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Drive in Peace

Ayush Gupta, Aditya Rane , Shashi Mallah
Computer Department,Mumbai University.
Datta Meghe College Of Engineering,
Sector-3 Airoli,Navi Mumbai,Maharashtra.

Jayant D. Sawarkar (Asst. Prof.).
Computer Department,Mumbai University.
Datta Meghe College Of Engineering, Sector-3Airoli,Navi Mumbai, Maharashtra.

Abstract:In this paper, in order to implement a computer vision-based recognition system of driving fatigue. In addition to detecting human face in different light sources and the background conditions, and tracking eyes state combined with fuzzy logic to determine whether the driver of the physiological phenomenon of fatigue from face of detection. Driving fatigue recognition has been valued highly in recent years by many scholars and used extensively in various fields, for example, driver activity tracking, driver visual attention monitoring, and in-car camera systems.In this paper, we use the Windows operating system as the development environment, and utilize PC as the hardware platform. First, the system uses a camera to obtain the frame with a human face to detect, and then uses the frame to set the appropriate skin color scope to find face. Next, we find and mark out the eyes and the lips from the selected face area. Finally, we combine the image processing of eyes features with fuzzy logic to determine the driver's fatigue level, and make the graphical man-machine interface with MiniGUI for users to operate.Along with that we are using Arduino Uno microcontroller which is connected to MQ2-smoke sensor through which we can detect smoke which appears through issue in the car system. The results of experiment show that we achieve this system on PC platform successfully.

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1. INTRODUCTION

In recent years, because of the need for public transportation, cars and motorcycles grow at a rapid rate. The reasons of traffic accidents become much more complex, general transport system has been inadequate. Therefore, researchesdiscuss intelligent transport system (ITS) which combine advanced communicated technologies with information systems. It has become a popular topic of many research units in recent years. The driver's fatigue recognition system is a part of ITS vehicles active safety system.

There are a number of safety devices used in vehicles to protect the driver at present, for examples, seat belts, airbags, brake systems and hard sheet metal, etc. However, these devices always act after the accident happened. There are less ofequipment's can warn drivers before the accidents happened. Nevertheless, some signs usually exist before many accidents occurring. Driver fatigue recognition system hopes to warn driver when they are fatigued and avoid traffic accidents caused by fatigue.

This paper presents a driver's fatigue recognition system combining with the fuzzy logic approach. In different light sources and backgrounds, it can effectively determine whether the current driving situation of fatigue and falling asleep, and then give warning.

In section 2, we will explain the details of fatigue recognition algorithm; the section 3 is to introduce usinghardware and software architecture ofthe system.The section 4 is about Arduino Uno hardware The section 5 is methods and results of the experiment, and the final section of this paper is conclusions.

2. FATIGUE RECOGNITION ALGORITHM

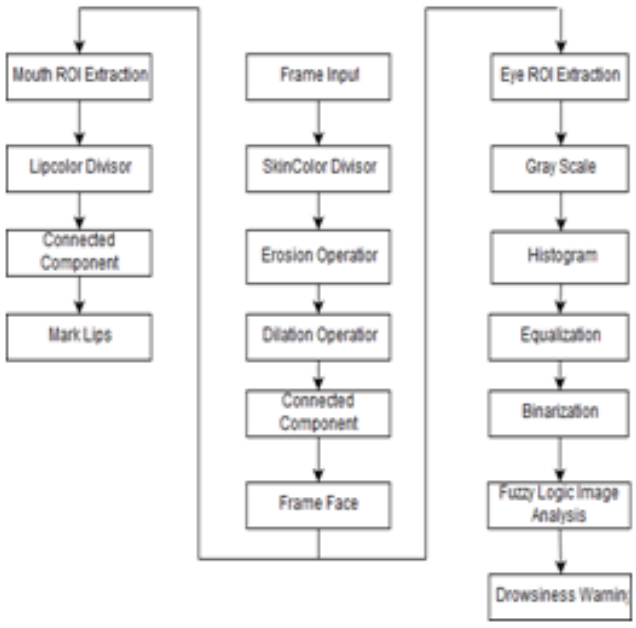

Fig. 1 The flow diagram of fatigue recognition algorithm

In figure 1, we proposed method of driver fatigue recognition using a multi-level image processing to filter out noises, and capture driver facial features in the image frame. Then, we used the eye's feature tracking combining with fuzzy logic approach to recognize the level of driver fatigue as well as give warning according to the degree of intensity.

