**DRIVER ALERTNESS DETECTION**

## A PROJECT REPORT

*Submitted by,*

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***in partial fulfillment for the award of the degree of***

**BACHELOR OF TECHNOLOGY**

**IN**

**COMPUTER SCIENCE AND TECHNOLOGY**

**At**



**PRESIDENCY UNIVERSITY,**

**BENGALURU,**

**JANUARY 2025**

**PRESIDENCY UNIVERSITY**

**SCHOOL OF COMPUTER SCIENCE ENGINEERING**

**CERTIFICATE**

This is to certify that the Project report “DRIVER ALERTNESS DETECTION”being submitted by Harish Bhaskaran, Ruthwick S. S., Raghavendra Rakesh, Kavana S. K., bearing roll numbers 20211CDV0053, 20211CDV0068, 20211CDV0018, 20211CDV0065 in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in COMPUTER SCIENCE AND TECHNOLOGY 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 **“Driver Alertness Detection”** in partial fulfillment for the award of Degree of **Bachelor of Technology** in **Computer Science and Technology (DevOps)**, is a record of our own investigations carried under the guidance of **Mr. Rajan. T, Assistant 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**

Road safety is a vital issue, as driver fatigue and alcohol influence are major factors leading to vehicle collisions. This project showcases an affordable and effective Driver Alertness Detection System utilizing Raspberry Pi, designed to reduce these hazards by tracking driver fatigue and alcohol intake. The system utilizes a camera and sensor configuration to evaluate the driver's condition in real-time and provides alerts via a speaker to avert possible accidents.

The sleepiness detection system uses a camera connected to the Raspberry Pi to observe and evaluate the driver's facial characteristics and eye movements. Employing machine learning algorithms, the system detects indicators of fatigue, including extended eye closure, frequent yawning, and unusual head movements. At the same time, an alcohol detection system with a gas sensor (MQ-3) evaluates the driver's breath for alcohol content. If the detected alcohol level goes beyond the allowable limit, the system activates an alert.

When drowsiness or alcohol use is identified, the system triggers an audio alert via a speaker, urging the driver to respond appropriately. The Raspberry Pi serves as the main processing unit, combining input from the camera and sensors, executing the detection algorithms, and managing the alert system. The suggested system is compact, economical, and ideal for incorporation into both personal and commercial vehicles.

Through real-time tracking and instant notifications, the project seeks to lower road accidents resulting from impaired driving. This solution showcases the real-world use of IoT and AI technologies in enhancing transportation safety and promoting responsible driving habits.

*Keywords: Driver Alertness, Raspberry Pi, Drowsiness Detection, Alcohol Detection, Machine Learning, IoT, Road Safety, Embedded Systems.*

**ACKNOWLEDGEMENT**

First of all, we indebted to the **GOD ALMIGHTY** for giving me an opportunity to excel in our efforts to complete this project on time.

We express our sincere thanks to our respected dean **Dr. Md. Sameeruddin Khan**, Pro-VC, School of Engineering and Dean, School of Computer Science Engineering & Information Science, Presidency University for getting us permission to undergo the project.

We express our heartfelt gratitude to our beloved Associate Deans **Dr. Shakkeera L. and Dr. Mydhili Nair,** School of Computer Science Engineering & Information Science, Presidency University, and **Dr. Pravinthraja**, Head of the Department, School of Computer Science Engineering & Information Science, Presidency University, for rendering timely help in completing this project successfully.

We are greatly indebted to our guide **Mr. Rajan T., Assistant Professor** and Reviewer **Mr. Shankar J., Assistant Professor**, School of Computer Science Engineering & Information Science, Presidency University for his inspirational guidance, and valuable suggestions and for providing us a chance to express our technical capabilities in every respect for the completion of the project work.

