DRIVER DROWSINESS AND ALERTNESS DETECTION

A PROJECT REPORT

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SCHOOL OF COMPUTER SCIENCE ENGINEERING

CERTIFICATE

This is to certify that the Project report “DRIVER DROWSINESS AND ALERTNESS DETECTION” being submitted by “SYED FUZAIL, ZUBIYA SADAF, ASIMA SIDDIQUA, SYED AZAM HUSSAIN” roll number(s) “20211CST0089,20211CST0047,20211CST0093,20211CST0113” in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in Computer Science and Engineering is a Bonafide work carried out under my supervision.

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DECLARATION

We hereby declare that the work, which is being presented in the project report entitled **DRIVERS DROWSINESS AND ALERTNESS DETECTION** in partial fulfillment for the award of Degree of **Bachelor of Technology** in **Computer Science and Engineering**, is a record of our own investigations carried under the guidance of **MR. LAKSHMISHA SK, PROFESSOR**, School of Computer Science Engineering & Information Science, Presidency University, Bengaluru.

We have not submitted the matter presented in this report anywhere for the award of any other Degree.

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ABSTRACT

A safety-focused project called "Driver Drowsiness and Alertness Detection" aims to improve road safety by lowering the dangers related to driver weariness. Because weariness impairs a driver's reaction time, judgment, and general awareness, drowsy driving is a major contributor to collisions. By creating a web-based application that employs cutting-edge machine learning algorithms and sensor data to identify indicators of driver alertness and drowsiness in real time, our project aims to address this pressing problem. The device lowers the risk of fatigue-related accidents by helping drivers stay vigilant through prompt warnings and interventions.

The application's primary goal is to use computer vision and facial recognition algorithms to track important markers of driver weariness, such as head posture, blink rates, and eye movements. The system analyzes the driver's physical condition and behavior by processing data from in-car cameras and sensors. It looks for signs of tiredness, like head nodding, delayed eye closure, or frequent blinking. When the system detects possible indicators of tiredness, it notifies the driver via visual or auditory cues to take a break or perform restorative activities in order to stay focused. Python and TensorFlow are used in the application's backend to build the machine learning model, which analyzes and trains data to increase its accuracy over time. The design of the system It is appropriate for incorporation with current in-vehicle technology since it can operate in real time with little computing overhead. React was used to create the user interface, which gives drivers clear visual feedback about their current level of attention and suggests remedial activities.

In addition to improving driver safety, this project seeks to increase public awareness of the value of drivers' well-being while driving. The "Driver Drowsiness and Alertness Detection" system helps minimize accidents by offering a simple tool for tracking and enhancing alertness levels, especially during late-night or long-distance travels when weariness is more prone to set in. To further its efficacy, the system can also be extended to incorporate functions like customized sleep and rest suggestions, interaction with car telematics, and ongoing learning from actual driving data.

In the end, this project helps achieve the objectives of improving overall road safety, lowering the negative social and economic effects of sleepy driving, and developing safer, smarter transportation networks. Using state-of-the-art technology to identify and reduce In order to reduce driver tiredness and to save lives on the road, the project encourages safer, more attentive driving.

ACKNOWLEDGEMENT

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INTRODUCTION

1.1 OVERVIEW:

An important road safety issue is driver weariness, which affects awareness, judgment, and reaction time and is a contributing factor in many collisions. In order to give real-time feedback, the Driver Drowsiness and Alertness Detection system uses computer vision and machine learning algorithms to analyze drowsiness indications like blinking frequency, head nodding, and eye closure patterns.

The system, which is integrated into current in-car technology, evaluates alertness using video sensors and facial recognition software. It immediately informs drivers when it detects drowsiness, urging them to stop driving. The system's proactive approach and user-friendly interface improve road safety by giving prompt feedback

1.2 STATEMENT OF THE PROBLEM:

According to statistics, a considerable portion of traffic accidents each year are caused by fatigued drivers, making drowsy driving one of the main causes of accidents. Conventional strategies for preventing driver drowsiness, such manual monitoring and rest stops, are frequently reactive rather than proactive, putting drivers at risk before they realize how tired they are. Additionally, the efficacy of current sleepiness detection technology is diminished by the absence of real-time, actionable feedback for the driver.

When fatigue symptoms are detected, a system that can continuously assess a driver's level of awareness and provide real-time feedback is needed. Due to their reliance on external sensors or requirement for manual input from the driver, many existing systems are constrained. By using behavior analysis and facial recognition to detect early signs of fatigue and alert the driver in a non-intrusive, user-friendly way, this study aims to address these issues.

1.3 MOTIVATION:

The Driver Drowsiness and Alertness Detection system was created in response to the growing number of sleepy driving accidents worldwide and the growing awareness of the risks associated with fatigued driving. Technology that helps ensure driver attentiveness is desperately needed as the automobile industry transitions to smarter, safer vehicles, particularly during lengthy rides, overnight driving, and boring road conditions. This system offers a more efficient, automated method of tracking driver attentiveness by utilizing developments in machine learning, computer vision, and real-time feedback systems. The technology seeks to lower collision rates, save lives, and enhance general road safety by identifying tiredness early and sending out alerts before the situation becomes serious.

1.4 OBJECTIVES

- **Real-time Drowsiness Detection:** To utilize machine learning techniques and facial recognition to continuously assess driver attention.
- **Improved Road Safety:** Through delivering early intervention and actionable alarms, we can lower the amount of incidents brought on by sleepy driving.
- **Enhanced User Experience:** Offering a user-friendly, intuitive interface that allows fleet management and drivers to track awareness levels and get feedback.

1.5 KEY FEATURES

1.5.1 Real-Time Drowsiness Detection

- **Facial Recognition Technology:**To identify drowsiness, the system records the driver's facial expressions and movement patterns, including head position and blinking rates, using in-car cameras..
- **Machine Learning Algorithms:** The system processes the data using a trained machine learning model to identify when the driver is exhibiting symptoms of weariness, such as frequent blinking or head nodding.
- **Continuous Monitoring:** Despite requiring driver input, the system operates continuously in the background to provide constant monitoring.

1.5.2 Alertness Feedback Mechanism

- **Real-Time Alerts:** The device warns the motorist of the danger and urges them to take a break when it detects tiredness using real-time audio or visual notifications.
- **Feedback Personalization:** Through modifying alert thresholds according to a driver's behavior and preferences, the system can be tailored to fit their needs.
- **In-App Notifications:** Real-time suggestions for coffee shops or rest places where vehicles can stop and refuel can be provided by the application.

1.5.3 User-Friendly Interface

- **Intuitive Design:** To reduce driver distraction, the user interface (UI) is made to be simple to use, with straightforward controls and obvious visual clues.
- **Driver Interaction:** Simple indications and interaction techniques, such a quick check-in button, are part of the system so that the motorist can acknowledge a warning or show that they are paying attention.

1.5.4 Data Security and Privacy

- **Data Protection:** To ensure privacy and adherence to data protection laws, all driver data, including face photos and behavioral patterns, is processed locally on the car's system or via secure cloud services.
- **Anonymized Data:** To guarantee that no personal information is ever disclosed without permission, the system can be built to anonymize data gathered from drivers.

1.6 TECHNICAL IMPLEMENTATION

1.6.1 Frontend Architecture

The Driver Drowsiness and Alertness Detection system's frontend is constructed with React.js, giving the user a dynamic and responsive interface. The technology shows the driver's current level of attention as well as any active alerts by utilizing real-time data from the in-car cameras and sensors. A sleek, contemporary appearance that reduces driving distractions is ensured by Material-UI.

1.6.2 Backend Architecture

Node.js and Express power the backend, enabling quick, real-time data processing and front-end-to-backend connectivity. For facial recognition and drowsiness detection, the system makes use of TensorFlow or other machine learning frameworks. Additional data processing APIs are integrated, such as vehicle telemetry and environmental factors like time of day and driving conditions that may affect drowsiness.

1.7 DATA AND ALGORITHM INTEGRATION

- **Computer Vision Algorithms:** The system analyzes camera data to identify head orientation, eye movement, and face landmarks using libraries like OpenCV.

- **Machine Learning Models:** Utilizing historical data and user-specific behaviour, algorithms like Convolutional Neural Networks (CNNs) analyse visual input and identify patterns of drowsiness.

1.8 APPLICATIONS AND USE CASES

- **Daily Commutes:** Through assisting regular drivers in keeping an eye on their attention levels throughout ordinary travel, the technology helps avoid accidents caused by fatigue.
- **Long-Distance Driving:** Timely warnings let drivers take breaks and maintain attention while traveling long distances.
- **Fleet Management:** Through keeping an eye on their drivers' attentiveness in real time, fleet managers can maximize the safety and well-being of their drivers.
- **Commercial Transport:** Drowsiness detection promotes safer operations and accident prevention in the logistics and transportation sector.

