DRIVER DROWSINESS DETECTION & RESPONSE SYSTEM

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CONTENTS

INTRODUCTION

- The major aim of this project is to develop a Driver Drowsiness Detection and Response System (DDDRS) by **monitoring eye** movement.
- Utilizing **computer vision**, we continuously track driver eye movements in real-time.
- The software immediately identifies signs of drowsiness, providing timely alerts to maintain driver attentiveness and prevent potential accidents.

LITERATURE REVIEW

1. Risk assessment of road traffic accidents related to sleepiness during driving: a systematic review, Shehzad Saleem

- The review aims to assess the relationship between sleepiness during driving and road traffic accidents.
- A significant proportion of accidents worldwide is caused by driver drowsiness.
- Ensuring a minimum of six hours of sleep daily is essential to reduce the risk of drowsiness-related accidents.
- Concludes that to address drowsy driving accidents, it is vital to have a system that monitors drivers' sleep patterns and tracks their driving hours.

2. Prevalence of Motor Vehicle Crashes Involving Drowsy Drivers, United States, 2009 – 2013 , Brian C. Tefft

- A study conducted by the AAA Foundation for Traffic Safety discovered that in the years 1999-2008,
  - 13% of crashes resulting in hospitalization involved a drowsy driver.
  - 17% of fatal crashes involved a drowsy driver.
  - 7% of all crashes involved a drowsy driver.
- According to the National Highway Traffic Safety Administration (NHTSA),
  - approximately 228,000 crashes involve a drowsy driver
  - resulting in 109,000 injuries and 6,400 fatal crashes annually.

LITERATURE REVIEW (Cont..)

3. Drowsiness Detection and Warning System Using Python, Pratiksha Kolpe, Pratibha Kadam

- This paper presents the development of a drowsiness detection and warning system using Python.
- The system utilizes OpenCV for eye detection, extracting 68-face-landmarks from live input video captured by a webcam.
- The eye blinking ratio is calculated using Euclidean eye aspect ratio, which determines whether the eyes are open or closed.

4. Drowsy or Not? Early Drowsiness Detection utilizing Arduino Based on Electroencephalogram (EEG) Neuro-Signal, Jennalyn N. Mindoro

- Integration of a wireless and wearable Electroencephalogram (EEG) tool with an effective prediction model enabled the development of a driver sleepiness prediction system.
- The paper introduces a wearable EEG tool designed to automatically assess the driver's mental state.
- An experimental setup involving 10 participants incorporated an alarm system activated by brain activity fluctuations, facilitated by an Arduino module. A label of 1 indicates drowsy, while 0 indicates attentive states, achieving an accuracy of 93.33%.

LITERATURE REVIEW (Cont..)

5. Evaluation of Haar Cascade Classifiers Designed for Face Detection, R. Padilla, C. F. F. Costa Filho

- Important features within the human face can be utilized by vision-based automated systems for identification and recognition purposes.
- Researchers commonly employ the Viola-Jones framework to detect faces and objects within images.

6. Drowsiness detection using heart rate variability analysis based on microcontroller unit", Muhammad Hendra

- The article discusses the use of heart rate variability (HRV) analysis for detecting drowsiness in drivers, employing a microcontroller unit.
- HRV, which is derived from electrocardiogram intervals, reflects changes that occur during drowsiness, fatigue, and stress.
- The AD8232 module captures the electrocardiogram signal, which is processed within the microcontroller unit. Electrocardiogram data is recorded during simulated driving.
- HRV features are extracted, and a radial basis function neural network is used to classify between drowsy and normal states with an accuracy of 79.26%.

PROBLEM STATEMENT

The absence of reliable, real-time systems to detect and prevent driver drowsiness is a major challenge, leading to a high rate of road accidents.There lacks a dependable system for preventing road accidents.

DDDRS employs cutting-edge **live eye tracking** to detect drowsiness instantly, **alerting the driver** using LEDs and buzzers. **Integrated GPS** enables automatic **emergency messaging**, enhancing road safety by preventing drowsy driving accidents.

TECHNOLOGY STACK

- OpenCV
- Python Program
- Twilio API
- Arduino and NEO-6M GPS Module
- Git

SOFTWARE REQUIREMENTS SPECIFICATION

Functional Requirements:

Eye Tracking Interface

This interface utilizes computer vision technology to monitor the driver's eye movements consistently. It captures input data through a camera and analyzes it to detect signs of driver drowsiness.

