DRIVER DROWSINESS DETECTION SYSTEM

A Minor Project Report

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For

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In

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CERTIFICATE BY THE SUPERVISOR

This is to certify that the Major Project Report entitled **"DRIVER DROWSINESS DETECTION SYSTEM"** is a record of project work carried out under my guidance and supervision for the fulfillment of the award of degree of Bachelor of Technology in the faculty of Computer Science & Engineering of Chhattisgarh Swami Vivekananda Technical University, Bhilai (C.G.) India.

To the best of my knowledge and belief the report

i) Embodies the work of the candidate himself

ii) Has duly been completed

iii) Fulfills the partial requirement of the ordinance relating to the B.Tech degree of the University

iv) Is up to the desired standard in respect of both contents and language for being referred to the examiners.

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The project report entitled **“DRIVER DROWSINESS DETECTION SYSTEM”** has been examined by the undersigned as a part of the examination of Bachelor of Technology in the faculty of Computer Science & Engineering of Chhattisgarh Swami Vivekananda Technical University, Bhilai.

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LIST OF ABBREVIATIONS

JS	Java Script
HTML	Hyper Text Markup Language
CSS	Cascading Style Sheet
API	Application Programming Interface
VS Code	Visual Studio Code
NPM	Node Package Manager
UI	User Interface
SRS	Software Requirements
SDLC	Software Development Lifecycle
RAM	Random Access Memory
ROM	Read Only Memory
OS	Operating System

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ABSTRACT

Driver drowsiness is one of the reasons for large number of road accidents these days. With the advancement in Computer Vision technologies, smart/intelligent cameras are developed to identify drowsiness in drivers, there by alerting drivers which in turn reduce accidents when they are in fatigue. In this work, a new framework is proposed using deep learning to detect driver drowsiness based on Eye state while driving the vehicle. To detect the face and extract the eye region from the face images, Viola-Jones face detection algorithm is used in this work. Stacked deep convolution neural network is developed to extract features from dynamically identified key frames from camera sequences and used for learning phase. A SoftMax layer in CNN classifier is used to classify the driver as sleep or non-sleep. This system alerts driver with an alarm when the driver is in sleepy mood. The proposed work is evaluated on a collected data set and shows better accuracy with 96.42% when compared with traditional CNN. The limitation of traditional CNN such as pose accuracy in regression is overcome with the proposed Staked Deep CNN.

Chapter 1
Introduction

1.1 Overview

Driver fatigue is one of the three commonest causes of motor vehicle accidents and the effect of driver fatigue has been underestimated in the past due to difficulties in identifying fatigue as the cause of a crash. The problem of driver fatigue of course moves far beyond just road vehicles to all modes of transportation, being an important factor in rail, sea and air accidents as well. Driver fatigue commonly causes “fall asleep” motor vehicle accidents. These tend to be more severe or fatal compared with other road accidents. This is because they often involve a single vehicle running off the road at high speed, they tend to occur on higher speed roadways, and braking or other preventative measures may be absent. If truck drivers are involved, the potential to cause death or serious injury to other road users is greatly increased. It is commonly known that drowsiness and driving is not a good combination. To be a good driver it is necessary to be perceptive, alert and focused on the task and it is difficult to combine these qualities with drowsiness. Another characteristic that is a bad combination with driving is distraction. Both these disturbances have the same effect on the driver in the sense that they have a negative effect on the perception, reaction time and focus, to name a few things. Drowsiness and distraction are parts of the human behavior, which makes the problem with drowsiness and inattentive driving difficult to completely eliminate. A similar case is alcohol which also has a negative effect on the driving abilities, but can (theoretically) be removed from the roads.

1.2 Definitions

To be able to examine the effects of drowsiness, distraction and inattention it is necessary to start with the definitions of these words.

Sleepiness and Drowsiness

Sleepiness, also referred to as drowsiness, is a basic physiological state that affects humans among others and it originates from changes of the alertness during each 24-hour sleep-wake cycle. This is caused by the internal body clocks, which programs us to be asleep twice a day in the middle of the night and between 14:00-16:00 in the afternoon .Sleepiness is a stage when the body needs to sleep and is defined as “the inclination to sleep”. Sleepiness should not be confused with fatigue, which is the consequence of physical labour or a long experience, and is defined as “disinclination to continue the task at hand”.

Distraction

Distraction is a shift in attention from the primary task to another task (secondary task). In behavioral models, human is modelled as information processing resource who has a maximal limit of information that can be processed. In these models distraction is modelled as surrounding disturbances taking processing resources from the main task. Distraction can result in reduced performance of the primary task.

There are several degrees of distraction, but no fixed scale. This is a problem when detecting a degree of distraction, because it is difficult to say that one thing “steals” more attention than another. Usually distraction is measured as the reduction of performance of the primary task. Another important part in the distraction is the drivers “willingness to engage” in the secondary task. How much the person engages in the task affects how distracted the person is. Distraction happens all the time in the daily life but the usual effect of the everyday distraction is very harmless. It results in a shift in attention from one thing to another for a brief or longer moment. This usually has little effect on the primary task other than a delay.
An example of this is a person reading the newspaper when he hears a car alarm go off. The result of this is that he stops reading for a while, but soon he continues reading with only a slight delay.

Sometimes this delay in the primary task may have a serious impact on a person, when he is driving for example. Distraction in a car is different from the everyday drowsiness because during the time you are not paying attention to the road, something may happen, which may cause the vehicle to crash in the worst case.

Inattention

Inattention is when a person is not paying attention to, or focusing on a task. It could be caused by drowsiness, distraction, fatigue, boredom or other things. If the drowsiness and distraction is compared with inattention, it is like cause and effect.

Drowsiness and distraction can be the cause of inattention. In the word inattention it is not so important what caused it, just that the result is inattention. With drowsiness and distraction the effect is usually inattention, but here it is also important what caused it.

1.3 Inattentive Driving

Inattention has a negative effect on a number of characteristics that are important while driving. It has a decreasing effect in vigilance, reaction time, memory, coordination, memory processing and decision making, to name a few.

Recent research has shown that sleep deprivation and late stages of inattention has the same effect as alcohol intoxication. In a research study, people were deprived of sleep and asked to do different tests. The results were that persons who were awake for 17 hours had the same results as a rested person with blood alcohol concentration (BAC) of 0.05% (0.5‰). A group of people that had been kept awake for 24 hours performed the same as people who had a BAC of 0.1% (1‰) .

Drowsy Driving

Drowsy driving causes a lot of accidents on the roads all over the world. Cars are involved in 96% of the drowsy driving accidents and trucks are involved in 3%. However for trucks the expected number of involvement per lifecycle in drowsy driving accidents is about four times greater than for a car, because of the long vehicle lives and high usage.

Trucks are especially affected by the problem with drowsy driving because of the long transport distances and the workload management with tight deliverance schedules. In 1998 there were approximately 1.6 million truck tractors and 3.6 million trailers used in the transportation industry in the world. Drowsiness of truck drivers causes 1 200 deaths and 76 000 injuries annually, world-wide.

In the truck industry 57% of all crashes are caused by drowsiness1, which makes it the number one cause for heavy vehicle crashes [26]. With the constantly growing traffic conditions, this problem will further grow. The physical and psychological effects that drowsiness has on humans are impossible to combine with the qualities that are expected from a good driver. Drowsiness changes the abilities of the driver in the following areas:

1) Slow reaction time.

2) Reduced vigilance.

