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ROAD SAFETY OF DRIVERS THROUGH EYE DETECTION

A Project Report of Capstone Project – 2

Submitted by

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SCHOOL OF COMPUTING SCIENCE AND ENGINEERING

BONAFIDE CERTIFICATE

Certified that this project report "**ROAD SAFETY OF DRIVERS THROUGH EYE DETECTION**" is the Bonafede work of "**SUSHIL KUMAR**" who carried out the project work under my supervision.

SIGNATURE SIGNATURE

HEAD OF THE DEPARTMENT SUPERVISOR

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CHAPTER 1

Abstract

The purpose of the project is stop/decrease the increasing number of road accident cases everywhere the planet. Car accident is the main reason for death in which around 1.3 million people die per year. sleepiness could be a state between consciousness and sleep. Driver dizziness one of the most important causes of road accidents within the world. Detecting the drowsiness of the driving force can surely help us. In this project we want to create a subsystem for drowsiness detection. By which we are going to watch the eyes of the drivers and an alarm will sound when driver is feeling drowsy or fall asleep. This project is monitoring the live data that it gets on real time. The aim of this project is to decrease the numbers in accidental road cases of the drivers without being obtrusive. We will be focusing on drivers eyes, if the eyes of driver remain closed for a particular amount of time, system will consider him drowsy and alarm will start ringing ,this will make the driver awake and he can safe himself and other from the accidents.

The principle of this proposed system is using OpenCV library relies on the facial images analysis by which we can warn the driving force of dizziness /sleepiness or in order to control the number of accidental cases all around on roads. This proposed system could also be used to evaluate the effect of drowsiness/asleep warning under various conditions of the drivers ,we will be accumulating the results and then we can use them in our system to reduce the number of cases and by which we can track the cases as well for further enhancement in the developed system .This will play a very critical role in saving life's and decreasing the count of death and accidents all over the world.

CHAPTER 2

2. INTRODUCTION

(i) OVERALL DESCRIPTION

From last few years we are seeing a vast increase in the road accident cases most of which are due to Driver's feeling sleepy or fall asleep due to tiredness. Recent statistics of National Highway traffic safety administration calculate that annually 1,800 deaths and 96,000 injuries are because of the driver's fatigue. According to Global status report on road safety given by WHO reflects 180 countries has indicated that worldwide the total number of road traffic death are plateau 1.25 million per year, with India reporting about 1.34 lakh people out of total population has road accidents every year, 70 % of them being due to sleepiness of driver.

We want to introduce a technology for detecting or preventing drowsiness is a major challenge in the field of accident avoidance systems.

Goal of this project is to make a detection system drowsiness that detect sleepiness of driver. The focus is to create a system which will monitor the open or closed state of the driver's eyes in real-time.

This monitoring of eyes will help us detecting the drivers fatigue at an early stage and with help of this we can avoid the accidents. System will monitor the fatigue of drivers by the movement of their eyes and with the eye's blinking patten. The closing time of eyes while blinking is 0.10 seconds and we blink in every 4 seconds if eye close for .20 sec then alarm will be ringing. So, this proposed model will calculate the time by focusing on the localization of the eyes, which involves looking at the entire image of the face, and determining the position of the eyes, by a proposing well image processing algorithm

Once the position of the eyes is located, the system is designed to determine whether the eyes are opened or closed, and detect fatigue

Distraction problem of the driver can also be solved through this project as it will detect the eyeball movement of the driver and let him/her know that he is not looking in the front and alarm will activate to stop the vehicle.

. For our project face and eye classifiers are required. So, we used the learning objects method to create our own haar classifier files. If detected, then alert will be sent to both the driver and owner of the vehicle and alarm will ring to wake up the driver asking him to stop the vehicle.

(ii)PURPOSE

The purpose of this project is to decrease the number of Car accident that are major cause of death which is around 1.3 million people die every year. Most of road accidents are caused because of unnecessary distraction or the global

.

Number of vehicles and peoples are increasing everyday who are travelling day and night. Improper sleep or tiredness, distractions like incoming call, talking with passenger, etc. might lead to an accident. For preventing these types of accidents, so we want to make a system which alerts the driver if the driver will be distracted or driver sleepiness.

(iii) MOTIVATIONS AND SCOPE

sleepiness of driver is a major factor in the increasing number of road accidents. That has been proof and verified by many researchers that have demonstrated ties between driver drowsiness and road accidents. We can't decide the exact number of accidents due to sleepiness of driver; it is much likely to be underestimated. But with this research we came across to know that it is major reason for the road accidental cases.

The scope here is to develop a application that make pre-assumptions about the relevant behaviour of drivers, focusing on blink rate, eye closure, and yawning and can make a decision in real time by which we can safe people life and can also control the accidental cases.

1. This project can be implemented in the form of mobile application to reduce the cost of hardware.
2. This project can be integrated with car, so that automatic speed control can be imparted if the driver is found sleeping.