Alert Mechanism

Upon detecting signs of drowsiness, the system activates alerts, comprising LED indicators and audible warnings.

Emergency Message

When the system surpasses the designated time limit threshold, it triggers an emergency message to preassigned emergency contacts.

SOFTWARE REQUIREMENTS SPECIFICATION (Cont..)

Non-Functional Requirements:

Performance: The system shall have low latency in detecting and responding to drowsiness, with a maximum delay of 1 second.

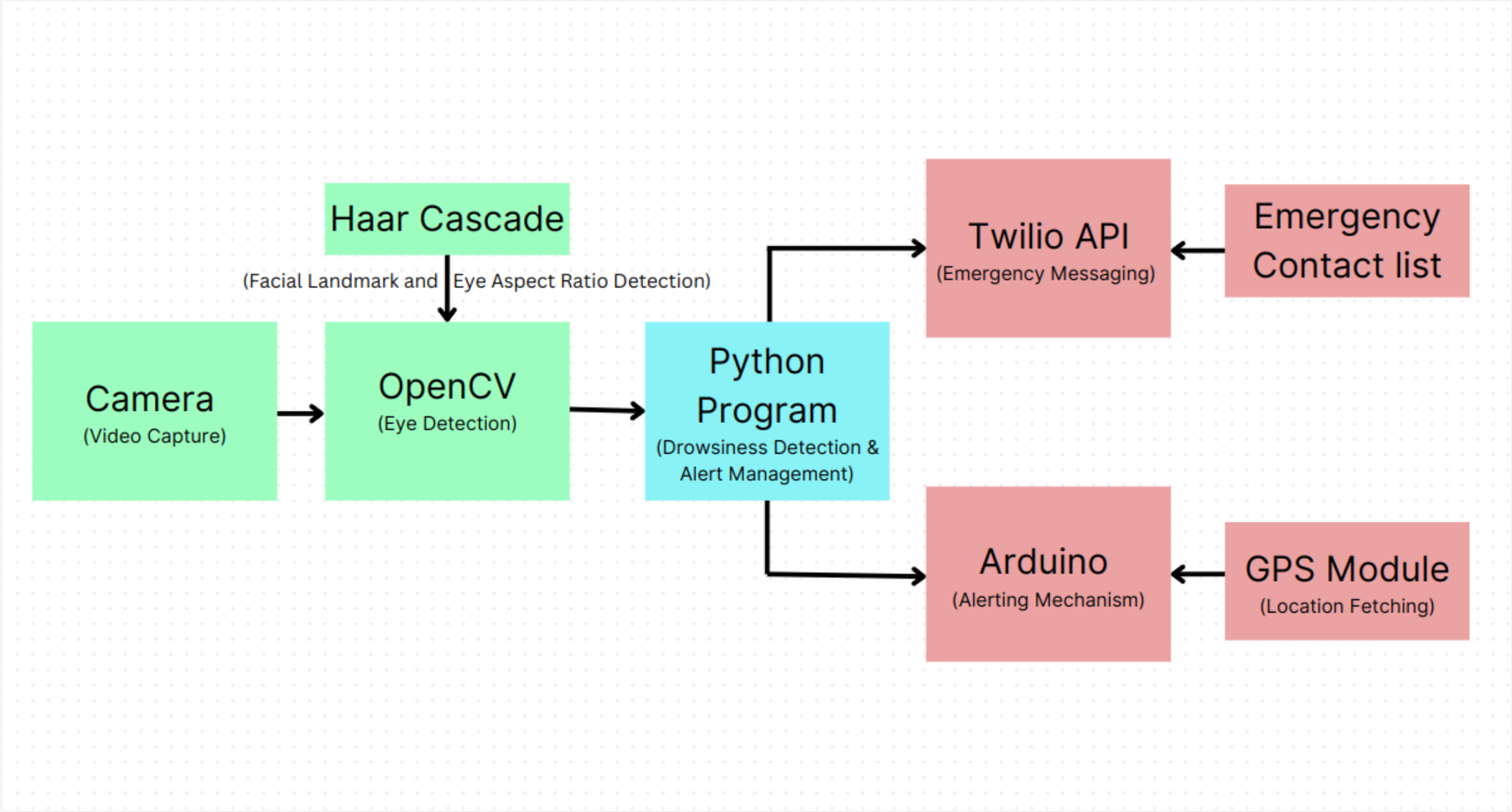
Reliability: The system shall operate reliably under varying lighting conditions and for users wearing glasses or contact lenses.

