A Minor Project-I Report

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HUMAN DROWSINESS DETECTION SYSTEM

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PROJECT APPROVAL SHEET

The project entitled “Human Drowsiness Detection system” submitted by Arpita vishwakarma, Disha Pandey, Mahak Chouhan as partial fulfillment for the award of **Bachelor of Technology in Information Technology** by Rajiv Gandhi Prodyogiki Vishwavidyalaya, Bhopal.

Project Coordinator:

Prof. Priyanka Kumrawat

Date:

RECOMMENDATION

The project entitled “Human Drowsiness Detection system” submitted by Arpita vishwakarma, Disha Pandey, Mahak Chouhan as partial is a satisfactory account of the bonafide work done under our guidance is recommended towards partial fulfillment for the award of the **Bachelor of Technology in Artificial Intelligence and Data Science** from Mahakal Institute of Technology, Ujjain by Rajiv Gandhi Prodyogiki Vishwavidyalaya, Bhopal.

Project Guide :

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We sincerely thank "**Prof. Neeraj Sharma**" for his guidance and encouragement in carrying out this project work.

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ABSTRACT

The project proposes a system which is developed for detecting drowsiness of an individual in real time. This system aims for the betterment of the society by increasing the productivity of the student and an employee using Artificial Intelligence and machine learning . This system will use a basic webcam programmed with a code, directly facing the individual to monitor the eyes and mouth of the user to derive whether the individual is drowsy or not.

If symptoms of drowsiness such as yawning and closed eyes are detected, then the system buzzes alarm to alert the Employee. It utilizes the concept of Image Processing to detect the target area of the face. Python programming along and Open CV is interfaced for determining if the Eyes are closed and the person is yawning. The main objective of this project is to monitor any student who is working online to increase the productivity caused due to drowsiness and work fatigue.

Firstly, the edge of the face is detected, after finding the face, eyes and mouth are found using Facial Landmark Detector file in Dlib Library. After locating the eyes and mouth the distance between them is measured to determine whether they are Open or closed. If the Eyes are found closed for a specific time and mouth is found open for a specific time, then it is recorded. If the same continues for more than four times, then the employee gets an alerting buzz.

FIGURE INDEX

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LIST OF ABBREVIATIONS

ML	Machine learning
DL	Deep learning
NN	Neural networks
CNN	Convolutional Neural Networks
CV	Computer vision
IDEs	Integrated Development Environment
DDD	Driver drowsiness detection
EAR	Eye aspect ratio
MAR	Mouth aspect ratio
PERCLOS	Percentage of eyelid closure

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Drowsiness is a state of near sleep, where the human 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 doing work , they will experience drowsiness and this leads to affect focus, concentration and academic performance.

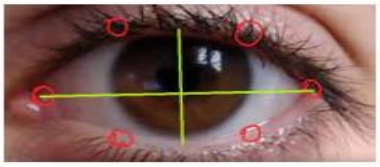
Fig 1.1 Introduction to drowsiness and fatigue

Drowsiness is identified by using vision-based techniques like eyes detection, yawning, and nodding. When it comes to yawning and nodding some people can sleep without yawning and nodding.

In this project we are going to build a detection system that uses OpenCV to capture drivers' faces using Eye Aspect Ratio (EAR), Mouth Aspect Ratio (MAR) and a machine learning model to detect drowsiness. 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.

This project is focused on the localization of the eyes and mouth, which involves looking at the entire image of the face, and determining the position of the eyes and mouth, by applying the existing methods in image-processing algorithm.


BABY YAWNING


EYE_DETECTION


UNCLE NODDING

Fig 1.2 Signs of drowsiness

In this project, we have build a human drowsiness detection system that will detect if the eyes of the user are close for too long and infer if the user is sleepy or inactive. The drowsiness detection system can be used as a user in a two ways:-

- It can be a safety technology that can prevent accidents that are caused by drivers who fell asleep while driving.
- It can also be used by the students who are working on the laptop/pc for too long and fell asleep while doing work.
-

1.2 IDENTIFICATION OF PROBLEM DOMAIN

A drowsiness detection system which use a camera placed in front of the person is more suitable to be use but the physical signs that will indicate drowsiness need to be located first in order to come up with a drowsiness detection algorithm that is reliable and accurate. Lighting intensity and while the driver tilt their face left or right are the problems occur during detection of eyes and mouth region. Firstly, sleepy.

students are less productive, they react more slowly, make more mistakes and possible forget to do things which can lead to adverse impact on the productivity of the particular organization. Also, they have worse adaptive performance. This mean that they will not be able to figure out how to handle the changing situation which are becoming increasingly common in the modern world. Additionally, they will have trouble with multitasking or quickly switching between different tasks, also common elements of the modern era.