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2.1 Face Detection

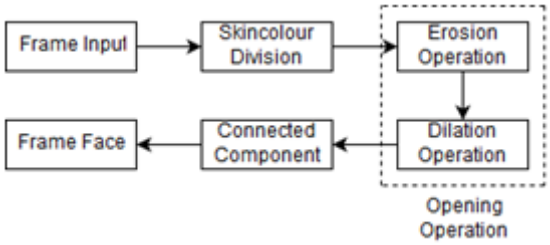

Fig. 2 The flow diagram of face detection

In figure 2, before capturing the facial features, we must find driver's face position. Therefore, this system uses a multi-level image processing to filter out noises and uses the method of connecting component to detect the driver's face location and mark it.

2.2 Eyes Feature Marking

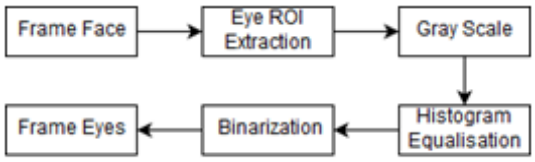

Fig. 3 The flow diagram of eyes feature marking

Driver fatigue recognition system can select accurately face position frame out; then, using a series of image processing actions to find the eye position and mark it, as in figure 3.

2.3 Lips Feature Marking

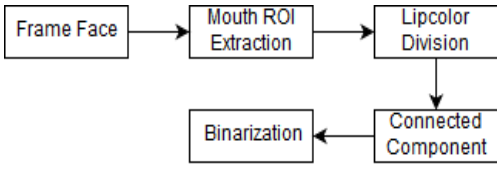

Fig 4 The flow diagram of lips feature marked

Due to the characteristics of lip's color, it is much easier than eyes, when we deal with skin color segmentation and filtering noises. We identify and mark the location of lips by segmentation of lip color and connected component method.

2.4 Use Fuzzy Logic to Computing Fatigue Level

Fatigue is physiology phenomenon of fuzziness, and it is not objective and quantitative; moreover, each person's feelings are different. Therefore, we employ fuzzy logic to make computer to determine whether people are fatigued. The fuzzy input variations of fatigue detection system are constituted by blinking period (eyes closed frames) and blinking interval (eyes open frames). We combine the above-mentioned input variations with fuzzy logic; it will issue warning when the driver is fatigued.

Until now, we can select out the eye feature precisely, so we set appropriate threshold based on the results of experiments. When we compute the white spot of ROI image which is higher than a certain value, it is frame of opening eyes; on the contrary, when it is lower than the certain value, it means closing eyes. On the basis of results, when we set the threshold value at about 30, the system can distinguish the eye which is opening or closing effectively.

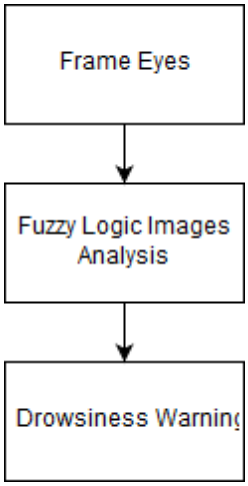

Fig.5 The flow diagram of fatigue recognition

3. SYSTEM IMPLEMENTATION

3.1 Hardware Structure

In this paper, we utilize PC based hardware system, the specification data sheet such as Table 1. External installation is Logitech QuickCamE3500 (CMOS) webcam which helps us image capture of basic, and its maximum resolution is VGA (640x480).