3) Slow information processing.

4) Reduced memory capacity.

5) Worse coordination.

6) Slow decision making.

Distracted Driving

During the last few years the number of distracting equipment in the vehicle has increased dramatically. Nowadays there are mobile phones, car audio equipment, navigation systems, TV-screens, DVD-players and cruise controls only to name a few. All these things “steal” attention from the primary task (driving) which can expose the driver to a dangerous situation. The trend is that the amount of distracting equipment in the vehicles is increasing as they get more available and easier to use at the same time as the complexity of these equipment increases. The result of this is that the drivers are more and more exposed to inattentive driving.

In research of distraction it is usually helpful to examine distraction in terms of four different categories:

♣ Visual distraction –looking away from the roadway

♣Auditory distraction –music or mobile phone

- ♣ Biomechanical distraction –adjusting the radio volume or changing channel
- ♣ Cognitive distraction –using navigation system

These are the main kinds of distraction that the driver can be exposed to while driving. How much distraction a certain device causes is determined by the workload combined with the willingness of the driver to engage in that task. This means that the worst kinds of equipment are interesting and demanding, which could be a description of a mobile phone, a radio or a navigation system, for example. Distraction causes many accidents annually and in some countries it is actually illegal to drive a car while speaking in a mobile phone without a hands-free system. Approximately 0.1% of all the car drivers have been involved in an accident caused by someone using a mobile phone. This may not seem much, but it is estimated (based on these numbers) that 292 000 people have experienced a vehicle crash caused by a person using a mobile phone.

Chapter 2
Literature Review

2.1 Overview

One system that today is considered the most effective in the detection of inattentive driving is the system based on eye detection. An enhanced percentage of eyelid closure is one of the most reliable predictors of drowsiness or inattention.

The best detection of primarily drowsiness, but also of inattention is the measurement of brain-waves, heart rate and pulse. To measure this while driving causes annoyance to the driver, because multiple sensors have to be attached to the driver. This can affect the driver so much that it changes the driving behavior, which is not good at all in traffic safety research. Eye detection on the other hand gives an accurate detection with minimal impact on the driver.

Eye closures occur with a high frequency just before the off-road accidents caused by drowsiness that has been recorded. In the minute preceding the accident an increase of the eyelid closure can be detected and 20-30 seconds before the accident a dramatic increase can be seen.

The eye detection system consists of a camera and demanding eye-tracking software. The camera, usually mounted on the dashboard in front of the driver, records the eyes of the driver. This signal is then processed in an advanced system to detect how many percent the eyes are open, the frequency of eye blinking and in which direction the driver is looking. With this signal it is then possible to detect the status of the driver with the accuracy of about 1 mm in the recorded images.

The eye detection systems are good but not perfect, when the driver is wearing glasses there might be errors in the detection, which in some systems leads to false warnings. Sunglasses cause problems that almost none of the systems can deal with, which makes the inattention detection almost impossible when the driver is wearing sunglasses. Different ethnical people are another problem, the eyes of Asian people differ from European people, but most manufacturers claim that it shouldn’t be a problem.

2.1.1 PERCLOS

PERCLOS (PERcent eyelid CLOSure) is a measure of driver alertness, which was identified as the most reliable and valid in a study by the US Federal Highway Administration; various authors refer PERCLOS as a standard for drowsiness detection. The measure is the percentage of eyelid closure over the pupil over time and reflects slow eyelid closures rather than blinks. The PERCLOS drowsiness metric was established in a 1994 driving simulator study as the proportion of time (%) in a minute when the eyelids are at least 80 percent closed.
PERCLOS system is defined as proportion of time that the eyes of the driver are closed (more that 80%) over a specified period that can be changed to suite the driver or the situation. This system is created to measure slow eyelid closures rather than blinks. PERCLOS originates from a drowsiness detection system that was created in a driving simulator in 1994, and has been developed ever since.

Based on research by Wierwille, the US Federal Highway Administration (FHWA) and the US National Highway Traffic Safety Administration (NHTSA) considers PERCLOS to be among the most promising known real-time measures of alertness for in-vehicle drowsiness-detection systems.

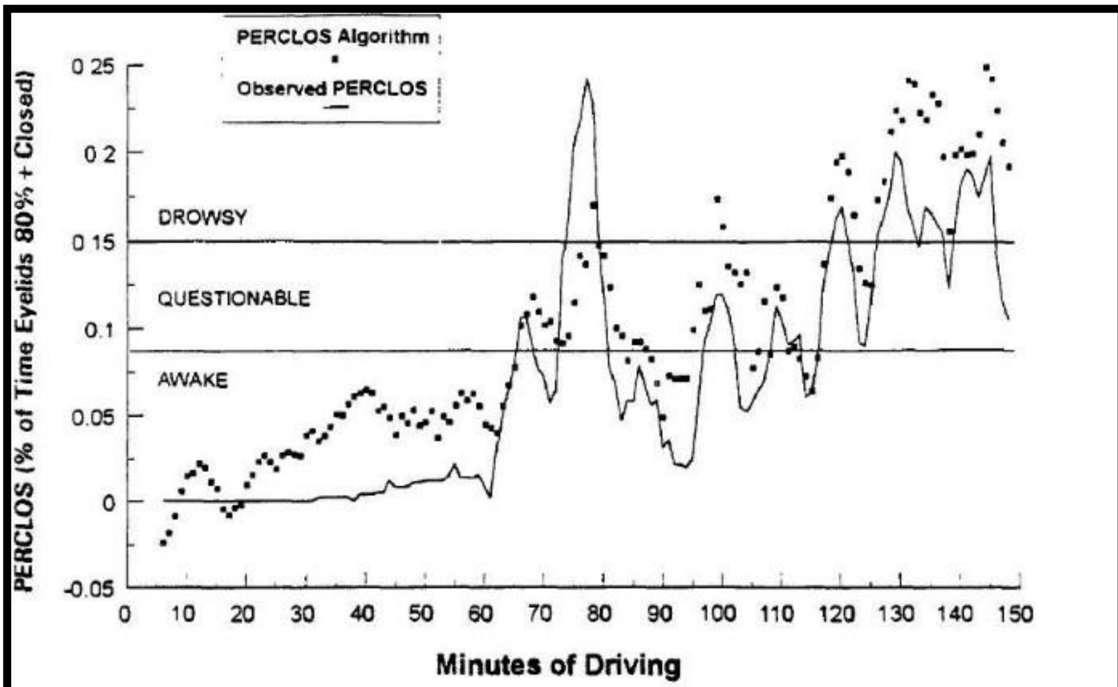


Figure 1.1 Progression of drowsiness and concordance of predicted and observed PERCLOS value.

- P70: the proportion of time when the eyes were closed at least 70percent.
- P80: the proportion of time when the eyes were closed at least 80 percent (the P80 metrics is usually referred as“PERCLOS”)
- EYEMEAS (EM): the mean square percentage of the eyelid closurerating.

PERCLOS has been validated in two separate laboratories as an accurate predictor of performance degradation caused by drowsiness. It is now used as a standard for drowsiness detection in many research projects and some in-vehicle detection systems try to estimate the PERCLOS value from in-vehicle signals, this is called estimated PERCLOS (ePERCLOS). The eye detection system provides information of how much the eyes are closed at every moment and with this information the PERCLOS value can be computed. This is done by simply calculating the percent of the time that the eyes are closed more then 80% for every three minutes. This value is then compared to a limit value to see if the driver is considered drowsy or not.