Therefore, this project aims to analyze all the previous research and method, hence propose a method to detect drowsiness by using video or webcam. It analyzes the video images that have been recorded and come up with a system that can analyze each frame of the video. It detects the drowsiness signs and alerts drivers when they are in drowsy state.

CHAPTER 2
LITERATURE REVIEW

2.1 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 is also several method which use different approaches to detect the drowsiness signs.

2.1.1 Study of Tools used

- Python: Widely used for data analysis, ML, and algorithm development.
- Machine Learning Libraries: Tensorflow and sci-kit.
- Apps: used for web camera and alert sound like Iruin and audiorelay.

2.1.2 Study of Technology used

- ML and AI Algorithms: Techniques like DL, NN, and ML models are applied to process sensor data and identify patterns associated with drowsiness.
- Eye-Tracking Sensors: Sensors detect signs of drowsiness based on changes in behaviour.
- JUPYTER Lab - It is a nonprofit organization created to develop open-source software, open-standards, and services for interactive computing across dozens of programming languages.

2.2 LIMITATION OF EXISTING SYSTEM

1. False Positives and Negatives: It can sometimes generate false alarms (false positives) or fail to detect drowsiness (false negatives). This can be due to various factors.
2. Dependency on Sensors: Many drowsiness detection systems rely on sensors which can be intrusive, uncomfortable, or expensive.
3. Calibration and Personalization: Future systems could benefit from user-specific calibration and personalization to improve accuracy.
4. Environmental Factors: Ambient conditions can affect the accuracy of drowsiness detection systems.

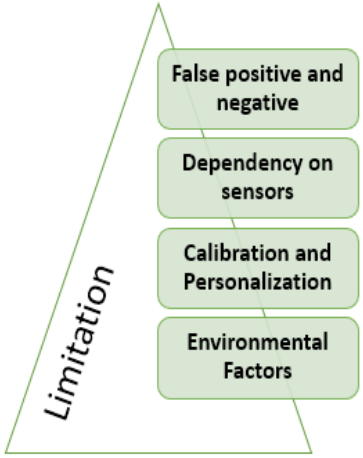


Fig.1.3 Limitations of drowsiness detection system

CHAPTER 3
RATIONALE AND PROCESS

3.1 OBJECTIVE

The objective of a human drowsiness detection system is to accurately and timely identify signs of drowsiness or fatigue in individuals, particularly in scenarios where alertness is critical, such as performing tasks that demand sustained attention. The system aims to mitigate the risks associated with drowsy behaviour by:

- Early Detection
- Prevention of Accidents
- Enhancing Safety
- Real-time Monitoring
- Improving Awareness
- Integration with Existing Systems

The objective of the human drowsiness detection system are as follows:-

- To suggest a way to detect fatigue and drowsiness while driving.
- To investigates the physical changes of fatigue and drowsiness.
- To develop a system that uses the closing of eyes and yawning to detect fatigue and drowsiness.
- To provide an alert (sound) when drowsiness occurs or the person goes in the drowsy state.

3.2 SOFTWARE MODEL ADAPTED

A software model for a drowsiness detection system depends on various factors such as the type of sensors used, the complexity of data analysis required, real-time processing needs, and the desired accuracy of the system.

1. Machine Learning Models:
   - Convolutional Neural Networks (CNNs): They are effective for image analysis in facial recognition and eye-tracking applications which identify facial features, eye movements, and patterns associated with drowsiness.
2. OpenCV (Open Source Computer Vision Library):
   - OpenCV provides various tools and libraries for computer vision applications, enabling tasks like facial recognition, eye-tracking, and image processing crucial for detecting signs of drowsiness.
     - Importing module in the environment like:

pip install opencv-python

- Syntax be like:

import cv2

3. Deep Learning Frameworks:
   - TensorFlow: A popular deep learning framework useful for developing complex neural networks used in drowsiness detection systems.
     - Importing module in the environment like:

       pip install tensorflow

     - Syntax be like:

