's emotional state and their intention to act. Emotion detection in body recognition technology focuses on gesture recognition.

The basic principle of body emotion recognition technology is to first collect data, then carry on data noise reduction processing, and then extract its characteristic value, and then through learning and training, classification, and finally complete the human movement identification. Most teams follow this common step to identify human behavior. Therefore, summarize the application of body emotion recognition technology in intelligent vehicle terminal; By vehicle intelligent terminal in-car cameras on the motion of the vehicle, posture, gestures, such as range of movement to collect the information such as records, and through the car networking information such as the wireless communication network will swing has sent to the cloud server, through a service terminal of human emotion recognition, finally by voice or software interface feedback to the user.

2.4. Physiological signal emotion recognition technology and principle: Physiological signals are used to determine a person's emotional state based on changes in their physiology. The main physiological signals include electrocardiogram (ECG), electromyogram (EMG), respiratory signal (RSP) and cortical potential signal (SC). So far, the drawbacks of physiological signals have been that they are weak, noisy, and subject to rigorous testing conditions, which have so far been confined to laboratory studies.

The basis of emotion identification technology of physiological signal is: firstly, meaningful information is obtained from physiology, and it is integrated into appropriate feature vector, and then it is recognized, processed and analyzed by emotion classifier, and which emotions are decisive are studied according to the original data collected from experimental data. Finally output the judgment of emotional state. Therefore, the use of the above can be summarized physiological signal emotion recognition technology, in the vehicle intelligent terminal implementation examples are based on the pilot wearing wearable intelligent equipment acquisition department of the driver's physiological signals, and extract its characteristics, then by car connected to the wireless communication network transmission to the cloud server, carries on the corresponding physiological signals and emotional identification, The final vehicle intelligent terminal will output feedback results through voice or software interface.

To sum up, intelligent vehicle warning terminals of emotion recognition technology mainly includes: the technical principle of the system adopts the vehicle-mounted receiver, on-board camera and wearable devices, through the wireless network of voice, facial, body movements, such as physiological information collection, and carries on the corresponding emotion recognition, and its output feedback in the form of voice and software interface.

The driver's psychological state and emotional changes are monitored in real time, and the relevant information is displayed on the intelligent terminal of the vehicle to realize real-time listening. The video and sound are synchronized and recorded on the hard disk of the vehicle, which is saved by the monitoring center. Emotion, vehicle intelligent terminal software once the driver interface tip the driver signal and automatic alarm, automatic alarm information uploaded to the administrative departments of public security and traffic police brigade, and then the car's image projected onto the screen, sirens vehicle icon on the map, the corresponding contingency plans it will pop up. The command center can ensure remote control by activating the terminal's voice call function using a remote control button.

3. WORK OF EARLY WARNING SYSTEM

3.1. Working principle of early warning system: Early warning System is an Advanced Driver Assistance System ADAS (Advanced Driver Assistance System) in essence. It mainly applies two technologies on the basis of comprehensive factors such as people, vehicles, roads, environment and cloud, and integrates the vehicle-road cooperation technology.

3.1.1.The ADAS: Through the use of various vehicle-mounted sensors, such as millimeter wave radar, laser radar, monocular camera and satellite navigation, it is used to perceive the driving environment, collect data, detect, identify and track stationary targets and animals, and combine them with navigation map data for systematic calculation and analysis. This is the Advanced Driver Assistance System (ADAS). The system is designed to help drivers anticipate potential dangers, improve alertness, and greatly increase the safety and comfort of the vehicle while driving. In recent years, the ADAS market has developed rapidly. Systems previously limited to the high-end market are moving into the mid-market, many low-tech applications are becoming more common, and advanced sensor technologies are providing new opportunities and strategies for system deployment.

ADAS is an active safety technology that collects in-car data through various in-car sensors and simultaneously collects the environment around the vehicle in real time, identifying, detecting and monitoring static and dynamic objects around the vehicle, enabling drivers to quickly identify and deal with potential dangers and improving driving safety. ADAS, typically in front and rear bumpers, side mirrors, steering wheels and windshields, detect light, heat and pressure and monitor vehicle conditions using sensors such as cameras, radar, lasers and ultrasound. In the early days, ADAS technology is a passive alarm technology. Once potential danger is found, it will automatically alarm to warn the driver of abnormal traffic conditions and road conditions. Among the latest technologies in ADAS, active intervention is also often involved.

3.1.2. Vehicle-road cooperation technology: Vehicle-road Collaboration (VRC) uses advanced wireless communication technology and a new generation of Internet technology to realize comprehensive and real-time dynamic information exchange between vehicles and between vehicles and roads, and to collect and integrate dynamic traffic information at any time and anywhere, so as to achieve active safety. Vehicle and road cooperative management is a safe, efficient and environmentally friendly road traffic system. It ensures traffic safety and improves traffic efficiency by fully and effectively coordinating people, vehicles and roads.

Vehicle-road systems can be divided into curbside networks and vehicle-mounted devices, and curbside networks provide communication between curbside and vehicle-mounted devices. Vehicle-road cooperation not only tests and studies the communication between road equipment and vehicles, but also evaluates the communication between road equipment. In order to verify the cooperation between vehicle and road, a roadside network including roadside equipment was developed, and the corresponding communication protocol was established to realize the vehicle-road communication.