PERCLOS is the result of a simple mathematical algorithm which is included in the majority of the commercial eye detection systems. The problem is to detect the eyelid opening in the camera systems, which is done with image processing. The ordinary PERCLOS system is a measurement of the time when the eyes of the driver are between 80% and 100% closed. If the time exceeds a boundary value a warning is given. Usually this detection is calculated over 3-minute periods. The warning limit can be changed to suit the situation but a limit value that is commonly used is 0.12%, so when PERCLOS is above 0.12% the driver is considered drowsy.

2.1.2 Steering Wheel Variability Detection

As reported by Wylie et al, steering wheel variability is related to the amount of drowsiness in drivers (variability greater as driver become more drowsy) after being adjusted for road dependent effects. Steering wheel variability is related to the amount of drowsiness in drivers (variability greater as drivers become more drowsy) after being adjusted for road dependent effects.

Steering wheel variability is also strongly and reliably affected by location on the route. Therefore this measure must be corrected for route dependent effects if it is to achieve its full potential as an indicator of driver fatigue. The adjustment for route dependent effects can be performed for example by subtracting the all-driver average steering wheel variability associated with each mile of road, thus reducing the variation associated with road curvature. The authors of the article also suggest considering the power spectral density of the steering wheel angle in relation to fatigue. Clearly this approach is arduous for real-time measurements.

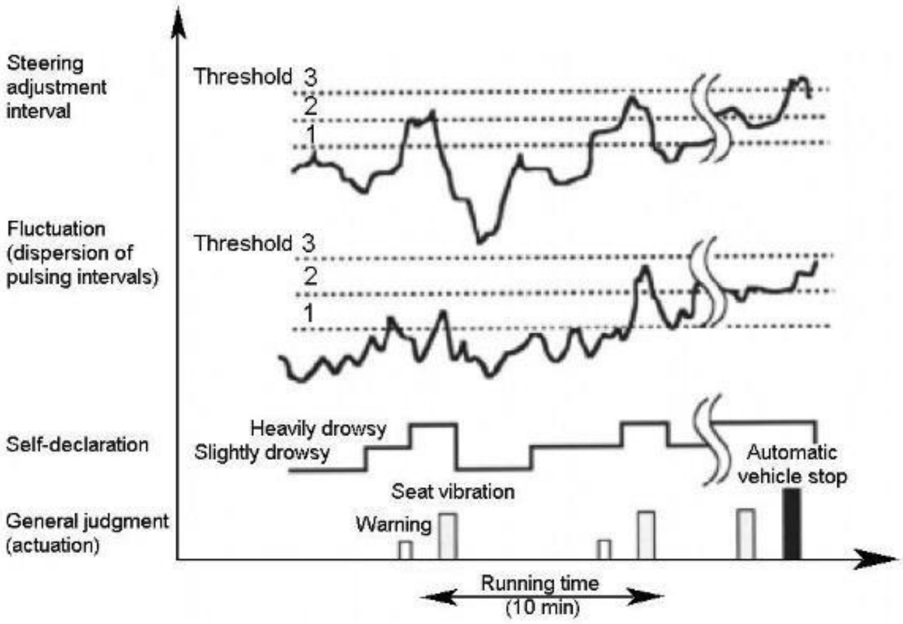


Figure 1.2 *Drowsiness judgment example* "General judgment (actua-tion)" *is the system output (detection of drowsiness),* "self declaration" *is the driver's subjective drowsiness experience, the* "fluctuation" *(pulse of the driver) and the* "steering adjustments interval" *are the recorded input variables for the drowsiness detection.*

Chapter 3
Software Requirements

3.1 Software Requirements

1. Anaconda Editor : Anaconda is a distribution of the Python and R programming languages for scientific computing, that aims to simplify package management and deployment. The distribution includes data-science packages suitable for Windows, Linux, andmacOS.

2. Web Browser : A web browser (commonly referred to as a browser) is application software for accessing the World Wide Web. When a user requests a web page from a particular website, the web browser retrieves the necessary content from a web server and then displays the page on the user'sdevice.

3. Python Compiler : A computer program that translates code written in one programming language into another is called a compiler. Python leads the factionof the fastest growing programming languages. As such, there is no scarcity to Python compilers that can cater to varying project needs (With all the necessarypackages).

4. Operating systems: An operating system is system software that manages computer hardware, software resources, and provides common services for computer programs. Windows® 10, macOS, and Linux.

3.2 Developer Requirements

The requirement for this project is a webcam through which we will capture images. You need to have Python (3.6 version recommended) installed on your system, then using pip, you can install the necessary packages.

1. **OpenCV –** pip install opencv-python (face and eyedetection).

   OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

   The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 18 million. The library is used extensively in companies, research groups and by governmentalbodies.

   Along with well-established companies like Google, Yahoo, Microsoft, Intel, IBM, Sony, Honda, Toyota that employ the library, there are many startups such as Applied Minds, VideoSurf, and Zeitera, that make extensive use of OpenCV. OpenCV's deployed uses span the range from stitching street view images together, detecting intrusions in surveillance video in Israel, monitoring mine equipment in China, helping robots navigate and pick up objects at Willow Garage, detection of swimming pool drowning accidents in Europe, running interactive art in Spain and New York, checking runways for debris in Turkey, inspecting labels on products in factories around the world on to rapid face detection in Japan.

   It has C++, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. OpenCV leans mostly towards real-time vision applications and takes advantage of MMX and SSE instructions when available. A full-featured CUDA and OpenCL interfaces are being actively developed right now. There are over 500 algorithms and about 10 times as many functions that compose or support those algorithms. OpenCV is written natively in C++ and has a templated interface that works seamlessly with STL containers.

2. **TensorFlow** – pip install tensorflow (keras uses TensorFlow asbackend).

   TensorFlow is an open source library for fast numerical computing.
   It was created and is maintained by Google and released under the Apache 2.0 open source license. The API is nominally for the Python programming language, although there is access to the underlying C++ API.

   Unlike other numerical libraries intended for use in Deep Learning like Theano, TensorFlow was designed for use both in research and development and in production systems, not least RankBrain in Google search and the fun DeepDream project.
   It can run on single CPU systems, GPUs as well as mobile devices and large scale distributed systems of hundreds of machines.

3. **Keras** – pip install keras (to build our classification model).

   Keras is an API designed for human beings, not machines. Keras follows best practices for reducing cognitive load: it offers consistent & simple APIs, it minimizes the number of user actions required for common use cases, and it provides clear & actionable error messages. It also has extensive documentation and developer guides.

   Built on top of TensorFlow 2.0, Keras is an industry-strength framework that can scale to large clusters of GPUs or an entire TPU pod. It's not only possible; it's easy.
4. **Pygame** – pip install pygame (to play alarm sound).

- Pygame is a cross-platform set of Python modules which is used to create video games.

- It consists of computer graphics and sound libraries designed to be used with the Python programming language.

- Pygame was officially written by **Pete Shinners** to replace PySDL.

- Pygame is suitable to create client-side applications that can be potentially wrapped in a standalone executable.

