Driver Drowsiness Detection System

A Project-II Report

Submitted in partial fulfillment of requirement of the

Degree of

BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE & ENGINEERING

BY

Utkarsh Yeole
EN19CS303055
Vedant Deshmukh
EN19CS303056
Vrinda Pareek
EN19CS303059

Under the Guidance of
Mr. Gaurav Sharma

Department of Computer Science & Engineering
Faculty of Engineering
MEDI-CAPS UNIVERSITY, INDORE- 453331

Jan 2023 – May 2023

Report Approval

The project work **"Driver Drowsiness Detection System"** is hereby approved as a creditable study of an engineering/computer application subject carried out and presented in a manner satisfactory to warrant its acceptance as prerequisite for the Degree for which it has been submitted.

It is to be understood that by this approval the undersigned do not endorse or approved any statement made, opinion expressed, or conclusion drawn there in; but approve the "Project Report" only for the purpose for which it has been submitted.

Internal Examiner

Name: Mr. Gaurav Sharma

Designation:

Affiliation:

External Examiner

Name:

Designation:

Affiliation:

Declaration

I/We hereby declare that the project entitled **"Driver Drowsiness Detection System"** submitted in partial fulfillment for the award of the degree of Bachelor of Technology in 'Computer Science and Engineering Department' completed under the supervision of **Mr. Gaurav Sharma -- Computer Science and Engineering,** Faculty of Engineering, Medi-Caps University Indore is an authentic work.

Further, I/we declare that the content of this Project work, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for the award of any degree or diploma.

(Utkarsh Yeole)

(Vedant Deshmukh)

(Vrinda Pareek)

Certificate

I/We, **Mr. Gaurav Sharma** certify that the project entitled **"Driver Drowsiness Detection System"** submitted in partial fulfillment for the award of the degree of Bachelor of Technology by _____ is the record carried out by him/them under my/our guidance and that the work has not formed the basis of award of any other degree elsewhere.

_____	_____
Mr. Gaurav Sharma	Pramod Jagtap
CSE Department	PDD-SMAAT
Medi-Caps University, Indore	VECV, Pithampur, Indore

_____

Dr. Ratnesh Litoriya

Head of the Department

Computer Science & Engineering

Medi-Caps University, Indore

Offer Letter of the Project work-II/Internship

1. Utkarsh Yeole

VECV Internship
1 message

Bhagyashree Patidar <zzbpatidar@vecv.in> Thu, 12 Jan 2023 at 4:03 pm
To: vrindapareek001@gmail.com <vrindapareek001@gmail.com>, vdd27102001@gmail.com <vdd27102001@gmail.com>, utkarshyeole77@gmail.com <utkarshyeole77@gmail.com>
Cc: Saurabh Dubey <sdubey8@vecv.in>

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You will be informed about your project, project guide and the place of posting on arrival.

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2. Vedant Deshmukh

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3. Vrinda Pareek

VECV Internship

1 message

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To: vrindapareek001@gmail.com <vrindapareek001@gmail.com>, vdd27102001@gmail.com <vdd27102001@gmail.com>, utkarshyeole77@gmail.com <utkarshyeole77@gmail.com>
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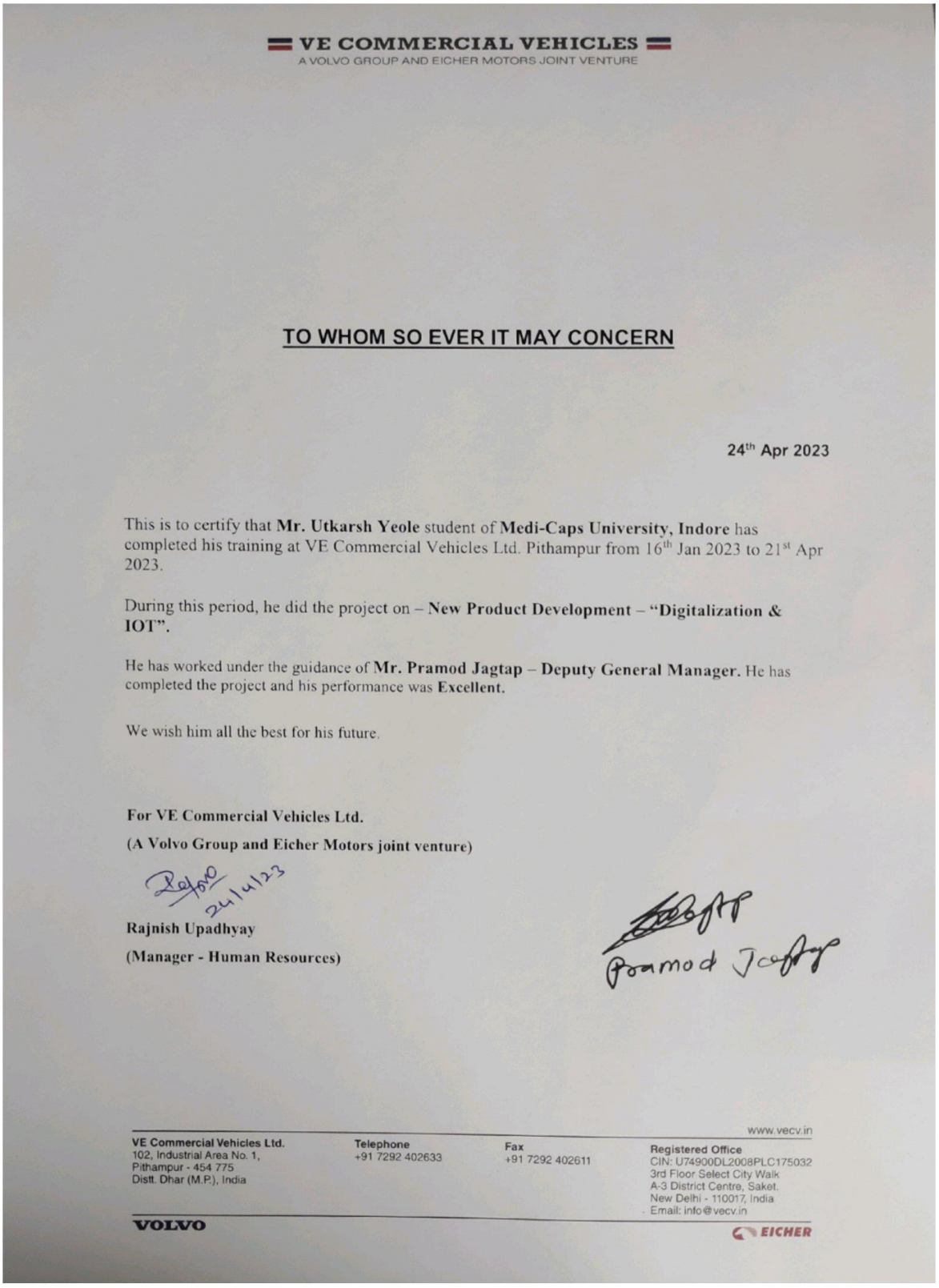
Completion certificate/Letter

1. Utkarsh Yeole



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During this period, he did the project on – **New Product Development – "Digitalization & IOT".**

He has worked under the guidance of **Mr. Pramod Jagtap – Deputy General Manager.** He has completed the project and his performance was **Excellent.**

We wish him all the best for his future.

For VE Commercial Vehicles Ltd.

(A Volvo Group and Eicher Motors joint venture)

24/4/23

Rajnish Upadhyay

(Manager - Human Resources)

Pramod Jagtap

www.vecv.in

VE Commercial Vehicles Ltd.
102, Industrial Area No. 1,
Pithampur - 454 775
Distt. Dhar (M.P.), India

Telephone
+91 7292 402633

Fax
+91 7292 402611

Registered Office
CIN: U74900DL2008PLC175032
3rd Floor Select City Walk
A-3 District Centre, Saket,
New Delhi - 110017, India
Email: info@vecv.in

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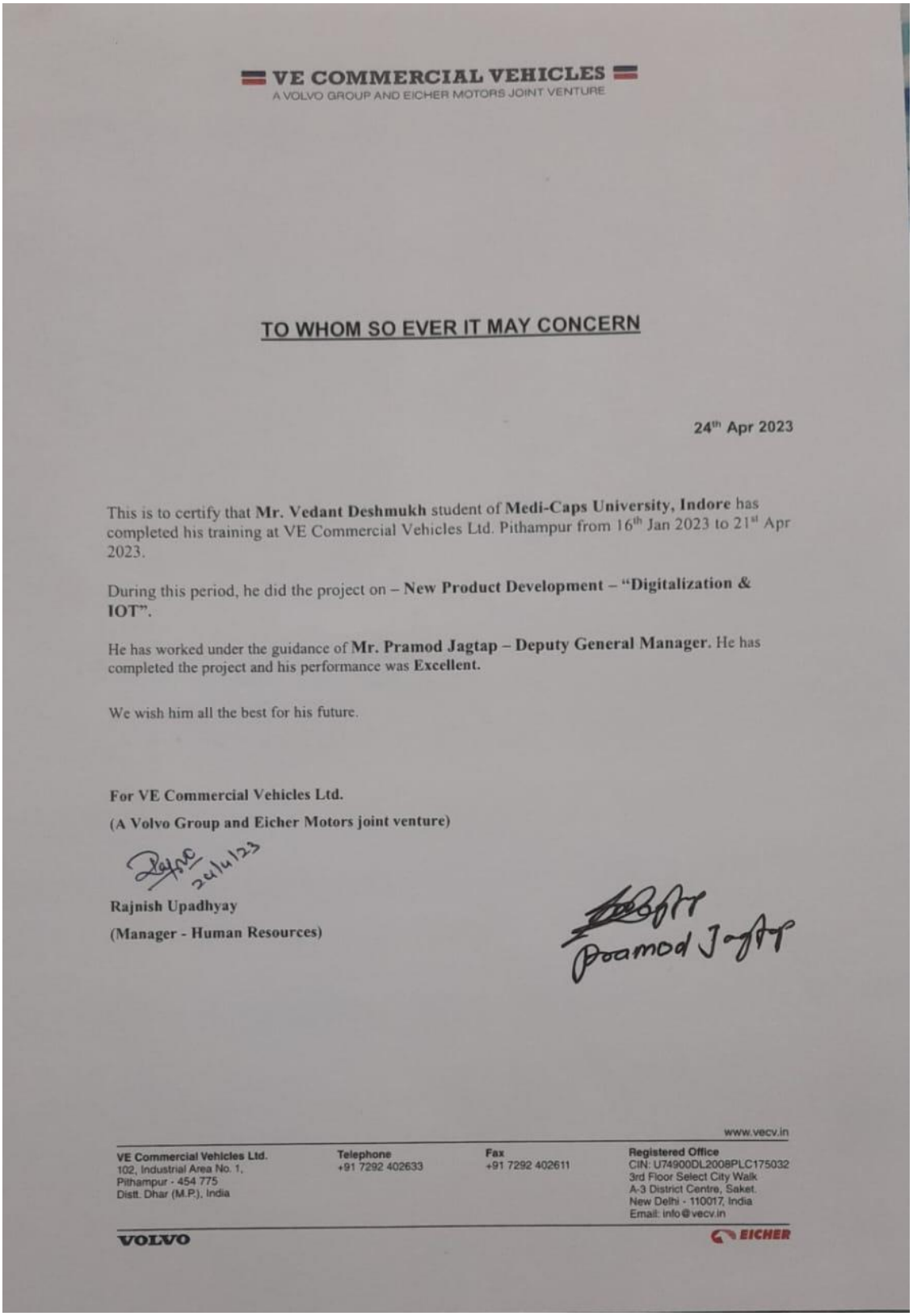
2. Vedant Deshmukh