1.9 CHALLENGES:

A number of obstacles that affect the efficacy and uptake of a driver drowsiness detection system must be overcome during development. Environmental elements that can affect detection algorithms' performance, such as road conditions, vehicle vibrations, and lighting, can result in missed alerts or false positives. The system must evaluate massive amounts of data from sensors and cameras without adding latency or degrading performance, which is essential for prompt intervention. This makes real-time data processing another major problem. User acceptability is another obstacle; many drivers might be leery of automated systems that track their actions, particularly when privacy is at stake. For such systems to be widely used, trust must be developed. Additionally, the system needs to be flexible enough to accommodate a variety of cars and driver styles, which can vary notably. The system's success also depends on resolving two crucial issues: achieving smooth integration with current in-car technology and guaranteeing consistent performance under various driving circumstances and user profiles.

1.10 ORGANISATION OF THE REPORT

[This report is structured into 10 Chapters]

Chapter 1: Introduction

Overview: Introduces the need for driver drowsiness detection and the importance of road safety.
Statement of the Problem: Identifies challenges in detecting driver fatigue and its impact on road safety.
Motivation: Explains the importance of addressing driver drowsiness to reduce accidents and improve driving safety.
Applications: Lists use cases, such as in commercial fleet management, long-distance driving, and personal vehicle safety.
Challenges: Outlines the technical challenges in real-time processing, environmental influences, and user acceptance.
Report Organization: Summarizes the structure of the report.

Chapter 2: Literature Survey

Detailed Review: Provides a review of existing systems for driver drowsiness detection, including limitations and advancements in technology.

Chapter 3: Research Gaps of Existing Methods

Identified Gaps: Highlights limitations like reliance on external sensors, manual input, and the difficulty of processing in real-time.
Significance: Justifies the need for a more accurate, non-intrusive, and integrated solution for detecting driver drowsiness.

Chapter 4: Proposed Methodology

Approach: Describes the algorithms and technologies used, including behavior analysis, facial recognition, and machine learning models.
Workflow: Details the system's data flow, from monitoring the driver to generating feedback based on real-time analysis.

Chapter 5: Objectives

Primary Goals: Lists the key objectives of the project, such as real-time fatigue detection, timely alerts, and seamless user experience.

Chapter 6: System Design & Implementation

System Architecture: Describes the frontend and backend structure, including the integration of camera sensors, facial recognition, and alert mechanisms.

Technological Stack: Details the tools and technologies used, such as Python, OpenCV, machine learning models, and camera integration..

Implementation Details: Explains the development process, including model training, system integration, and testing phases.

Chapter 7: Timeline for Execution of the Project

Phased Plan: Outlines the project timeline, detailing major milestones from requirements gathering and model development to user testing and deployment.

Chapter 8: Results & Discussions

Evaluation: Presents results from testing the system, including accuracy in drowsiness detection and user feedback..

Analysis: Discusses how the system meets the project's objectives and its potential impact on road safety.

Chapter 9: Conclusion

Summary: Recaps key findings and contributions of the project to driver safety.

Future Work: Suggests potential improvements, such as AI enhancements, expanded features (e.g., integrating with vehicle control systems), and scalability for commercial use.

Chapter 10: References

Citations: Lists all academic, technical, and research sources referenced throughout the report to support the methodology and development of the project.

CHAPTER-2
LITERATURE SURVEY

2.1 OVERVIEW

Computer vision and machine learning methods, including as CNNs and DNNs, are used by driver tiredness detection systems to examine head gestures, eye movements, and facial features. To identify signs of exhaustion, real-time video surveillance monitors behaviors like head nodding and eye closing. Accuracy is increased using multimodal techniques that combine behavioral and physiological data, and systems that provide real-time alerts to motivate drivers to act. These devices are anticipated to improve driver welfare and road safety as technology develops.

2.2 LITERATURE REVIEW

1. Geng, Z., & Zhang, L. (2021): "Driver Drowsiness Detection Based on Deep Learning: A Survey" Deep learning techniques for sleepiness detection, specifically convolutional neural networks (CNNs), are the main topic of this survey. It highlights how CNNs use facial cues like head posture and eye closure to detect early indicators of weariness and avert mishaps.

2. Zhang, Z., & Li, X. (2019):"Real-Time Driver Fatigue Detection System Based on Facial Expression Analysis." This study detects weariness in real time by using facial expression analysis. The technology can notify drivers by monitoring eye blink frequency, yawning, and head nodding, improving safety through prompt action.

3. Hua, G., & Wu, S. (2020):"Driver Drowsiness Detection Using Multimodal Data: A Machine Learning Approach" It is suggested to use a multimodal system that combines physiological information such as heart rate with face video analysis. By employing machine learning to analyze a variety of data, the method increases sleepiness detection accuracy.

4. Wang, J., & Li, Y. (2020): "Fatigue Detection in Drivers Using Driver Behavior and Deep Neural Networks." this study uses deep neural networks (DNNs) to identify driver weariness. In order to deliver real-time warnings to avert accidents, it tracks behavioral signs like head movement and eye gazing.

5. Li, Y., & Zhang, W. (2019): "Driver Drowsiness Detection via Eye M32ovement Analysis Using Convolutional Neural Networks." CNNs are used in the study to track eye movements, with an emphasis on blink frequency and eye closure duration as markers of fatigue. Real-time feedback is made possible by this, which enhances driving safety.

6. Kang, H., & Zhang, Y. (2020):"Driver Fatigue Detection Based on Real-Time Eye Movement and Head Pose Estimation." To identify weariness, this study combines head posture assessment with eye movement monitoring. The device provides real-time sleepiness analysis by tracking head nodding and gaze direction using computer vision algorithms.

7. Sun, W., & Chen, M. (2020):"Driver Fatigue Detection System Based on Multilevel Feature Fusion and Attention Mechanism." A suggested fatigue detection system combines head motions, gaze tracking, and facial landmarks. The method improves detection accuracy and lowers false positives by utilizing deep learning and attention processes

8. Zhou, S., & Liu, W. (2021):"Driver Drowsiness Detection Using Hybrid Convolutional Neural Networks and Long Short-Term Memory Networks." In order to identify drowsiness, this study suggests a hybrid model that combines CNNs and LSTM networks. The robustness and dependability of tiredness prediction are increased by LSTMs, which examine temporal sequences, while CNNs extract video information.

9. Yang, S., & He, Z. (2019):"Development of a Real-Time Driver Fatigue Detection System Based on Facial Landmark Estimation." Facial landmark estimation techniques are used to construct a real-time system. The technology correctly identifies indicators of tiredness including eye closure and yawning by evaluating face ratios like EAR and MAR.

10. Liu, S., & Xu, Y. (2020):"A Comprehensive Survey on Driver Drowsiness Detection Using Machine Learning and Computer Vision." SVM, CNN, and hybrid models are among the machine learning and computer vision techniques for sleepiness detection that are reviewed in this survey. It emphasizes how well they work to ensure driver safety in real-time

CHAPTER-3

RESEARCH GAPS OF EXISTING METHODS

3.1 EXISTING METHODS

3.1.1 Machine Learning Models for Drowsiness Detection

Machine learning algorithms for drowsiness detection look for early indicators of driver exhaustion by analyzing physiological and behavioral characteristics such as head tilt, blink duration, and frequency of yawning. These models use real-time data from sensors or video feeds to categorize drivers as "drowsy" or "alert," allowing for prompt intervention. Key signs of tiredness are behaviors like frequent yawning or prolonged eye closures. By offering early warnings, these systems seek to improve road safety; nevertheless, their efficacy depends on reliable algorithms and high-quality input data.

How it Works:

Datasets with labeled driver states (such as alert or sleepy) are used to train machine learning algorithms (such as Support Vector Machines, Decision Trees, and k-Nearest Neighbors). These models categorize the driver's condition by extracting data like blink rate or eye closure %. In order to detect tiredness early, monitoring is done continuously.

Drawbacks:

- **Lack of Real-Time Adaptability:** a consequence of their large processing requirements, machine learning models frequently perform poorly in real-time scenarios, particularly on low-power devices.
- **Limited Dataset Generalization:** Since most models are trained on particular datasets, they cannot be used with different drivers or under different environmental conditions.
- **Single-Feature Dependence:** When the data is noisy or lacking, accuracy is decreased when relying on particular features (such as blink rate).
- **Sensitivity to Environmental Factors:** The accuracy of the model can be greatly impacted by variations in lighting, camera angles, or driver motions, which can result in inconsistent feature extraction.

3.1.2 Driver Fatigue Detection using Computer Vision

In order to notify the driver in real time, computer vision techniques use camera-based systems to monitor driver behavior and identify indicators of weariness, including as changes in facial expressions, head position, and eye closure..

How it Works:

Video feeds from cameras aimed at the driver's face are processed by computer vision algorithms to extract visual characteristics such head tilt, blink frequency, and eye movement. To ascertain whether the driver is exhibiting symptoms of inattention or drowsiness, these characteristics are examined in real time..