3. LITERATURE SURVEY

- Quang N. Nguyen, Le T. Anh Tho, Toi Vo Van, Hui Yu and Nguyen Duc Thang H. Yu(Nature Singapore Pte Ltd. 2018)
- In the paper of School of Creative Technologies, University of Portsmouth Portsmouth, UK© Springer Quang N. Nguyen, Le T. Anh Tho, Toi Vo Van, Hui Yu and Nguyen Duc Thang, a camera-based system was proposed to detect and monitor drowsiness of a car driver in real time. The system utilizes an RGB image to track the drivers' face and their eyes to detect sleepy sign. Once the eyes are located, the local region of eyes is extracted to yield binary images of the eye silhouettes in which the open and close stages of the eyes are revealed. The portion of the close states of the eyes during a certain number of frames is calculated to track the drowsiness signs. If this portion exceeds a predefined threshold, the system concludes that the driver tends to be falling asleep and generate alert to the users. For the face detection and segmentation, a robust method based on Haar features is applied. In this paper, they present a drowsiness detection system using visual camera. Another contribution of this work is that they propose a novel method of eye region extracting using a state-of-the-art machine learning technique called decision tree (DT).
- Ines Teyeb, Olfa Jemai, Mourad Zaied, and Chokri Ben Amar

Research Groups in Intelligent Machines (REGIM-Lab), University of Sfax, National Engineering School of Sfax BP 1173, 3038 Sfax, Tunisia 2018

In their research paper they introduce a drowsy driver detection system of driver based on method for their head posture estimation and gave named it as a "A Drowsy Driver Detection System Based on a New Method of Head Posture Estimation". In first part, they introduced six possible models of head positions that can be detected by the algorithm which is explained in the second part. Indeed, there are three key stages characterizing the method: First of all, they proceed with driver's face detection by Viola and Jones algorithm. Then, they extract the image reference and the non-image reference coordinates from the face bounding's box. Finally, based on measuring both the head inclination's angle and distances between the extracted coordinates, they classify the head state (normal or inclined). Test results demonstrate that the proposed system can efficiently measure the above-mentioned parameters and detect the head state as a sign of driver's drowsinessYabo Yin, Yunkai Zhu,

Shi Xiong, and Jiacai Zhang College of Information Science and Technology, Beijing Normal University No.19, Xinjiekouwai Street, Haidian District, Beijing, P.R. China 2018

In their paper, they put forward an EEG labelling method employing K-means clustering to separate EEG signal recorded in consciousness and drowsiness states. EEG dataset is divided into two categories according to the EEG rhythms' spectrum pattern and assigned label of drowsiness or consciousness. Comparative study showed thatαand β wave in EEG correlated with the drowsiness level. They also designed an LDA classifier trained with the labelled EEG data and used it to classify the EEG data into consciousness and drowsiness states. The high classification accuracy illustrates the method put forward in their paper can distinguish these two states (i.e. drowsiness and consciousness) with a high recognition rate.

- Nawal Alioua1, Aouatif Amine1,2, Mohammed Rziza1, and Driss Aboutajdine11 LRIT, associated unit to CNRST, Faculty of Sciences, Mohammed V-Agdal University, Rabat, Morocco nawal.alioua@yahoo.fr, {rziza, aboutaj}@fsr.ac.ma 2 ENSA, Ibn Tofail University, Kenitra, Morocco 2017

In their paper they propose a robust system which monitor driver's fatigue/sleepiness in real time. That model extracts the face from the video frame using the Support Vector Machine (SVM) face detector. Then a new approach for eye and mouth state analysis -based on Circular Hough Transform (CHT) - is applied on eyes and mouth extracted regions. There drowsiness analysis method aims to detect micro-sleep periods by identifying the iris using a novel method to characterize driver's eye state. Fatigue analysis method based on yawning detection is also very important to prevent the driver before drowsiness. The system was tested with different situation recorded in various conditions and with different subjects. They named there project as "Driver's Fatigue and Drowsiness Detection to Reduce Traffic Accidents on Road ".

4. PROBLEM STATEMENT

Today drowsy driving is a serious problem that leads to thousands of accidents each year. Motor vehicle collisions lead to significant death and disability as well as significant financial cost to both security and individual due to the driver impairments. Drowsiness is one of the factors for collisions. In India, no monitoring device is used to measure the drowsiness of driver. Some kind of systems like driver fatigue monitor, real time vision based on driver state monitoring system, seeing driver assisting system, user centre drowsiness driver detection and working system are implemented in foreign countries. All the systems focus either changes in eye movement, physiological measures or driver performance measure. Due to illumination variation, the traditional systems have some defects, which have been already explained in the literature survey.

CHAPTER 3

EXISTING SYSTEM

By using a non intrusive machine vision based concepts, drowsiness of the driver detected system is developed. Many existing systems require a camera which is installed in front of driver [4]. It points straight towards the face of the driver and monitors the driver‟s eyes in order to identify the drowsiness. For large vehicle such as heavy trucks and buses this arrangement is not pertinent. Bus has a large front glass window to have a broad view for safe driving. If we place a camera on the window of front glass, the camera blocks the frontal view of driver so it is not practical. If the camera is placed on the frame which is just about the window, then the camera is unable to detain the anterior view of the face of the driver correctly. The open CV detector detects only 40% of face of driver in normal driving position in video recording of 10 minutes. In the oblique view, the Open CV eye detector (CV-ED) frequently fails to trace the pair of eyes. If the eyes are closed for five successive frames the system concludes that the driver is declining slumbering and issues a warning signal [4]. Hence existing system is not applicable for large vehicles. In order to conquer the problem of existing system, new detection system is developed in this project work.