Chapter 4
Hardware Requirements

4.1 Hardware Requirements

- CPU: 2 x 64-bit 2.8 GHz 8.00 GT/sCPUs
- RAM: 32 GB (or 16 GB of 1600 MHz DDR3RAM)
- Storage: 300 GB. (600 GB for air-gappeddeployments.)
- Additional space recommended if the repository will be used to store packages built by the customer.
- With an empty repository, a base install requires 2GB.
- Display – Any compatible monitor
- Connection – Internet Connection
- A Working WebCam

Chapter 5
Methodology

5.1 Proposed System

In this project, we will be using OpenCV for gathering the images from webcam and feed them into a ***Deep Learning*** model which will classify whether the person's eyes are 'Open' or 'Closed'. The approach we will be using for this Python project is as follows :

Step 1 – Take image as input from a camera.

Step 2 – Detect the face in the image and create a Region of Interest (ROI).

Step 3 – Detect the eyes from ROI and feed it to the classifier.

Step 4 – Classifier will categorize whether eyes are open or closed.

Step 5 – Calculate score to check whether the person is drowsy.

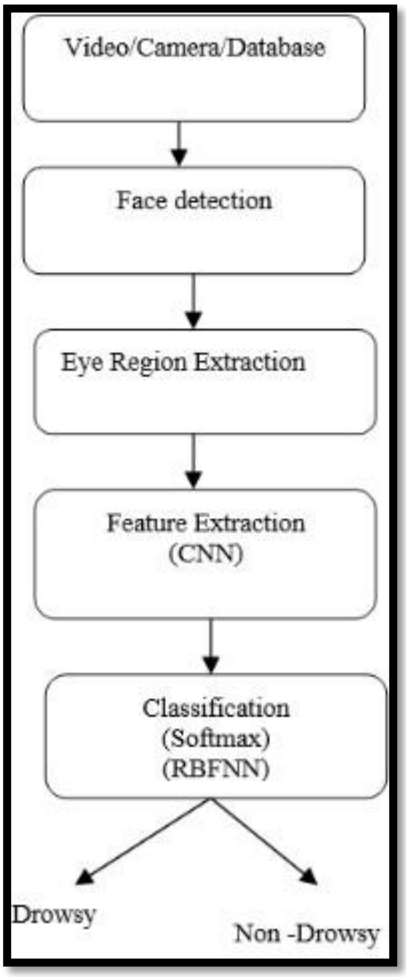


Figure 2 : Proposed System Architecture

Face detection and eye region extraction

Whole face region may not be required to detect the drowsiness but only eyes region is enough for detecting drowsiness. At first step by using the Viola-jones face detection algorithm face is detected from the images. Once the face is detected ,Viola-jones eye detection algorithm is used to extract the eye region from the facial images. In 2001, P Viola and M Jones developed the Viola-Jones object detection algorithm[20, 21], it is the first algorithm used for face detection. For the face detection the Viola-Jones algorithm having three techniques those are Haar-like features, Ada boost and Cascade classifier. In this work, Viola-Jones object detection algorithm with Haar cascade classifier was used and implemented using OPENCV with python. Haar cascade classifier uses Haar features for detecting the face from images. Figure shows the Eye region images extracted from the face image.

Figure 3 : Eye image extracted from a face

Convolutional neural network

Convolutional neural network (CNN) is used in the proposed system for detection of driver drowsiness. Since a feature vector is needed for each drowsy image to compare with existing features in a data base to detect either drowsy or not . Usually CNNs requires fixed size images as input so preprocessing is required. The preprocessing includes extracting the key frames from video based on temporal changes and store in database. From these stored images, feature vectors are generated in convolution layers of CNN. These feature vectors are then used for the detecting the driver drowsiness .CNN have layers like convolutional layers, pooling (max, min and average) layers,ReLU layer and fully-connected layer. Convolution layer is having kernels (filters) and each kernel having width, depth and height. This layer produces the feature maps as a result of calculating the scalar product between the kernels and local regions of image. CNN uses pooling layers (Max or Average) to minimize the size of the feature maps to speed up calculations .In this layer, input image is divided into different regions then operations are performed on each region. In Max Pooling, a maximum value is selected for each region and places it in the corresponding place in the output. ReLU (Rectified Linear Units) is an on linear layer. The ReLU layer applies the max functionon all the values in the input data and changes all the negative values to zero. The following equation shows the ReLU activationfunction.

$$f(x)=\max(0,x) \qquad (1)$$

The fully-connected layers used to produce class scores from the activations which are used for classification.

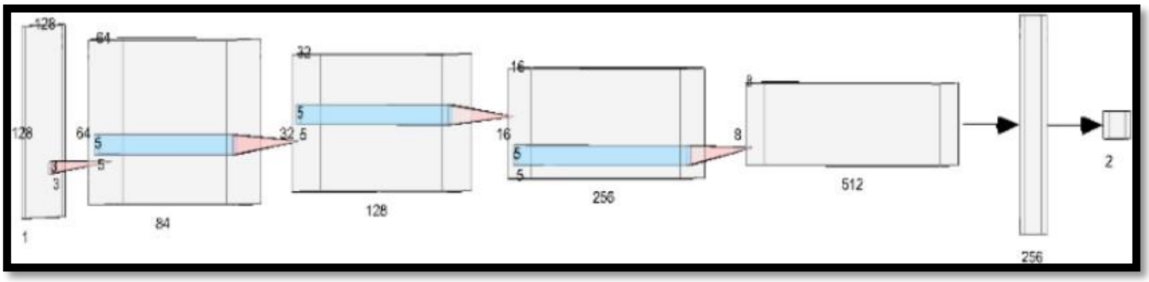


Figure 4: Proposed deep CNN Model

5.2 Working

The Dataset

The dataset used for this model is created by us. To create the dataset, we wrote a script that captures eyes from a camera and stores in our local disk. We separated them into their respective labels 'Open' or 'Closed'. The data was manually cleaned by removing the unwanted images which were not necessary for building the model. The data comprises around 7000 images of people's eyes under different lighting conditions. After training the model on our dataset, we have attached the final weights and model architecture file "models/cnnCat2.h5".

Now, you can use this model to classify if a person's eye is open or closed.

The Model Architecture

The model we used is built with Keras using **Convolutional Neural Networks (CNN)**. A convolutional neural network is a special type of deep neural network which performs extremely well for image classification purposes. A CNN basically consists of an input layer, an output layer and a hidden layer which can have multiple numbers of layers. A convolution operation is performed on these layers using a filter that performs 2D matrix multiplication on the layer and filter.

The CNN model architecture consists of the following layers:

- Convolutional layer; 32 nodes, kernel size3
- Convolutional layer; 32 nodes, kernel size3
- Convolutional layer; 64 nodes, kernel size3
- Fully connected layer; 128nodes

The final layer is also a fully connected layer with 2 nodes. In all the layers, a Relu activation function is used except the output layer in which we used Softmax.

Let's now understand how our algorithm works step by step.

Step 1 – Take Image as Input from a Camera

With a webcam, we will take images as input. So to access the webcam, we made an infinite loop that will capture each frame. We use the method provided by OpenCV, cv2.VideoCapture(0) to access the camera and set the capture object (cap). cap.read() will read each frame and we store the image in a frame variable.