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www.vecv.in

VE Commercial Vehicles Ltd.
102, Industrial Area No. 1,
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Distt. Dhar (M.P.), India

Telephone
+91 7292 402633

Fax
+91 7292 402611

Registered Office
CIN: U74900DL2008PLC175032
3rd Floor Select City Walk
A-3 District Centre, Saket,
New Delhi - 110017, India
Email: info@vecv.in

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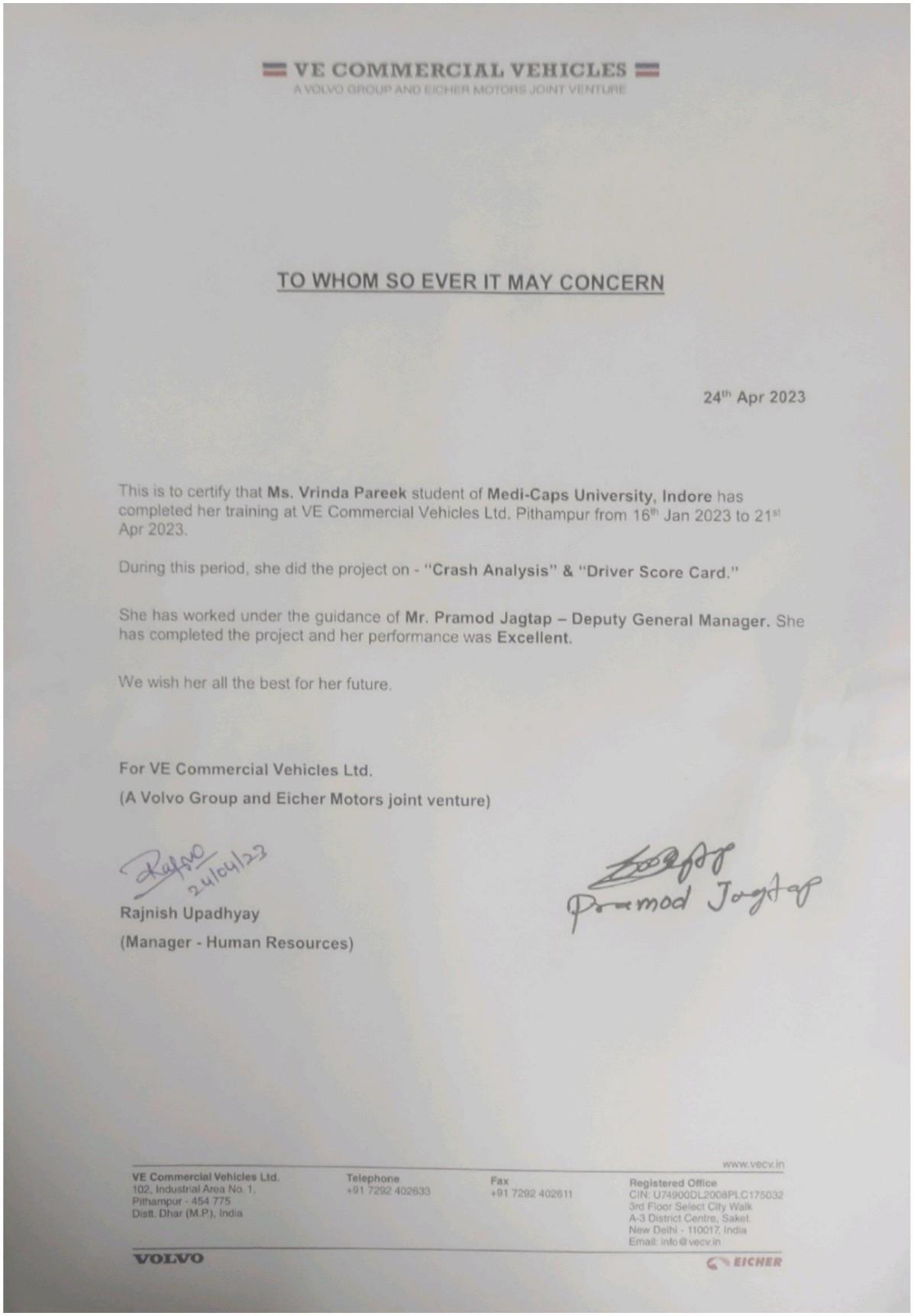
3. Vrinda Pareek



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24th Apr 2023

This is to certify that **Ms. Vrinda Pareek** student of **Medi-Caps University, Indore** has completed her training at VE Commercial Vehicles Ltd. Pithampur from 16th Jan 2023 to 21st Apr 2023.

During this period, she did the project on - **"Crash Analysis" & "Driver Score Card."**

She has worked under the guidance of **Mr. Pramod Jagtap – Deputy General Manager.** She has completed the project and her performance was **Excellent.**

We wish her all the best for her future.

For VE Commercial Vehicles Ltd.

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Rajnish 24/04/23

Rajnish Upadhyay

(Manager - Human Resources)

Pramod Jagtap

www.vecv.in

VE Commercial Vehicles Ltd.
102, Industrial Area No. 1,
Pithampur - 454 775
Distt. Dhar (M.P.), India

Telephone
+91 7292 402633

Fax
+91 7292 402611

Registered Office
CIN: U74900DL2008PLC175032
3rd Floor Select City Walk
A-3 District Centre, Saket,
New Delhi - 110017, India
Email: info@vecv.in

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Acknowledgement

I would like to express my deepest gratitude to Honorable Chancellor, **Shri R C Mittal,** who has provided me with every facility to successfully carry out this project, and my profound indebtedness to **Prof. (Dr.) Dilip K Patnaik,** Vice Chancellor, Medi-Caps University, whose unfailing support and enthusiasm has always boosted up my morale. I also thank **Prof. (Dr.) D K Panda,** Pro Vice Chancellor, **Dr. Pramod S. Nair,** Dean Faculty of Engineering, Medi-Caps University, for giving me a chance to work on this project. I would also like to thank my Head of the Department **Dr. Ratnesh Litoriya** for his continuous encouragement for betterment of the project.

I express my heartfelt gratitude to my **External Guide, Pramod Jagtap**, Deputy General Manager, VE Commercial Vehicles Limited (VECV) as well as to my Internal Guide, **Mr. Gaurav Sharma,** Assistant Professor, Department of Computer Science and Engineering, MU, without whose continuous help and support, this project would ever have reached to the completion.

I would also like to thank to my team at VECV Mr. Amit Kumar Tiwari, Mr. Rakesh Mahali, Mr. K Dinesh Krishna, Mr. Shrikant D Hiwase who extended their kind support and help towards the completion of this project.

It is their help and support, due to which we became able to complete the design and technical report. Without their support this report would not have been possible.

Utkarsh Yeole

Vedant Deshmukh

Vrinda Pareek

B.Tech. IV Year

Department of Computer Science & Engineering

Faculty of Engineering

Medi-Caps University, Indore

Executive Summary

As we all know, a significant number of people are loosing their lives due to accidents each year. Among all those accidents, a major part of the accidents are road accidents. Most accidents that involve big and heavy vehicles often result in victim loosing the lives. These vehicles travel large distances and travel at night at most times. Drowsiness of the driver is one of the major factor that contribute towards such happenings.

So there is a need for a solution that prevents driver from falling asleep while driving.

Proposed Solution

We proposed a solution named as " Driver Drowsiness Detection System " which will help to alert the driver in the night time or long rides when he is sleepy.We will use some Machine learning and Deep learning concepts and build a model that act as a savior for driver's and other peoples' lives. So that there can be reduction in number of accidents due to sleepiness and lives could be saved.

Value

This project provides portion of most effective and a reliable solution as per current technology advancements by providing desktop application where user can view the driver and with the help of Machine Learning and Image Processing.

Final value and Thoughts

Considering today's technology and needs this project may overcome the problem but an effective solution must be required by improving this project which is helpful to stop such casualty. Further developments can help add more features to this solution and can perfect the solution even more.

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Chapter-1

INTRODUCTION

1.1 INTRODUCTION

Drowsiness is a state of near sleep, where the person has a strong desire for sleep. It has two distinct meanings, referring both to the usual state preceding falling asleep and the chronic condition referring to being in that state independent of a daily rhythm. Sleepiness can be dangerous when performing tasks that require constant concentration, such as driving a vehicle. When a person is sufficiently fatigue while driving, they will experience drowsiness and this leads to increase the factor of road accident.

Condition The development of technologies for detecting or preventing drowsiness while driving is a major challenge in the field of accident avoidance system. Because of the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects. The aim of this project is to develop a simulation of drowsiness detection system. The focus will be placed on designing a system that will accurately monitor the open or closed state of the driver’s eyes and mouth. By monitoring the eyes, it is believed that the symptoms of driver's drowsiness can be detected in sufficiently early stage, to avoid a car accident.

Yawning detection is a method to assess the driver’s fatigue. When a person is fatigue, they keep yawning to ensure that there is enough oxygen for the brain consumption before going to drowsiness state . Detection of fatigue and drowsiness involves a sequence of images of a face, and the observation of eyes and mouth open or closed duration. Another method to detect eye closure is PERCLOS.

This detection method is based on the time of eyes closed which refers to percentage of a specific time. The analysis of face images is a popular research area with applications such as face recognition, and human identification and tracking for security systems.

1.2 LITERATURE REVIEW

There are many previous researches regarding driver drowsiness detection system that can be used as a reference to develop a real-time system on detecting drowsiness for drivers. There are also several methods which use different approaches to detect the drowsiness signs.

1. Drowsiness and Fatigue

Antoine Picot et al, [2] stated that drowsiness is where a person is in the middle of awake and sleepy state. This situation leads the driver to not giving full attention to their driving. Therefore, the vehicle can no longer be controlled due to the driver being in a semi-conscious state. According to Gianluca Borghini et al, [3] mental fatigue is a factor of drowsiness and it caused the person who experiences to not be able to perform because it decreases the efficiency of the brain to respond towards sudden events.