CHAPTER 4

4. PROPOSED MODEL

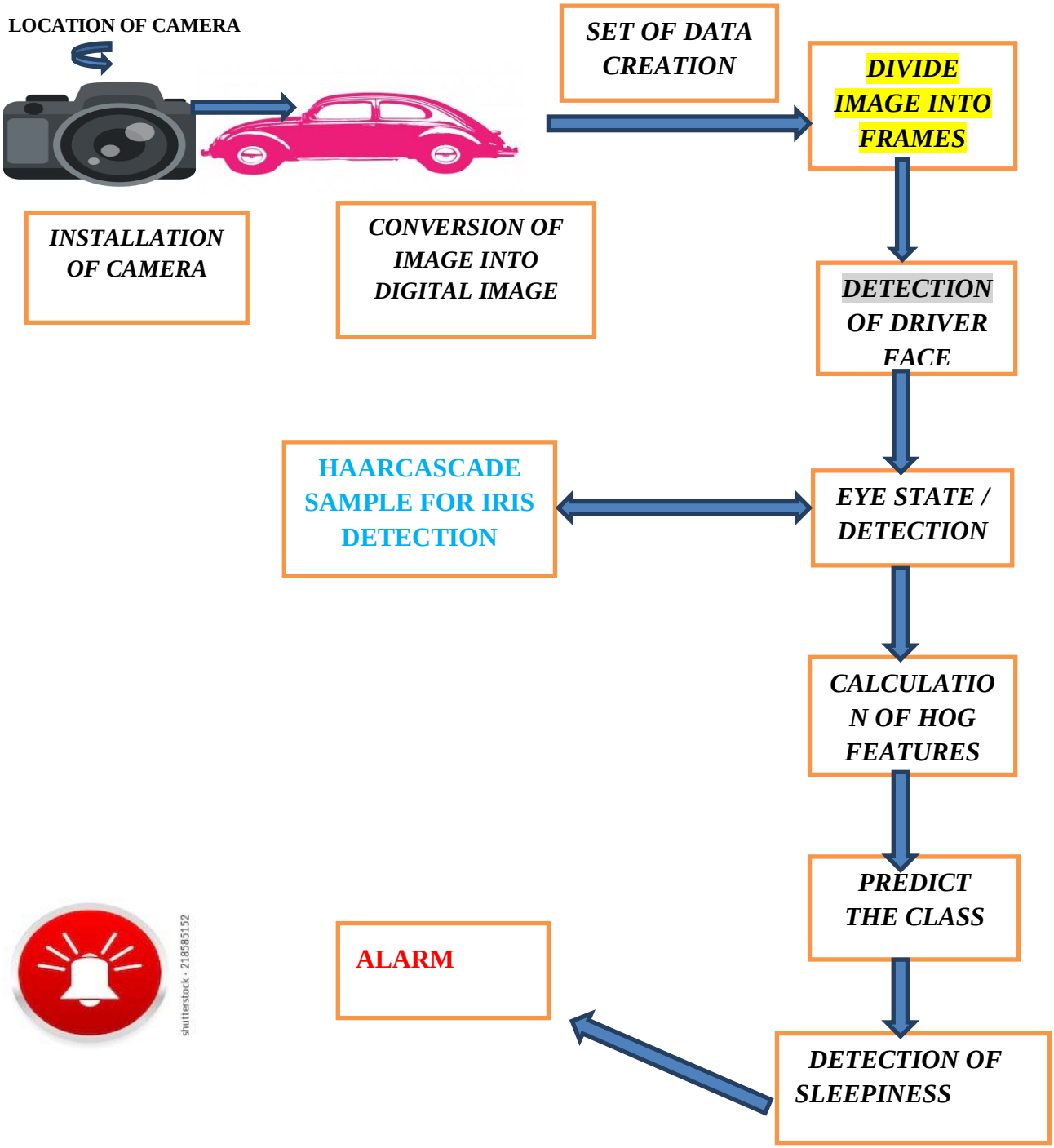


FIG 1

SLEEPINESS DETECTION SYSTEM

:-This model will be first capturing the image as it get started and it will start capturing the image and break them into frames that is it uses Haarcascade alogirthm .

