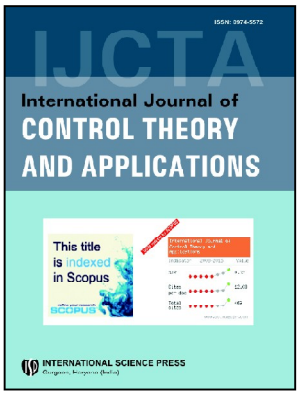

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IoT Based Monitoring & Alerting System Using Pupil Detection

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Abstract: *Objectives:* In this paper we discuss about the design of simple driver sleepiness detection system along with cloud storage of data and prediction of sleepiness by IOT. Based on the detected data this system alerts driver as well as owner of the vehicle. Driver sleepiness or sleepiness monitoring is one of the most demanded technologies for active prevention of severe road accidents.

Method: In this paper we detect the sleepiness of the driver by continues monitoring of driver's face by a monochrome camera and especially focus on pupil. Based on the pupil area the system compares and commands for alert or continuing the process. By adding IOT system to this project we can track the location of vehicle also. We can predict the time at which the drive is sleepiness based on the storage data in cloud by IOT and thus it is easy to prevent the problem of sleepiness and severe road accidents.

Keywords: camera, Image processing with Open CV library, Raspberry-pi 3, python, buzzers for alerts, Internet of things (IOT) technology using GSM or GPS techniques.

1. INTRODUCTION

The major reason for road accidents is the sleepiness of the driver. In the recent statistics shows that 20% of road accidents are only because of sleepiness of driver. During this about 1 lakh people are dying and many more are being injures every year.

So, in order to reduce the road accidents especially by sleepiness we detect and monitor the sleepiness levels of driver and alert them [1]. In this monitoring and alerting system we use a Raspberry-pi board as the base of the system. We use a camera which is fixed in front of driver which sends or scans the face continuously. By using the Haar cascaded algorithm and Hough circle algorithm we detect the pupil of the driver. The detected data is transmits to Raspberry-pi board. The board detects the Hough radius and compares with reference level. Based on the Hough circle's radius, it gives alert of sleepiness. We use the additional feature to this system i.e. IOT. We use GSM and GPS modules in the board which the owner can access the data of vehicle position and also he can access the data were the driver is sleepiness or normal and also the alerting levels of the system.