Scalability: The system architecture shall be designed to accommodate future enhancements or integrations.

Usability: The user interface shall be intuitive and easy to understand for drivers of varying technical expertise.

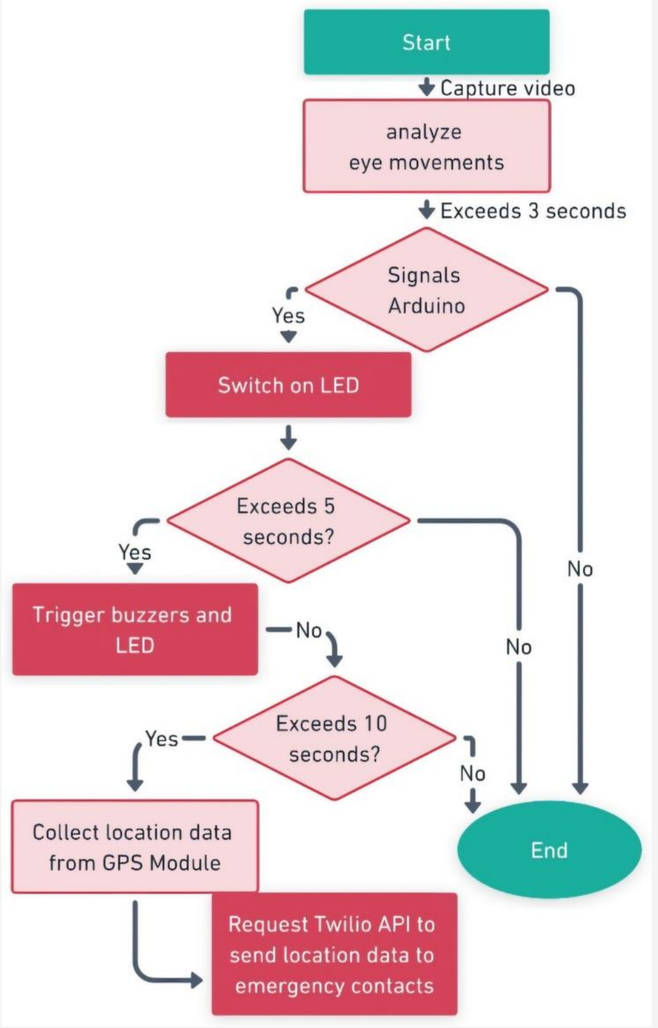
SYSTEM ARCHITECTURE DESIGN

Dataflow Diagram:



SYSTEM ARCHITECTURE DESIGN (Cont..)

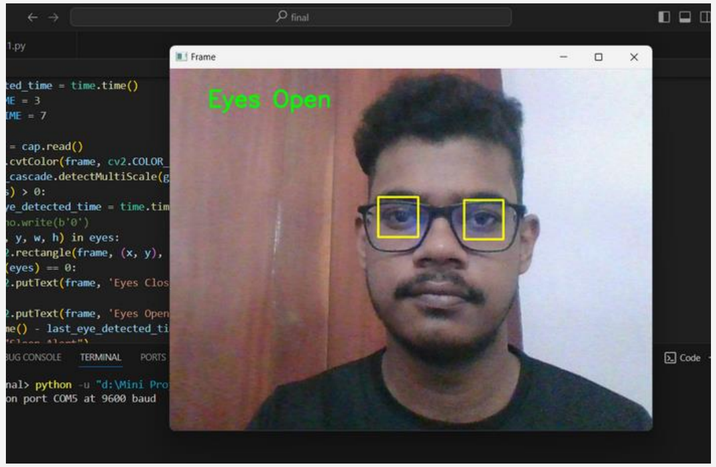
- The Eye Tracking Module **captures and analyzes** video for **eye movements**.
- **Signals Arduino** if eye closure exceeds 3 seconds.
- Arduino triggers **buzzer for alerts** over 5 seconds.
- Arduino requests **Twilio API** with location if over 10 seconds for **alert messages**.
- Eye Tracking Module and Arduino **exchange real-time data**.
- Arduino integrates with Twilio API for alerts.
- **GPS module** interfaces with Arduino for **current location** in alerts.



