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Human Drowsiness Detection System

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***Abstract:** Accidents have now become a daily part of the routine. There are various factors that play part in the growing amount of accidents. The quality of road accounts for half of the accidents and the human state of feeling sleepy, also called as drowsiness, forms a second major reason for these fatal accidents. To bring this kind of mishap under control, we are devising a system to alert the sleepy/drowsy drivers while driving the car to avoid any accidents. In this experiment, we take into account certain parameters like the detection of the face, position of the head and most importantly the blinking of the eye. Image Processing Algorithms are used to ensure proper detection of drowsiness in order to avoid accidents. The System is going to have an android application to have sessions for each vehicle driver, which will have detailed analysis of the drivers activities, such as drowsiness alerts, location, etc.*

***Keywords:** Face detection, Blinking of the eye, Drowsiness.*

I. INTRODUCTION

Drowsiness is a human characteristic that is not taken seriously by any individual. But this particular human feature can have grave and fatal consequences if not considered and acted upon especially on roads while driving. Drowsiness is defined as the state of feeling sleepy. A human being requires to have a minimum amount of 6-7 hours of sleep per day for proper functioning and for carrying out his/her day to day activities. When this particular factor is ignored and a person is not getting enough sleep due to any reason it directly leads to a state of drowsiness. This can get dangerous while a person is driving any vehicle. Most of the accidents occur because of the drowsiness of the driver and this is something that can be brought under control. Driver drowsiness detection is a technology that ensures car safety that can in turn help prevent mishap such as accidents when the driver is feeling sleepy. There are various other factors that can cause car accidents like the conditions of the road, weather conditions and mechanical fault/error of the car. But 80% of the mishaps occur due to driver's error that includes drinking and driving, fatigue and drowsiness. There are factors that affect the driver's ability to control the vehicle such as perception, natural reflexes and recognition. The diminishing of these factors can cause accidents. Our paper aims to evaluate specific activities of the driver to determine the drowsiness level. Various studies have suggested that around 20% of all road accidents are related to fatigue.

Driver fatigue is a significant factor in large number of vehicle accidents. The recent advancement in technologies for detecting or preventing drowsiness at the wheel is a major challenge in the field of accident avoidance systems. There are various methods through which drowsiness of the person driving the vehicle could be detected. Drowsiness detection can be divided into categories based on the vehicle, the behavior of the driver and somethings the physiological factors [1]. Possible detection technique based on the vehicle could be deviation from the lane or the pressure on the acceleration portal. Also detection through pulse rate, heartbeat etc. fall under the physiological methods. The Drowsiness detection system provided here focuses on the behavioral factors of the person driving the car. The behaviors shown by the person driving the car in the state of drowsiness include eye closure, eye blinking, yawning and also the head pose [1]. We majorly focus on the factors related to the eyes of the driver and detecting the state of drowsiness The use of image processing in the following system is very important and necessary as it provides one of the best solutions to detect the drowsiness at earliest and spares time to work on avoiding the accidents. Image processing is used in this system to process the images that are collected from the vehicle of the person driving the vehicle. We are also including one more feature in our project module that is Intrusion detection. This is an important feature for ensuring safety of the cars from the burglars.

II. MATERIALS

The Human Drowsiness detection system provides a solution to the accidents occurring due to the drivers being in the state of drowsiness. To achieve this the proposed system includes a collection of hardware components as well and android application to provide optimum solution/results. The components used in the system are explained in brief as follows:

A. Hardware

i. Raspberry pi B+
ii. Raspberry Pi Camera module
iii. GPS/GPRS module (PAM-7Q)
iv. Accelerometer sensor (GY-521)

We decided to use Raspberry Pi model B+ and Raspberry Pi Camera in our project because of the high performance of its CPU and higher frame rate. Raspberry Pi Model B+ supports C++ and OpenCV library. The GPS/GPRS module is included in the system to know the location of the vehicle. If the drowsiness is to be detected for any particular person in the vehicle the location of the vehicle is in hand and necessary precautionary measures can be made before-hand to ensure safety of the drivers as well as any other people in the vehicle.

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In case of accidents the location can also be used to send medical assistance and other support. Accelerometer sensors are used in the system to maintain a record of the speed of the person driving the car. If drowsiness is detected for a particular person driving the car the data regarding that specific person will be highlighted in the portal with any higher subordinate along with the speed of the car so the subordinate can then assess the situation accordingly. Using a web camera of low cost , we aim at capturing the picture of the driver driving the particular vehicle. The algorithm is applied on each edge of the video stream developed by the camera. The camera used has a frame rate of 30fps in VGA mode.