2. Electroencephalography (EEG) for Drowsiness Detection

Electroencephalography (EEG) is a method that measures the brain electrical activity. As shown in Figure 3, it can be used to measure the heartbeat, eye blink and even major physical movement such as head movement. It can be used on human or animal as subjects to get the brain activity. It uses a special hardware that place sensors around the top of the head area to sense any electrical brain activity.

Authors in [4] mentioned that from the method that has been implemented by the previous researcher to detect drowsiness signs, the EEG method is best to be applied for drowsiness and fatigue detection. In the method, EEG have four types of frequency components that can be analyzed, i.e. alpha (α), beta (β), theta (θ) and delta (δ). When the power is increased in alpha (α) and delta (δ) frequency bands, it shows that the driver is facing fatigue and drowsiness [4]. The disadvantages of this method are, it is very sensitive to noise around the sensors. For example, when the person is doing the EEG experiment, the surrounding area must be completely silent.

The noise will interfere with the sensors that detect the brain activity. Another disadvantage of this method is that even if the result might be accurate, it is not suitable to use for real driving application [10]. Imagine when a person is driving and he is wearing something on his head with full of wires and when the driver moves their head, the wire may strip off from their place. Even though it is not convenient to be used for real-time driving but for experiment purposes and data collection, it is one of the best methods so far [2].

3. Drowsiness detection using face detection system

Drowsiness can be detected by using face area detection [5], [6] and [2]. The methods to detect drowsiness within face area are vary due to drowsiness sign are more visible and clear to be detected at face area. From the face area, we can detect the eyes location. From eyes detection, author in [5] stated that there are four types of eyelid movement that can be used for drowsiness detection. They are complete open, complete close, and in the middle where the eyes are from open to close and vice versa [5]. Figure 4 is an example of the image taken for detecting eyelid movement.

4. PERCLOS (Percentage of Eye Closure)

Drowsiness can be captured by detecting the eye blinks [5] and percentage of eye closure (PERCLOS). For eye blink detection, [5] propose a method which learned the pattern of duration of eyelid closed. According to [10], 'this proposed method measures the time for a person closed their eyes and if they are closed longer than the normal eye blink time, it is possible that the person is falling asleep'. In [10], the author mentioned that 'nearly 310.3ms are the average of normal person eye blink'. PERCLOS method proposes that drowsiness is measured by calculating the percentage of the eyelid 'droops' [11]. Sets of eyes open and eye closed have been stored in the software library to be used as a parameter to differentiate either the eyes is fully open or fully closed. For eyelid to droops, it happened in much slower time as the person is slowly falling asleep. Hence, the transition of the driver's drowsy can be recorded.

Thus, PERCLOS method put a proportional value where when the eyes is 80% closed, which it is nearly to fully close, it assumed that the driver is drowsy [2], [10], and [9]. This method is not convenient to be used in real-time driving as it needs fix threshold value of eye opening for the PERCLOS method to perform accurately. Both methods to detect drowsiness using eye blink pattern and PERCLOS have the same problem where the camera need to be placed at a specific angle in order to get a good image of video with no disturbance of eyebrow and shadow that cover the eyes.

5. Yawning Detection Method

According to [15], drowsiness of a person can be observed by looking at their face and behavior. The author propose a method where drowsiness can be detected by mouth positioning and the images were process by using cascade of classifier that has been proposed by Viola-Jones for faces. The images were compared with the set of images data for mouth and yawning [8]. Some people will close their mouth by their hand while yawning. It is an obstacle to get good images if a person is closing their mouth while yawning but yawning is definitely a sign of a person having drowsiness and fatigue. Figure 5 are the examples of yawning detection method used in the [10] research

1.3 PROBLEM DEFINITION

According to Records of Ministry of Road Transport and Highways of India, more than 7 Lakh people were affected by accidents in 2020 and 2021 that involved roads. This number increases a lot more when it comes to people affected by accidents involving all the other modes of transports. The following image shows a detailed summary of people affected by road accidents in 2020-21.

Category of Road	2020			2021			% Change in 2021 over 2020		
	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured
National Highways	1,16,496	47,984	1,09,898	1,28,825	56,007	1,17,765	10.58	16.72	7.16
% share	31.8	36.4	31.6	31.2	36.4	30.6			
State Highways	90,755	33,148	88,208	96,382	37,963	92,583	6.20	14.53	4.96
% share	24.8	25.2	25.3	23.4	24.6	24.1			
Other Roads	1,58,887	50,582	1,50,173	1,87,225	60,002	1,74,100	17.84	18.62	15.93
% share	43.4	38.4	43.1	45.4	39.0	45.3			
All Roads	**3,66,138**	**1,31,714**	**3,48,279**	**4,12,432**	**1,53,972**	**3,84,448**	**12.64**	**16.9**	**10.39**

Table 1.3.1 Road Accidents, Fatalities and Injuries by Road Category (2020 and 2021)

Every year, approximately 1.5 lakh people dies on India roads, which translate, on an average, into 1130 accidents and 422 deaths every day or 47 accidents and 18 deaths every hour. Official Records state that India Recorded 1,55,622 Road Accident Deaths in the year 2022.

Drowsiness refers to feeling more sleepy than normal during the day. People who are drowsy may fall asleep in when they do not want to or at times which can lead to safety concerns. Drowsiness is one of the major factors that lead to a road accident. When driving on long routes, for long hours or at night, people are more likely to fall asleep.

The problem is simple – drowsiness. So to tackle this problem, there needs a system to be in existence that continuously monitors the driver at all times. When the driver is sleepy, the system should awaken the driver in any way possible.

1.4 OBJECTIVES

Each year we lose so many people to accidents. Many who are affected are left with chronic diseases, suffer for a long time. People who are left crippled in these accidents are forced to live life with such conditions. Addressing this problem, our project has following objectives

1. Reduction in the numbers of accidents and fatalities each year.
2. Helping drivers to stay focused on roads and drive safely.
3. Have a constant monitoring system for the owners or employers of the vehicles.
4. Driver Identification and Authentication using the live video feed by the employer. 5. Making roads safer to travel for all the pedestrians, street animals and small vehicle drivers.

1.5 SIGNIFICANCE

According to a study conducted by the Indian Journal of Sleep Medicine, drowsy driving is a significant problem in India. The study found that 27% of drivers in India reported experiencing drowsiness while driving, and 16% reported falling asleep at the wheel.

In addition, the study found that drowsy driving was more prevalent among commercial drivers, with 34% of commercial drivers reporting drowsiness while driving, compared to 23% of non-commercial drivers.

The Indian government has also recognized the issue of drowsy driving and has taken steps to address it. In 2018, the Ministry of Road Transport and Highways issued an advisory to all state governments and union territories to include provisions for driver fatigue management in their respective road safety policies.

Despite these efforts, drowsy driving remains a significant problem in India, with a high number of accidents and fatalities attributed to driver fatigue. The driver drowsiness detection system has the potential to significantly reduce the risk of accidents caused by drowsy driving in India, making the roads safer for all users.

1.6 SOURCE OF DATASET

For this project, we use image dataset called MRL – Eye Dataset which has images of thousands of eyes of people from different countries and races. This dataset has images in Black and White 11 and contains images of both left and right eyes. This dataset is a combination of images of open and closed eyes.

This dataset contains infrared images in low and high resolution, all captured in various lightning conditions and by different devices. The dataset is suitable for testing several features or trainable classifiers. In order to simplify the comparison of algorithms, the images are divided into several categories, which also makes them suitable for training and testing classifiers. To obtain eye images, they have used the eye detector based on the histogram of oriented gradients (HOG) combined with the SVM classifier. The eye images presented in the proposed dataset can be used to train the eye detector.

Link: http://mrl.cs.vsb.cz/eyedataset.

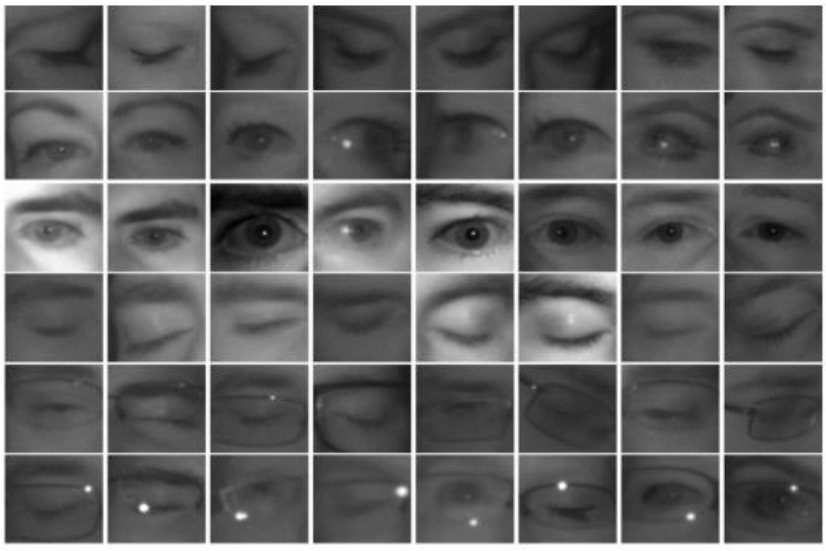


Fig. 1.6.1 MRL - Eye Dataset

1.7 CHAPTER SCHEME

Chapter 1

These Chapter includes the complete introduction about the project. It also mentions the research done on the prior work done on the project. These chapter also talks about the objectives of the project and its significance in real-world. It also explains the process of research which tells about the how the research begins, number of research papers reviewed etc. It also mentions about the different sources of the data.

Chapter 2

These chapter includes about the different types of requirements needed to run and development of the project. It explains the experimental setup required for the development, debugging, and testing of the project. These chapter also talks about the activities included in the development process. It also specifies all the functional, non-functional and technical requirements for the project. It describes all the UML diagrams to define the system design and processes of SDLC.

Chapter 3

These chapter focuses on the implementation and results of the project. It includes the code snippets, results, model evaluation and testing of the model. It also explains about the data generation process which includes Background Subtraction, Image Thresholding and Storage of Images. It also discuss about the frontend development and integration of ML model with the frontend to make it user - friendly.

Chapter 4

These chapter summarizes the whole process and results obtained after development and testing of the project. It also talks about the future scope of the project and scope of improvement in the project. It also lists all the references taken during the project development.

Chapter – 2

SYSTEM REQUIREMENTS AND SPECIFICATION

2.1 EXPERIMENTAL SETUP

- **Computer Vision:** Computer vision works much the same as human vision, except humans have a head start. Human sight has the advantage of lifetimes of context to train how to tell objects apart, how far away they are, whether they are moving and whether there is something wrong in an image. Computer vision trains machines to perform these functions, but it has to do it in much less time with cameras, data and algorithms rather than retinas, optic nerves and a visual cortex. Because a system trained to inspect products or watch a production asset can analyse thousands of products or processes a minute, noticing imperceptible defects or issues, it can quickly surpass human capabilities.