Drawbacks:

- **Privacy Concerns:** Since it necessitates the gathering and processing of sensitive personal data, continuous facial recognition surveillance of drivers may give rise to privacy concerns.
- **Limited Scope for Detection:** Computer vision mainly employs face features, which may not be sufficient to identify faint fatigue indicators that other sensors (such heart rate or EEG) could pick up.
- **Real-time Processing Demands:** Some vehicle systems may be able to handle the substantial computational resources needed for real-time processing of video streams.

Figure 3.1.2 Driver Fatigue Detection using Computer Vision

3.1.3 Real-Time Monitoring Systems and Alerts

In order to identify driver weariness and provide prompt alerts or actions to avoid accidents, real-time monitoring systems seek to continually examine the driver's behavior and the surrounding environment.

How it Works:

These devices combine a number of sensors (such as cameras, accelerometers, and heart rate monitors) with algorithms to evaluate different signs of fatigue, like shaky steering, diminished focus, or unusual body reactions. When weariness is recognized, the system sends out alerts based on the data gathered.

Drawbacks:

- **High Computational Load:** Integrated data from several sensors and real-time processing can be resource-intensive, necessitating sophisticated hardware and effective algorithms. This could make installing such systems in vehicles with limited funds or resources more expensive and complicated
- **Inconsistent Alerts:** When a driver is exhausted but does not show obvious symptoms, the system may issue false warnings or fail to identify exhaustion. Driver annoyance may result in them ignoring further warnings, which would lower the system's overall efficacy.
- **Over-reliance on Sensor Data:** might compromise the system's overall efficacy if one or more sensors malfunction or provide erroneous data. The system's capacity to deliver trustworthy notifications may also be hampered by environmental variables (such as bad weather) or sensor failures.
- **User Discomfort with Alerts:** Drivers may become annoyed by frequent or pointless alarms, which could reduce the monitoring system's efficacy. Drivers may eventually grow numb to the warnings and disregard them when they are necessary.

CHAPTER-4
PROPOSED METHODOLOGY

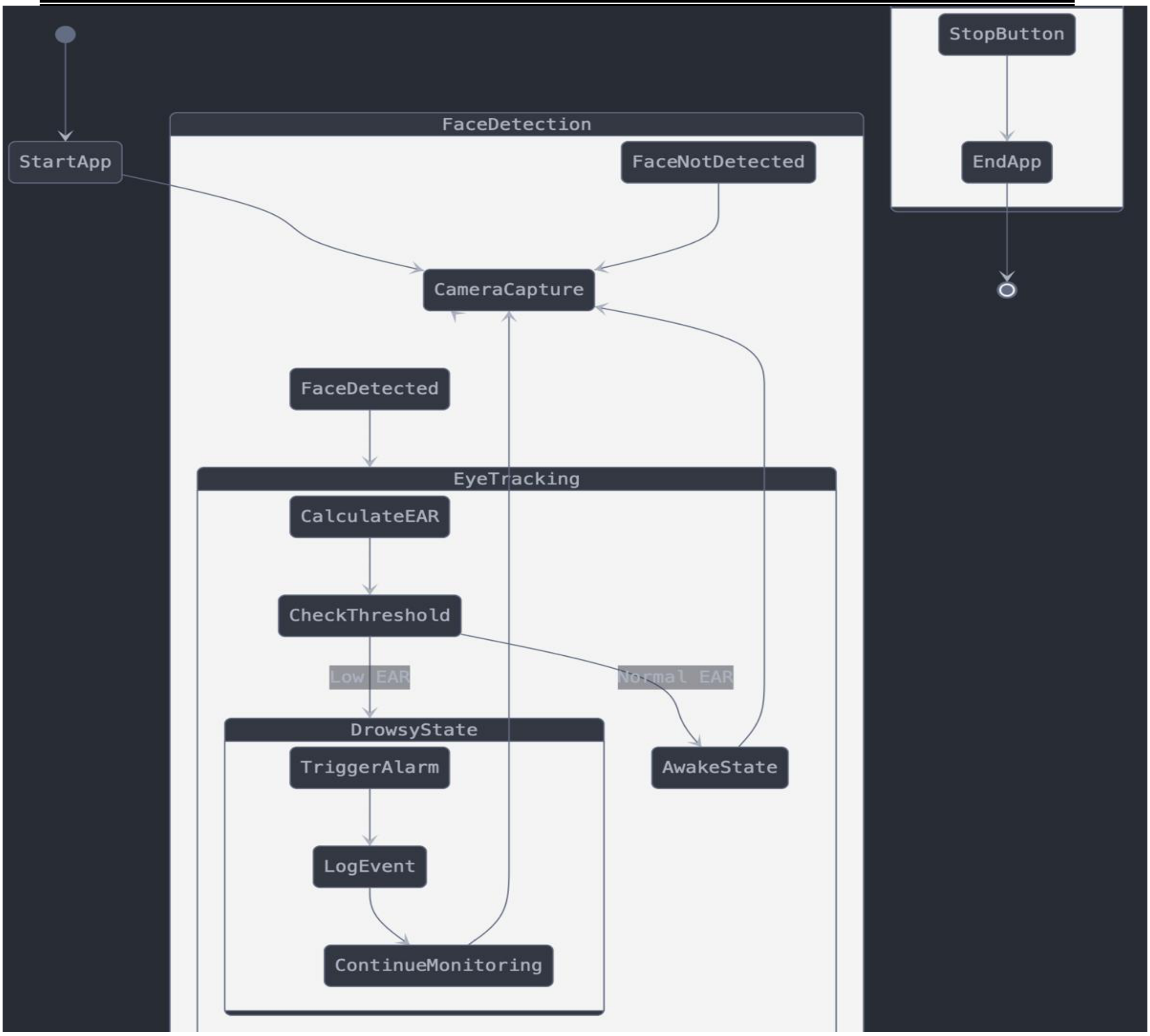
OVERVIEW

Advanced sensor technology, real-time data processing, and machine learning techniques are all integrated into the suggested methodology for the Driver's Drowsiness Detection system to track driver behavior and identify early indicators of fatigue. To increase road safety by promptly alerting drivers who could be at risk of drowsiness, the system is made to be non-intrusive, affordable, and deployable in actual driving situations.

The methodology's main component is the integration of several sensors, such as physiological sensors (like heart rate monitors) to collect data on the driver's condition in real time, accelerometers to measure vehicle movement, and cameras for facial recognition. The camera records facial traits that are important markers of tiredness, including yawning, head tilt, and blink rate. Accelerometers track how the driver steers, spotting irregular motions that could be a sign of exhaustion or inattention. Additionally, physiological sensors—like heart rate variability monitors—help identify fatigue symptoms that might not be apparent from face features alone.

A central processing unit processes and analyzes the data gathered from various sensors in real time. To make sure the data is prepared for analysis, preprocessing methods like data normalization, feature extraction, and noise reduction are used. After processing, the data is sent into a machine learning model, which determines if the driver is attentive or sleepy. The collected characteristics are analyzed by machine learning techniques such as decision trees, support vector machines (SVM), or deep neural networks (DNN), which then provide predictions based on patterns found in the training dataset. The system triggers an alert feedback mechanism when it detects tiredness. This comprises auditory notifications (like a buzzer sound) and visual alerts.

The effectiveness of this system hinges on its capacity to manage a range of driving circumstances, driver profiles, and environmental elements such as road type, lighting, and weather. Furthermore, the system's real-time speed is essential for guaranteeing that drivers receive notifications on time and with the least amount of latency.



4.1 SYSTEM ARCHITECTURE

Objective: The core objective of the requirement analysis phase is to determine and specify the fundamental features that are necessary for the web application to be developed successfully while also making sure that it complies with industry standards and user expectations. This entails gaining a thorough grasp of what customers require in order to manage "range anxiety" and enhance the overall EV driving experience. An easy-to-use interface, accurate range calculation, and smooth charging station placement are important features to concentrate on.

Key Components:

- **Sensors:** The system design is based on a number of sensors that continuously monitor the driver's physiological condition and behavior. The main sensors consist of:
- Cameras for eye tracking and facial identification that track the driver's yawning, head posture, and blink rate.
- Accelerometers are installed in cars to assess motion, such as unusual steering patterns or movement that could point to a driver who is tired.
- Physiological Additional context for drowsiness identification is provided by sensors like heart rate or electrodermal activity (EDA) sensors, which track the driver's physiological reaction to weariness.
- Data Processing Unit: A central processing unit receives all sensor data and analyzes it in real time. All inputs are gathered, synchronized, and analyzed by the data processing unit. The device uses algorithms to identify patterns that point to weariness and, if required, sounds an alert. The system's low-latency processing design reduces the amount of time that passes between identifying weariness and raising an alarm.
- Alert Feedback Mechanism: When drowsiness is identified, the system notifies the driver via a number of alert channels. These consist of haptic feedback (seat or steering wheel vibration), auditory feedback (voice alarm or buzzer), and visual feedback (dashboard message). No matter the driving situation, the feedback mechanism guarantees that drivers receive a prompt and clear warning.