Dividing into frames:

Here we deal with a real time situation where in our video gets recorded and needs processing to be done. But the processing can be done only on the image. Hence the captured image has to be divided into frames for further analyzation. In this stage of the process, we deal with identifying the face of the driver. By identifying the face of the driver we mean that detecting facial features or characters through the use of computer. The frame maybe random. Only facial related structures are identified other types of objects are ignored.

Eye Detection:

After successfully detecting the face, we now focus on detecting the eye for further processing. This parameter is essential that helps in detecting the state of the driver whether the driver is active, sleepy or drowsy. The eye detection is done by analyzing the rate at which the driver blinks his eye. There is a particular threshold value set that decides the drowsiness. It is a time taking process and once the detection is done the result is matched with the particular threshold value set. After the successful eye detection , if the system detects the driver drowsy or sleepy, an alert alarm is sent to the driver to prevent accidents or any other mishap. The further demonstration for the same is given in the paper for the same. We use a library called 'dlib' that helps in easy detection of face as well as the eye. We use a method called 'Euclidean Distance' to identify the distance between the eye lids that helps in detecting the drowsiness. A driver with small eyes, with a spectacles or any other feature can be easily detected with the help of this library.

B. Software

The detection system also includes an android application which will have a login for the person driving the vehicle. The application will have a notification update on whenever the drowsiness of the driver is detected. It will have a log of all the time the drowsiness was detected for that particular person for further use. The android application requires an android device running on 5.0 and Onwards.

Our application does the work of alerting the driver regarding the drowsiness. It gives an alert to the admin about any kind of intrusion happening in the system to avoid any kind of robbery or burglary. The application gets refreshed every time the system restarts.

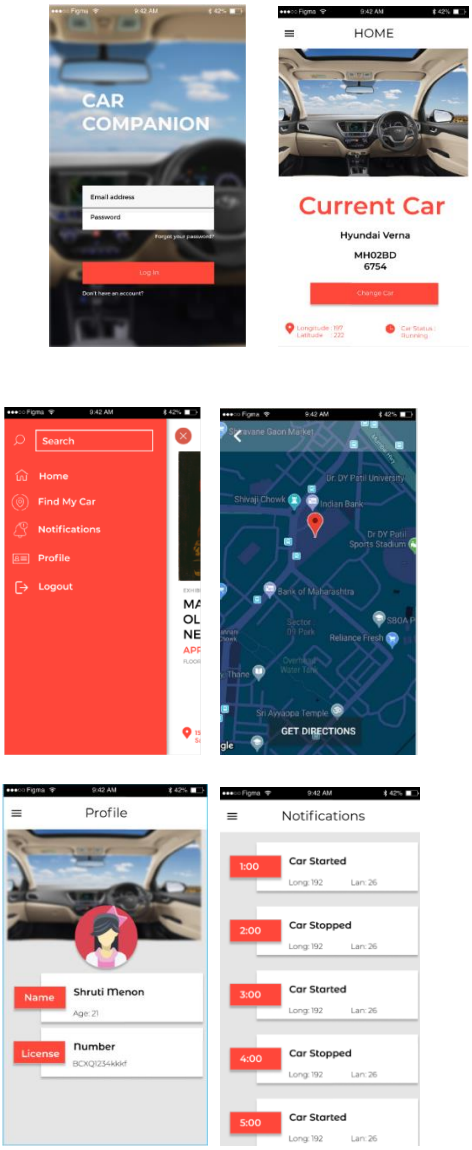

Figure 1. Snippents of Android Application for Human Drowsiness Detection System.

III. METHODOLOGY

The different aspects and features provided by the system to detect drowsiness as well as other features to provide intrusion detection are explained in detail.

Figure 2 shows the flowchart of the drowsiness detection system. As mentioned, the process begins with gathering streams of data by collecting image frames from the video streaming via the camera module. The collected images are used for processing, and the drowsiness is detected. Once drowsiness is detected, the person driving vehicle is alerted in the vehicle through the speakers in the car as well as in the mobile application.