- **Tkinter:** Python offers multiple options for developing GUI (Graphical User Interface). Out of all the GUI methods, tkinter is the most commonly used method. It is a standard Python interface to the Tk GUI toolkit shipped with Python. Python with tkinter is the fastest and easiest way to create the GUI applications. Creating a GUI using tkinter is an easy task.

- **Tensor Flow:** TensorFlow is an end-to-end open-source platform for machine learning. TensorFlow is a rich system for managing all aspects of a machine learning system; however, this class focuses on using a particular TensorFlow API to develop and train machine learning models. • Keras : 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.

- **Convolutional Neural Network (CNN):** is a Deep Learning algorithm that can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image, and be able to differentiate one from the other. The preprocessing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics.

- **Background Subtraction:** The background subtraction method (BSM) is one of the most popular approaches to detecting objects. This algorithm works by comparing moving parts of a video to a background image and foreground image. This method is used to find foreground objects by isolating them while comparing them to the frame where no objects are present; it will find the differences between them and create a distance matrix. Basically, what it does is compare the difference in the value of two frames, one frame without an object and the other with objects to count, with the threshold value. The threshold value is predefined by using the first few frames of the video. Hence if the difference in the value of two frames is greater than the pre-set threshold value, the result is marked as a moving object detected.

- **Thresholding:** Image thresholding is a simple form of image segmentation. It is a way to create a binary image from a grayscale or full-color image. This is typically done in order to separate "object" or foreground pixels from background pixels to aid in image processing.

2.2 PROPOSED METHOD

- **Data Collection:** For this project, we use real images taken from webcam and then it can be categorized into different classes.

Table: 2.2.1 Image Statistics

CLASS	Number of Images
Open Eyes	2000
Closed Eyes	2000
Total	4000

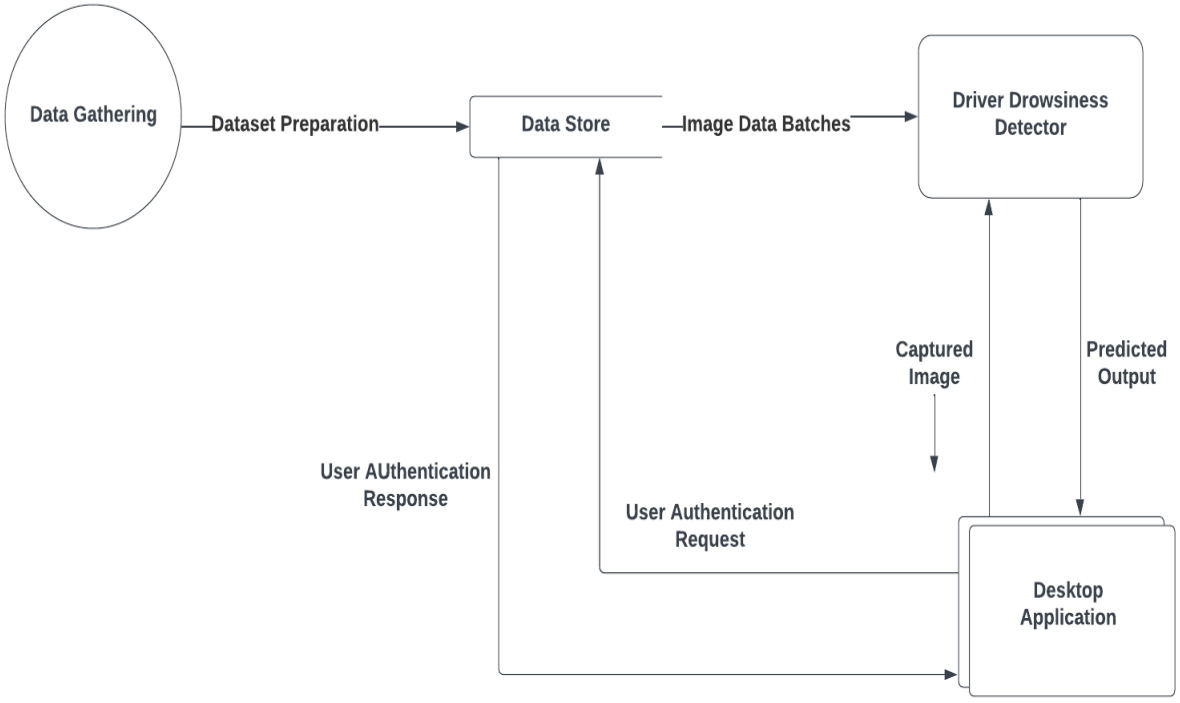
- **Model Building:** For model building, we use python and its frameworks in which we add the images according to the classes and then by changing some of the attributes like epochs, batch size etc. And the last stage is of exporting model with given types:
  i) Tensorflow ii) Tensorflow.js iii) Tensorflow Lite.

- **Convolutional Neural Network (CNN)**: A convolutional neural network (CNN or ConvNet) is a network architecture for deep learning that learns directly from data. CNNs are particularly useful for finding patterns in images to recognize objects, classes, and categories. They can also be quite effective for classifying audio, time-series, and signal data.

- **Integrating model with Desktop App:** The TensorFlow Lite Android Support Library makes it easier to integrate models into application. It provides high level APIs that help transform raw input data into the form required by the model, and interpret the model's output, reducing the amount of boilerplate code required. It supports common data formats for inputs and outputs, including images and arrays. It also provides pre and post processing units that perform tasks such as image resizing and cropping. For front end implementation of the project is as follows:
- **Developing Desktop Application:** An interactive and operable desktop application is developed with minimalistic UI design so that all the operations are in approach to the user easily. User just need to capture images per words or live stream and then click single button to see the recognized text and single click to hear the audio of corresponding text.