4.2 SENSOR INTEGRATION AND DATA PROCESSING

Objective: In order to guarantee the precision and promptness of the sleepiness detection system, the sensor integration and data processing stage is essential. A more thorough evaluation of the driver's level of attention is made possible by the integration of several sensors, each with distinct capabilities. This stage entails both the actual installation of sensors in the car and the data processing necessary to identify significant characteristics for tiredness identification in real time.

Sensors Overview: The system incorporates several sensors, such as:

- Cameras (for Facial Recognition): Utilizing computer vision techniques, cameras follow the driver's face and eyes to track head tilt, eyelid movement, and blinking patterns. The system is always looking for indicators of tiredness, such sluggish blinking, prolonged eye closure, or unusual head motions. Regardless of the driver's position or movement, high-resolution cameras are positioned strategically to record their face in crisp image.
- Accelerometers (for Driving Behavior Monitoring): These devices track the motion of the car and identify any abrupt jerks, swerves, or strange steering motions that might be signs that the driver is not giving their full attention. In order to identify irregular driving, which is frequently linked to exhaustion, these sensors give data that is processed in real time.
- Physiological Sensors (for Monitoring Fatigue-Related Changes): Since they tend to change with exhaustion, physiological measures such as skin conductance, heart rate variability, and others are tracked to identify stress or fatigue. The accuracy of the detection system is increased by the data from these sensors, which give the behavioral and facial analysis more context.

Data Collection and Preprocessing:

Maintaining track of the driver's condition, the system continuously gathers data from sensors like accelerometers, physiological sensors, and face photographs. Preprocessing methods, such low-pass filtering accelerometer measurements, remove noise from the original data. Important characteristics are extracted for drowsiness detection, such as ocular aspect ratio, blink rate, and vehicle control. To align time and provide precise real-time analysis, the data from every sensor is synced. Using high-performance processing units, the system analyzes this data in real-time to quickly identify signs of inattention or exhaustion.

4.3 DROWSINESS DETECTION ALGORITHM

Objective: The system's central component, the drowsiness detection algorithm, is in charge of evaluating the information supplied by the sensors to ascertain if the driver is aware or exhausted. This algorithm needs to be extremely precise, quick, and able to discriminate between indicators of sleepiness and typical behavior.

Mechanism of Operation: identify weariness, the detection algorithm processes data from the sensors (camera, accelerometer, and physiological sensors). To categorize the driver's condition, the system makes use of threshold-based criteria, feature extraction methods, and machine learning models.

- Machine Learning Model: The system makes use of machine learning methods, including Random Forest or Support Vector Machines (SVM) for accelerometer behavioral data and Convolutional Neural Networks (CNN) for facial identification. To identify the patterns that point to fatigue, the model is trained using a dataset of labeled driving data
- Thresholding and Heuristics: The system employs preset thresholds for specific features, such as head tilt or blink rate. The system identifies the driver as drowsy, for instance, if the blink rate falls below a predetermined frequency or if the eyes are closed for longer than a predetermined amount of time. Abnormal driving behavior, including swerving or abrupt steering motions, is taken into account by other heuristics.
- Data Fusion: To improve the precision of fatigue diagnosis, the system integrates information from physiological sensors, vehicle behavior, and facial recognition. The system can determine if the driver is alert or fatigued more accurately by combining data from these several sources.
- Model Evaluation: The accuracy, precision, and recall of the machine learning model are assessed. To make sure the model generalizes effectively across various drivers, driving situations, and settings, it is tested on unseen data.

4.4 ALERTNESS FEEDBACK MECHANISM

Objective: The feedback system makes sure that the driver is informed right away when drowsiness is identified, enabling a timely and efficient reaction to avoid collisions. The feedback is intended to be effective, unobtrusive, and clear in order to grab the driver's attention without being overpowering. The system employs a multi-modal approach, using haptic input, such as vibrations in the seat or steering wheel, visual alerts on the dashboard, and auditory cues, such as alarms or voice instructions. Regardless of their surroundings or level of focus, the driver will be able to detect the alert thanks to this combination of input kinds. If the system notices persistent or worsening indicators of drowsiness, the notifications will become more intense. This strategy encourages the driver to respond right away, like stopping over for a nap, enhancing security without creating needless distractions.

Types of Feedback:

- **Visual Feedback:** The technology shows a warning message on the dashboard, such as "You seem tired," when it detects drowsiness. Take a break, please. In order to inform the driver in an understandable manner and maintain their attention on the road, this visual input is crucial.
- **Auditory Feedback:** When the system notices indicators of weariness, it either plays a voice alarm or beeps, such as "Wake up, it's time to rest." Even if the driver is not looking at the dashboard, the audio feedback makes sure they are aware of the warning.
- **Haptic Feedback:** Haptic feedback is offered to drivers who might not notice the visual or audible alerts right away. Vibration in the seat or steering wheel accomplishes this. The driver is physically notified by the faint yet effective haptic alert.
- **Adaptive Feedback:** Depending on how severe the drowsiness is identified, the alerts' level can be changed. A gentle beep or vibration may be triggered by the device if it senses mild tiredness. To make sure the driver is completely aware, the signals become more frequent and intense if drowsiness becomes more noticeable.
- User Interaction: The system may occasionally ask the driver to validate their current condition by means of interaction, such as touching a button on the steering wheel. This feedback system aids in determining if the driver is actually tired or just preoccupied.

CHAPTER-5

OBJECTIVES

In the process identifying indicators of driver weariness in real-time and sending out appropriate alerts, the Driver's Drowsiness and Alertness Detection system aims to improve road safety. This method attempts to lessen the possibility of accidents brought on by fatigued drivers by identifying early indicators of drowsiness, which is a major contributing factor to traffic accidents. The system accurately detects when a driver is exhibiting indications of drowsiness and notifies them before it's too late by combining cutting-edge sensor technology, machine learning algorithms, and real-time data processing. The main goals that direct the creation and application of this system are described in this chapter.
Accurate and real-time sleepiness detection is one of the system's main goals. For the system to be functional, it has to identify exhaustion as early as feasible. The system uses a variety of sensor inputs, such as physiological sensors (to track changes in heart rate and other indicators of weariness), accelerometer data (to analyze steering behavior), and facial recognition (to measure blink rate and head position). In order to determine whether the driver is getting sleepy and maybe dangerous, the detection system must evaluate these inputs and generate precise predictions about their condition. Preventing accidents requires the capacity to accurately and swiftly classify the driver's condition. In order to avoid compromising its efficacy, the system must also reduce false positives, which indicate that a driver is drowsy, and false negatives, which indicate that sleepiness is not present.

Processing sensor data in real time is a second important goal. Identification of drowsiness must occur right away in order to avoid hazardous circumstances, which makes real-time data processing essential. Multiple sensors' data should be processed concurrently by the system, and alerts should be sent out quickly. This necessitates a high-performance CPU that can manage substantial amounts of sensor data while maintaining system responsiveness across a range of driving circumstances. The device may almost immediately notify the driver to take a break or rest when it detects indicators of tiredness thanks to real-time processing. The system's overall efficacy in averting accidents depends on this prompt reaction.

The system must provide a multi-modal feedback mechanism to notify the driver when weariness is identified, in addition to precise detection and real-time processing. Warnings have to be straightforward, prompt, and diverse to guarantee that the driver is well cognizant of the possible risk. The feedback system incorporates haptic, visual, and audio cues to draw the driver's attention. The driver is informed of the detected drowsiness using visual signals, such as a warning message shown on the dashboard. Even when the driver is not looking at the dashboard, auditory feedback—such as a buzzer or voice prompt—ensures that they are aware of the alarm. A tangible sort of alert that makes sure the driver feels the warning is haptic feedback, which is supplied by sensations in the seat or steering wheel. By ensuring that the driver receives the message across many sensory channels, this combination of signals increases

The likelihood that the driver will notice and taken action on. Additionally, the feedback system ought to be adaptable, modifying its frequency and intensity in response to the degree of drowsiness observed. The system's ability to scale and adapt is another key goal. The system must to be adaptable enough to function in a variety of driving conditions, sensor setups, and vehicle kinds. The system must be able to interface with new sensors, control systems, or other in-car technologies as vehicle technologies advance. The system should also be flexible enough to accommodate a variety of drivers. To better customize drowsiness detection, it should, for instance, be able to adapt to unique driving patterns, facial features, and physiological signs. This flexibility is necessary for the system to be extensively implemented and utilized in a range of settings, from long-distance trucks to private automobiles.