       import tensorflow as tf

4. Python Libraries:
   - scikit-learn: Useful for implementing machine learning algorithms and performing data preprocessing, classification, and model evaluation.
     - Importing module in the environment like:

       pip install scikit-learn

     - Syntax be like:

       import sklearn
   - Keras: Built on top of TensorFlow, Keras simplifies the development and experimentation of neural networks, making it suitable for rapid prototyping in drowsiness detection.
     - Importing module in the environment like:

       pip install keras

     - Syntax be like:

       import keras

5. Different methods used for calculations:
   - EAR : It reflects the width and height of coordinates can be derived. Each eye are characterized by 6 coordinates which are then applied on the equation

$$\text{EYE ASPECT RATIO} = \frac{\|p2-p6\|+\|p3-p5\|}{2\|p4-p1\|}$$

$$\text{MOUTH ASPECT RATIO} = \frac{\|p2-p8\|+\|p3-p7\|+\|p4-p6\|}{2\|p1-p5\|}$$

   - MAR : Mouth is characterized with the help by 20 coordinates . Using this, the distance between the lips is calculated which is the difference between the top lip and bottom lip which determines whether person mouth is open. If distance is greater than threshold amount then it determine the state of drowsiness.

CHAPTER 4
SYSTEM ANALYSIS OVERVIEW

5.1 REQUIREMENT ANALYSIS

Requirement analysis for a drowsiness detection system involves identifying and documenting the needs, functionalities, constraints, and goals of the system.

5.1.1 Hardware requirements

1. Processing Unit:
   - Central Processing Unit (CPU): A powerful CPU capable of handling real-time data processing and analysis is necessary.
2. Memory and Storage:
   - Random Access Memory (RAM): Sufficient RAM to handle the data being processed, store models, and support concurrent operations efficiently.
   - Storage Space: Adequate storage for storing collected data, analysis results, and system logs.
3. Connectivity:
   - Wireless Connectivity: For systems requiring remote monitoring or data transmission, options such as Wi-Fi, Bluetooth, or cellular connectivity might be necessary.

5.1.2 Software requirements

1. Development Environments and Tools:
   - Integrated Development Environments (IDEs): Such as Visual Studio, or Jupyter Notebook for programming and development.
2. Programming Languages:
   - Python: Widely used for machine learning, data analysis, and rapid prototyping due to its extensive libraries like TensorFlow, Keras, scikit-learn, OpenCV, etc.
3. Machine Learning and AI Frameworks:
   - TensorFlow: For building and training neural networks used in deep learning-based models.
   - scikit-learn: For implementing machine learning algorithms and performing data preprocessing and model evaluation.
4. Computer Vision Libraries:
   - OpenCV: Essential for computer vision tasks, such as facial recognition, eye-tracking, and image processing.

5.1.3 Functional and non-functional requirements

Functional and non-functional requirements are essential components of system requirements that define what a system should do (functional) and how it should operate (non-functional).

1. **Functional requirements**
   - Real-Time Monitoring: The system should continuously monitor physiological and behavioural indicators in real-time.
   - Data Collection: It should gather data from sensors such as eye-tracking devices.
   - Data Analysis: Analyze collected data to detect signs of drowsiness, including patterns in eye movements.
   - Alert Generation: Generate timely alerts or warnings to users or relevant systems upon detecting drowsiness indicators.
   - Intervention Triggers: Trigger interventions (e.g., alarms, vibrations, notifications) to prompt users to take actions to counteract drowsiness.
   - User Interface: Provide an intuitive user interface for configuration, monitoring, and acknowledgment of alerts.
2. **Non-functional requirements**
   - Accuracy: The system should achieve a high level of accuracy in detecting drowsiness indicators to minimize false positives or negatives.
   - Real-Time Responsiveness: Respond to drowsiness indicators with minimal latency to ensure timely alerts or interventions.
   - Scalability: Ability to handle an increasing volume of data or users without compromising performance.
   - Usability: Provide an interface that is easy to use and understand for users interacting with the system.

5.2 USE CASE DIAGRAM & USE-CASE DESCRIPTION

The interactions between users (actors) and the system itself.

1. Actors:
   - User: Represents the individual interacting with the drowsiness detection system.
2. Use Cases:
   - Start /stop: Use to start and stop the camera.
   - Capture: It capture the real-time footage.
   - Face-extraction: Different algorithms are used to extract the face landmarks.