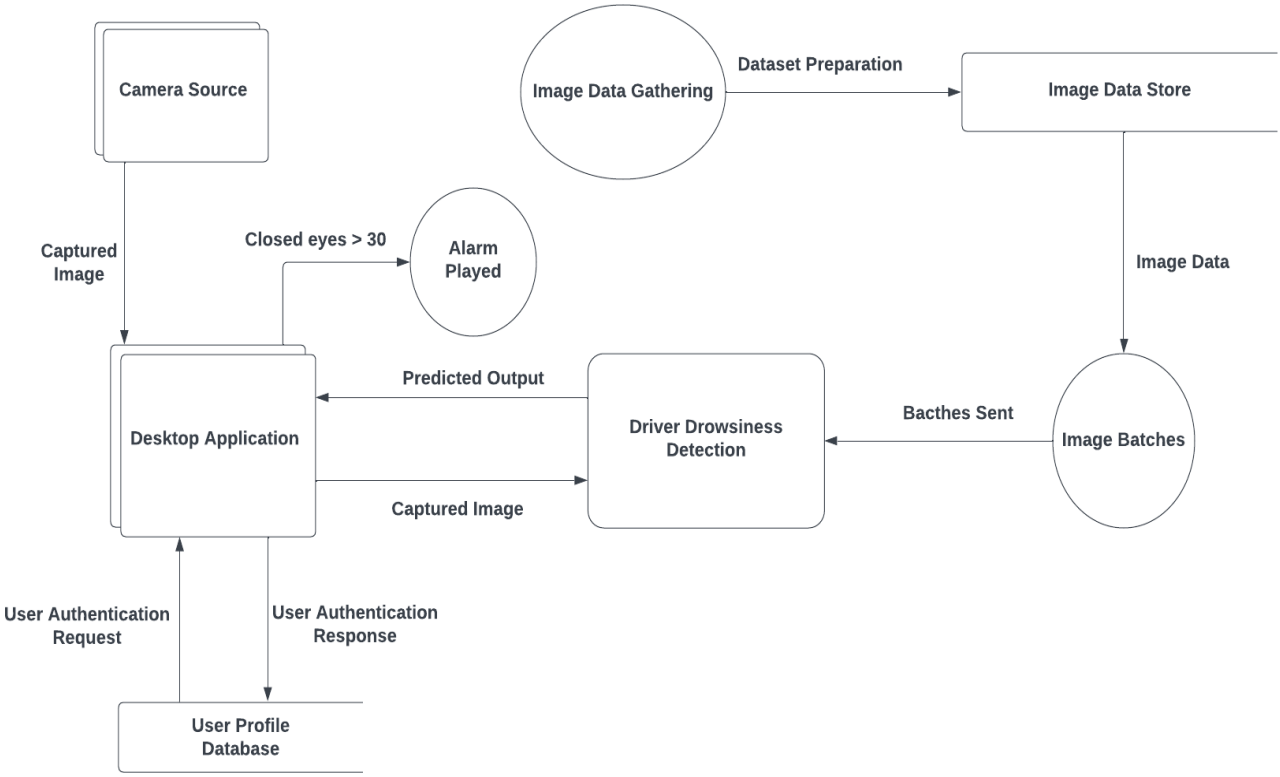
2.3 DATAFLOW DIAGRAM

2.3.1 Data Flow Diagram (Level 0)



2.3.1 Data Flow Diagram (Level 0)

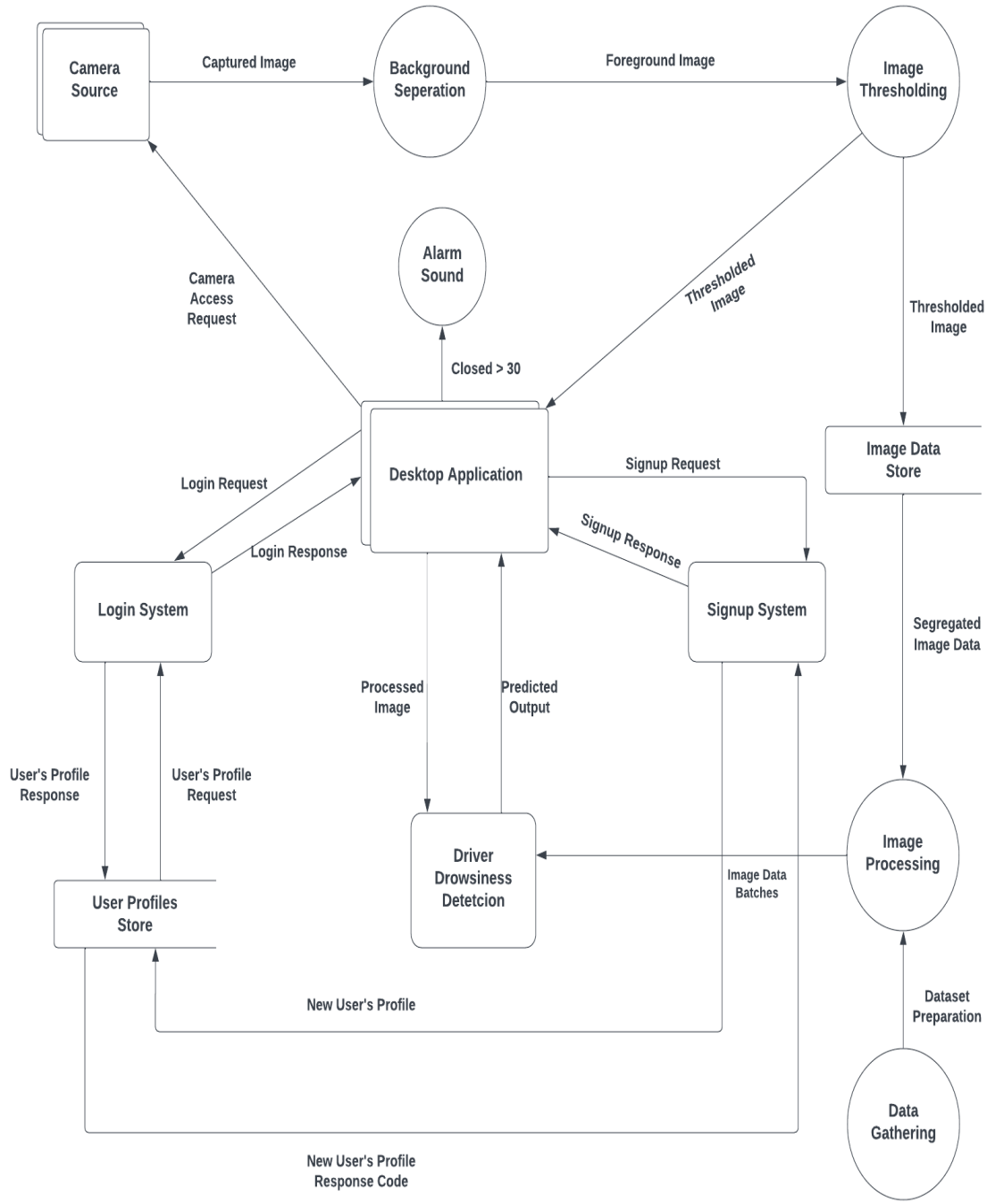
2.3.2 Data Flow Diagram (Level 1)



2.3.2 Data Flow Diagram (Level 1)

In 1-level DFD, a context diagram is decomposed into multiple bubbles/processes. In this level, we highlight the main objectives of the system and breakdown the highlevel process of 0-level DFD into subprocesses. Level 1 DFD breaks down the main process into subprocesses that can then be seen on a more deep level. Also, level 1 DFD contains data stores that are used by the main process.

2.3.3 Data Flow Diagram (Level 2)



2.3.3 Data Flow Diagram (Level 2)

• **Camera Source:** It is the external device used for both the process of Data Generation as well as taking input for translation of Sign Language into English Language.

• **Background Subtraction:** The background subtraction method (BSM) is one of the most popular approaches to detecting objects. This algorithm works by comparing moving parts of a video to a background image and foreground image. This method is used to find foreground objects by isolating them while comparing them to the frame where no objects are present.

• **Image Thresholding:** Image thresholding is a simple form of image segmentation. It is a way to create a binary image from a grayscale or full-color image. This is typically done in order to separate "object" or foreground pixels from background pixels to aid in image processing.

• **Image Data Store:** It is the database used for storing the images captured during the process of Data Generation as well as in the process of Translation to improve accuracy.

• **Driver Drowsiness:** Analyzes the image and checks both eyes and labels it as open or close and gives score according to it.

• **Alarm Sound:** If the score of driver drowsiness reaches 30 then it will start beeping.

• **Desktop Application:** These is a Frontend for Sign Language Translator with which user interact to use the features of the translator with some additional features. 16

• **Login System:** It is a system which is integrated with the Desktop Application for the purpose of User Authentication.

• **Signup System:** It is a system which is integrated with the Desktop Application for the purpose of Data collection of the New User and assigning the credentials for using the Sign Language Translator.

• **User Profile Store:** It is database which is used by Login and Signup system to store and retrieve the user's data for User Authentication and Data Collection.

2.4 FUNCTIONAL REQUIREMENTS

• **Live Capturing Video:** The system should take the live feed from the User for further analysis.

• **Background Subtraction:** The system should be able to clip foreground object from background.

• **Thresholding:** The system should separate "object" or foreground pixels from background pixels to aid in image processing.

• **Driver Drowsiness:** Analyzes the image and checks both eyes and labels it as open or close and gives score according to it.

• **User Authentication:** The system should have the functionalities of Login and Sign up to authenticate the User and build individual sessions.

2.5 NON - FUNCTIONAL REQUIREMENTS

• **Accuracy:** Since we will give the priority to the accuracy of the software, the performance of the Music Recommender will be based on its accuracy on recommendations.

• **Failure handling System:** Components may fail independently of others. Therefore, system components must be built so they can handle failure of other components they depend on.

• **Openness:** The system should be extensible to guarantee that it is useful for a reasonable period.

• **Security:** User profile information will be used, so data security is one of the most important concern of the system.

• **Usability:** The software will be embedded in a website. It should be scalable designed to be easily adopted by a system.

• **Reliability:** The system should have accurate results and fast responses to user's changing habits.

• **Hardware Constraints:** To use Sign Language Translation system, user should enter from a personal computer, mobile device, tablet etc.

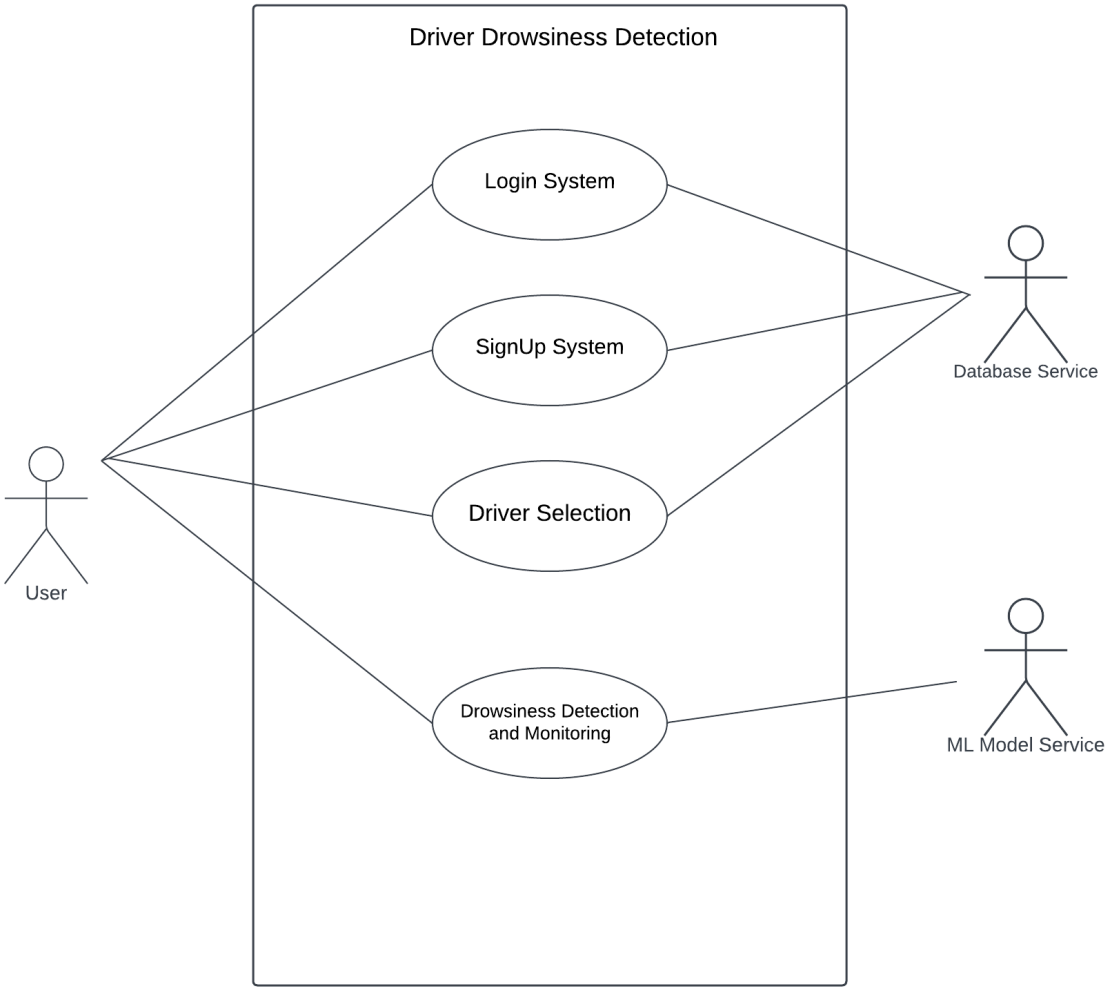
2.5 TECHNICAL SPECIFICATIONS

• 4 GB RAM
• 5 GB free disk space
• Intel Core i3 processor or above
• 40 GB Cache memory
• Web Camera (Integrated / External)
• Python 3.9 or above