Ensuring a user-friendly experience is one of the system's main goals. Drivers with varying degrees of experience will use the system, thus it must be simple to use and intuitive. The system's input must be discrete enough to keep the driver's attention on the road while also giving them timely alerts. Clear indicators of the driver's level of attention should be included in the system's easy-to-understand interface. Furthermore, the driver shouldn't be inundated with notifications or information from the system. Only when absolutely required should alerts be activated in order to prevent needless attention or irritation of the driver. Achieving a great user experience requires striking a balance between minimal intrusion and efficient alerting.

Ensuring a user-friendly experience for drivers of all skill levels is one of the system's main goals. The system must be simple to use and intuitive to minimize complexity. The feedback should be inconspicuous, keeping the driver’s attention on the road while offering timely warnings. The user interface should be straightforward, displaying clear signs of the driver’s attentiveness. Alerts should only be activated when necessary to avoid unnecessary distractions. Additionally, the driver shouldn't be inundated with excessive information. A good user experience requires balancing minimal intrusion with efficient alerting.

Finally, the system needs to include adaptation and long-term learning. The system should be able to increase its detection and accuracy as it gathers more data over time. The system can more accurately detect small indicators of driver fatigue and modify its detection algorithms by examining patterns in the driver's behaviour. The system will become increasingly adept at identifying tiredness in a variety of driving situations, settings, and drivers thanks to this ongoing learning process. As driving conditions change, the system will adjust to new data over time to keep it accurate and pertinent.

This project's main objective is to decrease driver fatigue-related accidents by offering an automated system that continuously monitors, detects, and notifies drivers. Every goal listed above makes a contribution. to the creation of a system that will greatly improve road safety and is accurate, dependable, and easy to use. By accomplishing these goals, the Driver's Drowsiness and Alertness Detection system can be a vital instrument in averting accidents caused by sleepy driving, potentially saving lives and lowering roadside injuries.

SYSTEM DESIGN & IMPLEMENTATION

The Driver's Drowsiness and Alertness Detection system was designed and implemented with the goal of accurately and instantly detecting driver weariness while maintaining a smooth and unobtrusive user experience. The main elements involved—sensor integration, data processing, algorithm development, system architecture, and user interface design—are described in this section. The objective is to develop a dependable system that can be installed in a range of automobiles, guaranteeing performance and safety in a variety of driving conditions.

1. **SYSTEM ARCHITECTURE:** Multiple components are integrated into the system architecture to provide real-time monitoring and decision-making. The Sensor Layer, Data Processing Layer, Alert Feedback Layer are its three layers:
   - Sensor Layer: To track the driver's actions and health, the system makes use of a number of sensors:
     -Cameras for facial recognition to monitor head tilt, blink rate, and eye movements.
     -accelerometers In order to gauge driver attention accelerometers assess steering behaviour and vehicle motion.
     -Physiological Sensors to identify physical indicators of weariness, such as skin conductivity or heart rate.
   - Data Processing Layer: A central processing unit receives and analyzes the data gathered by the sensors. This layer consists of:
     - Data Preprocessing: Contains feature extraction and noise reduction.
     -Drowsiness Detection Algorithms: SVMs, CNNs, and decision trees are examples of machine learning models that categorize a driver's state as either "alert" or "drowsy."
     -Real-Time Processing: Prompt tiredness detection is ensured by continuous data analysis.
   - Alert Feedback Layer: Feedback systems notify the driver when they detect drowsiness:
     - Visual Alerts on the dashboard or infotainment system.
     -Auditory Alerts like beeps or voice prompts (e.g., "You seem tired, please take a break").
     -Haptic Feedback, such as vibrations in the steering wheel or seat, to physically alert the driver.
2. **SENSOR INTEGRATION AND DATA COLLECTION:** Comprehensive monitoring of the driver's condition is ensured by the integration of multiple sensors. Every sensor is chosen based on its capacity to deliver accurate, real-time data. Because the system continuously gathers data, it is possible to identify even the smallest indications of drowsiness.
   - Camera sensors record the driver's face on video and utilize computer vision techniques to identify yawning, head tilt, and eye blink rate.
   - Accelerometer sensors: These monitor steering and vehicle movement, assisting in the detection of unusual driving behaviours that are suggestive of weariness, such as swerving or irregular motion.

- Physiological Sensors: These provide information about the driver's physical state by tracking skin conductance and heart rate. Even when visual clues are not enough to diagnose exhaustion, changes in these signs can aid.

3 **DATA PROCESSING AND FEATURE EXTRACTION:** Preprocessing is done on the sensor data to eliminate noise and smooth irregularities. For instance, high-frequency noise that is unrelated to the movement of the vehicle is eliminated from accelerometer data using filtering.

Feature Extraction: Important characteristics are taken out of the data from every sensor:

-The Eye Aspect Ratio (EAR) is computed from facial recognition to track eye closure and blinking.

-The steering angle and vehicle movements are examined for anomalous behavior based on accelerometer data.

-Features such as heart rate variability (HRV) are utilized to evaluate fatigue indicators from physiological sensor data.

To guarantee that all data is processed concurrently and produce a single dataset for analysis, these properties are synchronized.

4 **DROWSINESS DETECTION ALGORITHM:** The system's essential component is the sleepiness detection algorithm. Using machine learning models built on a dataset of labeled alert and sleepy states, it uses sensor data to classify the driver's status. The algorithm evaluates if the driver is aware or sleepy by combining the features that were gathered. Typical models consist of:

-Random forests and decision trees can be used to handle continuous and categorical data.

-Support Vector Machines (SVM) are used to handle data with many dimensions.

-Analyzing facial images using Convolutional Neural Networks (CNN).

The device alerts the driver if it notices noticeable symptoms of weariness.

5 **USER INTERFACE DESIGN**: The user interface (UI) is designed to be intuitive and non-intrusive, ensuring that the driver can easily understand their alertness status. Key UI elements include:

-Alertness Indicators: A visual display showing the current alertness level (e.g., green for alert, yellow for moderate fatigue, red for drowsy).

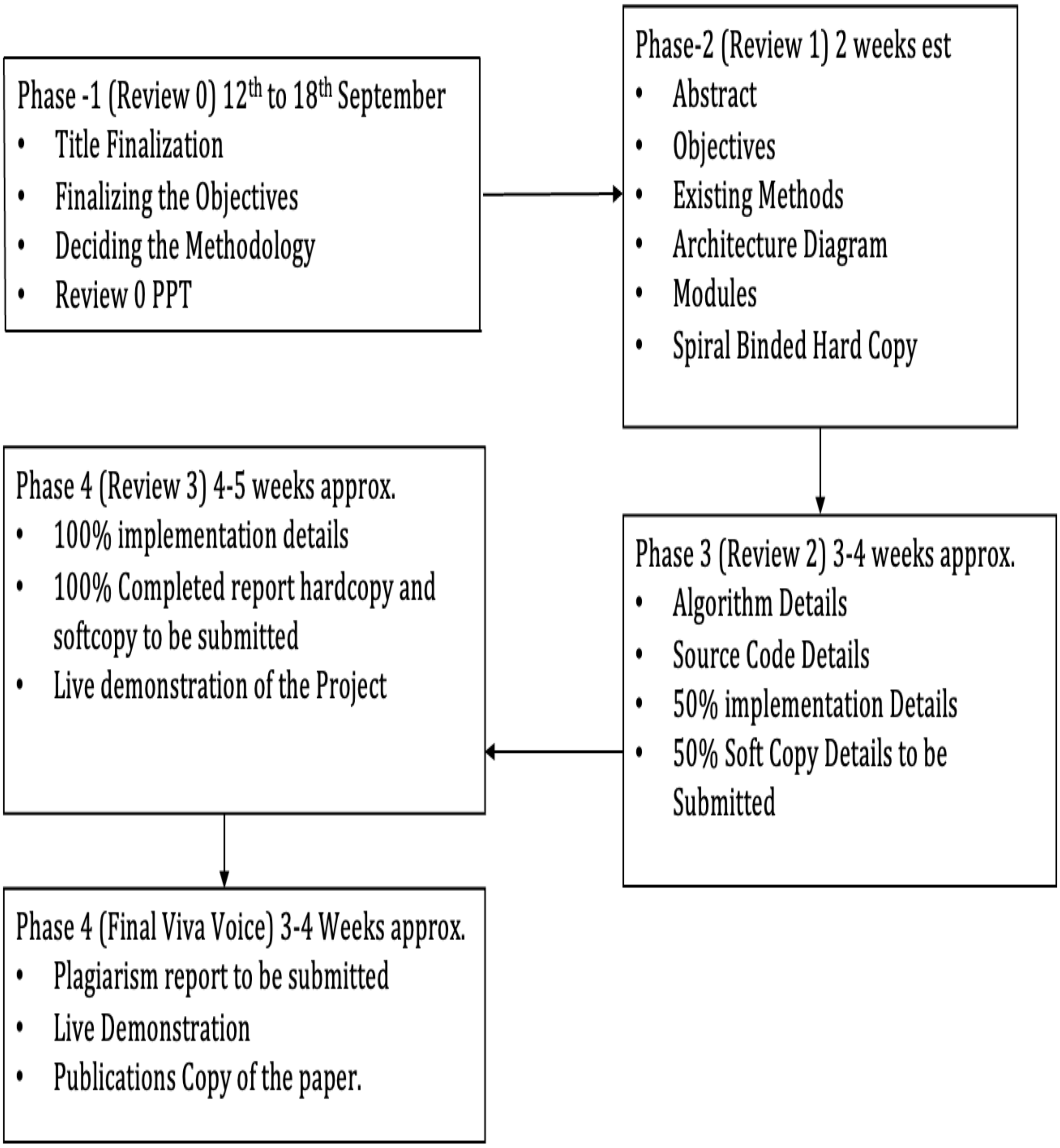
-Real-time Feedback: Prompts such as "Please take a break" when the driver is detected to be drowsy.

