A System to Detect Drowsiness of a Driver while Driving a Vehicle

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***Abstract*—** Driver drowsiness is the major reason behind most of the road/vehicle accidents. It is very important to build a system to prevent collisions due to drowsiness problem of drivers. The basic goal to develop the Drowsy Driver Detection System is to avoid the road accidents which occur in a large scale on roads. The purpose of developing such a system is to keep the driver alert while driving to avoid accidents on roads and to save life. A Drowsy Driver Detection System has been developed, using a non-intrusive machine vision based concepts. The major components that the system encompasses are Raspberry pi, IC 555, Battery, goggle, IR Sensor, GSM Module. It finds the eyes blink, and also determines if the eyes are open or closed. If the eyes are found closed for 5 consecutive frames, the system draws the conclusion that the driver is falling asleep and issues a warning signal. This paper describes the Drowsy Driver Detection System that work accurately and efficiently, and also serve the best for the life.

Keywords*-drowsiness; eye blink; Raspberry pi; goggle; IR Sensor*

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I. INTRODUCTION

A Drowsy Driver Detection System has been developed, using a non-intrusive machine vision based concepts. This paper describes how to find the eyes blinking, and also how to determine if the eyes are open or closed. Once the eyes blinks, measuring are measured. If the eyes are found closed for 5 consecutive frames, the system draws the conclusion that the driver is falling asleep and issues a warning signal. The system captures the movement of eyes and determines if the eyes are open or closed.

The system deals with using information obtained for the binary version of the image to find the edges of the face, which narrows the area of where the eyes may exist. Once the face area is found, the eyes are found by computing the horizontal averages in the area. Taking into account the knowledge of eye regions in the face present great intensity changes, the eyes are located by finding the significant intensity changes in the face. Large distance corresponds to eye closure. If the eyes are found closed for 5 consecutive frames, the system draws the conclusion that the driver is falling asleep and issues a warning signal.

In this paper localization of the eyes, involves looking at the entire behavior of eyes while driving, and determining the behavior of the eyes. Once the behavior of the eye is analyzed, the system determines whether the eyes are open or closed, and detect fatigue. Because of the hazard that Drowsiness presents on the road, methods need to be developed for counteracting its affects. The focus is placed on designing a system that will accurately monitor the open or closed state of the driver's eyes in real-time. By monitoring the eyes, the symptoms of driver fatigue will be detected early enough to avoid a car accident.

From the table I, it can be observed that road accidents are consistently increasing every year.

Table I. Survey of Road Accidents

No. of Accidents And No. of Persons Involved: 2002-2011					
Year	No. of Accidents		No. of Persons		Accidents Severity*
	Total	Fatal	Killed	Injured	
2002	407497	73650(18.1)	84674	408711	20.8
2003	406726	73589(18.1)	85998	435122	21.1
2004	429910	79357(18.5)	92618	464521	21.5
2005	439255	83491(19)	94968	465282	21.6
2006	460920	93917(20.4)	105749	496481	22.9
2007	479216	101161(21.1)	114444	513340	23.9
2008	484704	106591(22)	119860	523193	24.7
2009	486384	110993(22.8)	125660	515458	25.8
2010	499628	119558(23.9)	134513	527512	26.9
2011	497686	121618(24.4)	142485	511394	28.6
*Accident severity: No. of Persons killed per 100 accidents					

There are various reasons which are responsible for accidents to occur. The details of causes of Road accidents as given by Government of India [1] is summarizes as follows:

1) Due to Driver (77%)
2) Weather Condition (1%)
3) Vehicle Condition (2%)
4) Pedestrian's fault (2%)
5) Cyclist's Fault (1%)
6) Road Condition (2%)
7) Other (14%) For major of accidents occurred "Driver" is found responsible with different reasons.

To address the issue of Road safety different pronged strategy may be adopted as:

1) Engineering
2) Enforcement
3) Education
4) Emergency Care

There are various functionalities that have been added in different Vehicles to avoid road accidents or sometimes to minimize the effect of accidents.

Driver's drowsiness or fatigue has been found as one of the main causes of accidents. To determine the drowsiness there are different measures that are useful like heart beat rate, brain signals and eye blinking of a driver. From all, eye blinking is found to be the most robust parameter which can detect drowsiness of driver more accurately.