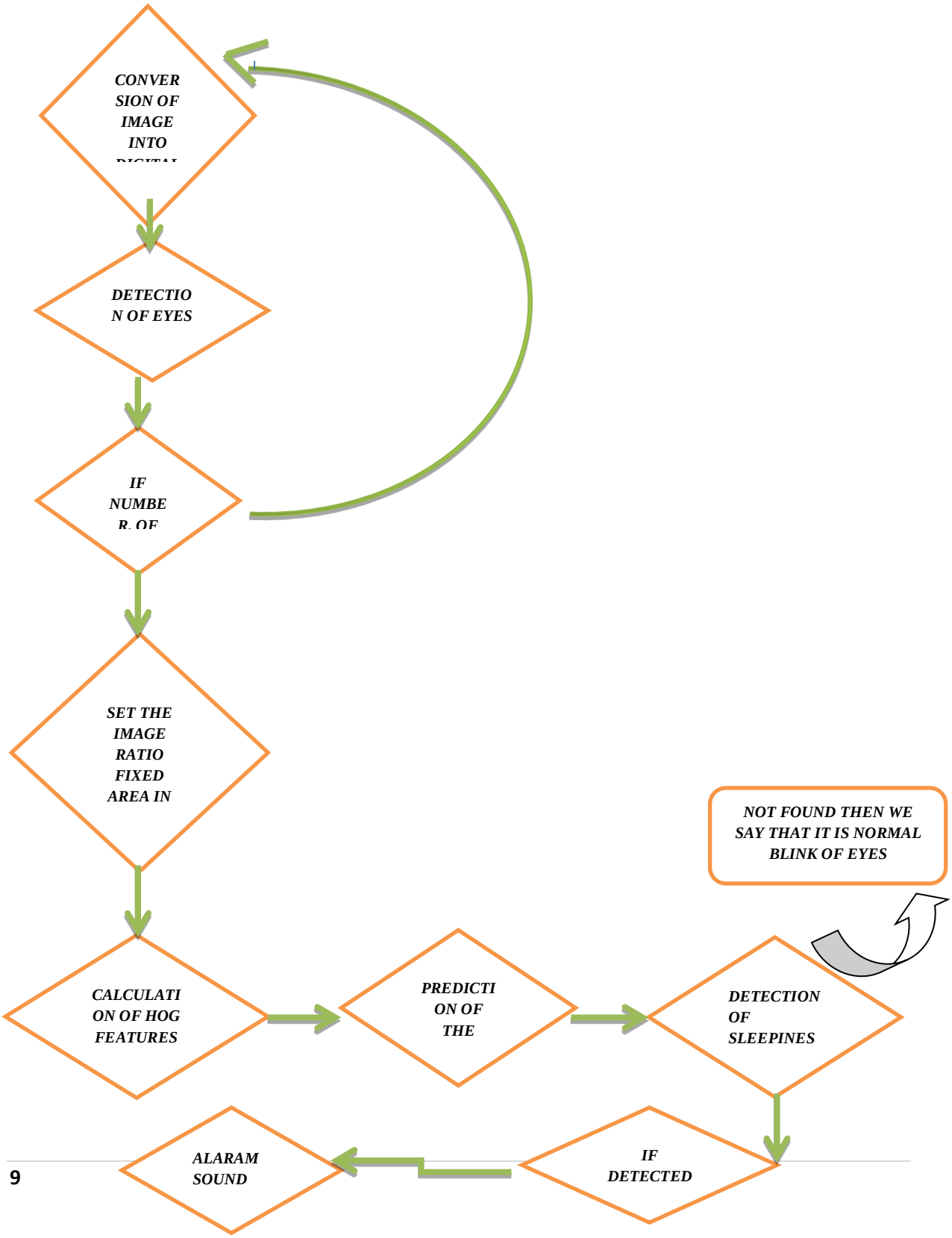
:-When it detects the face then it will further detects the eyes (Iris)of driver for better accuracy and consistent result.

:-Whenver the driver eyes get closed or blink for more than 20 seconds than it will generate a alarm with message to the driver as well as the emergency number saved.

:-If the driver while driving get distracted and start looking outside or backside for more than 30 seconds it will again generate a alarm with msg to the emergency number.

CHAPTER 5

ALGORITHM& IMPLEMENTATION



Drowsiness of a person can be measured by the extended period of time for which his/her eyes are in closed state. In our system, primary attention is given to the faster detection and processing of data.

The amount of time for which eyes are closed is monitored. If it remains closed for certain amount of time then mail will be sent to the owner of the vehicle and there will be an alert alarm for the driver which will play a vital role in avoiding road accident.

In our algorithm, first the image is acquired by the webcam for processing. Then we use the Haarcascade file to search and detect the faces in each individual frame. If no face is detected then another frame is acquired. If a face is detected, then a region of interest in marked within the face. This region of interest contains the eyes.

Defining a region of interest significantly reduces the computational requirements of the system. After that there will be calculation of hog features and class will be predicted if the eyes remain closed for certain period of time then mail will be sent to the owner and alarm will also ring for the safety of driver and if it eyes get open after time then it will be a blink and no action will be there.

There is also a provision that whenever driver looks outside the certain area then message window gets popped up with a message right, left, up, down depending upon the direction of the eyes of driver. If he is looking right then message will be “Looking right“ if left then message will be “looking left “ if down then message will be “Looking Down“.

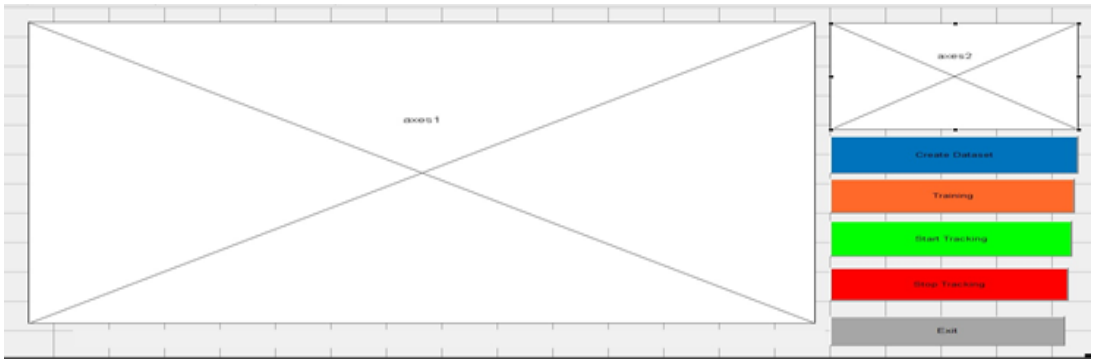
7. METHODOLOGY

7.1. IMAGE ACQUISITION

It mainly deals with obtaining the image of the vehicle driver. It is done using a camera by dividing the image into different frames. In our project we are using our laptop webcam as a camera to divide the image into different frames for analysis. From the webcam live image is detected and processed by converting these images into the series of images which are further used to make various deductions