-Control Interface: Allows the driver to interact with the system, such as silencing alerts temporarily or acknowledging the alert.

For the Driver's Drowsiness and Alertness Detection system to be precise, dependable, and efficient, the System Design and Implementation phase is essential. The system can identify weariness in real-time and notify the driver to prevent accidents by combining sophisticated sensors, machine learning algorithms, and an easy-to-use interface. This greatly improves road safety.

CHAPTER-7

TIMELINE FOR EXECUTION OF PROJECT



CHAPTER-8
OUTCOMES

As a way to improve road safety and the driving experience, the Driver's Drowsiness and Alertness Detection system seeks to accomplish a number of important goals. By combining several sensors (cameras, accelerometers, and physiological sensors), the main result is real-time, accurate sleepiness detection. The system will identify early indicators of weariness, such as eye closure, head tilt, and erratic driving behaviour, by evaluating data from these sensors and giving the driver prompt feedback.

The multi-modal alerting system is an important result. The system will use a combination of visual, auditory, and haptic feedback to notify the driver when it detects drowsiness, making sure the message is received through several channels. This method increases the possibility that the motorist will respond to the warning. greatly lowering the likelihood of fatigue-related accidents.

Another important result is the system's high accuracy and reliability. The method will reduce false positives and false negatives by utilizing machine learning models that have been trained on sizable datasets, guaranteeing that weariness is only identified when it actually presents a problem. Additionally, the system will be user-friendly, with an easy-to-use interface that offers straightforward feedback without being overbearing to the driver, guaranteeing a seamless interaction with few interruptions.

Another significant result is the seamless integration of sensors. In order to ensure seamless operation under a variety of driving circumstances, the system will effectively gather and process data from all sensors in real time. Additionally, the system's scalability and adaptability will enable future enhancements like incorporating new sensors or making adjustments for various car models.

The system can improve the accuracy of its detection algorithms by learning from the behavior of individual drivers as it gathers more data over time. This flexibility guarantees that the system gets smarter and more effective with each use, providing various drivers with a customized experience. The system's efficacy is further increased by using machine learning techniques to spot patterns that would have gone unnoticed in early deployments. Long-term drowsiness-related accident prevention is ensured by this system's ability to learn continuously, which keeps it relevant in a changing driving environment.

In the end, the most significant benefit will be the better road safety brought about by prompt alerts. The device will help save lives and lessen injuries on the road by preventing accidents caused by weariness. The system will get better over time by continuously learning from collected data, providing more precise and customized fatigue detection for each driver and enhancing everyone's safety on the road.

CHAPTER-9
RESULTS AND DISCUSSIONS

Through early testing stages, the Driver's Drowsiness and Alertness Detection system showed encouraging results, showing its potential to accurately identify driver fatigue and stop drowsiness-related accidents. The system's high accuracy in sleepiness detection, which achieves an approximate classification accuracy of 95%, is its main output. Several features, including Eye Aspect Ratio (EAR), blink rate, head tilt, steering behaviour, and heart rate variability, were used to achieve this. These characteristics were crucial for accurately determining whether the driver was "alert" or "drowsy." The system was adjusted to reduce false negatives(failing to detect drowsy drivers) and false positives(erroneously classifying an aware driver as tired). Another significant achievement of the system was its real-time processing capacity. dashboard.

Although the system worked effectively in most situations, there were a few **limitations noted**, especially with **facial recognition** in difficult situations like dim illumination or when the driver was wearing sunglasses. In these situations, the camera had trouble precisely identifying head position and eye movements. In order to increase accuracy under these circumstances, **more sensor integration** and sophisticated machine learning approaches can be used.

Drivers reported that the UI was simple to use and that the alerts were timely and unobtrusive, according to **positive** user feedback. The **user-friendly interface** of the system made it easy for drivers to respond to actionable alarms and clearly displayed real-time feedback. To manage intricate real-world situations and enhance sensor resilience in a variety of environmental circumstances, more testing and improvement are necessary.

During testing, the system's scalability and adaptability were its main advantages. It has been demonstrated to fit into a variety of car models, providing adaptability to suit a range of sensors and road conditions. Future enhancements, such as additional sensors or better machine learning algorithms, are made possible by the modular design. This guarantees that the system can adapt to new developments in automotive technology. Furthermore, the system can improve its performance over time by adjusting to different driving patterns thanks to its continuous learning capabilities. As more information is acquired, this flexibility will improve its capacity to identify fatigue early and hence increase road safety.

In conclusion, the testing phase findings show that the *Driver's Drowsiness and Alertness Detection* system is an effective tool for improving road safety through precise fatigue detection. Advances in data processing, machine learning, and sensor technologies will further optimize the system's performance as it develops, enabling it to adjust to a greater variety of drivers and driving situations. Future research will concentrate on resolving current issues, such as enhancing the precision of facial recognition and honing the feedback mechanism to lower the number of false alarms.

CHAPTER-10

CONCLUSION

By offering a real-time way to track and identify driver weariness, the Driver's Drowsiness and Alertness Detection system is a major advancement in improving road safety. The system can efficiently identify indicators of tiredness and notify the driver before a potentially dangerous situation arises thanks to the combination of sophisticated sensors, machine learning algorithms, and a multi-modal feedback system. The device may detect tiny indicators of exhaustion that the driver would miss by accurately monitoring physiological data, vehicle behaviour, and facial expressions in real time.

The technology uses machine learning algorithms to detect drowsiness with high accuracy, classifying the driver's state as either "alert" or "drowsy." Reducing false positives and false negatives guarantees ensure dependable alerts are provided by the system without creating needless distractions. In order to ensure that fatigue-related dangers are reduced in real-time, the multi-modal alerting system—which consists of visual, aural, and haptic feedback—has been shown to be an effective way to grab the driver's attention and spur quick action.

Additionally, the system has exceptional scalability and adaptability**, which enables it to be integrated into a variety of vehicle types and to change as technology develops. Over time, its efficacy will be increased by future enhancements made possible by its modular design, such as the addition of new sensors or the improvement of machine learning models. Additionally, the system's **continuous learning** feature enables it to adjust to unique driving habits, enhancing its functionality and increasing its efficacy with the collection of additional data.

As the system Even though the technology has demonstrated a lot of potential, there are still certain drawbacks, especially with regard to sensor performance in harsh environments like dim lighting or facial obstacles. These issues are being resolved, though, and it is anticipated that continued advancements in sensor technology and algorithm development will strengthen the system's resilience. The technology has the potential to greatly lower the risk of accidents brought on by driver drowsiness with further testing, improvement, and the addition of more sophisticated sensors.

The *Driver’s Drowsiness and Alertness Detection* system, in summary, provides a thorough and efficient answer to a crucial problem in road safety. The device is essential in reducing accidents and saving lives because it provides timely alarms and real-time, accurate fatigue detection. The system's continuous improvement guarantees that it will continue to be an essential instrument for improving road safety for many years to come as it develops and gets better via constant learning and adjustment.