2.6 UML DIAGRAMS

1. Use Case Diagram

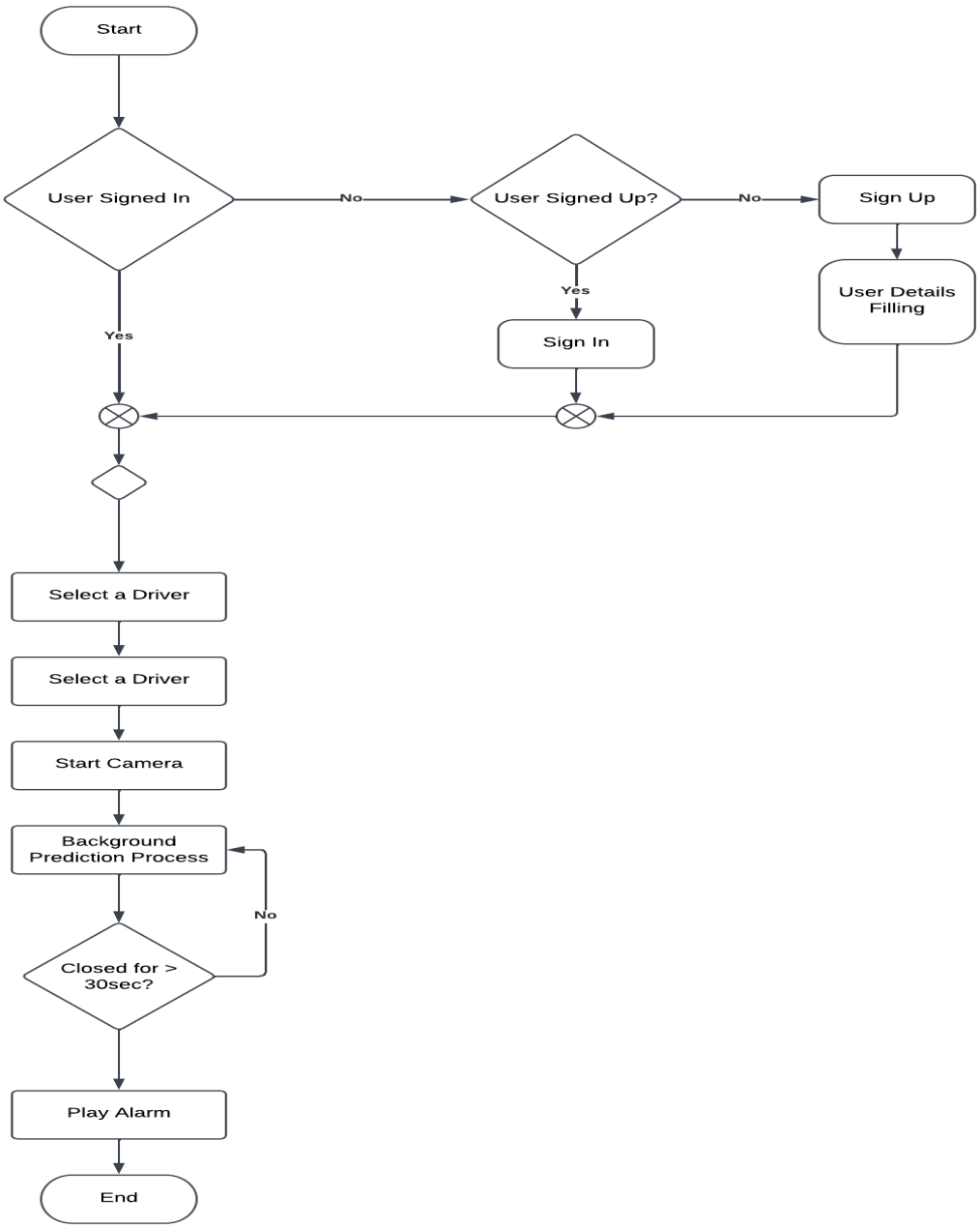
A use case diagram is used to represent the dynamic behavior of a system. It encapsulates the system's functionality by incorporating use cases, actors, and their relationships. It models the tasks, services, and functions required by a system/subsystem of an application. It depicts the high-level functionality of a system and also tells how the user handles a system. The main purpose of a use case diagram is to portray the dynamic aspect of a system. It accumulates the system's requirement, which includes both internal as well as external influences. It invokes persons, use cases, and several things that invoke the actors and elements accountable for the implementation of use case diagrams. It represents how an entity from the external environment can interact with a part of the system.



2.6.1 Use Case Diagram

2.6.2 Activity Diagram

The activity diagram is used to demonstrate the flow of control within the system rather than the implementation. It models the concurrent and sequential activities. The activity diagram helps in envisioning the workflow from one activity to another. It put emphasis on the condition of flow and the order in which it occurs. The flow can be sequential, branched, or concurrent, and to deal with such kinds of flows, the activity diagram has come up with a fork, join, etc. It is also termed as an object-oriented flowchart. It encompasses activities composed of a set of actions or operations that are applied to model the behavioral diagram.



2.6.2 Activity Diagram

2.6.3 Deployment Diagram

The deployment diagram visualizes the physical hardware on which the software will be deployed. It portrays the static deployment view of a system. It involves the nodes and their relationships. It ascertains how software is deployed on the hardware. It maps the software architecture created in design to the physical system architecture, where the software will be executed as a node. Since it involves many nodes, the relationship is shown by utilizing communication paths. The main purpose of the deployment diagram is to represent how software is installed on the hardware component. It depicts in what manner a software interacts with hardware to perform its execution.

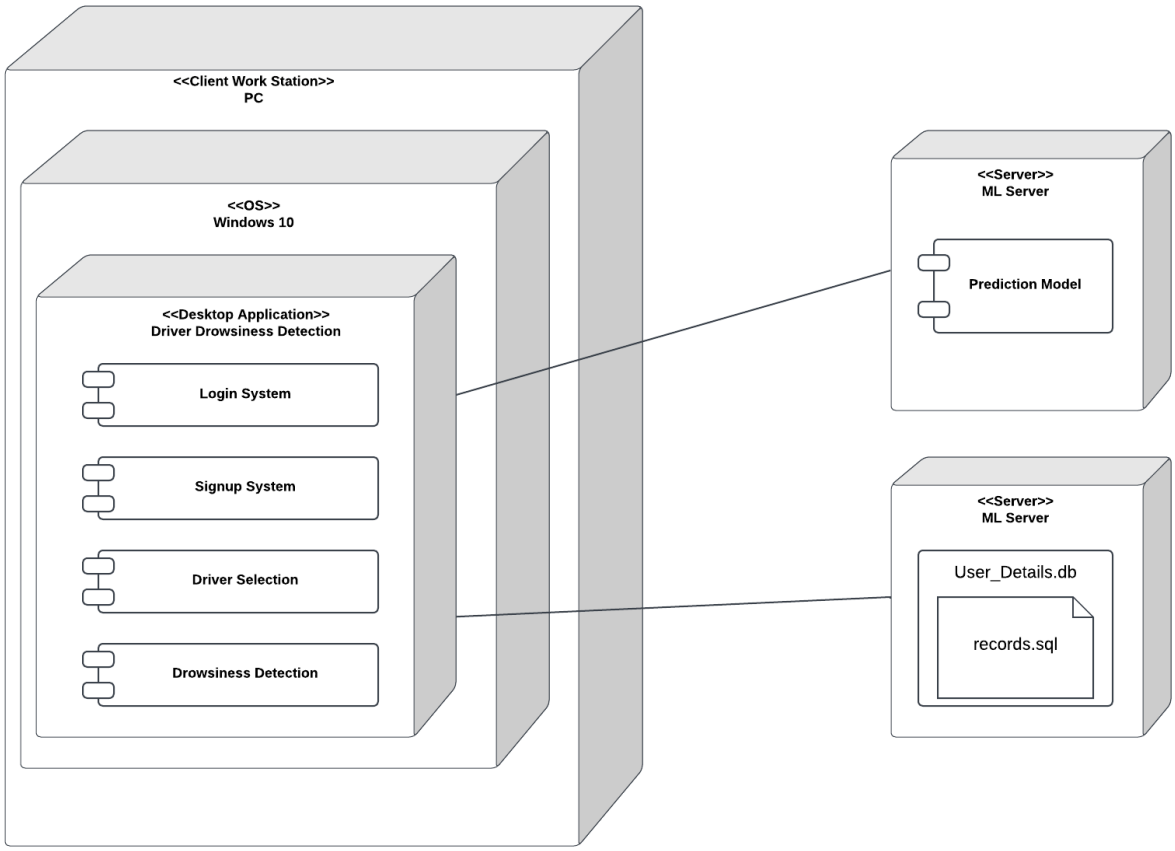


Fig 2.6.3 Deployment Diagram

Chapter – 3

IMPLEMENTATION & RESULTS

3.1 Data Collection

For this project, we use real images taken from webcam and then it can be categorized into different classes.

For this project, we use image dataset called MRL – Eye Dataset which has images of thousands of eyes of people from different countries and races. This dataset has images in Black and White 11 and contains images of both left and right eyes. This dataset is a combination of images of open and closed eyes.

This dataset contains infrared images in low and high resolution, all captured in various lightning conditions and by different devices. The dataset is suitable for testing several features or trainable classifiers. In order to simplify the comparison of algorithms, the images are divided into several categories, which also makes them suitable for training and testing classifiers. To obtain eye images, they have used the eye detector based on the histogram of oriented gradients (HOG) combined with the SVM classifier. The eye images presented in the proposed dataset can be used to train the eye detector.

3.2 Model Building:

For model building, we use python and its frameworks in which we add the images according to the classes and then by changing some of the attributes like epochs, batch size etc. And the last stage is of exporting model with given types i) Tensorflow ii) Tensorflow.js iii) Tensorflow Lite.

3.2.1 Creating CNN Layers

```
bmodel = InceptionV3(include_top = False, weights = 'imagenet',
                     input_tensor = Input(shape = (80,80,3)))
hmodel = bmodel.output
hmodel = Flatten()(hmodel)
hmodel = Dense(64, activation = 'relu')(hmodel)
hmodel = Dropout(0.5)(hmodel)
hmodel = Dense(2,activation = 'softmax')(hmodel)

model = Model(inputs = bmodel.input, outputs= hmodel)
for layer in bmodel.layers:
    layer.trainable = False


from tensorflow.keras.callbacks import ModelCheckpoint,EarlyStopping, ReduceLROnPlateau
checkpoint = ModelCheckpoint(os.path.join("models", "model.h5"),
                             monitor = 'val_loss', save_best_only = True, verbose = 3)
earlystop = EarlyStopping(monitor = 'val_loss', patience = 7,
                          verbose= 3, restore_best_weights = True)

learning_rate = ReduceLROnPlateau(monitor= 'val_loss', patience=3, verbose= 3, )

callbacks = [checkpoint, earlystop, learning_rate]

model.compile(optimizer = 'Adam',
              loss = 'categorical_crossentropy',
              metrics = ['accuracy'])

model.fit_generator(train_data,steps_per_epoch = train_data.samples// BATCH_SIZE,
                    validation_data = validation_data,
                    validation_steps = validation_data.samples// BATCH_SIZE,
                    callbacks = callbacks,
                     epochs = EPOCHS)
```

```
# Model Evaluation
acc_tr, loss_tr = model.evaluate_generator(train_data)
print(acc_tr)
print(loss_tr)

acc_vr, loss_vr = model.evaluate_generator(validation_data)
print(acc_vr)
print(loss_vr)

acc_test, loss_test = model.evaluate_generator(test_data)
print(acc_tr)
print(loss_tr)
```

Fig. 3.2.1.1 Creating CNN Layer

Model: "model_1"