Step 2 – Detect Face in the Image and Create a Region of Interest (ROI)

To detect the face in the image, we need to first convert the image into grayscale as the OpenCV algorithm for object detection takes gray images in the input. We don't need color information to detect the objects. We will be using haar cascade classifier to detect faces. This line is used to set our classifier face = cv2.CascadeClassifier(‘ path to our haar cascade xml file’). Then we perform the detection using faces = face.detectMultiScale(gray). It returns an array of detections with x,y coordinates, and height, the width of the boundary box of the object. Now we can iterate over the faces and draw boundary boxes for each face.

```
for (x,y,w,h) in faces:
    cv2.rectangle(frame, (x,y), (x+w, y+h), (100,100,100), 1 )
```

Step 3 – Detect the eyes from ROI and feed it to the classifier

The same procedure to detect faces is used to detect eyes. First, we set the cascade classifier for eyes in leye and reye respectively then detect the eyes using left_eye = leye.detectMultiScale(gray). Now we need to extract only the eyes data from the full image. This can be achieved by extracting the boundary box of the eye and then we can pull out the eye image from the frame with this code.

```
l_eye = frame[ y : y+h, x : x+w ]
```

l_eye only contains the image data of the eye. This will be fed into our CNN classifier which will predict if eyes are open or closed. Similarly, we will be extracting the right eye into r_eye.

Step 4 – Classifier will Categorize whether Eyes are Open or Closed