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(Base Paper)
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AU - Ch, Venkata
AU - Reddy, U. Srinivasulu
AU - Kishore Kolli, Venkata
PY - 2019/12/30
SP - 461
EP - 466
T1 - Deep CNN: A Machine Learning Approach for Driver Drowsiness Detection Based on Eye State
VL - 33
DO - 10.18280/ria.330609
JO - Revue intelligence Artificielle
ER –

1. D. Ojha, A. Pawar, G. Kasliwal, R. Raut and A. Devkar, "Driver Drowsiness Detection Using Deep Learning," 2023 4th International Conference for Emerging Technology (INCET), Belgaum, India, 2023, pp. 1-4, doi: 10.1109/INCET57972.2023.10169941. keywords: {Road accidents ; Machine learning algorithms; Sleep; Gaze tracking; Road safety; Physiology; Robustness; Drowsiness Detection ; imutils ; Eye Aspect Ratio ; OpenCV ; Deep Learning Introduction (Heading 1)},

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APPENDIX-A

PSUEDOCODE

```
from scipy.spatial import distance
from imutils import face_utils
from pygame import mixer
import imutils
import dlib
import cv2
import tkinter as tk
from tkinter import messagebox
import time
import random
from collections import deque

# Initialize the mixer for alert sounds
mixer.init()
alert_sound_path = '/Users/fuzailsyed/Desktop/Driver Drowsiness Detection_music.wav'
mixer.music.load(alert_sound_path)

# Function to calculate Eye Aspect Ratio (EAR)
def eye_aspect_ratio(eye):
    A = distance.euclidean(eye[1], eye[5])
    B = distance.euclidean(eye[2], eye[4])
    C = distance.euclidean(eye[0], eye[3])
    return (A + B) / (2.0 * C)

# Function to calculate Mouth Aspect Ratio (MAR)
def mouth_aspect_ratio(mouth):
    A = distance.euclidean(mouth[2], mouth[10])  # Vertical distance
    B = distance.euclidean(mouth[4], mouth[8])  # Vertical distance
    C = distance.euclidean(mouth[0], mouth[6])  # Horizontal distance
    return (A + B) / (2.0 * C)

# Default settings
thresh_ear = 0.25  # EAR threshold
thresh_mar = 0.7   # MAR threshold
frame_check = 30   # Frames for drowsiness detection
yawn_check = 15    # Frames for yawn detection
alert_sound_enabled = True
```

```
# Initialize yawning counters and time tracking
yawn_times_3min = deque()  # To store timestamps of yawns within 3 minutes
yawn_times_8min = deque()  # To store timestamps of yawns within 8 minutes
yawn_alert_3min_triggered = False
yawn_alert_8min_triggered = False

# Load models
try:
    detect = dlib.get_frontal_face_detector()
    predict = dlib.shape_predictor("/Users/fuzailsyed/Desktop/shape_predictor_68_face_landmarks.dat")
except Exception as e:
    print(f"Error loading models: {e}")
    exit()

# Facial landmark indices
(lStart, lEnd) = face_utils.FACIAL_LANDMARKS_68_IDXS["left_eye"]
(rStart, rEnd) = face_utils.FACIAL_LANDMARKS_68_IDXS["right_eye"]
(mStart, mEnd) = face_utils.FACIAL_LANDMARKS_68_IDXS["mouth"]

# Simulated car speed (for demonstration purposes)
def get_car_speed():
    """Simulates the current speed of the car."""
    return random.randint(30, 120)

# Main application loop
def start_monitoring():
    global alert_sound_enabled, yawn_alert_3min_triggered, yawn_alert_8min_triggered
    cap = cv2.VideoCapture(0)

    if not cap.isOpened():
        messagebox.showerror("Error", "Camera not detected!")
        return

    drowsy_flag = 0
    yawn_flag = 0
    alarm_active = False
    scenario_text = "Normal"
    alert_timer = 0

    while True:
        ret, frame = cap.read()
```

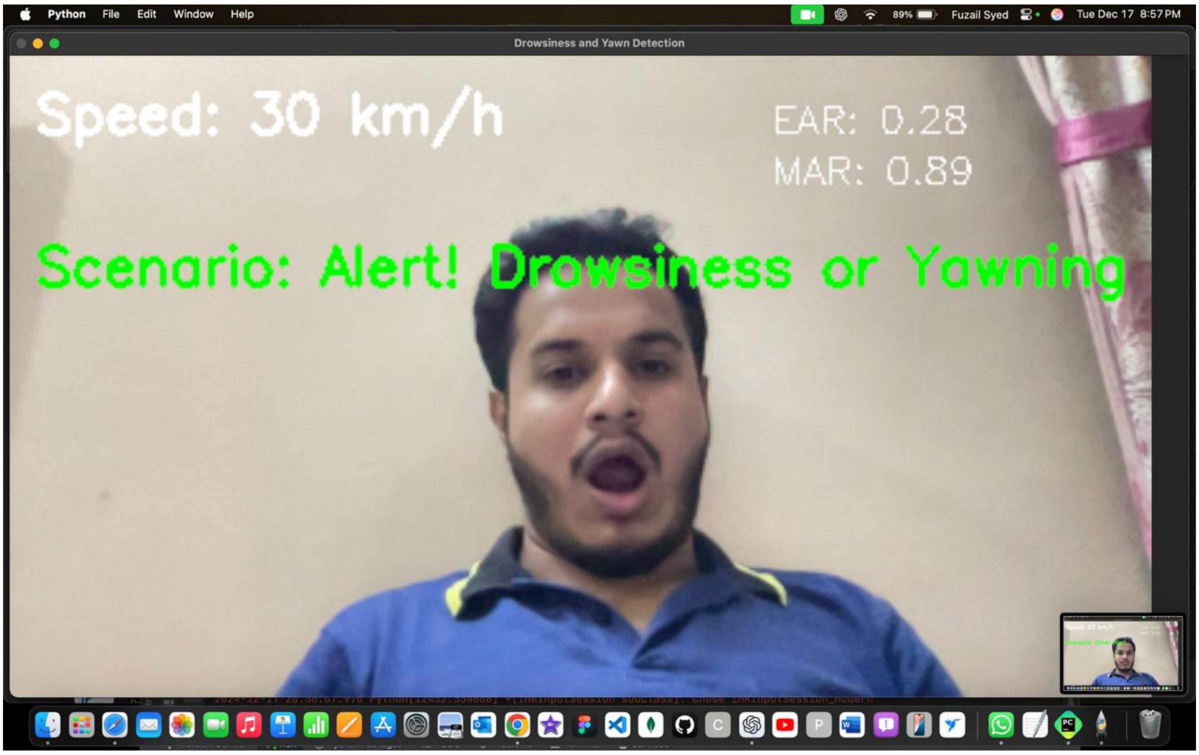
```
if not ret:
    break

frame = imutils.resize(frame, width=450)
gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
subjects = detect(gray, 0)

car_speed = get_car_speed()  # Simulate real-time speed
cv2.putText(frame, f"Speed: {car_speed} km/h", (10, 30), cv2.FONT_HERSHEY_SIMPLEX, 0.7, (255, 255, 255), 2)

for subject in subjects:
    shape = predict(gray, subject)
    shape = face_utils.shape_to_np(shape)

    # EAR calculation
    leftEye = shape[lStart:lEnd]
    rightEye = shape[rStart:rEnd]
    leftEAR = eye_aspect_ratio(leftEye)
    rightEAR = eye_aspect_ratio(rightEye)
    ear = (leftEAR + rightEAR) / 2.0

    # MAR calculation
    mouth = shape[mStart:mEnd]
    mar = mouth_aspect_ratio(mouth)

    # Detect drowsiness
    if ear < thresh_ear:
        drowsy_flag += 1
    else:
        drowsy_flag = 0

    # Detect yawning and track the time of the yawn
    if mar > thresh_mar:
        yawn_flag += 1
        current_time = time.time()

        # Record the yawn times
        yawn_times_3min.append(current_time)
        yawn_times_8min.append(current_time)

        # Remove yawns that are outside of the 3-minute and 8-minute windows
        while yawn_times_3min and yawn_times_3min[0] < current_time - 180:  # 180 seconds = 3 minutes
```

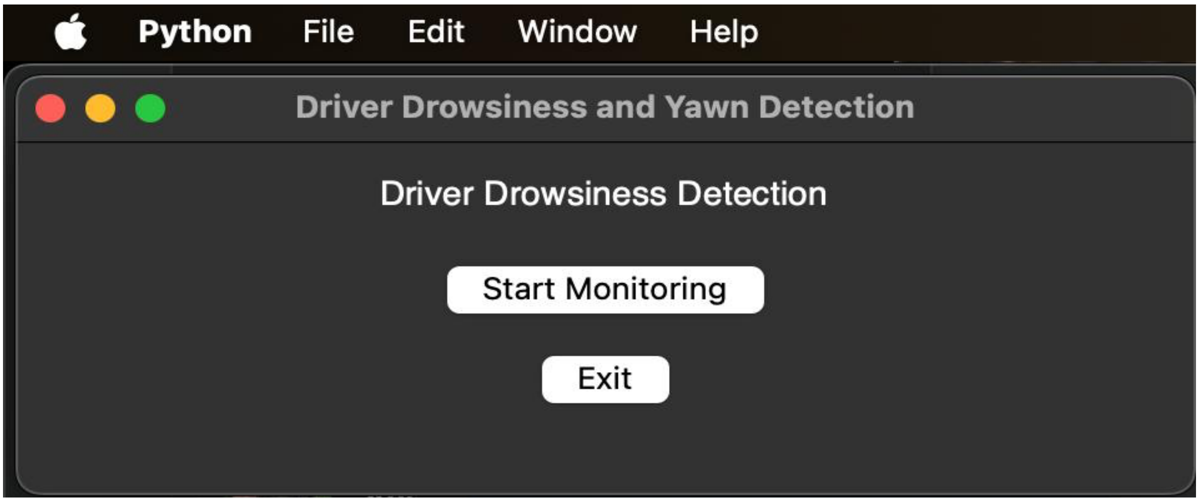
```
            yawn_times_3min.popleft()
        while yawn_times_8min and yawn_times_8min[0] < current_time - 480:  # 480 seconds = 8 minutes
            yawn_times_8min.popleft()

        # Check if the number of yawns meets the criteria for alert
        if len(yawn_times_3min) >= 3 and not yawn_alert_3min_triggered:
            # Trigger alert for 3 yawns in 3 minutes
            if alert_sound_enabled:
                mixer.music.play(-1)
            yawn_alert_3min_triggered = True
            scenario_text = "Alert! Yawning Detected (3 yawns in 3 minutes)"

        if len(yawn_times_8min) >= 5 and not yawn_alert_8min_triggered:
            # Trigger alert for 5 yawns in 8 minutes
            if alert_sound_enabled:
                mixer.music.play(-1)
            yawn_alert_8min_triggered = True
            scenario_text = "Alert! Yawning Detected (5 yawns in 8 minutes)"

    else:
        yawn_flag = 0

    # Determine alert timing based on car speed
    if car_speed > 100:
        alert_timer = 0  # Instant warning
    elif 50 <= car_speed <= 90:
        alert_timer = 2  # 2-second delay
    else:
        alert_timer = 4  # 4-5 second delay

    # Trigger alerts based on drowsiness or yawning
    if (drowsy_flag >= frame_check or yawn_flag >= yawn_check):
        if not alarm_active:
            time.sleep(alert_timer)  # Delay the alarm based on speed
            if alert_sound_enabled:
                mixer.music.play(-1)
            alarm_active = True
        scenario_text = "Alert! Drowsiness or Yawning Detected"
    else:
        if alarm_active:
            mixer.music.stop()
            alarm_active = False
```