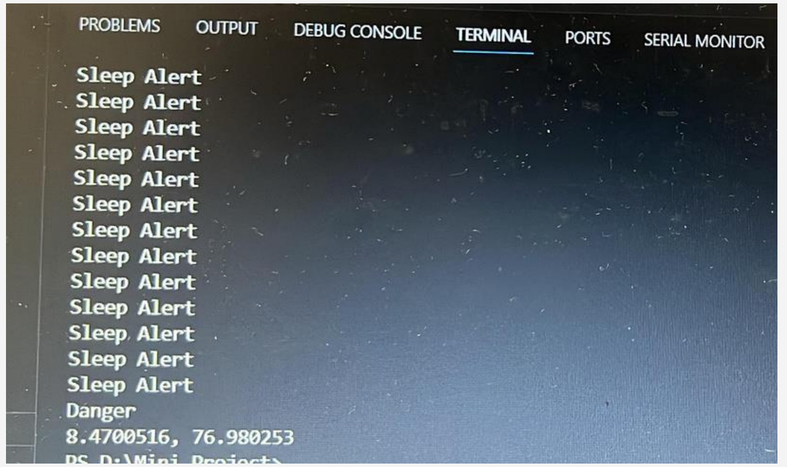
SYSTEM ARCHITECTURE DESIGN (Cont..)

- **OpenCV** captures real-time video from the camera, while the Haar Cascade Algorithm detects eyes using facial landmarks and the eye aspect ratio.
- The **Python Program** analyzes the eye closure duration to detect drowsiness.
- If drowsiness is detected, the Python Program initiates the **alerting mechanism** through the Arduino Module, which triggers physical alerts such as buzzer sounds.
- The **GPS Module** retrieves the current location and transmits the location details to the Python Program.
- The Python Program evaluates drowsiness constraints and, if they are met, forwards the location details to the **Twilio API** to trigger emergency alerts.
- The Twilio API processes the location data from the Python Program and sends **emergency messages** to preassigned contacts.

RESULT

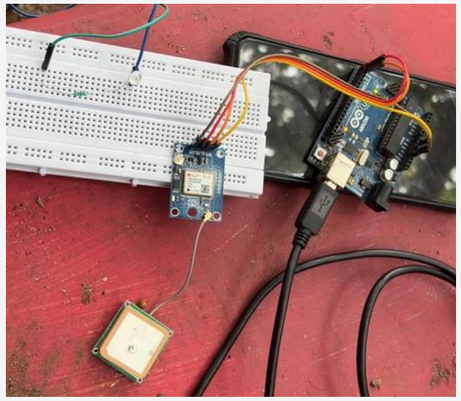


Eye detection utilizing OpenCV.

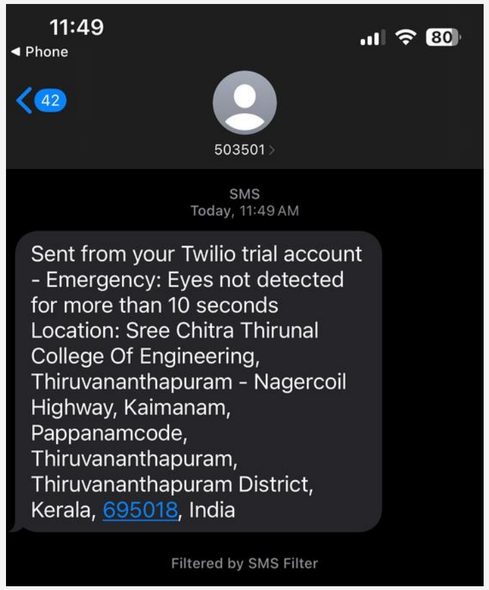


Detection of closed eyes triggers an alert mechanism upon reaching the specified time limit.

RESULT (Cont..)



Activation of the alert mechanism.



Receipt of alert messages by emergency contacts.

The system successfully detected drowsiness in real-time by analyzing eye closure duration and activated alerts and emergency procedures, including controlled vehicle stopping and alert messages with the vehicle's location.

CONCLUSION

- The DDDRS project **aimed to enhance road safety** by detecting and alerting drowsy drivers in real-time, using technologies like OpenCV, Python, Arduino, and Twilio.

- The **system accurately detected drowsiness through eye movement analysis**, promptly **alerting drivers** and initiating emergency procedures. It has the potential to reduce accidents caused by drowsy driving significantly.

- F**uture research** could focus on **reinforcement learning algorithms and hybrid control strategies** to enhance the system further.

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