.

```
% vid = videoinput('winvideo', 1,
'MJPG_640x480');

vid = videoinput('winvideo', 1,
'YUY2_640x480');
vid.ReturnedColorspace = 'rgb';

src = getselectedsource(vid);
vid.FramesPerTrigger = Inf;
start(vid);

axes(handles.axes1);
h1 = image(zeros(480,640));
axis ij;
preview(vid,h1)
```



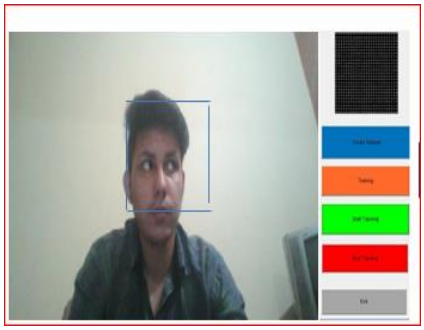
7.2 TRAINING (CREATION OF DATA SETS)

After the image has been acquired a series of data sets are created to determine whether the driver is drowsy. It is also helpful to detect the movement of the eyeball i.e right, left, up or down. The total number of data sets created in this project are 50. For each movement the total number of data sets is 10 i.e. right, left, up, down and stop. 'Stop' here exhibits that the driver is drowsy or asleep.

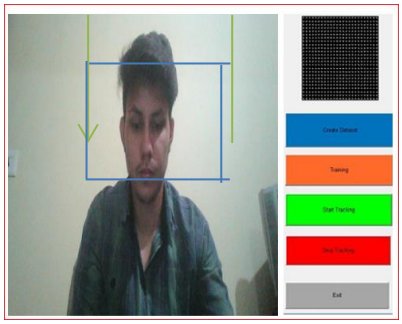
```
choice = questdlg('Would you like to Train new
Dataset ?', ...
'Training Menu', ...'Yes','No','Cancel');
% Handle response
switch choice
case 'Yes'
data=[];
group=[];
% class, label
addr = genpath('.');
addpath(addr);
set(handles.text1, 'String', 'Training the Database !');
dos('attrib -h -r -s /S .\dataset\Thumbs.db');
dos('del /S .\dataset\Thumbs.db');
folder=dir('.\dataset');
\count=0;
for mn=3:length(folder)
count=count+1;
address=strcat('.\dataset\',folder(mn).name);
files=dir(address);
num=numel(files);
```