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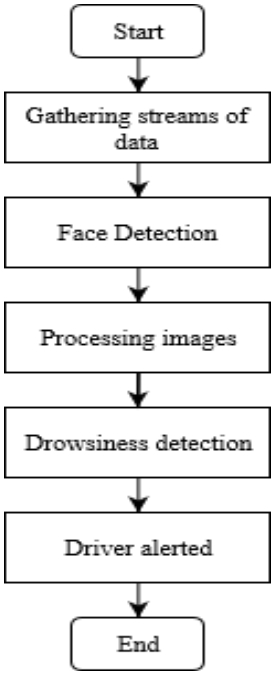

Figure 2. Flowchart of Drowsiness system

A. Overview Design

An IOT cum Android based project where we ensure the safety of car drivers by detecting drowsiness, detecting accident notifying all the nearby hospitals and GPS tracking where owners can track their car even after being stolen through their app. Using Raspberry PI3 and a normal PI camera module (compatible with RPI) , through python open cv we detect whether a driver is feeling sleepy or not by tracking his eyes. Using GPS module, GSM modem and accelerometer sensor we can detect whenever a car is involved in accident. For android app, we have included normal signup login page along with Firebase-auth sign-in page. Whenever accident is detected by our rpi3, it will notify our app through firebase and then our app will send messages with the GPS locations to the hospitals.

B. Face Detection

Driver Drowsiness Detection requires a video sensor to detect the faces of drivers. A Pi Camera was employed in this capacity. Also, it is processed by Raspberry Pi. This camera is also used to detect if there is any kind of intrusion in the system. This particular camera shall first detect the face and compare it with the template available in the database with the concerned authority. If the face matches with the given template, then there is no kind of intrusion detected. If the face doesn't match the template the concerned authority will get a notification and inform the particular driver about the intrusion taking place.

C. Eye Detection

The camera can detect the face of the driver, we calculate the drowsiness level of the driver based on eye blink rate. For instance, if drivers blink their eyes more frequently, the authors assume that the drivers are drowsy. Thus, it is necessary for this paper to detect eyes accurately in order to calculate for eye blink frequency. The camera recognizes the difference between the normal eye blink and a drowsy eye. This helps in turn in reducing the false alarm regarding the same.

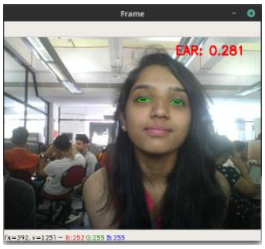

Figure 3. Normal Person without drowsiness output.

In Figure 3, the eyes of the user is in normal state and the eye blinking rate is less than expected. So it doesn't give any false alarm about the drowsiness of the driver.

Figure 4. Person with drowsiness detection output.

In this particular output, the eyes of the user remain closed for more than the required frames per second and hence the drowsiness level is detected. This is now notified to the concerned authority to alert the user.

IV. EXPERIMENTAL RESULTS

This section presents the results on the detection of visual indicators of drowsiness. Collecting the data set to properly evaluate the system is a challenge, this is because dangerous drowsiness events are not guaranteed to occur during daily driving for application testing. The table formats [1].

A. Detection levels under normal conditions.

This section focuses on data of various observations of data collected of driver drowsiness to calculate the efficiency of the system to detect drowsiness.

Table 1. Detection levels under normal conditions.

Test	Number of observations	Number of hits	Percentage of hits
Blink Detection	30	15	50%

B. Detection levels under special conditions.

This section focuses on the observations of drowsiness detection that were carried out which included different conditions than normal such as the driver wearing spectacles or the driver wearing a cap, etc.

Table 2. Detection levels under special conditions.

Test	Number of observations	Number of hits	Percentage of hits
Driver wearing cap	20	5	25%
Driver wearing glasses	30	10	33%

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C.Detection levels for other parameters.

This section focuses on the observations of data while considering any other factors.

Table 3. Detection level for other parameters.

Test	Number of observations	Number of hits	Percentage of hits
Hair covering driver's face	30	5	16%
Hair not covering driver's face	40	20	50%

V. CONCLUSION

This project proposes a drowsiness and intrusion detection system based on driver behavior. The role of the system is to detect facial landmark from images that are collected while the person is driving the vehicle by a camera module attached to the vehicle and deliver the obtained data to the trained model to identify the driver's state. Once the collected data is detected to be showing signs of drowsiness the person will be alerted using the speakers in the vehicle so that the person can stop the vehicle to avoid any accidents due to his drowsy state. The system also includes GPS tracking of car and alerts on mobile app regarding car movement. The admin of the system can monitor the sessions of the drivers and incase of any events such as person ignoring the drowsiness alerts or accidents can take proper actions according to situation. According to the experimental results, the size of the used model is small while having the accuracy rate of 81 percentage. Hence, it can be integrated into advanced driver-assistance systems, the Driver drowsiness detection system, and mobile applications. However, there is still space for the performance improvement. The further work will focus on detecting the distraction and yawning of the driver. Also accelerometer is to be incorporated to track the speed of the car.

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