- Eye region extraction: The landmarks for eye region are extracted using formulas as Euclidean distance.
- Analysing: The extracted data is then analysed using different machine learning algorithms.
- Drowsy status detection: After all extraction and analysing of data, the prediction is performed to get the drowsy status.
- Alarm running with notification: Alert gets when the status is drowsy and sleeping and also the notification on telegram will come.

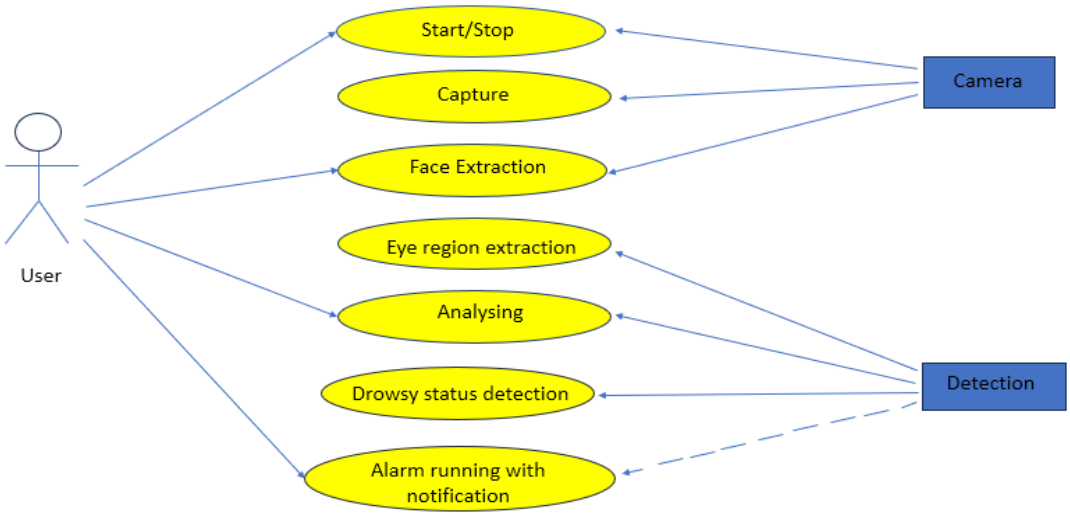


Fig 1.4 Use case diagram

5.3 SEQUENCE DIAGRAM

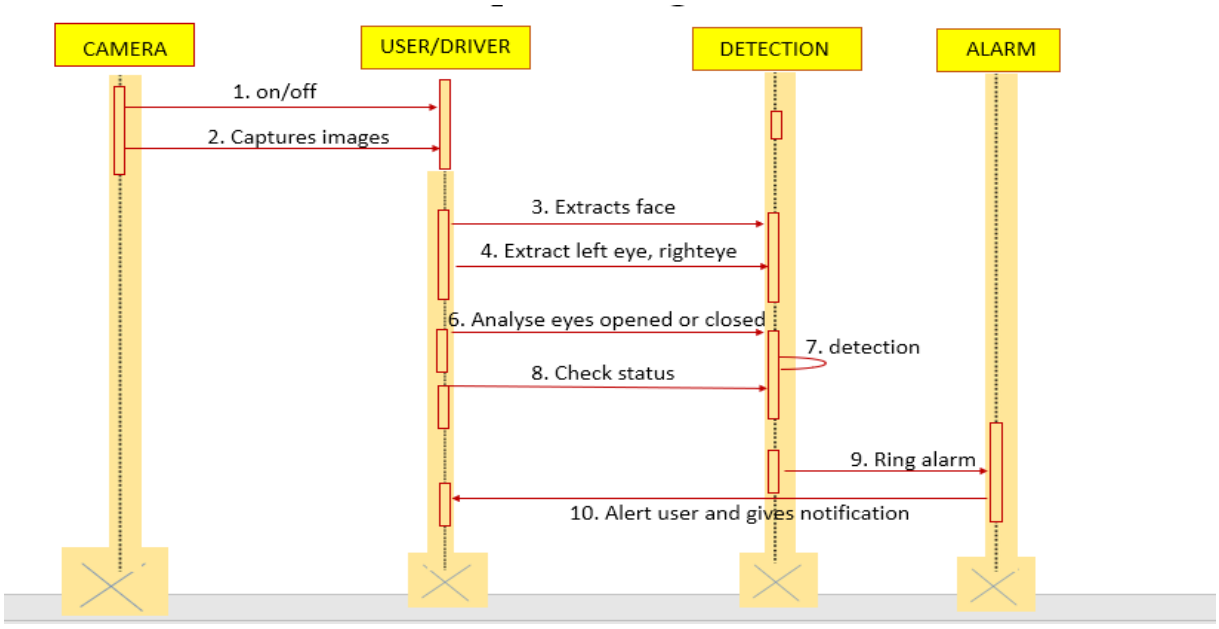


Fig 1.5 Sequence diagram

CHAPTER 5
SYSTEM DESIGN OVERVIEW

5.1 DATA DICTIONARY

Data Element Name	Description	Datatype	Size/ length	Format/ Constraints	Source	Usage
EyeTrackingData	Eye-tracking sensor data	String	Variable	N/A	Eye-tracking sensors	Detecting eye movement
AlertTrigger	Alert trigger signal	Boolean	1 bit	True/False	Analysis module	Initiating alert Mechanism
UserInput	User Interaction input	String	Variable	N/A	User Interface	Acknowledging alerts