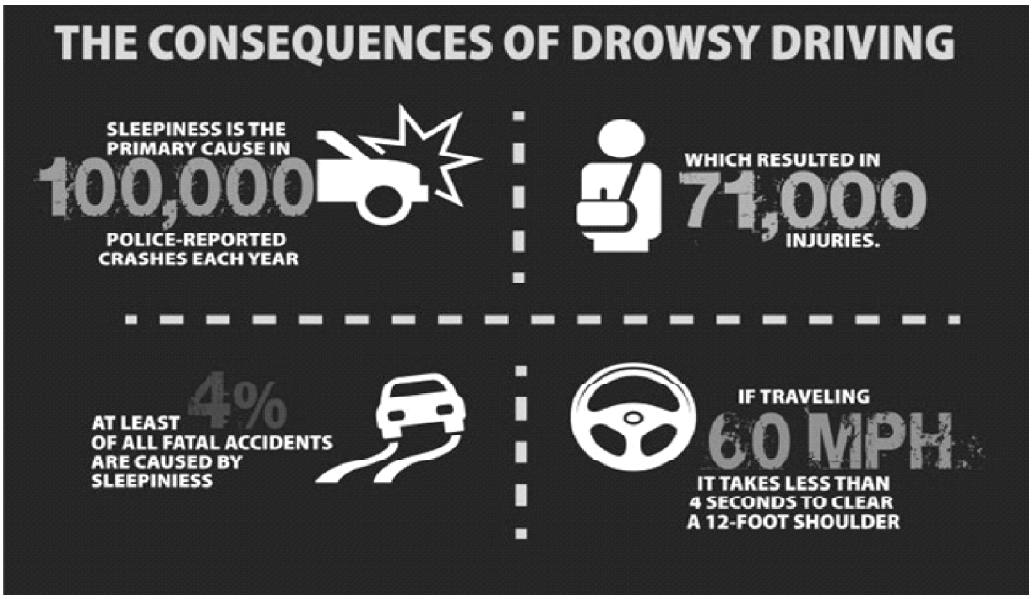

Figure 1: The consequences of Drowsy Driving

2. LITERATURE SURVEY

This IOT based monitoring and alerting system is not the newest of detecting and alerting the driver of vehicle when they feel sleepiness [2]. In previous studies and papers many methods are implemented to detect the sleepiness of the driver. They used three main methods. They are monitoring the vehicle based on the alignment on road, biometric data of driver body like heartbeat, temperature etc. Later they detect the sleepiness by comparing the face area and gestures like yawning, blinking rate of eye etc. and lastly the most useful and accurate the detection of pupil.

Coming to the failures of each system, the first method is of detecting by alignment of vehicle on road. In this method if we have to overtake or cross the vehicle which are going besides us base on the traffic and space, we used to steer the vehicle both sides of the road. It does not work in uneven roads also, because of the patches on road we often have to turn the vehicle on both sides of road. This is not a good method to detect the sleepiness of driver [4].

While coming to the second method of detecting, it is based on body biometrics. In this system we observe the heartbeat, temperature, skin resistance etc. of driver. This are vary in sleeping time and non-sleeping time. But implementing of this method, the biggest drawback is the reference values are changes according to the person and their age. Based on his health condition those parameters are also changes. So it is also not the best method and it has its own disadvantages.

Here coming to the next method of detecting the sleepiness by continuous monitoring of face. The area and shape of the face are taken as the reference level and compares [8]. In this method the gestures like yawning and the expressions of mouth end eye brows it detects the sleepiness level. But it has defects of varying face area from person to person and the expressions are also not matches. Anyway it is better when compare to previous methods but not of much accurate. Then the last method which we use is similar to previous but little bit change is that we detect direct pupil instead of entire face. The radius of Hough circle is taken as reference level and based on detected data alert is produced. This driver sleepiness monitoring and control system is already implemented for various prominent car companies like Audi, BMW, Range rover, Mazda, Mercedes Benz, Ford, Volks wagon etc. But they are all uses different methods which we discussed above. Because of using this

pupil detection we have more efficiency in the working and monitoring. Many of the previous papers and projects explained the sleepiness detection. But they were not used the GSM and GPS modules to track the system on the method of pupil detection.

The main advantage of the system is it can stores the detected data in cloud by IOT method. While coming to the other all previous systems they give alert or warning only when the driver is drowsy. But in this system we can predict the time when the driver feels sleepiness often by continues monitoring of multiple days. So it gives alert or suggests the driver to take rest or stop vehicle during the time whenever the driver feels drowsy. So we can avoid road accidents before the driver feels sleepiness and we can reduce the accidents most efficiently.

3. SYSTEM MODEL

As the name indicates it is a continues method of monitoring the driver by detecting the pupil [5]. The first and foremost requirement of system is power supply to run the each individual components of equipment like camera, Raspberry-pi board, modules, buzzer, screen etc. in the system. The Raspberry-pi is the key controller for this system which controls the entire operations like processing monitored data, alerting, controlling etc. Raspberry-Pi board can be used for most efficient working of this system for multiple image processing and also in continuous manner as it is of RTOS system. Coming to the next part i.e. Camera for capturing of images [6] we can use a web camera of normal resolution or HD, but the memory taken by the image should be small because of more efficiency of camera. The time taken for the processing of image should be small, so the memory consumed by an image should be small.

The Raspberry Pi initialize the commands to the buzzer circuit, which enables the GPIO pins to perform operation such as alerting, sending message to owner of vehicle etc. are performed based on sleepiness level. As mentioned above this system is RTOS (Real Time Operating System) which process the signal on real time it means of no delay. The program used for working of this board is “Raspbian” which is based on Linux software and it is own operating system.

In the total part of operation the detection of eye pupil is the most difficult part. So, a new image processing technique is used to detect the pupil based on open CV. Most of the coding part is done with the help of Open CV library. The operation takes place in different steps and those steps are performed based on different algorithms like Haar cascading, Hough algorithm. In order to get connect with the Raspberry-pi board to the system we use putty software and we use Python language for easily understanding of data to user and system also.

