International
Journal
Of Advanced Research in Engineering& Management (IJAREM)
ISSN: 2456-2033 || PP. 35-39

Driver Fatigue Driving State Detection and Alarm System

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Abstract: With the development of social economy large distance transportation vehicles increase sharply drivers often ignore traffic laws fatigue driving for maximizing economic returns while some private cars often drive themselves out of fatigue because of various reasons. Causing lots of traffic accidents, bringing harm to society. Fatigue driving refers to the driver after long continuous driving resulting in physiological function and psychological dysfunction but objectively appear driving skills decline phenomenon. Fatigue driving refers to the driver after long continuous driving resulting in physiological function and psychological dysfunction but objectively appear driving skills decline phenomenon. A fatigue detection method based on AdaBoost and PERCLOS algorithm is designed. Firstly we locate driver face region through face detection algorithm then extract human eye region image and improve image processing process threshold contour recognition etc. Finally based on PERCLOS standard alarm mechanism is established. This system greatly enhances the accuracy of detection and real-time performance of system. Experimental equipment is stable and reliable, which can be applied effectively to operating vehicles.
Keywords: AdaBoost, Face recognition, Perclos

I. INTRODUCTION

With the development of modern chemical industry, especially since the beginning of the 21st century, the development of automobiles has been rapid, and automobiles have become everywhere[1][2]. It has become a necessary means of transportation in daily life, and the number of automobiles has grown rapidly. This is caused by many traffic accidents, such as driving at a speed exceeding the road, driving fatigue, deliberately drinking a vehicle, etc. These are the result of human factors. Driver fatigue driving can be early warning and prevention through scientific means. Fatigue driving refers to the sudden problems caused by the driver driving the vehicle for a long time or lack of sleep, and the decision-making ability is slow. The main changes are drowsiness, driving mistakes, intuitive delays and decision making. The driver is sleepy and completely loses his driving ability. Of all driver errors, the most common are intuitive delays and decision errors, which can be unresponsive, inattentive, and mishandled. Therefore, it is hoped that there can be an instrument that can detect the driver's fatigue in real time, and promptly remind the driver before the safety hazard occurs, then this system will be an effective means to prevent fatigue driving[3].

In the research process of fatigue driving, fatigue driving has attracted the attention of scientists for a long time. From different perspectives, medical, mechanical, computer vision and other research on it, for various reasons, there is still no one that can completely A system of fatigue driving. At present, a relatively complete fatigue driving warning method includes detecting a trajectory of the vehicle, whether the vehicle is tilted on the road, the driver's operating state, and the like. More reliable is to measure the driver's physiological signals to give early warning information[4]. From a medical point of view, the measurement of pulse signal technology is quite mature. However, the method is relatively limited, and the driver needs to wear a signal sensor during the entire driving process, which may cause serious discomfort to the driver and bring hidden danger to the driver[5].

In Europe, America and Japan, which have been studied in this respect, they have made a lot of progress in this aspect. The research results of Europe and the United States in this respect are:

The full name of the DDDS DDDS (Drowsing Driver Detection System) of Silicon Valley Research in the United States uses Doppler radar and signal processing methods to obtain a tracking and positioning system for the driver's eyes. The driver is detected by a camera placed in the vehicle facing the driver's face. And use fast and simple algorithms. To quickly determine the exact location of the driver's eyes in the facial image. The system can be made into a small instrument and mounted on the cab head above the cab. The Spanish ANT1 sleepiness system measures the grip of the driver on the steering wheel while driving, and judges whether the driver enters the fatigue driving stage when the driver changes the grip strength of the steering wheel as the driving time increases. Once fatigue occurs, the car's lights flash to alert the surrounding traffic vehicles[6]. In January 1997, Niloek of the Department of Computer Science and Engineering at Harvard University used continuous images, psycho-emotional and blink frequencies to determine whether the driver was asleep or sleeping. Professor Nikolaos Papanikolopoulos has successfully developed an amplitude image for monitoring driver fatigue. In March of the same year, he improved the system with infrared color cameras and filters, filtering out image noise and non-face images, reducing the number of searches for face images and speeding up image processing.

The Japanese pioneer company successfully developed the electronic "wake-up belt" which is an anti-fatigue system that is fixed to the driver's head and inserts one end of the plug into the socket of the cigarette lighter device in the car. The semiconductor thermocouple mounted on the tape cools the forehead aluminum plate, eliminating the driver's sleepiness and spirit. Toyota has recently developed a system that detects the physiological signal by wearing a physiological signal sensor on the driver's arm and measures the driver's heart rate by detecting the pulse of the pulse to determine the driver's fatigue. Mitsubishi has developed a driver anti-snoring system by studying the safety of vehicles. It can detect the driver's heart rate through the heartbeat sensor every minute, monitor the driver's sleep, remind the driver to pay attention to the driver and prevent accidents. Mitsubishi has also studied systems that monitor driver sleepiness by measuring blink frequency and body shake. Ericsson's head position measurement tracking system worked with Volvo to assess fatigue driving by measuring head position, eye closure and blinking, but he asked the driver's face to have a lot of signs on it, which gave the driver a pole. Great inconvenience.