Table 1.1 Data Dictionary

5.2 CLASS DIAGRAM

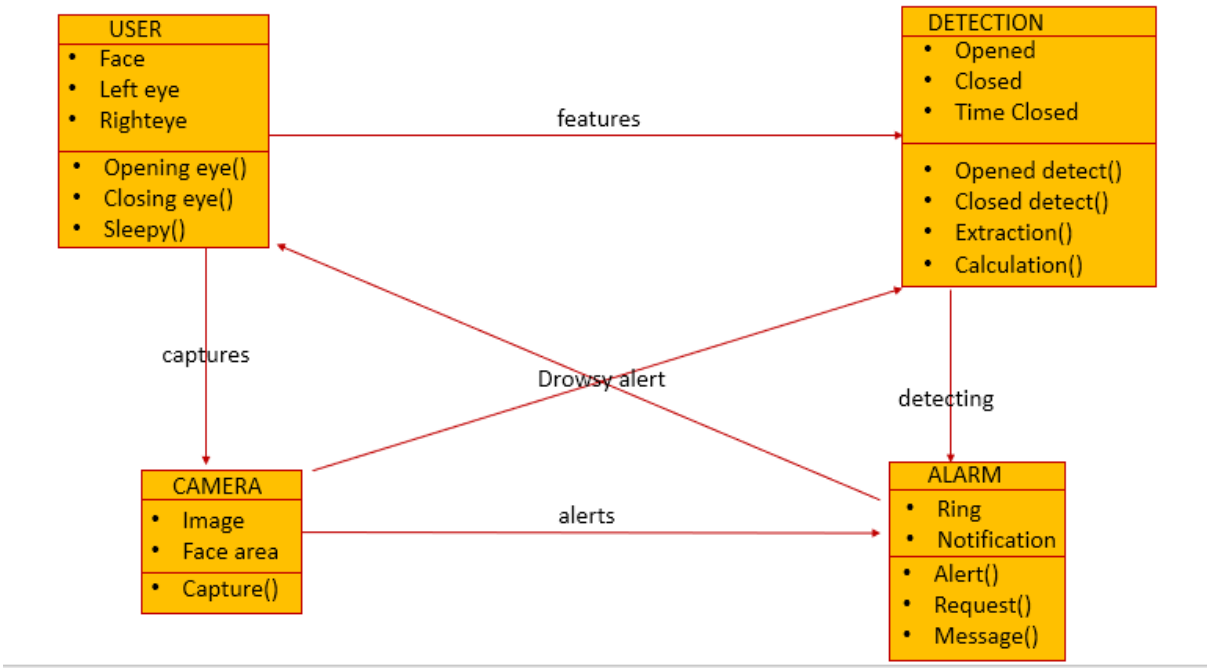


Fig 1.6 Class diagram

5.3 DATAFLOW DIAGRAM

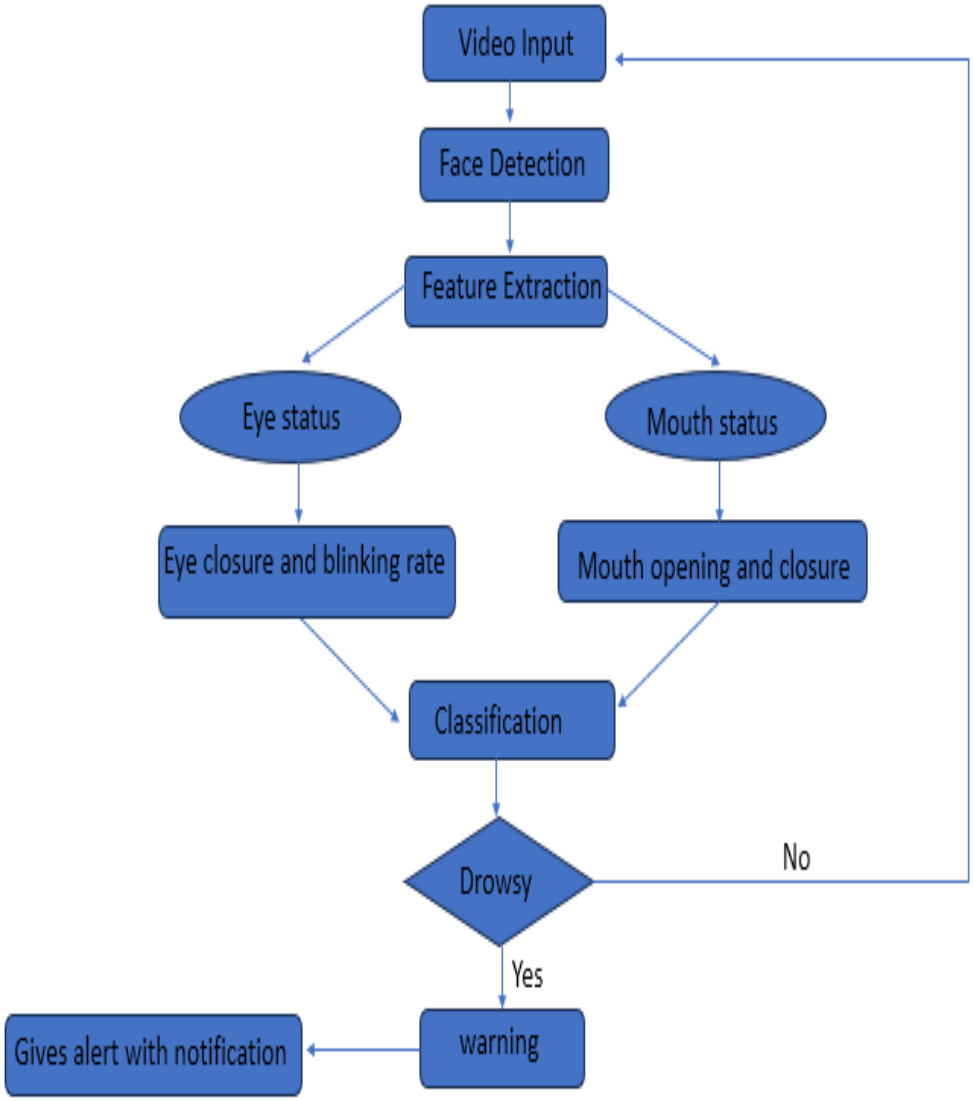


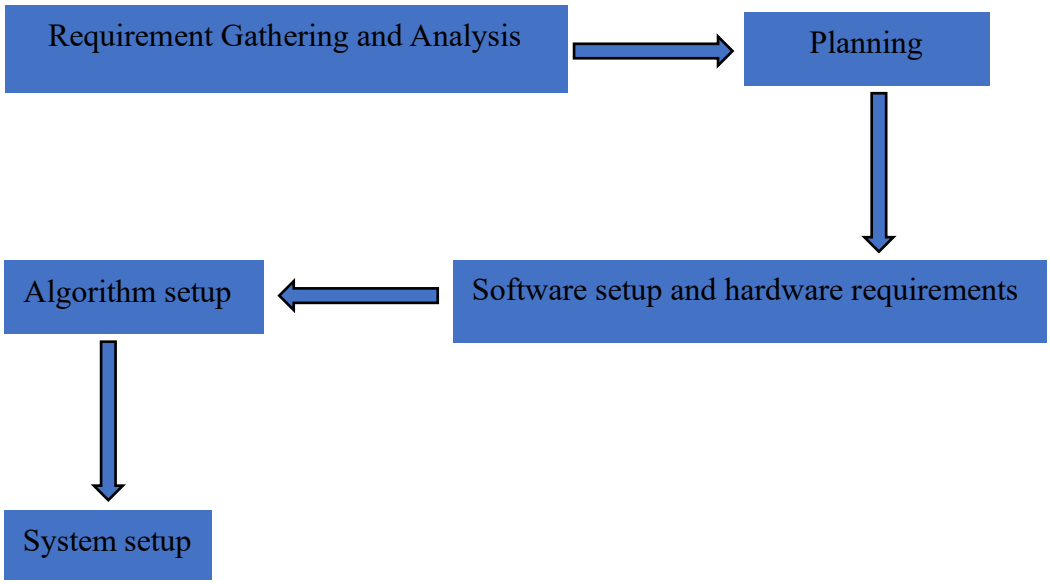
Fig 1.7 Dataflow diagram

CHAPTER 6
WORK PLAN

6.1 TIME FRAME WORK

Developing such a system involves various stages, and a timeframe could be outlined as follows:

1. Requirement Gathering and Analysis (3-4 days):
   Define the system's objectives, functionalities requirements.
2. Planning (2-3 days):
   Plan the system architecture, and data processing methods.
3. Software Setup & hardware requirements (1-2 days):
   Set up the software environment, including development tools, libraries, and frameworks.
4. Algorithm setup(1-2 days):
   Implement machine learning models .
5. System setup(5-6 days):
   Develop the system components, including data processing, alert generation, and user interface modules.



CHAPTER 7
IMPLEMENTATION AND TESTING

7.1 TESTING STRATEGY ADAPTED

A comprehensive testing strategy for a drowsiness detection system involves various types of testing to ensure the system's functionality, accuracy, reliability, and performance. Here are some adapted testing strategy listed below;

- Unit Testing.
- Integration Testing