We would like to convey our gratitude and heartfelt thanks to the PIP2001 Capstone Project Coordinators **Dr. Sampath A. K., Dr. Abdul Khadar A. and Mr. Md Zia Ur Rahman,** department Project Coordinators **Ms. Suma N. G.** and Git hub coordinator **Mr. Muthuraj.**

We thank our family and friends for the strong support and inspiration they have provided us in bringing out this project.

Harish Bhaskaran

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**CHAPTER-1**

**INTRODUCTION**

Operating a vehicle demands continuous attention and vigilance, as even a brief distraction can result in fatal accidents. Two major elements that hinder driving performance are driver fatigue and alcohol intake, which together contribute to a large number of traffic incidents worldwide. Exhaustion slows down reaction times and decision-making abilities, whereas alcohol hinders motor skills and judgment. Tackling these concerns has emerged as a priority in automotive safety, creating the necessity for systems capable of detecting and notifying drivers in real-time.



**Fig 1.1 DRIVER DROWSINESS DETECTION**

* 1. **NEED FOR DRIVER ALERTNESS SYSTEM**

Traffic accidents continue to be among the top causes of deaths around the globe, with tiredness of drivers and alcohol intoxication being significant factors. Research indicates that accidents due to fatigue make up a notable portion of collisions, particularly during extended driving or travel at night. Likewise, operating a vehicle while intoxicated significantly raises the chances of accidents because of slower reaction times and compromised decision-making. Although there are stringent regulations and awareness initiatives, the absence of real-time monitoring and enforcement has created a gap in guaranteeing road safety.

Below is a detailed analysis of the need for a **Driver Alertness Detection System**:

#### 1. ****Rising Incidence of Fatigue-Related Accidents****

* **Statistics**: Research shows that fatigue is responsible for 20-30% of traffic accidents worldwide, with increased incidence during long trips or nighttime driving.
* **Impact**: Tiredness hinders reaction speeds, diminishes alertness, and causes micro-sleeps, during which drivers briefly become unaware without being conscious of it.
* **Requirement**: A system capable of continuously observing the driver's condition and identifying early indications of sleepiness, like eye closure, yawning, or head nodding, is essential for averting accidents due to fatigue.

#### 2. ****Prevalence of Drunk Driving****

* **Alcohol-Related Accidents**: Driving under the influence continues to be a major factor in road incidents, as compromised decision-making and slow reactions present serious dangers.
* **Challenges in Enforcement**: Existing techniques, like breath tests at the roadside, are more reactive than preventive and frequently do not stop impaired drivers from accessing the roadway.
* **Requirement**: An onboard alcohol detection system that measures the driver's breath alcohol levels in real-time and promptly alerts them is crucial for reducing and preventing these risks.

#### 3. ****Limitations of Human Supervision****

* **Inability to Self-Assess**: Drivers might fail to notice their own tiredness or alcohol impairment until it’s too late.
* **Need for Automation**: A computerized system eliminates dependence on personal judgment and delivers an impartial evaluation of the driver's state.

#### 4. ****Economic and Social Impact****

* **Loss of Lives**: Traffic collisions result in the loss of thousands of lives each year, affecting families and communities.
* **Economic Losses**: Accidents lead to substantial financial burdens stemming from healthcare costs, damage to property, and decreased productivity.
* **Requirement**: Taking proactive safety precautions can assist in saving lives and alleviating the financial strain tied to road accidents.

#### 5. ****Technological Feasibility****

* **Advancements in IoT and AI**: The emergence of inexpensive micro-controllers such as Raspberry Pi, along with progress in image processing and sensor technologies, has rendered real-time driver monitoring systems practical and cost-effective.
* **Integration Potential**: Compact systems can be effortlessly incorporated into vehicles without major alterations, facilitating their broad acceptance.

#### 6. ****Regulatory and Social Push for Safety****

* **Government Regulations**: Growing focus on vehicle safety regulations and compulsory integration of driver assistance technologies in automobiles.
* **Social Awareness**: An increasing consumer demand for safety features in cars, particularly in high-risk areas.