In order to reduce traffic accidents caused by driver fatigue driving, a driver fatigue driving state detection scheme is proposed. The front face of the driver is detected by the camera, the position of the human eye is obtained from the face area after detecting the face, and the analysis of the closing frequency of the human eye is performed to determine whether the driver is in a fatigue state, and how to judge different drivers The difference in the human eye, such as the size of the eye. The rapid detection of the experimental face is improved by the strong classifier training algorithm of the AdaBoost algorithm. The position of the human eye after the face area is detected is determined by the number of frames closed by the PERCLOS to determine the fatigue of the driver.

II. ALGORITHM DESIGN FOR DRIVER FATIGUE DETECTION SYSTEM

This program uses a machine vision based fatigue detection method. Using the VISA STUDIO and the graphic image processing development kit OPENCV to develop the open source package program, and based on the knowledge gained from the reference documents, the driver generally looks forward during driving, occasionally using the left rear view mirror and the right rear view mirror, and Under the light. Under the sun, the head will be low to avoid the sun. It roughly locates the range of motion of the face. The camera is installed in front of the driver, and the image is processed by real-time image acquisition to obtain the frequency of closing of the human eye and finally obtain the result of the driver being fatigued. Therefore, in the process of actually designing the system, we must not only consider the normal face image, but also consider the dynamic situation of the face and the situation of illumination, so that the control system can be maintained under the perturbation of parameters of certain structure and size. Other performance characteristics achieve better results.

A. Face localization algorithm

Various face detection methods have certain advantages and disadvantages, and have limitations on the application. Knowledge-based modeling is usually based on statistical methods, which are generally based on statistical assumptions. Generally speaking, the precision is high, and the control system maintains some other performance characteristics under the perturbation of a certain structure and size parameters, but the calculation amount is large. The rapid changes in the light environment of the cab and a certain degree of vibration make it difficult to guarantee a stable and imaginary environment. For example, the lighting environment of the cab does not guarantee the modeling conditions for stable illumination based on the skin color detection algorithm, and the vibration environment of the cab cannot guarantee the modeling conditions based on background stability. Equivalent to the motion detection algorithm. The statistical detection method extracts a large number of facial features in the face sample through the pattern recognition training process. In the case of poor illumination, the face can be correctly recognized even if there are few features. In general, the statistical face detection method only requires that the current frame image is less sensitive to the vibration environment, and only a small amount of image noise has little effect on the performance of the algorithm.

According to the above analysis, the statistical-based algorithm has strong adaptability to the complex and variable light environment and vibration environment of the automobile driving room. In the statistical face detection algorithm, we finally choose the face detection algorithm based on AdaBoost algorithm.

B. Integrated learning

Most machine learning algorithms can only predict new samples by generating a single classifier, which is a combination of multiple weak classifiers. Each weak classifier can be a traditional machine learning model. The integrated classifier classifies the new sample and delivers the new sample to multiple low classifiers, and then somehow combines the classification results of each low classifier with new samples (such as voting and averaging) to predict synthesis Learning results. Hansen et al. found that classifiers generated by integrated learning algorithms are more accurate than classifiers that participate alone. We can also say that the advantage of integrated learning is that the performance of the integrated classifier is better than that of a single weak classifier. Among many integrated learning algorithms, the AdaBoost algorithm has the following advantages: the fast algorithm does not need to adjust any parameters except the training round number parameter T, and does not need to know any prior knowledge about the weak classifier and the performance of the weak classifier. . Don't need to be too high. It only requires a little better performance than random guess performance. In the actual situation, it is easy to obtain a weak classifier with low performance, which reduces the complexity of the algorithm, improves the efficiency, and is compatible with various methods in the composition of the weak classifier. These weak classifiers can be neural networks, decision trees, nearest neighbor classifiers, empirical rules, etc. Training data can be text, numbers, and data. Discrete values, etc., AdaBoost algorithm is easy to generalize to the classification problem of multi-class targets.

C. Adaboost detection algorithm

The training process of the AdaBoost algorithm is a repeated loop update process of sample indicators. The index value of each sample in the AdaBoost algorithm indicates the number of times the sample is misclassified, and the weight of the error sample increases during each round of weight update. The algorithm in the loop will pay more attention to the sample of the last error. If the sample is misclassified multiple times, the weight of the sample is weighted. As the weights get bigger and bigger, we call this sample a "difficult sample." In this way, the AdaBoost algorithm can aggregate more informative samples. Combined with two key issues of integrated learning algorithms, the AdaBoost algorithm is introduced. Firstly, the AdaBoost algorithm is applied to the H-like class feature of weak classifier for face detection, and then the integration method of AdaBoost is introduced. A weak classifier constructed by Haar-like class features generates a strong classifier, and finally a cascade classifier is obtained.

D. Human eye localization algorithm

Face positioning is a coarse positioning, that is, a human eye in a human face. Human eye positioning is the precise positioning of the human eye. If you look at the human eye from the entire image from the beginning, it will increase the positioning time. The human eye is an inevitable event on the human face, so face detection and human eye positioning in the face area can greatly shorten the time of human eye positioning and improve the real-time performance of the system.