II. RELATED WORK

A. *Existing System*

'**Drowsy Driver Detection Using Eye movement**' has been proposed for detecting drowsiness [1]. The focus is placed on designing a system to work accurately to monitor the open or closed state of the driver's eyes in real-time. By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident. Detection of fatigue involves a sequence of images of a face, and the observation of eye movements and blink pattern.

Disadvantages of the Existing Systems: Component does not establish interface with drivers, Due to varying illumination error in detecting occurs.

'In **Accident Prevention Using Eye Blinking'** [2] the efficiency is found to be medium. This system is further increased by using web camera with high resolution. Eye based control will be the future of all types of device control, thus making the operation so comfortable and much easier with less human presence. The results are subject to ambient illumination. If illumination is increased system fails to detect face and object. This limitation helps the system whenever multiple faces are found in an image frame, then the system detects only face which is closer i.e. having sufficient illumination.

B. *Disadvantages of existing system*

There are some disadvantages of the existing system, these are given below:

1) All the available projects are mostly based on image processing. In image processing localization of eyes and other drowsiness symptom doesn't result in accuracy.
2) Image processing doesn't allow driver to wear goggle in day time.
3) Component does not establish interface with other drivers very easily, Due to locking the ignition system of the car it may turn to a more bad accident.
4) Increases the risk of Traffic management to be maintained by these accidents and traffic jams.
5) As the system runs on the power provided by engine and it suddenly gets of then it does not help with GSM or GPS to work properly and the system fails.
6) Driver fatigue is a huge traffic safety problem and is widely believed to be one of the largest contributor to fatalities and severe injuries in traffic today, either as a direct cause of falling asleep at the wheel or as a contributing factor in lowering the attention and reaction time of a driver in critical situations [2], [3].
7) Accidents with commercial heavy vehicles are not only dangerous but also very costly and the counteraction of driver fatigue is highly important for improvement of road safety.

III. PROPOSED WORK

This section describes various modules involved in the Drowsy Driver Detection System.

A. *Sensor Data Exchange*

It is the first module of this project. It is designed to capture the data through hardware sensor. Inputs from the real world users will be recognized and recorded by hardware sensors. The IR sensors are place in the goggles and then it is connected to the circuit (Battery 9v, timer IC 555, analog to digital converter, alarm, LED). Connect Wi-Fi device to USB port of raspberry pi and connect the wires to pins. As the user wear these goggles and starts to drive the sensor starts working and it exchange the data (i.e. closed and open eye) whether the driver is drowsy or awake.

B. *Data Collection*

The module is designed to store hardware sensors information after every 15 seconds. This information includes different pattern such as blinking of eyes, redness of eyes and the normal distance between the eyelids.

When a system starts working it needs to be collected somewhere and the data is collected in database of the proposed system. A driver who is driving a vehicle is being recorded with the action of his eye blinks.

Stored data which is in the database of the system is verified and seen with the help of lx terminal in Ubuntu operating system. The command is entered to display the recording of eye blink pattern with every eye blink of the driver.

C. *Data Analysis and Inference*

It will process and understand the data and identify the results. All detection logic will be processed through the bunch of checks and conditions to confirm the final output.

The received data from the IR sensors are then processed as it is stored in the data base of the system. The algorithm will work on the data and an output is produced. Every eye blink of the driver is calculated as to measure the eye blink pattern of the driver.

After all the calculations of eye blinks the readings help us to find the result as whether

1) The driver is drowsy.
2) The driver is not drowsy he is awake.

D. *Data View*

A collection of UI-User Interface layers present the data. GSM module is used to give intimation over the phone about the status of driver drowsiness. This user interface is an android app which shows the results of the system. It is very user friendly as in today's world everyone has a mobile phone and almost everyone uses a smart phone.

If the result is driver is drowsy, immediately a message will be produced and sent to the police and any of his family members that the driver (name) is drowsy while driving.

E. Calculation of Eye Blinks

The main feature for drowsiness detection is eye blinking. The normal eye blinking rate varies from 12 to 19 per minute. The frequency more or less than this normal range indicates the drowsy condition of a person/driver. In this paper we have considered all the possibilities of an eye. Eye may be fully open, fully closed and partially open/closed. Instead of calculating eye blink rate, Algorithm calculates average drowsiness. For eye blinking, detected eye is equated with zero, which indicates closed eye. Where as one value is considered as fully open /partially open eye. The average drowsiness is calculated as follows:

$$\%d = \frac{\text{No. of Times eye closed}}{\text{No. of frame}} * 100 \quad (1)$$

Where d: drowsiness

After calculating % drowsiness, if this value is found to be more than a set threshold value then alert signal is generated for driver.