- System Testing
- User Acceptance Testing (UAT)
- Performance Testing
- Security Testing
- Reliability and Availability Testing
- Usability Testing

7.2 SYSTEM TESTING

System testing for a drowsiness detection system involves evaluating the system as a whole to ensure it meets specified requirements, functions correctly, and performs reliably in different scenarios.

1. Test Planning
   - Define Test Objectives and Scope
   - Identify Test Scenarios and Use Cases
   - Create Test Cases
2. Test Execution
   - Functional Testing
   - Performance Testing
   - User Interface Testing
   - Integration Testing
3. Test Evaluation
   - Record Test Results

4. Documentation:
   - Create Test Reports
5. Iterative Improvement:
   - Iterate and Improve

7.3 TEST CASES

1. Data Collection
   - Test Case 1 – Wireless Connectivity
     - Objective: Ensure app connect and transmit data correctly.
     - Steps:
       - Turn on Iruin Webcam, AudioRelay and verify connectivity with the system.
       - Check for accurate data transmission from them to the system.
     - Expected Result: App connect without errors, and data is received accurately.
2. Data Processing:
   - Test Case 2 - Data Analysis Accuracy:
     - Objective: Verify the accuracy of drowsiness detection algorithms.
     - Steps:
       - Input test data with known drowsiness indicators.
       - Validate if the system correctly identifies drowsiness patterns.
     - Expected Result: System accurately detects drowsiness based on test data.
3. Alert Generation:
   - Test Case 3 - Alert Triggering and getting notification
     - Objective: Validate the system's alert triggering mechanism and proper messaging app.
     - Steps:
       - Simulate drowsiness indicators within the system.
       - Verify if the system triggers alerts promptly and message sends securely.
     - Expected Result: System generates alerts promptly upon detecting drowsiness and sending notification when get in drowsy state.

CHAPTER 8
CONCLUSION AND FUTURE EXTENSION

8.1 CONCLUSION

In conclusion, drowsiness detection systems represent a critical advancement in enhancing road safety by addressing the risky issue of drowsy driving. These systems have the potential to save lives and prevent accidents, but they also come with their own set of limitations and areas for improvement. Drowsiness detection systems are not only relevant to the field of automotive safety but also have practical applications and implications for students and young adults. These systems offer several key takeaways for students.