The proof of concept of vehicle-road cooperative systems begins with the assumption that wireless communication technology can solve traffic problems. DSRC technology is based on wireless communication technology, which is applied to the interaction between vehicles and roads. These results lay a solid foundation for the application planning and experiment of automobile safety technology. At the same time, the confirmation of the concept of vehicle-road cooperation also provides new impetus for the creation of the network car program and accelerates its development.

4. OVERALL DESIGN OF EARLY WARNING SYSTEM

The operation process of the system includes three stages: collecting information, processing data and actively warning drivers to prevent potential risks.

4.1. Collect information: In gathering information stage, this system not only through the vehicle sensors and integrated in the car terminal the OBU (on-board unit) of high precision GPS to collect relevant real-time position, the steering wheel Angle, vehicle real-time speed of transverse and longitudinal acceleration, will also conduct a wearable smart devices (smart watches, for example) to collect the driver including heart rate and blood pressure and other physiological index data, Collect vehicle environment information through roadside remote sensing equipment.

4.2. Data processing: After the information of vehicle, driver and road environment is uploaded to the cloud database through signal processing and signal calculation, the processor obtains abnormal speed characteristics of the driver according to the data analysis process in Chapter 4, judges the anxiety degree of the driver based on the abnormal degree, and determines whether there is a potential dangerous driving behavior. In terms of data of physiological indicators of drivers, although this project does not involve experiments related to physiological indicators and dangerous driving behaviors, when physiological indicators exceed the threshold of normal calm state, drivers can still be judged to be in an abnormal state.

4.3. Warning: After the cloud processing platform determines that the driver is in an anxious mood and has a potentially dangerous driving behavior, it uses the V2X system to communicate directly with the OBU of the vehicle terminal through the Uu communication interface. The early warning system will remind the driver to pay attention to controlling emotions through the vibration of the smart wearable device.

The system is complemented by an alarm system made up of red, orange and green lights and speakers, which uses a multi-stage decision warning mode to provide corresponding warnings for driving behavior under different levels of anxiety. ① Mild anxiety warning. The system starts flashing green lights, and the speaker plays "You are already tired, slight anxiety has been detected, please go to bed early." "And a slow beep. ② Moderate anxiety warning. The system starts flashing orange light, and the loudspeaker

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announces twice in succession, "You have been in a state of fatigue, moderate anxiety has been detected, please take a rest immediately", and the sound of "beep" accelerates and continues. ③ Warning of severe anxiety. The system started to speed up the frequency and kept flashing red lights. The loudspeaker increased the voice to announce "You have felt very tired, detected severe anxiety, must immediately stop to rest" for two times, while the rapid and harsh "ticking" sound was continuously issued.

Through voice prompt and visual prompt, the system can effectively improve the driver's vigilance against anxiety while driving, so as to ensure driving safety. At the same time, vehicles are flagged as potentially dangerous to drive, and short-range communication networks based on V2V technology can be used between vehicles to alert other drivers using the system nearby to the vehicles with lower latency. Receive warning signals in other drivers' systems to avoid traffic accidents.

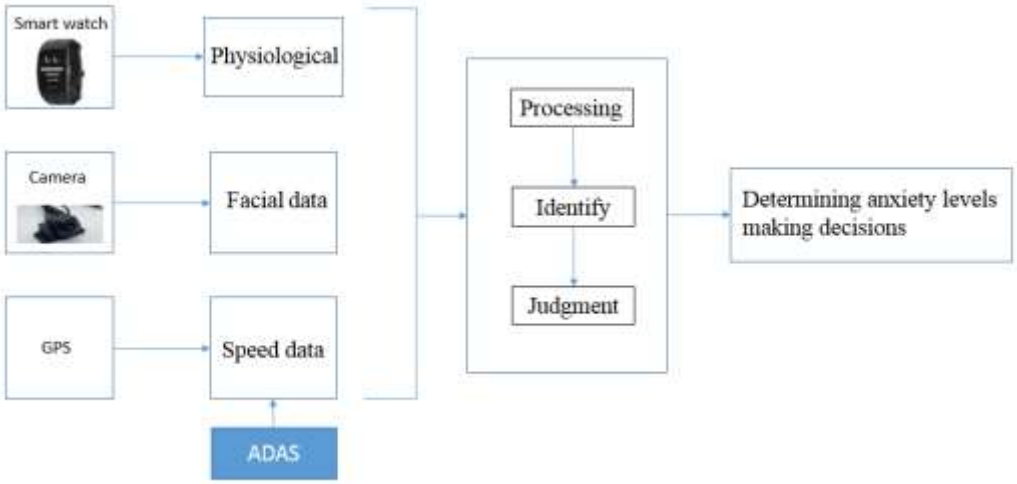

Figure 3: Concept diagram of early warning system design

5. CONCLUSION

According to the literature on dangerous driving behavior at home and abroad, the perception of the actual behavior of drivers and the identification of driving emotions are the key to judge whether the driver has anxiety and determine whether there is a potentially dangerous driving behavior, so as to give early warning and reduce accidents. In this paper, the early warning system of dangerous driving behavior is designed from the working principle of the early warning system and emotion recognition technology.

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