IV. Implementation Details

This section presents hardware details as well as software details that were used to develop the Drowsy Driver Detection System.

Fig. 1 depicts the arrangement of hardware which includes goggle, IR Sensor, IC 555, counter, Battery, Buzzer.

Figure 1. Hardware Arrangement

Fig. 2 shows connected raspberry pi with the other hardware in a way to receive input and send output.

Figure 1. Raspberry pi

Fig. 3 depicts the home page of Linux and the command prompt of Linux i.e. LX Terminal. LX Terminal is used to enter the command.

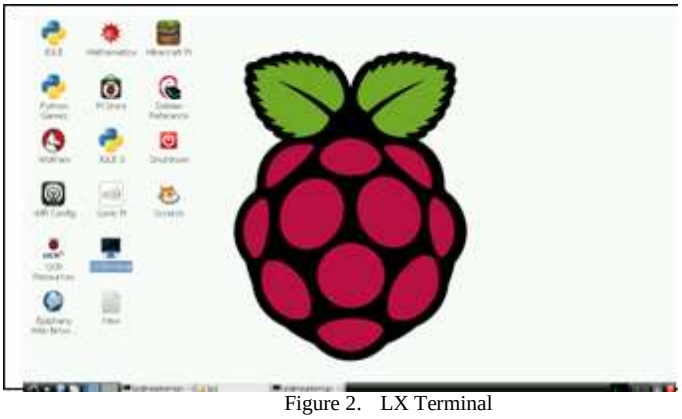

Figure 2. LX Terminal

Fig. 4 illustrates how the system will start the program at its backend and the program will run.

Figure 3. Python Shell - Backend of the system

Fig. 5 depicts the user interface built in Android in which list of contact numbers are added and saved. And Fig. 6 shows the message that is sent to those saved numbers in case of emergency.

Figure 4. User Interface (Android Application)

Figure 5. Alert message

V. DISSCUSSION

The newly generated system is lookout to be very standard and easy for working. A driver needs to wear a spectacle which is the main object in this system. If the eyes are found closed for 5 consecutive frames, the system draws the conclusion that the driver is falling asleep and issues a warning signal i.e. the system alerts a driver by generating an alarm. The system also delivers a message to the ICE numbers as well as to the numbers that are saved in the application if continuously drowsiness is detected so, that the appropriate action can be taken for that moment. These are the ultimate beneficiaries of the new system which provides life safety.

VI. CONCLUSION

A system to localize the eyes and monitor drowsiness is proposed. During the monitoring, the system will be able to decide if the eyes are open or closed. When the eyes are closed for a long time, a warning signal will be issued. In addition, during monitoring, the system is able to automatically detect any eye localizing error that might have occurred. In case of this type of error, the system is able to recover and properly localize the eyes.

IR sensor achieves highly accurate and reliable detection of drowsiness. Sensor offers a non-invasive approach of detecting drowsiness without the annoyance and interference. A drowsiness detection system developed around the principle of Sensor judge driver's alertness level on the basis of continuous eye closures. The IR sensor transmits (infra-red) rays and (infra-red) acceptor detects the rays and it sends information about it to raspberry pi where the algorithm works.

This system helps driver to keep alert while driving. The system includes a spectacle in which, IR sensors are placed in a way that when person (driver) starts feeling drowsy it plays an alert alarm.

VII. FUTURE SCOPE

Using a 3D image is another possibility in finding eyes. The eyes are the deepest part of a 3D image, and this maybe a more robust way of localizing the eyes.

Instead of alarm we can use Automatic Braking System which will reduce the speed of the car. Car can also automatically be parked by using Automatic braking system, which will slow down the car and simultaneously will turn on the parking lights of the car and will detect the parking space and will automatically park the car preventing from accident.

Using Pressure sensor on the steering alarm or Automatic braking System can be set in case of drowsiness.

By using wire-less technology such as Car Talk2000 If the driver gets a heart attack or he is drunk it will send signals to vehicles nearby about this so driver become alert.

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