4. METHODOLOGY

The principle of this system is detecting the eye ball or pupil and comparing Hough circle’s radius with the reference level that we fixed already. The first part of the operation is to detect the face by capturing the face and detects the eye. The USB camera which is placed in the vehicle uses to capture the face by Haar cascade algorithm. In this Haar cascade algorithm consists of following steps. First the camera captures the face and that captured image is converted to gray scale and then the Haar algorithm program runs by detecting the shape and features of face. Then finally face is recognised. After face is detected eyes are detected using same algorithm. pupil is detected we calculate the radius of the Hough circle and gives the data to Raspberry-pi board. After detection of eye we implement Hough transform algorithm for the detection of pupil and its area. . It compares the radius and dimensions of pupil with the reference level which we fix before gives alert. Lets call the dimensions as threshold values. The camera continuously monitors the detected eye and its pupil, when the detected pupil is reaches to below the fixed threshold levels than the system will alert the driver with the call or buzzer and the related information will also get updated to the cloud.

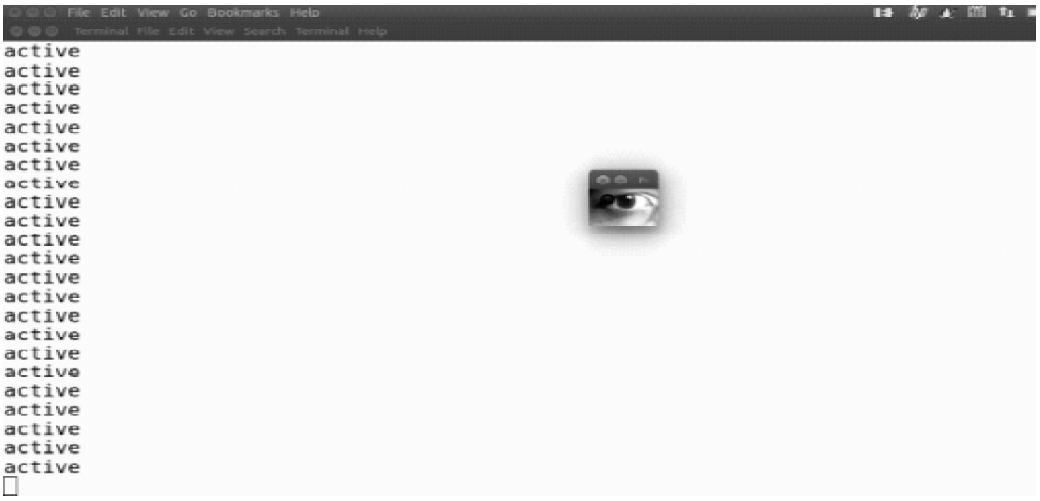

Figure 2: When the Driver is Active

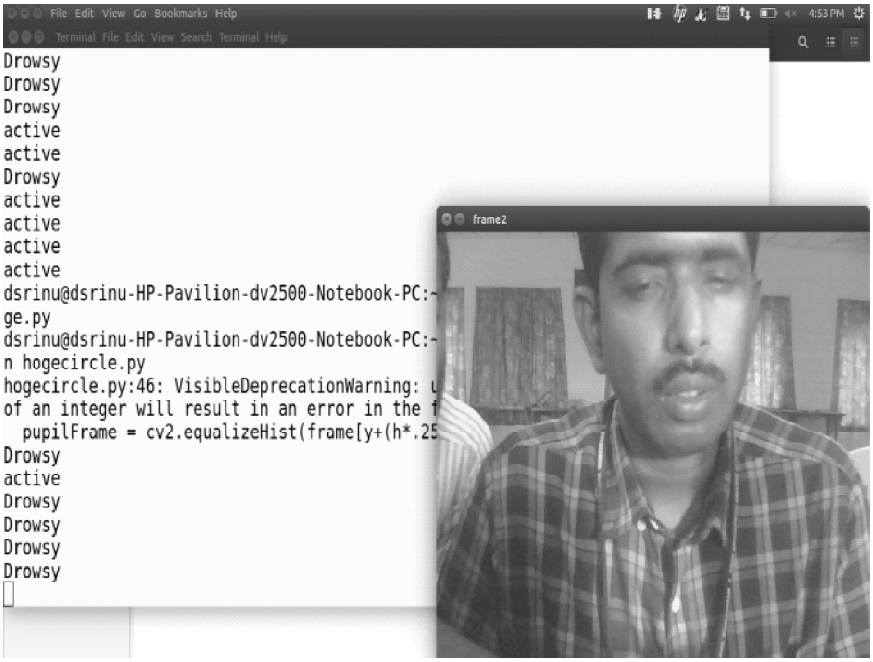

Figure 3: When Driver is Drowsy

Here we have to take care of the eye blinking. So we add extra feature in program for avoiding small eye blinks which are common and necessary [11]. The regular eye blinks which the time taken is in the order of few milliseconds are avoided by continues monitoring. For suppose