The unification of these elements into one system promotes a proactive method for preventing accidents, merging technology with practicality. Utilizing IoT and embedded technologies, this solution tackles the increasing demand for smart safety systems that improve driver efficiency and diminish road dangers.

* 1. **SCOPE OF THE PROJECT**

The Raspberry Pi-based Driver Alertness Detection System aims to improve road safety by offering a real-time monitoring and notification system to identify driver fatigue and alcohol impairment. This system possesses a broad scope regarding its uses, features, and influence.

The following points outline the scope of the project:

#### ****Functional Scope****

#### ****Drowsiness Detection****:

* + Constantly observing the driver's facial characteristics with a camera.
  + Examination of eye-blink patterns, yawning rates, and head orientation employing machine learning techniques.
  + Instant notifications activated when extended eye closure or other fatigue indicators are identified.

**Alcohol Detection**:

* + Employ an MQ-3 gas sensor to assess the alcohol concentration in the driver’s breath.
  + Automatic identification of alcohol concentrations exceeding a specified limit.
  + Activation of sound warnings to notify the driver if alcohol is present.

**Alert System**:

* + A speaker emits loud, distinct signals to capture the driver’s focus.
  + Optional connection with vehicle control systems to reduce speed or immobilize the vehicle in critical situations.

#### 2. ****Technological Scope****

**Hardware**:

* + Employment of Raspberry Pi as the main processing unit.
  + Incorporation of a camera for facial observation and a gas detector for alcohol identification.
  + Compatibility with outside hardware, including speakers and possible vehicle control systems.

**Software**:

* + Deployment of machine learning algorithms for image analysis and behavioral assessment.
  + Creation of real-time data processing algorithms for smooth system functionality.
  + Intuitive interfaces for setup and oversight.

#### 3. ****Application Scope****

**Personal Vehicles**:

* + Improves driver safety during long trips or nighttime driving.
  + Ideal for private vehicle owners seeking an economical safety option.

**Commercial Vehicles**:

* + Beneficial for fleet managers to maintain driver awareness and adherence to safety standards.
  + Relevant in logistics, public transit, and ride-hailing services to avoid accidents.

**Public Sector**:

* + Incorporation into governmental programs for enhanced road safety.
  + Possible application in driving schools and training facilities to encourage safe driving behaviors.

#### 4. ****Geographical Scope****

* **Urban Areas**:
  + Reduces the chances of fatigue and alcohol-related incidents in busy areas.
* **Highways**:
  + Helps prevent accidents caused by drowsiness during long drives.
* **Global Adaptability**:
  + Aids in avoiding accidents resulting from fatigue on extended journeys.

#### 5. ****Future Development Scope****

**Enhanced Features**:

* + Incorporation of GPS for alerts based on location or emergency assistance.
  + Incorporation of heart rate and body temperature sensors for thorough health tracking.

**Vehicle Automation**:

* + Ability to incorporate with sophisticated driver-assistance systems (ADAS) and self-driving vehicles.

**Scalability**:

* + Implementation across various types of vehicles, from private automobiles to heavy-duty trucks.
  + Versatile design for incorporation into current automotive production methods.

**CHAPTER-2**

**LITERATURE REVIEW**

The literature review offers a summary of current studies and research related to Driver Alertness Detection. Its goal is to create a theoretical basis and pinpoint shortcomings that the present project seeks to tackle. This project seeks to enhance current knowledge, address research voids, and contribute to the progress of wireless black box technology and vehicle safety applications through a comprehensive literature review. The knowledge acquired from the literature review will guide the project's design, methodology, and execution, ensuring it matches contemporary research trends and industry requirements.