Layer (type)	Output Shape	Param #	Connected to
input_9 (InputLayer)	[(None, 80, 80, 3)]	0	
conv2d_752 (Conv2D)	(None, 39, 39, 32)	864	input_9[0][0]
batch_normalization_752 (BatchN	(None, 39, 39, 32)	96	conv2d_752[0][0]
activation_752 (Activation)	(None, 39, 39, 32)	0	batch_normalization_752[0][0]
conv2d_753 (Conv2D)	(None, 37, 37, 32)	9216	activation_752[0][0]
batch_normalization_753 (BatchN	(None, 37, 37, 32)	96	conv2d_753[0][0]
activation_753 (Activation)	(None, 37, 37, 32)	0	batch_normalization_753[0][0]
conv2d_754 (Conv2D)	(None, 37, 37, 64)	18432	activation_753[0][0]
batch_normalization_754 (BatchN	(None, 37, 37, 64)	192	conv2d_754[0][0]
activation_754 (Activation)	(None, 37, 37, 64)	0	batch_normalization_754[0][0]
max_pooling2d_32 (MaxPooling2D)	(None, 18, 18, 64)	0	activation_754[0][0]
conv2d_755 (Conv2D)	(None, 18, 18, 80)	5120	max_pooling2d_32[0][0]
batch_normalization_755 (BatchN	(None, 18, 18, 80)	240	conv2d_755[0][0]
activation_755 (Activation)	(None, 18, 18, 80)	0	batch_normalization_755[0][0]
conv2d_756 (Conv2D)	(None, 16, 16, 192)	138240	activation_755[0][0]
batch_normalization_756 (BatchN	(None, 16, 16, 192)	576	conv2d_756[0][0]
activation_756 (Activation)	(None, 16, 16, 192)	0	batch_normalization_756[0][0]
max_pooling2d_33 (MaxPooling2D)	(None, 7, 7, 192)	0	activation_756[0][0]
conv2d_760 (Conv2D)	(None, 7, 7, 64)	12288	max_pooling2d_33[0][0]
batch_normalization_760 (BatchN	(None, 7, 7, 64)	192	conv2d_760[0][0]
activation_760 (Activation)	(None, 7, 7, 64)	0	batch_normalization_760[0][0]
conv2d_758 (Conv2D)	(None, 7, 7, 48)	9216	max_pooling2d_33[0][0]
conv2d_761 (Conv2D)	(None, 7, 7, 96)	55296	activation_760[0][0]
batch_normalization_758 (BatchN	(None, 7, 7, 48)	144	conv2d_758[0][0]
batch_normalization_761 (BatchN	(None, 7, 7, 96)	288	conv2d_761[0][0]
activation_758 (Activation)	(None, 7, 7, 48)	0	batch_normalization_758[0][0]
activation_761 (Activation)	(None, 7, 7, 96)	0	batch_normalization_761[0][0]

FIG. 3.2.1.2 Model Summary

3.2.2 Training CNN

The process of adjusting the value of the weights is defined as the “training” of the neural network. Firstly, the CNN initiates with the random weights. During the training of CNN, the neural network is being fed with a large dataset of images being labelled with their corresponding class labels

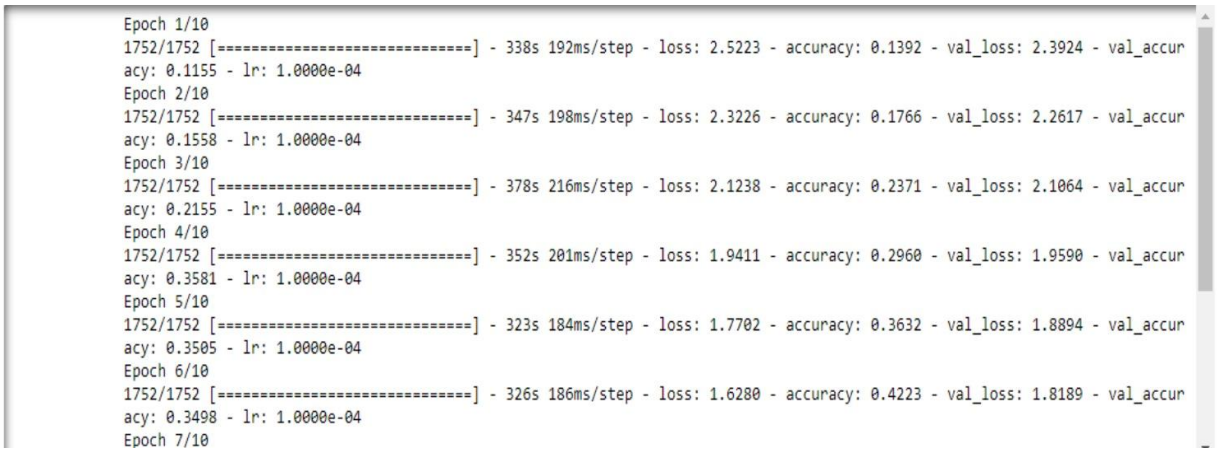


Fig.3.2.2.1 Training CNN

3.2.3 Model Analysis

Post Training quantization is a conversion technique that can reduce model size and inference latency, while also improving CPU and hardware accelerator inference speed, with a little degradation in model accuracy. Thus, it's widely used to optimize the model. We can achieve the better accuracy of model by tweaking some the training hyperparameters.

→ **Epochs:** more epochs could achieve better accuracy until it converges but training for too many epochs may lead to overfitting.
→ **Dropout - rate:** The rate for dropout, avoid overfitting. None by default.
→ **Learning - rate:** The rate to train the model.
→ **Batch - size:** A batch is a set of samples used in one iteration of training.
→ **Samples – Amount:** Amount of sample input data for training.

Here, we are using 80% of input data for training purpose and 20% for the test purpose.

3.3 Developing Desktop Application

An interactive and operable desktop application is developed with minimalistic UI design so that all the operations are in approach to the user easily. User just need to capture images per words or live stream and then click single button to see the recognized text and single click to hear the audio of corresponding text.