The Viola Jones classifier uses the AdaBoost algorithm to learn the multi-layer tree classifier, which has a high detection rate and a low rejection rate at each node of the cascade. This algorithm is suitable for face detection. The algorithm has the following innovative features: Haar input features are used to threshold the sum or difference of rectangular image regions. Create two class problems with statistical BooStices enhancements. The problem (face and non-face) classifier nodes (high pass rate, low rejection rate) make the weak classifier form a cascade filter, as shown in Figure 1.

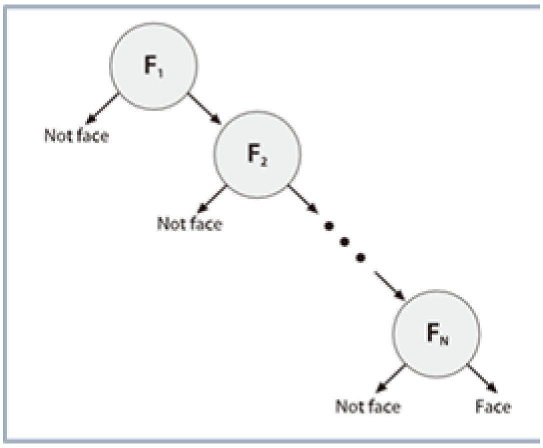

Figure 1 Viola-JonesClassifier

In the test mode, an object is considered to exist as long as the image area passes through the entire cascade. This ensures that the cascading runs very fast. Soon, because it usually does not include the image area of the object in the first few steps, and does not have to go through the entire cascade.

Viola and Jones combine the classifier with the node with the cascaded filter. The basic idea is to use classification capabilities. The weak classifier is superimposed (Boost) by some method to form a strong classifier. Each node in the cascade sets a threshold B such that almost all face samples can pass, and most non-face samples cannot pass. From simple to complex nodes, the more complex a node, the weaker the classifier it contains. For example, the recognition rate is 99.9%, the rejection rate is 50%, 99.9% of the face and 50% of the non-face can pass, the total recognition rate of 20 nodes is 95%, and the error acceptance rate is only 5%.

Both face detection and human eye detection are implemented using the AdaBoost algorithm. ACE detection and eye detection. The difference is that the face detection area is a complete whole image. The human eye detection area is only in the face area. If face positioning fails, human eye detection and direct processing are not required. Instead, go directly to the next image to save time. The area of the image to be detected is recorded as EA (effective area) each time. At this point, the data is transferred to the memory through the camera. At this time, the EA is the entire frame image. After detecting the face, the AdaBoost algorithm first records the face area according to the distribution of the human face organs. Place the new EA on the top half of the face 1/5 to 1/3 and then re-detect the human eye. After detecting the human eye portion, the EA is reconfigured for post-processing of the human eye.

The closed state of the eye is the main basis for judging fatigue. In order to obtain a partial image that is clearly reflected in the eye features, it is necessary to extract the calibrated human eye region by image segmentation and remove the interference portion. Threshold segmentation is one of the most commonly used methods in image segmentation. By selecting an appropriate threshold, the target in the original image can be separated from the background to provide a basis for classification and recognition of subsequent images. However, how to choose the optimal threshold is always a difficult point of threshold segmentation. And because of the influence of the driving environment, even if the optimal threshold is found, the effect of using the same threshold for different weathers and time periods is very different. Image segmentation using the improved Otsu algorithm improves some of the shortcomings of the traditional Otsu segmentation algorithm, but the resulting processing results still have the problem of blurred edges. In this paper, the adaptive threshold algorithm is used to achieve better results.

After thresholding the eye, simply scan all the points in the image, then find the coordinates of the highest and lowest points, and finally get the eyelid height. However, if the eye area thresholding effect is not good, the wrong result is obtained due to the existence of some points, and the interference factors such as the bridge of the nose cannot be removed, resulting in a large eyelid height result. In this paper, the method is improved. Firstly, the Canny edge detection algorithm is used to obtain the edge image of the eye part after threshold processing. Then use the contour detection method to obtain each contour of the image, and then perform the following operations for each contour line: the contour line is composed of a series of consecutive points, and the number of points of the contour line is counted, and the contour line with the number of points less than 10 is removed. This will remove some of the interference points in the image.

III. CONCLUSION

With the development of social economy, large-scale long-distance transportation vehicles have increased sharply. In order to maximize the economic benefits, drivers often ignore the provisions of the Traffic Law and drive fatigue. Some private cars are often driven by various reasons, causing a large number of traffic accidents. Bring harm to society. Fatigue driving refers to the imbalance between physiological functions and psychological functions after long-term driving, which objectively leads to a decline in driving skills. A fatigue detection method based on AdaBoost and PERCLOS algorithm is designed. The system firstly locates the driver's face area through the face detection algorithm, then extracts the human eye area image and improves the thresholding and contour recognition in the image processing process. Finally, an early warning mechanism is established based on the PERCLOS standard. The system greatly enhances the accuracy of detection and the real-time nature of the system. The experimental device is stable and reliable and can be practically applied to operating vehicles.

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