We are using CNN classifier for predicting the eye status. To feed our image into the model, we need to perform certain operations because the model needs the correct dimensions to start with. First, we convert the color image into grayscale using r_eye = cv2.cvtColor(r_eye, cv2.COLOR_BGR2GRAY). Then, we resize the image to 24*24 pixels as our model was trained on 24*24 pixel images cv2.resize(r_eye, (24,24)). We normalize our data for better convergence r_eye = r_eye/255 (All values will be between 0-1). Expand the dimensions to feed into our classifier. We loaded our model using model = load_model(‘models/cnnCat2.h5’) . Now we predict each eye with our model
lpred = model.predict_classes(l_eye). If the value of lpred[0] = 1, it states that eyes are open, if value of lpred[0] = 0 then, it states that eyes are closed.

Step 5 – Calculate Score to Check whether Person is Drowsy

The score is basically a value we will use to determine how long the person has closed his eyes. So if both eyes are closed, we will keep on increasing score and when eyes are open, we decrease the score. We are drawing the result on the screen using cv2.putText() function which will display real time status of the person.

```
cv2.putText(frame, “Open”, (10, height-20), font, 1, (255,255,255), 1, cv2.LINE_AA )
```

A threshold is defined for example if score becomes greater than 15 that means the person’s eyes are closed for a long period of time. This is when we beep the alarm using sound.play().

5.3 Data Flow Diagram

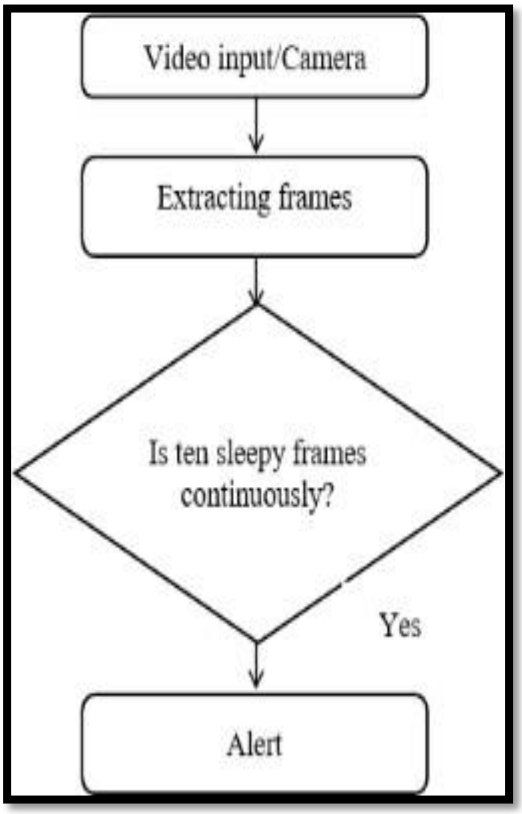
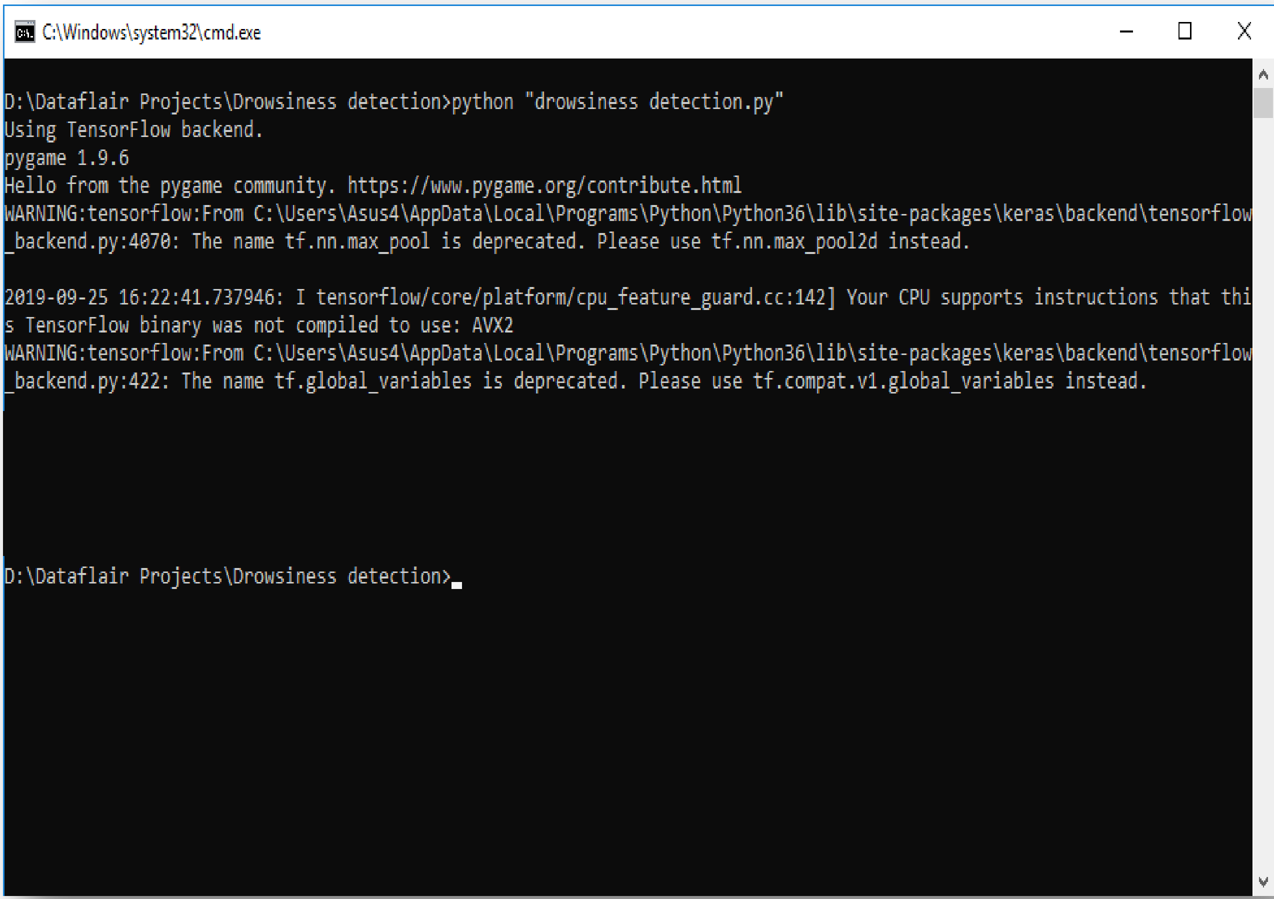
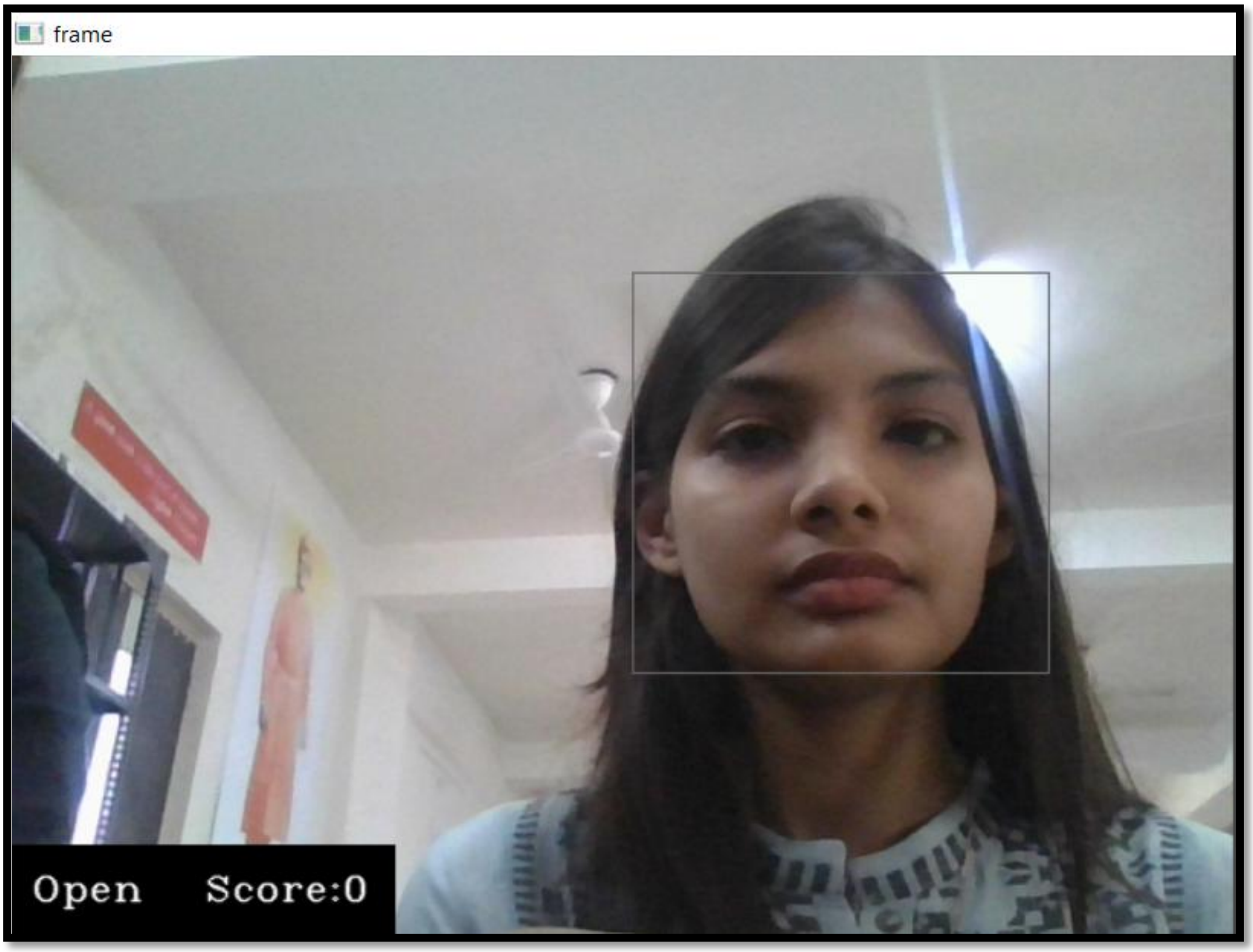