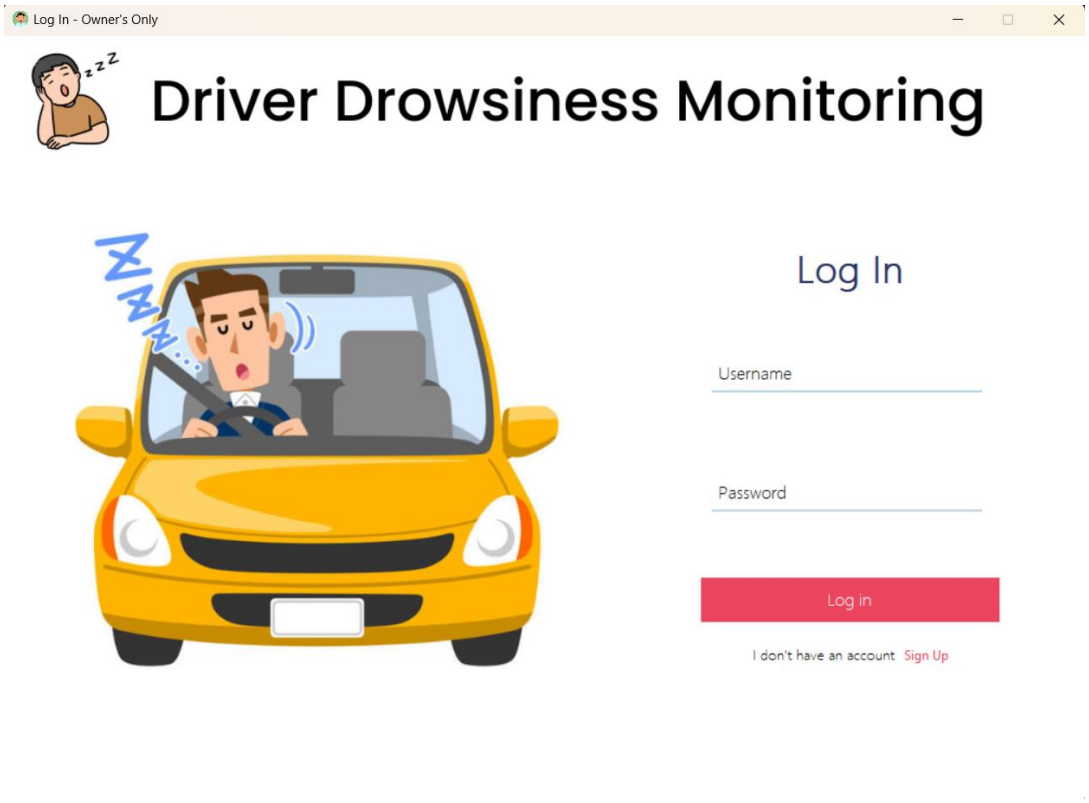


Fig 3.3.1 Login UI

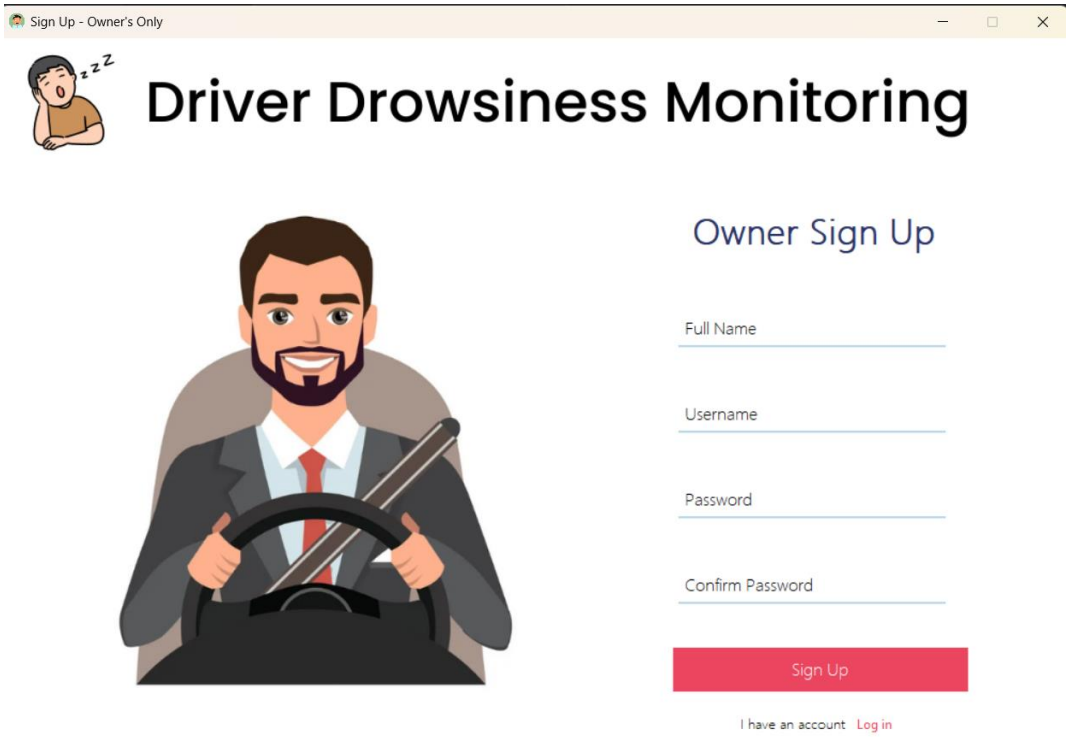


Fig 3.3.2 Sign Up Window

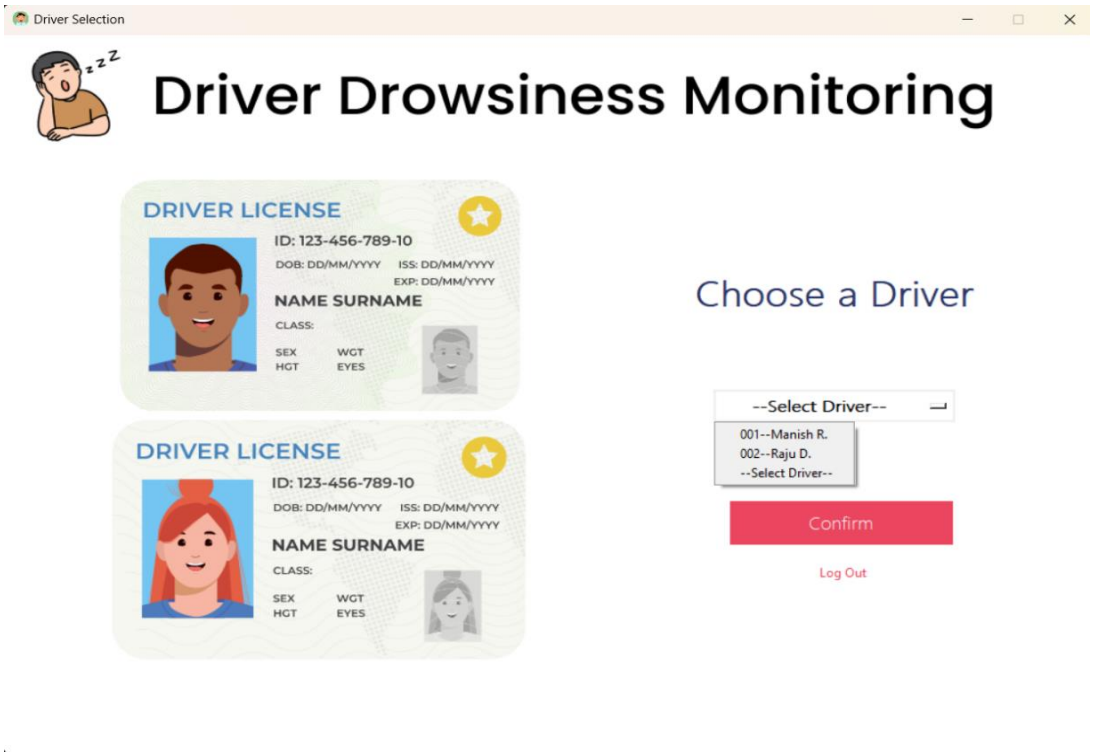


FIG 3.3.3 Option Window

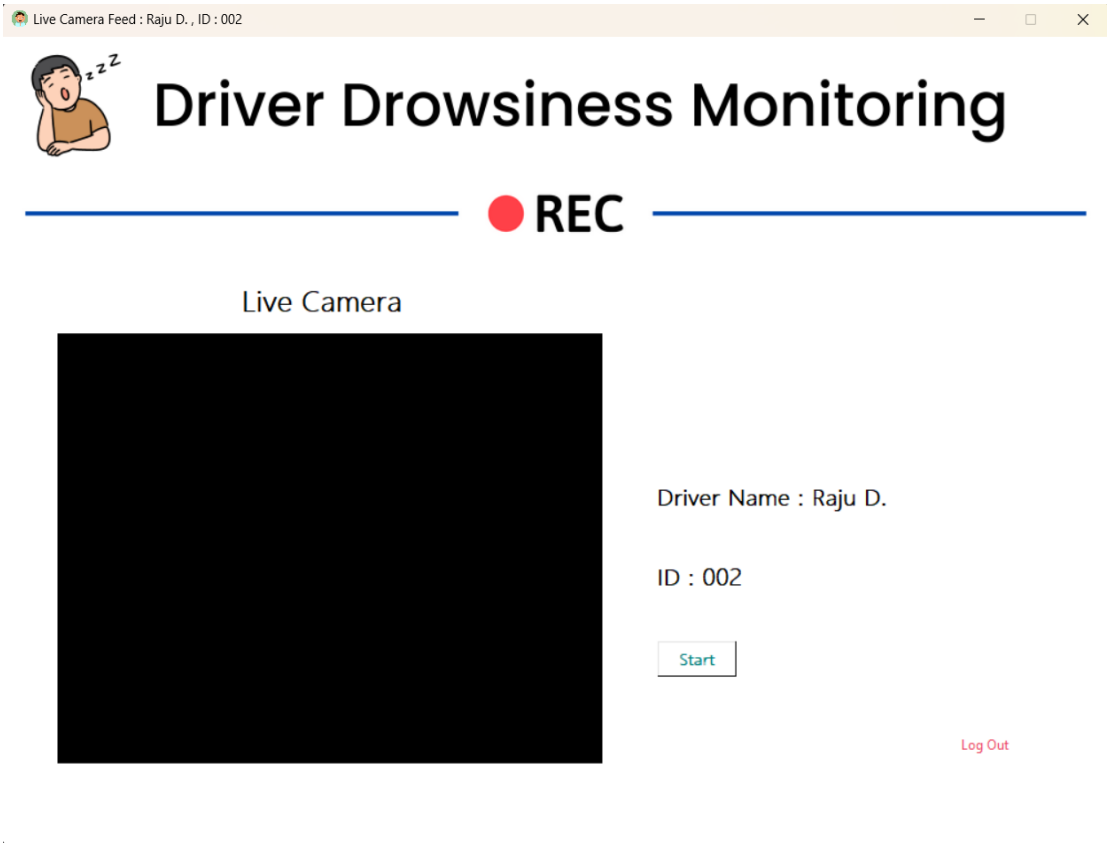


FIG 3.3.4 Live Camera Window (Off Camera)

3.4 Integrating model with Desktop Application

It provides high-level APIs that help transform raw input data into the form required by the model, and interpret the model's output, reducing the amount of boilerplate code required. It supports common data formats for inputs and outputs, including images and arrays. It also provides pre- and post-processing units that perform tasks such as image resizing and cropping.

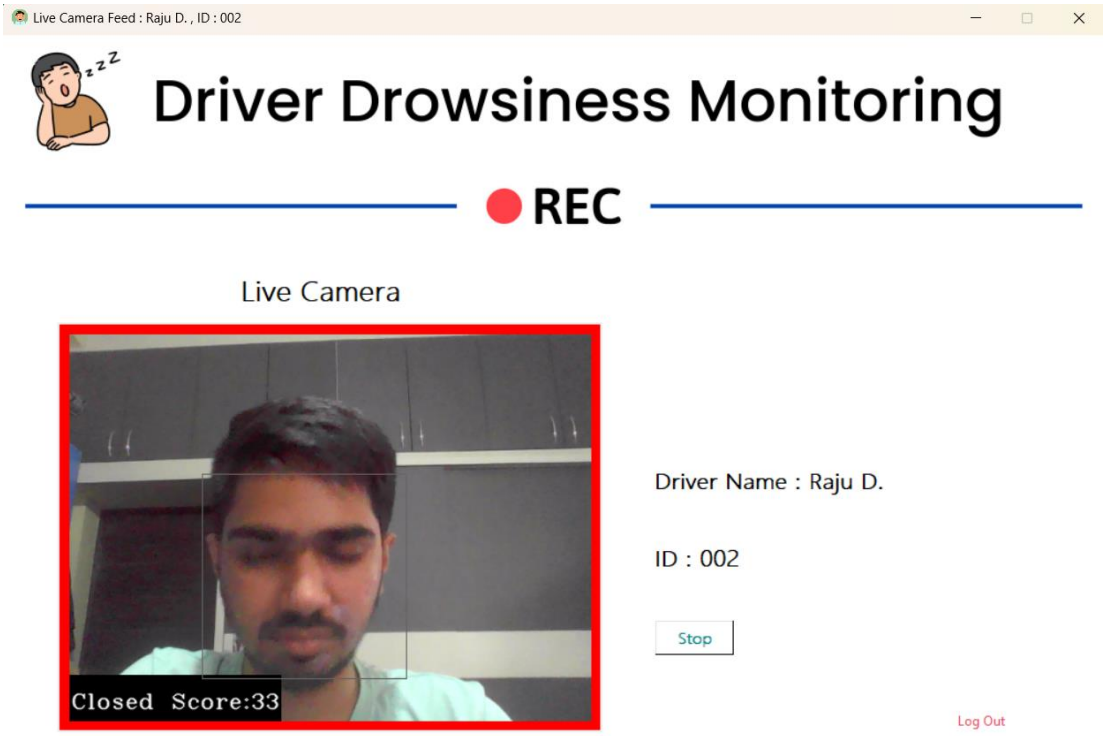


FIG 3.4.1 Live Camera Window (Camera On)

3.5 Results and Discussion

Detection of drowsy driving events: The system can accurately detect the signs of drowsiness, such as drooping eyelids.

Signs of drowsiness early on: When the system detects signs of drowsiness, it can give the driver an early warning, giving them time to take corrective actions like taking a break, drinking coffee, or opening a window.

Accidents can be avoided: The system can assist in the prevention of accidents caused by fatigue-related driver error by providing early warnings and educating the driver about the dangers of drowsy driving.

Safety for drivers: By lowering the likelihood of drowsy driving-related collisions and encouraging safer driving practices, a driver drowsiness detection system can increase driver safety.

Increased efficiency: A driver drowsiness detection system can also help increase productivity by reducing downtime caused by accidents and injuries by lowering the number of accidents and increasing driver safety.

Chapter – 4

FUTURE SCOPE & CONCLUSIONS

4.1 Summary and Conclusions

In summary, a driver drowsiness detection system is a technology that can detect signs of drowsiness in drivers and alert them to the risks of falling asleep at the wheel. The system uses cameras and sensors to monitor the driver's behavior and actions, process images to detect signs of drowsiness, and deliver warnings or alerts to prevent accidents caused by fatigue-related driver error. The results of a driver drowsiness detection system can include improved driver safety, prevention of accidents, and improved productivity by reducing downtime caused by accidents and injuries. The design and implementation of such a system can vary, but it typically follows a workflow involving driver monitoring, image acquisition, image processing, drowsiness detection, warning/alert, and driver notification.

4.2 Future Scope

Multi-sensor approach:

Right now, most driver drowsiness detection systems utilize only a couple of sensors, like cameras and accelerometers. Nonetheless, using a multi-sensor approach, which includes additional sensors like EEG sensors, can work on the accuracy of the system.

Artificial intelligence (AI):

AI can be utilized to foster further developed and accurate algorithms for detecting driver drowsiness. AI algorithms can learn and adapt to the behavior of the driver and the climate to work on the accuracy of the system.

Real-time feedback:

Real-time feedback can be given to the driver when the system recognizes drowsiness. This feedback can include ideas for taking a break or pulling over to the roadside.

Integration with different systems:

The driver drowsiness detection system can be integrated with different systems, like the vehicle's navigation system, to give information on nearby rest areas or to adjust the course based on the driver's fatigue level.

Wearable gadgets:

Wearable gadgets, for example, smartwatches and wellness trackers, can be utilized to recognize drowsiness and give real-time feedback to the driver. These gadgets can also be utilized to screen the driver's health and prosperity.

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