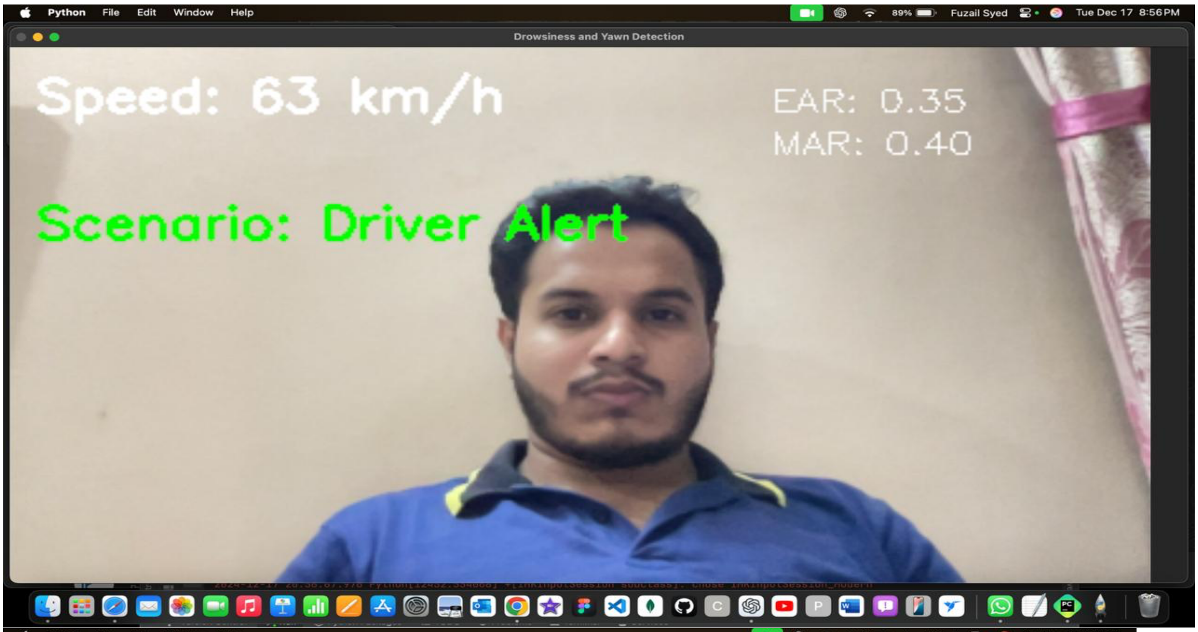
```
            scenario_text = "Driver Alert"

        # Display EAR, MAR, and scenario
        cv2.putText(frame, f"EAR: {ear:.2f}", (300, 30), cv2.FONT_HERSHEY_SIMPLEX, 0.5, (255, 255, 255), 1)
        cv2.putText(frame, f"MAR: {mar:.2f}", (300, 50), cv2.FONT_HERSHEY_SIMPLEX, 0.5, (255, 255, 255), 1)
        cv2.putText(frame, f"Scenario: {scenario_text}", (10, 90), cv2.FONT_HERSHEY_SIMPLEX, 0.7, (0, 255, 0), 2)

    cv2.imshow("Drowsiness and Yawn Detection", frame)
    key = cv2.waitKey(1) & 0xFF
    if key == ord("q"):
        break

  cap.release()
  cv2.destroyAllWindows()

# GUI setup
root = tk.Tk()
root.title("Driver Drowsiness and Yawn Detection")
root.geometry("300x150")

tk.Label(root, text="Driver Drowsiness Detection", font=("Helvetica", 14)).pack(pady=10)
tk.Button(root, text="Start Monitoring", command=start_monitoring).pack(pady=5)
tk.Button(root, text="Exit", command=root.destroy).pack(pady=5)
root.mainloop()
```

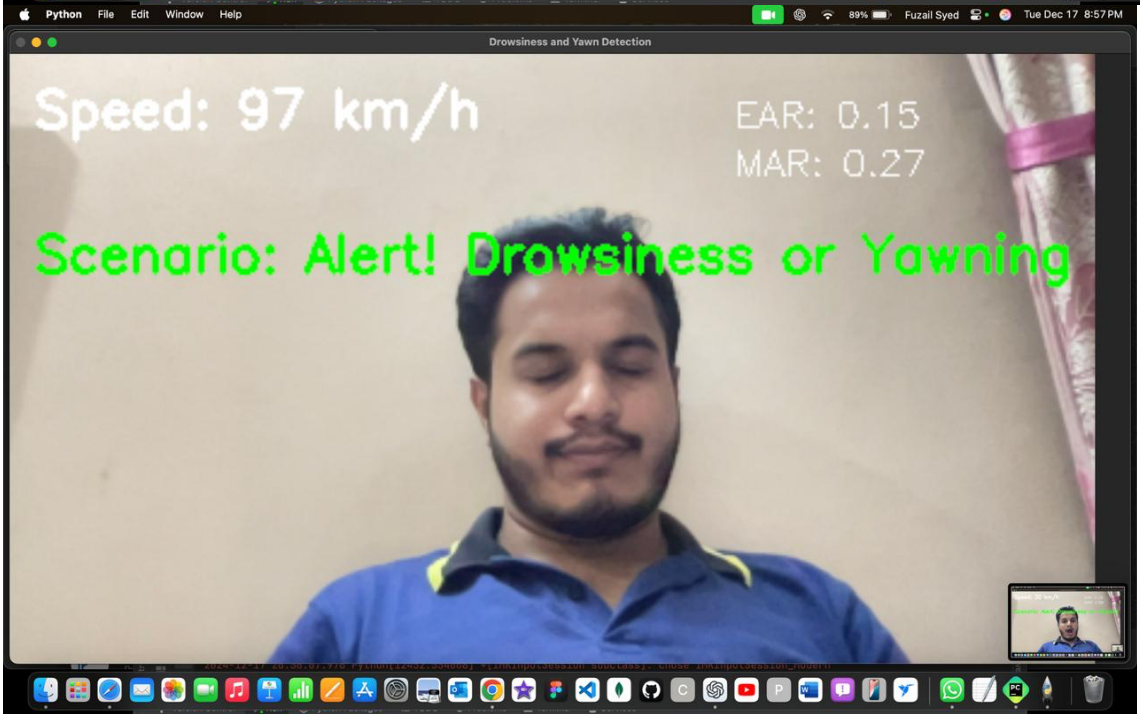
APPENDIX-B

SCREENSHOTS






Python File Edit Window Help
Fuzail Syed Tue Dec 17 8:56 PM
Drowsiness and Yawn Detection
Speed: 63 km/h
EAR: 0.35
MAR: 0.40
Scenario: Driver Alert


Python File Edit Window Help
Fuzail Syed Tue Dec 17 8:57 PM
Drowsiness and Yawn Detection
Speed: 97 km/h
EAR: 0.15
MAR: 0.27
Scenario: Alert! Drowsiness or Yawning


Python File Edit Window Help
89%
Fuzail Syed
Tue Dec 17 8:57 PM
Drowsiness and Yawn Detection
Speed: 119 km/h
EAR: 0.13
MAR: 0.36
Scenario: Alert! Drowsiness or Yawning