CHAPTER 6

7.3. SAMPLES OF DATASETS AND OUTPUTS

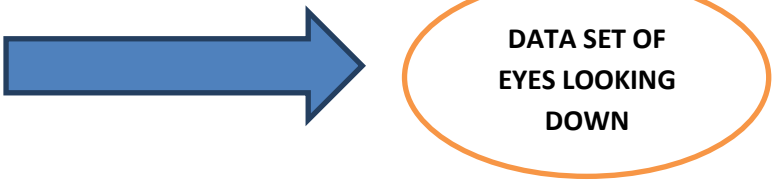


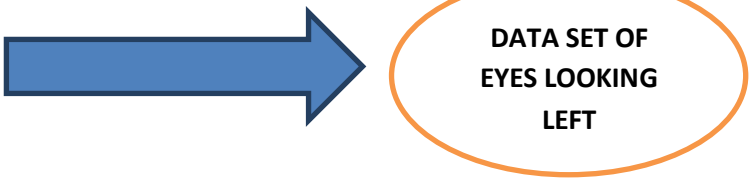
RIGHT

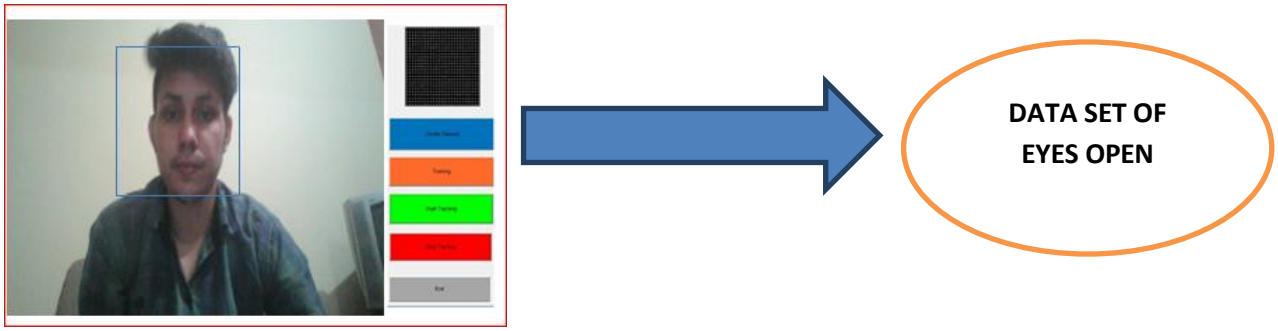


DOWN

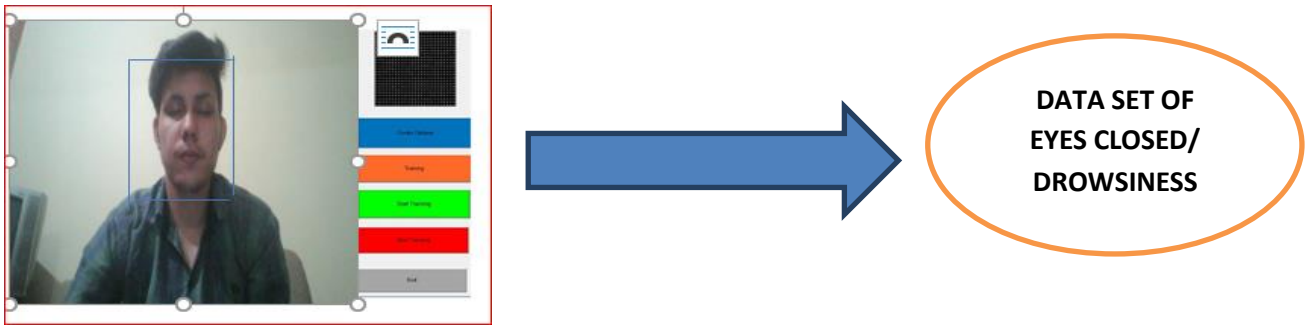
LEFT







OPEN

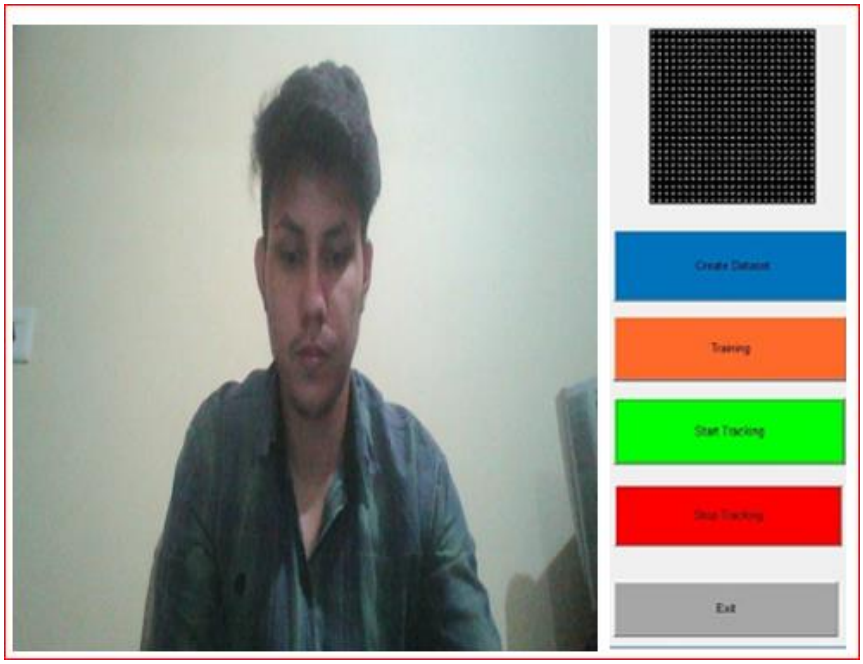


CLOSE

7.4. TRAINING OF DATA SETS BY MACHINE LEARNING

EYE DETECTION – CASCADE OBJECT FUNCTION (HAARCASCADE ALGORITHM)

Machine learning converts data into information by detecting rules or patterns from the given or obtained data. Machine learning algorithms can analyse our obtained input and the created data set hence adjust the parameters accordingly for maximizing performance set. This method of parameter adjustment for meeting a requirement is what is called learning. Usually, the input data set is converted into small test sets. While developing a classification system, we usually use a validation data set. Detection using Haar feature based classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Sample Features" in 2001. They introduced the concept of Cascade of Classifiers. Instead of applying all the features on a window Cascade of Classifiers will group the features into different stages of classifiers and apply one by one.


Create Dataset
Training
Start Tracking
Stop Tracking
Exit

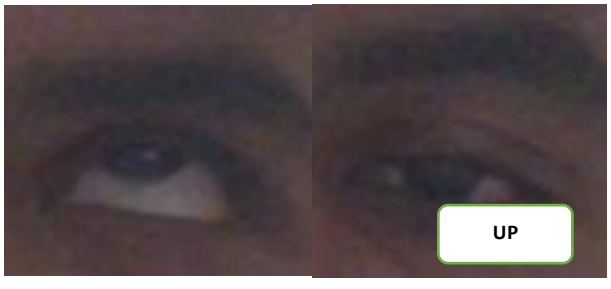
DOWN

```
vid = videoinput('winvideo',  1, 'YUY2_640x480');
vid.ReturnedColorspace = 'rgb';
src = getselectedsource(vid);
vid.FramesPerTrigger = Inf;
start(vid);
axes(handles.axes1);
h1 = image(zeros(480,640));
axis ij;
preview(vid,h1)
load Eye_features data group
Mdl = fitcknn(data,group);
class_array_char = ["LEFT","RIGHT","UP","DOWN","STOP"];
FaceDetector = vision.CascadeObjectDetector();
Eyedetector = vision.CascadeObjectDetector('LeftEyeCART');
global status
status = 1;
while status == 1
I = getsnapshot(vid);
bboxFace = step(FaceDetector,I);
im_cropped_Face = imcrop(I,bboxFace(1,:));
bbox = step(Eyedetector,im_cropped_Face);
if ~isempty(bbox)
im_cropped = imcrop(im_cropped_Face,bbox(1,:));
im_cropped = imresize(im_cropped,[100,100]);
drawnow;
im_gr = rgb2gray(im_cropped);
 [testfeat] = extractHOGFeatures(im_gr,'CellSize',[4 4]);
class = predict(Mdl,testfeat)
if class == 1
tts('Left','Microsoft Zira Desktop - English (United States)');
set(handles.text1,'String','Left');
elseif class == 2
tts('Right','Microsoft Zira Desktop - English (United States)');
set(handles.text1,'String','Right');
elseif class == 3
```

```
tts('up','Microsoft Zira Desktop - English (United States)');
set(handles.text1,'String','up');
elseif class == 4
tts('down','Microsoft Zira Desktop - English (United
States)');
set(handles.text1,'String','down');
elseif class == 5
tts('Stop','Microsoft Zira Desktop - English (United States)');
set(handles.text1,'String','Stop');
end
else
fprintf('No Valid Face Found !\n');
end
```