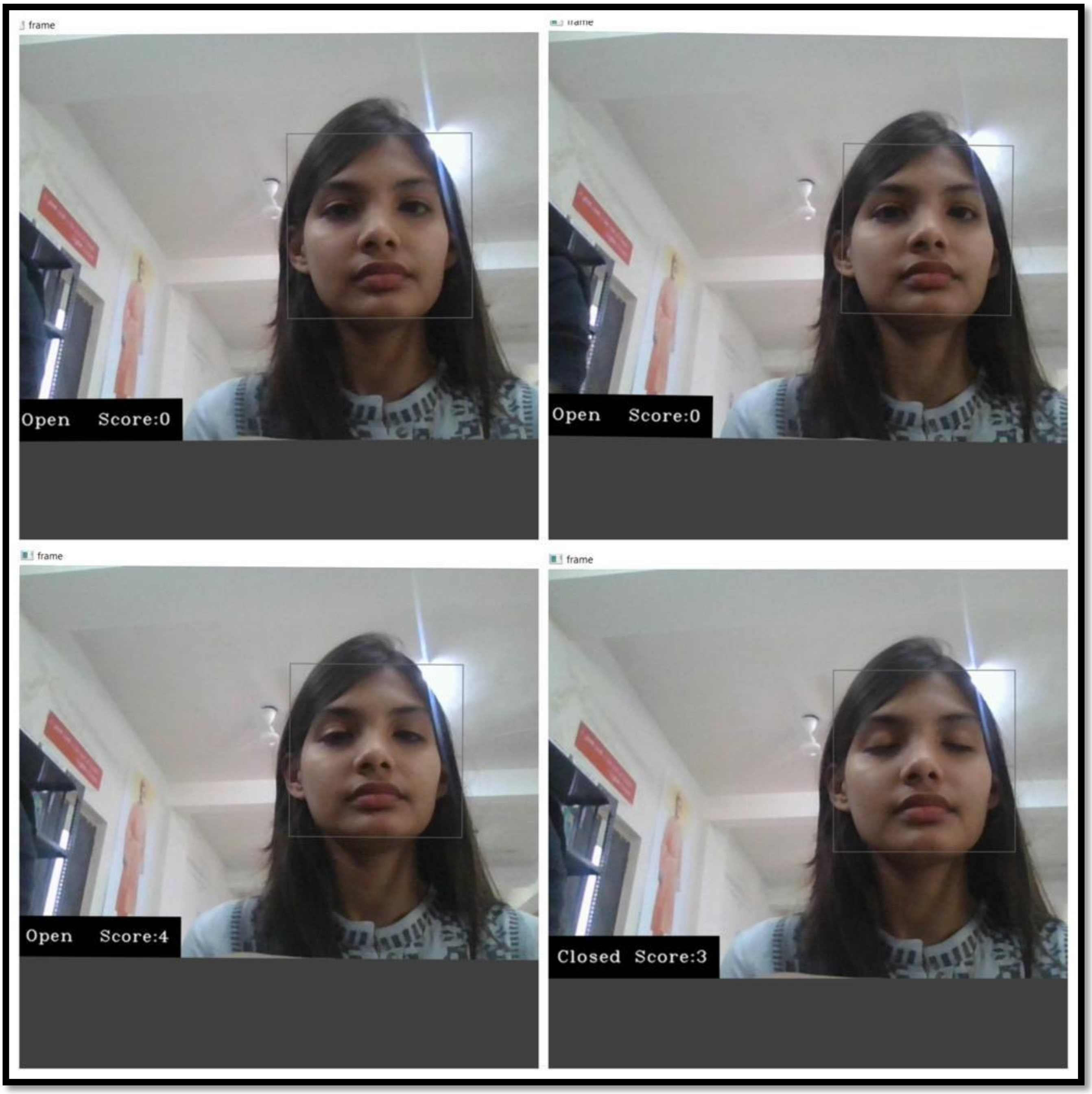
Figure 5 : Data Flow Diagram

Chapter 6
Front-End Snapshots


C:\Windows\system32\cmd.exe
D:\Dataflair Projects\Drowsiness detection>python "drowsiness detection.py"
Using TensorFlow backend.
pygame 1.9.6
Hello from the pygame community. https://www.pygame.org/contribute.html
WARNING:tensorflow:From C:\Users\Asus4\AppData\Local\Programs\Python\Python36\lib\site-packages\keras\backend\tensorflow_backend.py:4070: The name tf.nn.max_pool is deprecated. Please use tf.nn.max_pool2d instead.
2019-09-25 16:22:41.737946: I tensorflow/core/platform/cpu_feature_guard.cc:142] Your CPU supports instructions that this TensorFlow binary was not compiled to use: AVX2
WARNING:tensorflow:From C:\Users\Asus4\AppData\Local\Programs\Python\Python36\lib\site-packages\keras\backend\tensorflow_backend.py:422: The name tf.global_variables is deprecated. Please use tf.compat.v1.global_variables instead.
D:\Dataflair Projects\Drowsiness detection>


frame
Open Score:4


frame
Open Score:0


frame
Open Score:0
frame
Open Score:0
frame
Open Score:4
frame
Closed Score:3

Chapter 7
Result And Analysis

7.1 Analysis

Few samples from the dataset are shown in Figure. Out of 2850 images, 1450 images are drowsy images and remaining are non-drowsy images. To conduct experiment, a total of 1200 images are used for training out of which 600 images are drowsy images and another 600 images are non-drowsy images. A total of 500 images are used for validation out of which 250 images are drowsy images and another 250 images are non-drowsy images. A total of 1150 images are used for testing out of which 550 images are drowsy images and another 600 images are non-drowsy images and proposed model has achieved an accuracy of 96.42% on test dataset. Table shows accuracy of the proposed model after 50 epochs with batch size 4. The training loss and validation loss against number of epochs are shown in Figure. The training accuracy and validation accuracy against number of epochs are shown in Figure. Confusion matrix is shown in Figure 8.In second type of experiment, first we have trained our model with 1200 samples. During testing phase, we capture the video frames through camera and alert with an alarm when the model predicts drowsy output state continuously. Static images are used for training but during testing phase key frames are extracted from continuous video and tested against the trained staticimages.
Experimental flow diagram is shown in Figure . Results in 2ndtypeof experiment are given in Figure.

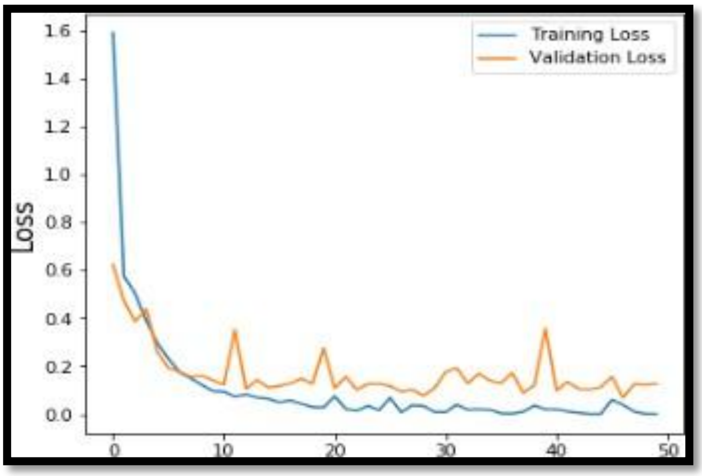


Figure 6 : The training loss and validation loss against no of epochs

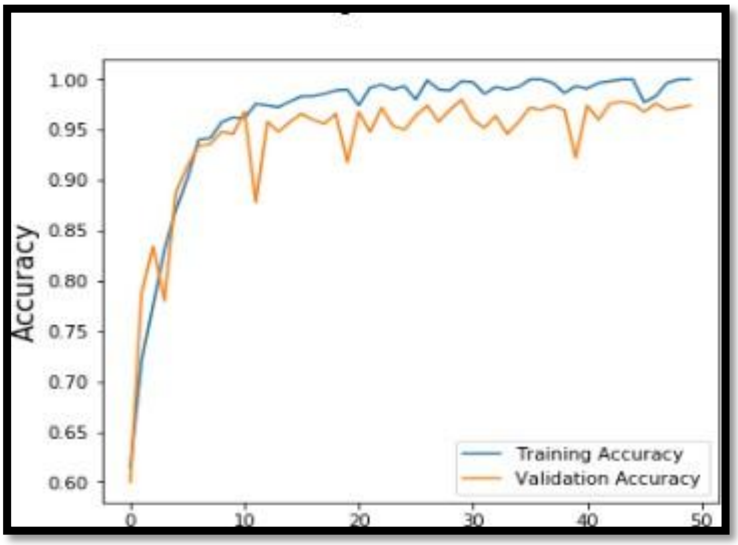


Figure 7: The training accuracy and validation accuracy against no of epochs

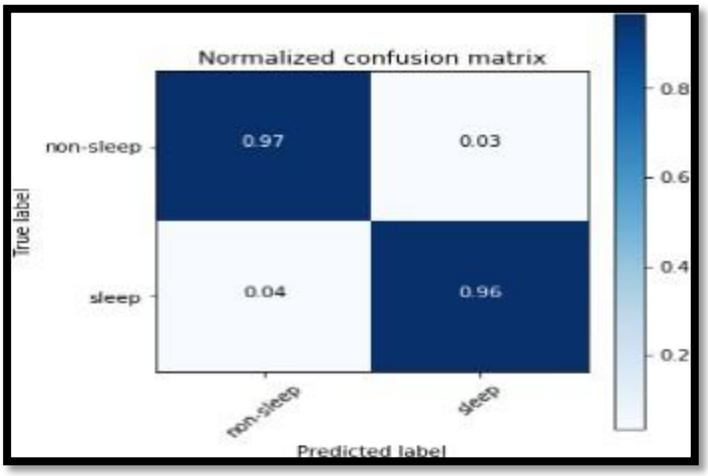


Figure 8: Confusion Matrix

7.2 Result

In this proposed work a new method is proposed for driver drowsiness detection based oneye state. This determines the state of the eye that is drowsy or non-drowsy and alert with an alarm when state of the eye is drowsy. Face and eye region are detected using Viola-Jones detection algorithm. Stacked deep convolution neural network is developed to extract features and used for learning phase. A SoftMax layer in CNN classifier is used to classify the driver as sleep or non-sleep. Proposed system achieved 96.42% accuracy. Proposed system465
effectively identifies the state of driver and alert with an alarm when the model predicts drowsy output state continuously. In future we will use transfer learning to improve the performance of the system.