Table 1

Hardware specification data sheet

Mother Board
CPU: Intel Pentium4 processor 533/400 MHz FSB Memory: DDR266 (PC 2100) / DDR200(PC1600)
184 pins (2.5v)
USB Host and Device Port TFT LCD

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3.2 Software Structure

The UVC (USB video camera driver) driver is a webcam driver of LINUX. It makes the user utilize webcam on LINUX platform by UVC driver. Through USB video camera driver, we store the video streaming (motion JPEG, AVI Format) in the register. Then, we store JPEG (AVI Format) which has not been joined Huffman coding into the temporary block of memory by utilizing MiniGUI function and API of video for LINUX two (V4L2) . Furthermore, we insert Huffman coding table and JFIF information into temporary block of memory and we use MiniGUI to provide windows component and graphic function to display images on the monitor through frame buffer of Linux.

3.3 Software Development

There are two essential steps to building and constructing our system except the selection of the hardware platform and operating system at the beginning.

1) Image Capture in Linux: The V4L2 is an API for executing the image capture function under LINUX. It only needs hardware driver to offer input and output function (IOCtl) and makes the image capture programming easily. We can use timer function of MiniGUI to set up capture frame quantity in every second. Figure 7 shows the operation procedures of V4L2.

2) Building GUI Framework: At present time, most systems have a graphic user interface. We choose MiniGUI open source code to implement the graphic user interface (GUI) for plentiful user operating interface. The reason is not that MiniGUI has special fortes but its code size is smaller than general GUI open source code. The code size is one of the decisive conditions while we implement a real-time system. Besides, the system designer must also consider the question in many aspects such as the cost, hardware resource of the system and user's habit, etc.

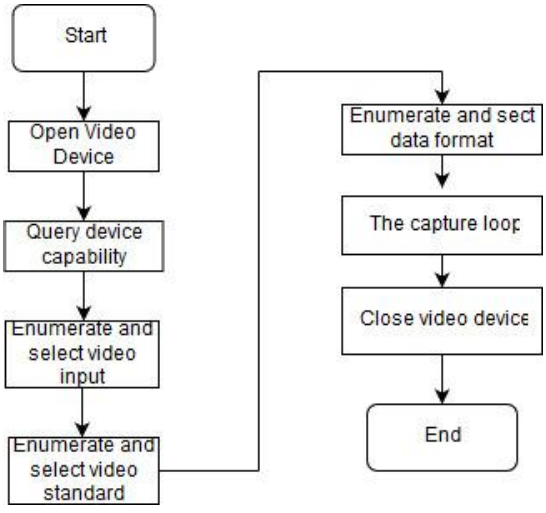

Fig. 7 The operation procedures of V4L2

4 How does Arduino Work?

Thevoltage that the sensoroutputs changes accordingly, to the smoke/gas level that exists in the atmosphere. The sensor outputs a voltage that is proportional to the concentration of smoke/gas.you will read the sensor analog output voltage and when the smoke reaches a certain level, it will make sound a buzzer and a red LED will turn on.

When the output voltage is below that level, a green LED will be on.

In other words, the relationship between voltage and

gas concentration is the following:

1. Thegreaterthe gas concentration, the greaterthe output voltage.
2. The lowerthe gas concentration, the lowerthe output voltage.

5 EXPERIMENTATION AND RESULTS

In this paper, the camera is set up on LCD monitor. User being in front of the monitor imitates the situation of driver sitting in front of dashboard when driving. The camera faces to driver to catch images.

Figure 10 is results of driver fatigue recognition. We use rectangular blue box to frame the face and white and yellow box to frame left and right eyes. In this paper, we can recognize driver's physiological state by combining with eye's feature and fuzzy logic and warn driver when they are fatigued.

According to (a) of figure 10, when the driver's physiological condition is normal in the screen, the system will determine that the driver is conscious; moreover, it will show as safety in the graphic user interface. Otherwise, when the driver is slightly fatigued, the system will change safety into caution to remind driver, as shown in (b). Furthermore, the system will display danger to warn the driver to pay much attention or take a rest when the driver is tired seriously or drowsy, as shown in (c).

(a) (b) (c) Fig. 10 Recognition result of driver fatigue

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CONCLUSION

This paper presents a system of drowsiness detection for driving car. Its main functions are face detection, feature extraction, warning of fatigue, and photograph for recording.

The system can find the positions of face and featuresin different light conditions and backgrounds and also detect the smoke with the help of Arduino Uno.

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