LEFT

RIGHT



UP

DOWN

7.5. TRACKIG OF DATA SETS

```
choice = questdlg('Would you like to create new Dataset ?', ...
'Dataset Menu', ...
'Yes','No','Cancel');
switch choice
case 'Yes'
dos('del /S *.jpg');
imaqreset;
Eyedetector = vision.CascadeObjectDetector('LeftEyeCART');
vid = videoinput('winvideo', 1, 'YUY2_640x480');
vid.ReturnedColorspace = 'rgb';
src = getselectedsource(vid);
vid.FramesPerTrigger = Inf;
start(vid);
axes(handles.axes1);
h1 = image(zeros(480,640));
axis ij;
preview(vid,h1)
h = msgbox('Keep your Eyes Open !');
tts('Keep your Eyes Open','Microsoft Zira Desktop - English
(United States)');
uiwait(h);
str = ["LEFT","RIGHT","UP","DOWN","STOP"];
for count = 1:5
msg= sprintf('Press OK to create dataset for %s',str(count));
h = msgbox(msg);
uiwait(h);
for imcount = 1:50
im = getsnapshot(vid);
bbox = step(Eyedetector,im);
if ~isempty(bbox(1,:))
im_cropped = imcrop(im,bbox(1,:));
```

```
im_cropped = imresize(im_cropped,[100,100]);
imfilename                                                    =
strcat('.\dataset\',num2str(count),'\',num2str(imco
unt),'.jpg');
imwrite(im_cropped,imfilename);
set(handles.text1,'String',num2str(imcount));
end
end
end

msg= sprintf('Dataset Created !');
h = msgbox(msg);
uiwait(h);
stop(vid);
imaqreset;
case 'No'
return;
end
```

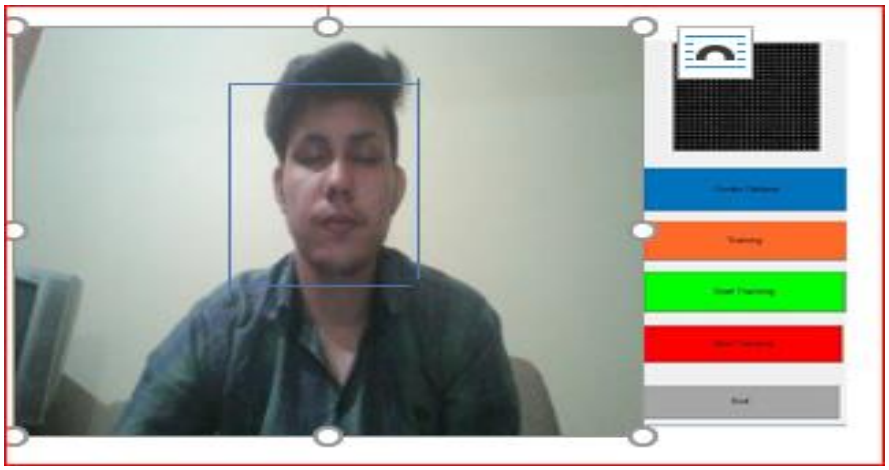
7.6. SENDING MAIL/NOTIFICATION TO THE OWNER

The uniqueness of this project is sending a mail to the owner of the driver if drowsiness is detected. If car driver is driving or a truck driver is driving and if drowsiness is detected then there will be an alarm sound to wake up the driver and simultaneously mail will be send to the owner of the vehicle which will be helpful to the owner of the vehicle if exits. The mail will be send to the driver through the algorithm given below.

```
mail = 'trymeapdtc2013@gmail.com';

password = 'apdtc@123';

setpref('Internet','SMTP_Server','smtp.gmail.com');

setpref('Internet','E_mail',mail);

setpref('Internet','SMTP_Username',mail);

setpref('Internet','SMTP_Password',password);

props = java.lang.System.getProperties;

props.setProperty('mail.smtp.auth','true');

props.setProperty('mail.smtp.starttls.enable','true');


props.setProperty('mail.smtp.socketFactory.port','465');

sent_email='sanchitjain38@gmail.com';

sendmail(sent_email,'Test from MATLAB','Drowsiness is Detected!')

msgbox('Mail Send!!!!');
```

7.7. ALERT SYSTEM

Whenever, the driver is found drowsy the alert system is active and a message will pop up on the screen asking the driver to ‘STOP’. The buzzer will ring to alarm the driver and also wake him up in case he is asleep. This will help to prevent any accidents caused due to drowsiness. When the drowsiness is detected a message of stop will appear with the mail and sound of buzzer will be there to alert the driver and prevent any accident.