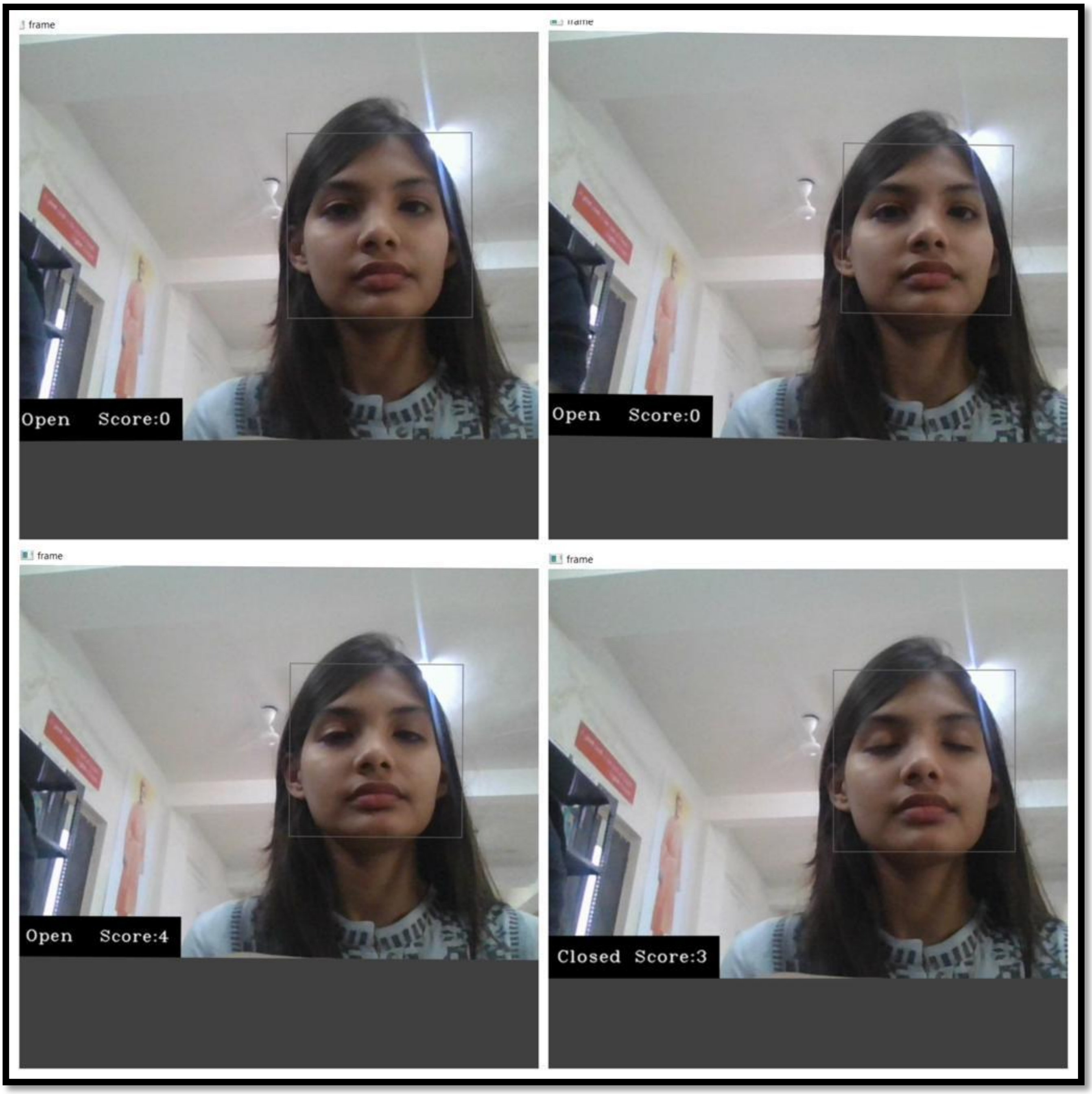


Figure 9 : Final Result Output

Chapter 8
Features And Functionalities

8.1 Features

As a result this application will provide a cutting edge feature of detecting drowsiness which will help drivers among the globe for saving life from various accidents which causes due to drowsiness.

- The detected abnormal behavior is corrected through alarms in realtime.
- Component establishes interface with other drivers veryeasily.
- Life of the driver can be saved by alerting him using the alarmsystem.
- Speed of the vehicle can becontrolled.
- Traffic management can be maintained by reducingaccidents.
- Practicallyapplicable.

The main objective of driver's fatigue identification researches was to propose prototypes which capture, track and store driver behaviors signals. These signals are then analyzed and various characteristics are extracted to describe driver behaviors and identify its state. Several features have been used to detect driving fatigue, especially those describing visual facial expressions signals. The relationships between driving fatigue and driver behavior characteristics have been investigated experimentally and performed on a limited set of features such as PERCLOS, head nodding (Of and Carriers 1998), steering wheel movements (Otmani et al. 2005) and the standard deviation of lane position (Thiffault and Bergeron 2003). The use of these features is not substantiated, then the results reported in several studies are not consistent, although they are based on the same datasets (Azim et al. 2014; Bergasa and Nuevo 2006). In addition, some conclusions have been considered with respect to simulation studies, although they are not necessarily applicable and nor meaningful in real-world driving.

8.2 Functionalities

Driver drowsiness/fatigue is an important cause of combination-unit truck crashes. Recent analyses of the problem estimates that 15% - 36% of all crashes fatal to combination-unit-truck drivers are drowsiness related. The cost of these crashes is estimated to be $2,060 per vehicle over the lifetime of a combination-unit truck.

Drowsy driver detection methods can form the basis of a system to potentially reduce the number of crashes related to drowsy driving. Recently, significant strides have been made in the development and application of a real-time drowsiness monitor. The monitor employs a novel dual image video processing technique to measure PERCLOS, a scientifically validated measure of drowsiness. Uses for the PERCLOS monitor include:

- Providing real-time drowsiness feedback to thedriver,
- Providing performance feedback to a fatigue management program, and/or
- Providing regulatory compliance information to enforcement officials.

Chapter 9
Limitations And Future Improvements

9.1 Limitations

- There must be proper light for camera so that it can easily perform facial recognition, hence it’ll be difficult to run in night.
- Requires too much data for implementation i.e. sample images although it also increases the efficiency still it can be reduced.

9.2 Future Improvements

To provide better evidence of the usefulness of this system future research should address the following issues. Research should be done to make system work more accurately when driver is in motion with respect to camera as here camera used is highly directional.

Thus would help in more security and privacy of systems. It should be noted and understood that with respect to the embodiments of the present invention, the ideas suggested may be modified or substituted to achieve the general overall resultant high efficiency.

The future works may focus on the utilization of outer factors such as vehicle states, sleeping hours, weather conditions, mechanical data, etc. for fatigue measurement. Driver drowsiness poses a major problem to highway safety. 24 hours operations, high annual mileage ,exposure to the challenging environmental condition, and demanding work schedules all contribute to the serious safety issue. Monitoring the driver's state of drowsiness and vigilance and providing feedback on their conditions of that they can take appropriate action is one crucial step in a series of preventive measure to necessary to address this problem. Currently there is no adjustment in zoom or direction of the camera during operation. Future work may be automatically zoom in one yes once they are localized. This would avoid trade-off between having wide field of view in order to locate the eyes, and narrow view in order to detect fatigue.

Drowsiness characteristics differ for different individuals with people having different blink frequencies, the introduction of personal features for a specific driver in detecting his/her drowsiness could improve the drowsiness recognition rate. An individual model using data during the beginning of the driving task (e.g., in the first 20 min) when the driver is alert could be used to develop individualized evaluations. Combining general criteria developed from many participants can also improve the drowsiness recognition accuracy.

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