in certain instant of capturing, the eye is closed because of blinking. But the system takes it as eye is closed and driver is extremely sleepy because of Hough circle's radius detected is almost zero. So we also calculate the time of Hough circle's radius is smaller than reference level. While that time is in few milliseconds then it considers that position as eye blink. If the time taken for the Hough circle's radius is smaller than reference level is grater or in the range of few seconds, then depending upon the Hough circle's radius the systems decides the sleepiness level of the driver.

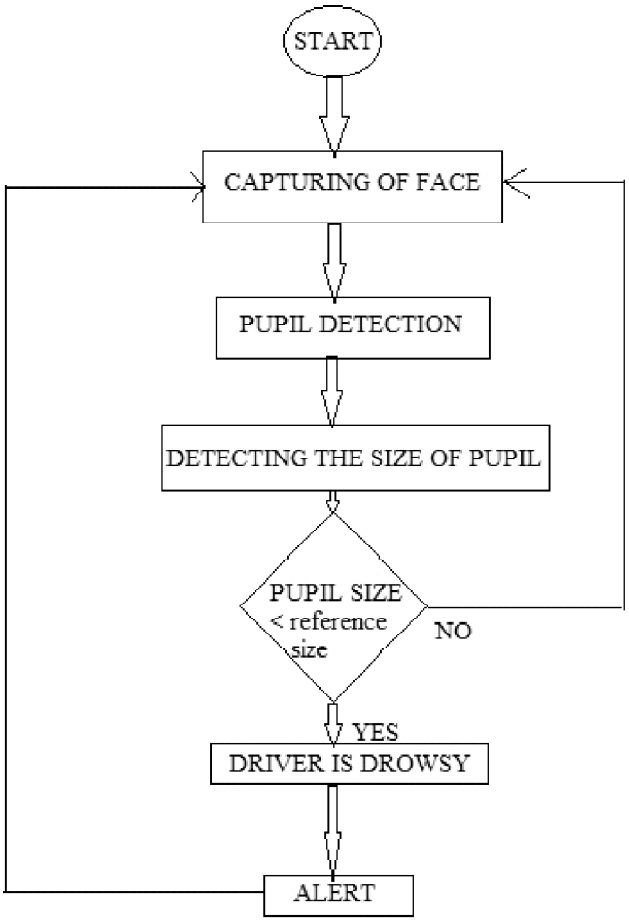

Figure 4: Flow chart

5. SYSTEM IMPLEMENTATION

Coming to the power requirements and connections of Raspberry-pi board, it consumes low amount of power only. We have the connections to the board like GPIO pins, USB ports, UART, Port and GPS/GSM module for connecting the system to cloud. The memory size of the Raspberry-pi board is 1GB RAM and it can capable of up to 32GB external memory

6. IOT CONNECTION WITH THE SYSTEM

Internet of Things (IOT) is the most commonly using technology in present days. It is the process of controlling the electronic devices through internet. So, by using this IOT method i.e. to connect the system with internet we can store the monitored data in cloud. GPS/GSM module which is in the system used to connect with internet. So we can track the vehicle position and the position of driver whether the driver is sleepy or not with the cloud data. Raspberry-pi board sends all the monitored data after the processing of operation to Cloud by connecting with the GSM/GPS Module. We can access the data from cloud like the route or navigation, nearest restrooms etc.