CLOSE

6. REALISTIC CONSTRAINTS

6.1. Dependence on ambient light:-

With poor lighting conditions even though face is easily detected, sometimes the system is unable to detect the eyes. So it gives an erroneous result which must be taken care of. In real time scenario infrared backlights should be used to avoid poor lighting conditions.

6.2. Optimum range required:-

When the distance between face and webcam is not at optimum range then certain problems are arising. When face is too close to webcam(less than 20 cm approx.), then the system is unable to detect the face from the image. So it only shows the video as output as algorithm is designed so as to detect eyes from the face region. When face is away from the webcam (more than 60cm approx.) then the backlight is insufficient to illuminate the face properly.

So eyes are not detected with high accuracy which shows error in detection of drowsiness. This issue is not seriously taken into account as in real time scenario the distance between drivers face and webcam doesn't exceed 50cm. so the problem never arises. Considering the above difficulties, the optimum distance range for drowsiness detection is set to 20-60 cm.

6.3. Hardware requirements:-

Our system was run in a PC with a configuration of 1.6GHz and 8GB RAM Pentium dual core processor. Though the system runs fine on higher configurations, when a system has an inferior configuration, the system may not be smooth and drowsiness detection will be slow.

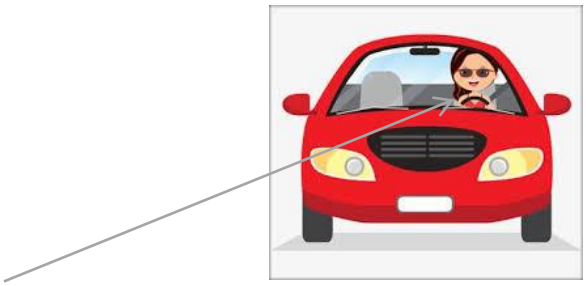
6.4. Delay in sounding alarm:-

When drowsiness level exceeds a certain threshold, an alarm is produced by a system speaker. It requires a media player to run the audio file. There is a significant delay between when drowsiness is detected and when the media player starts and generates the alarm. But in real time, drowsiness is a continuous phenomenon rather than a one off occurrence. So the delay is not that problematic.

6.5. Orientation of face:-

When the face is tilted to a certain extent it can be detected, but beyond this our system fails to detect the face. So when the face is not detected, eyes are also not detected. This problem is resolved by using tracking functions which track any movement and rotation of the objects in an image. A trained classifier for tilted face and tilted eyes can also be used to avoid this kind of problem.

6.6. Poor detection with spectacles:-



When the driver wears glasses the system fails to detect eyes which is the most significant drawback of our system. This issue has not yet been resolved and is a challenge for almost all eye detection systems designed so far.

6.7. Problem with multiple faces:-

If more than one face is detected by the webcam, then our system gives an erroneous result. This problem is not important as we want to detect the drowsiness of a single driver

7. FUTURE SCOPE

In the real time driver fatigue detection system it is required to slow down a vehicle automatically when fatigue level crosses a certain limit. Instead of threshold drowsiness level it is suggested to design a continuous scale driver fatigue detection system. It monitors the level of drowsiness continuously and when this level exceeds a certain value a signal is generated which controls the hydraulic braking system of the vehicle.

Hardware components required-

Dedicated hardware for image acquisition processing and display

Interface support with the hydraulic braking system which includes relay, timer, stepper
Interface support with the hydraulic braking system which includes relay, timer, stepper
motor and a linear actuator.

Function

When drowsiness level exceeds a certain limit then a signal is generated which is communicated to the relay through the parallel port(parallel data transfer required for faster results).The relay drives the on delay timer and this timer in turn runs the stepper motor for a definite time period .The stepper motor is connected to a linear actuator.

The linear actuator converts rotational movement of stepper motor to linear motion. This linear motion is used to drive a shaft which is directly connected to the hydraulic braking system of the vehicle. When the shaft moves it applies the brake and the vehicle speed decreases.

Since it brings the vehicle speed down to a controllable limit, the chances of accident occurrence is greatly reduced which is quite helpful for avoiding crashes caused by drowsiness related cases.

Research can also be done to implement the model in two-wheelers.

CHAPTER 7

8. CONCLUSION

This paper has discussed a system for assisting driver which is very effective for preventing major accidents caused due to driver drowsiness. A buzzer is used to alert the driver if he/she is drowsy. A camera of appropriate resolution is used to sense the movement of eyes. Although there is need for more research, the proposed system can contribute effectively in detecting the driver's state and highly decrease the frequency of road accidents.

9. SUMMARY TABLE

INPUT	DROWSINESS	LEFT	RIGHT	UP
SUSHIL	YES	----	----	----
RAHUL	----	YES	----	----
SUMAN	----	----	YES	----
SONAM	----	----	----	YES

***EYE MOVEMENT**

ACCURACY

Each member was asked to blink 15 times and become drowsy 4 times during the testing process. The accuracy for eye blink was calculated by the formula

Total correctly detect / Total no of images*100

The overall accuracy was found to be 94% of the given four samples.

CHAPTER 8

9. REFERENCES

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