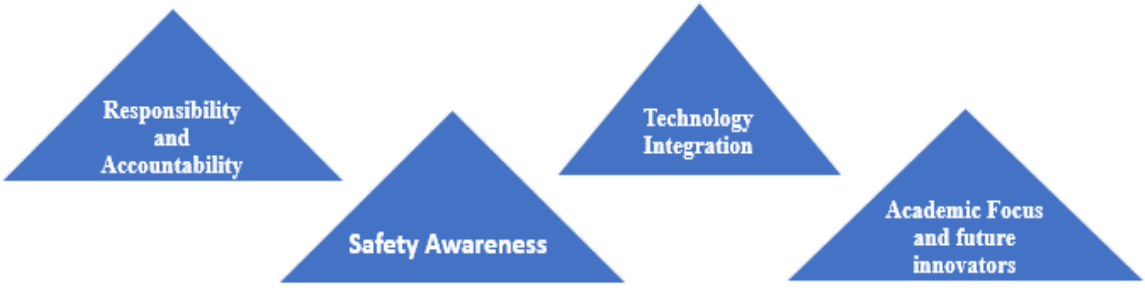


Fig 1.8 Key factors for drowsiness detection system

8.2 FUTURE SCOPE

1. Multimodal Sensing: Combining data from different apps can enhance the system's ability to detect drowsiness more reliably.
2. Machine Learning and AI: Advancements in ML & AI can be leveraged to develop more sophisticated algorithms that can adapt to individual and improve the overall performance.
3. Real-time Feedback: Future systems could provide real-time feedback to users when drowsiness is detected. This could include audio or visual alerts.
4. Long-term Monitoring: Expanding the capabilities of drowsiness detection systems to monitor driver fatigue over longer periods, such as during long road trips, can be beneficial.

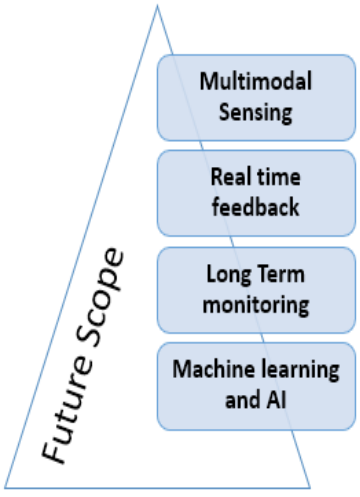


Fig 1.9 Future scope for drowsiness detection system

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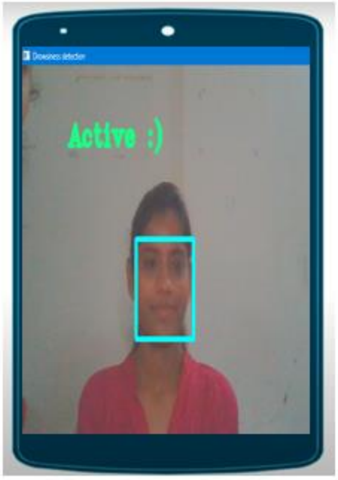
APPENDIX A(Screenshots)

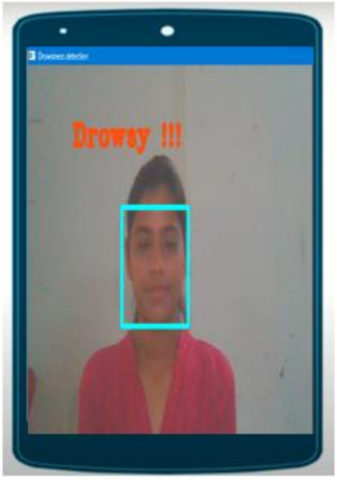
Representing drowsiness detection in which person is Active.

Representing drowsiness detection in which person is Drowsy.

Representing drowsiness detection in which person is Sleeping.

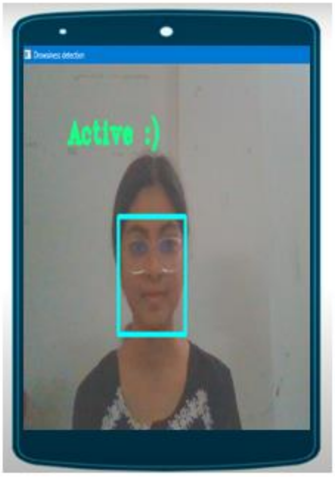


Representing drowsiness detection in which person is Active.



Representing drowsiness detection in which person is Drowsy.

Representing drowsiness detection in which person is Sleeping.



Representing drowsiness detection in which person is Active.

Representing drowsiness detection in which person is Drowsy.

Representing drowsiness detection in which person is Sleeping.

APPENDIX B