7. ADVANTAGES

It alerts the driver if he/she feels sleepiness. It sends information of driver activeness, if he/she fell too much of sleepiness or sleep while driving. We can access the position of driver through IOT using GPS/ GSM module.

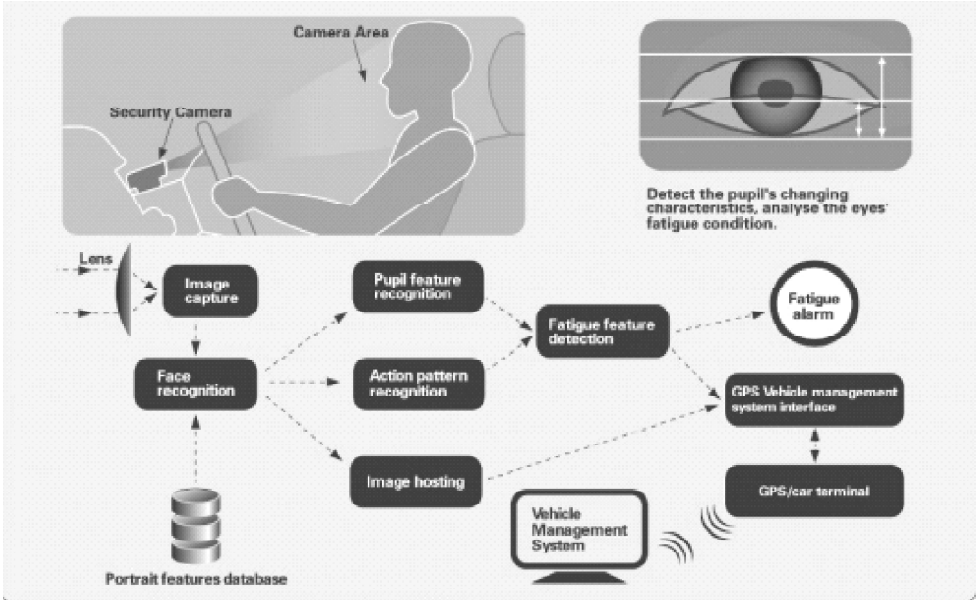

Figure 5: System Functionality

We can track the position of vehicle by GPS module and tracks the longitude & latitude position. It predicts the time when the driver feels sleepiness often and suggest to stop the vehicle and to take rest based on the analysis of the collected data present on cloud.

8. LIMITATIONS

The main disadvantage of this system is the position and capturing of image by camera should not grab the attention of driver while driving. So camera size should be small as much and it will not produce much intensity of light while capturing.

9. FUTURE SCOPE

We can develop this IOT based monitoring and alerting system in upcoming days by resolving the issues or limitations that we faced while implementing this system. The first and foremost development wants to make for this system is to avoid its main disadvantage of variation in calibration by Hough circle radius changes from person to person. So, at the time driver starts the vehicle or when this system is ON, it takes the picture if driver and detects his/her pupil and calculates Hough circle's radius. Then that value is taken as reference level, so the problem of variation in calibration can be avoided.

In future we can add one more feature to this system that it suggests driver to take rest which is already included but the difference is based on location of place. It means if the driver is sleepy the system searches for the places which are convenient to take rest like hotels, lodges, parking places etc. which are nearer to vehicles position. As this system is already connected to internet we can access the data that we require to locate such places and then system suggests driver to take rest by that you are felts sleepy and there is a hotel or lodge or parking place which are 2km or 5oomts etc. away to stop the vehicle and take rest.

10. CONCLUSION

IOT based monitoring and alerting system helps to avoid the road accidents which are occur mainly due to sleepiness of driver. Adding IOT to this system helps more and increases the efficiency of system by tracking of

vehicle position and also it sends data recorded to cloud which uses to predict the drowsiness of driver and suggests taking rest before they fell fatigue which reduces the accidents highly. The tracking of pupil is most difficult as the area of pupil or Hough circle's radius is varies from person to person. We have to implement the system which the reference level is adjusted base on person. Continuous development is being proceeds to develop this system for more applications.

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