**2.1 EXISTING METHODS**

Current techniques for identifying driver alertness and alcohol influence utilize a range of technologies and strategies. To detect fatigue, a typical approach involves physiological monitoring, which employs sensors to track signals like heart rate, brain activity (EEG), or skin conductance. Although precise, these techniques are frequently invasive, necessitating the driver to use devices that may be uncomfortable on extended trips. A widely used method involves observing facial features, utilizing cameras and image processing algorithms to monitor eye closure, yawning, and head movements. Metrics such as PERCLOS (Percentage of Eye Closure) are commonly used to identify drowsiness, though these systems are affected by lighting conditions and obstacles like sunglasses. Behavioral approaches, including the examination of steering patterns and lane shifts, offer indirect yet valuable insights into driver fatigue; nonetheless, these methods are affected by external elements such as road conditions.

Breath analysis is the most commonly utilized technique for alcohol detection, using sensors such as the MQ-3 to gauge alcohol levels in a driver's breath. Although efficient, these systems may occasionally yield inaccurate readings because of other volatile substances present in the surroundings. Additional techniques involve sweat-based detection, which assesses alcohol concentrations via skin sweat, although they generally exhibit slower response rates. Hybrid systems that integrate various detection methods have been suggested to improve reliability, but they usually come with greater expenses and added complexity. These constraints underscore the necessity for a thorough, affordable, and unobtrusive system that can tackle both problems at once.

**2.2 RESEARCH ON FEW AFFILIATED PAPERS**

**[1] “Driver fatigue detection technology in active safety systems” by Qiong Wang, Huan Wang:**

The study titled “Driver Fatigue Detection Technology in Active Safety Systems” by Qiong Wang, Huan Wang, and their team explores the different technologies implemented to identify driver fatigue, which significantly contributes to road accidents. The document classifies detection systems into three primary methods. The initial aspect is observing the driver's condition, which encompasses physiological indicators like eye movements, head orientation, and facial expressions (for instance, mouth contour), to detect indications of fatigue or distraction.

The second method emphasizes driver performance, examining behaviors such as lane-keeping, braking habits, and the distance kept from other cars to identify variations that might indicate tiredness. The third method integrates both driver condition and performance metrics, providing a more comprehensive perspective and improving the precision of fatigue identification. These integrated techniques utilize cutting-edge technologies like infrared sensors, cameras, and eye-tracking systems, intending to offer prompt alerts to avoid accidents.

The article also examines various active safety systems in operation today, emphasizing the development of fatigue detection technologies, their efficacy, and their incorporation into contemporary vehicles to enhance road safety. By examining previous developments, the study provides important insights into the future trajectory of innovations in driver monitoring systems.

### Merits:

1. **Enhanced Safety**: The system lowers the chances of accidents due to drowsy driving through real-time monitoring and notifications.
2. **Advanced Detection Techniques**: By employing physiological indicators (such as EEG, EOG) and behavioral measures (like facial recognition, eye tracking), the system attains high precision in determining fatigue levels.
3. **Integration with Active Safety Systems**: The technology is effortlessly integrated with other vehicle safety features, including automatic braking and lane departure alerts, forming a comprehensive safety system.
4. **Non-Invasive Monitoring**: Vision-based methods, such as observing blinking or head movements, are non-intrusive and driver-friendly, enhancing user acceptance.

### Demerits:

1. **Complexity of Implementation**: The system needs advanced hardware (sensors, cameras) and software (machine learning algorithms), resulting in elevated production expenses.
2. **Potential for False Positives/Negatives**: Differences in personal driving habits, surrounding conditions, and physical states can lead to incorrect detections, which may compromise dependability.
3. **Privacy Concerns**: Ongoing surveillance of facial characteristics and physiological indicators could lead to privacy concerns, hindering user acceptance.

### Challenges:

1. **Environmental Interference**: Illumination conditions, reflections, and road vibrations can influence the precision of visual monitoring systems.
2. **User Adaptation**: Drivers might consider some monitoring technologies to be invasive or unneeded, particularly if they experience frequent false alarms.
3. **Data Processing in Real-Time**: The substantial computational requirements for real-time processing of extensive video and physiological data present challenges for deployment in vehicles with limited resources.

### Limitations:

1. **Focus on Single Driver**: The system is typically adjusted for a single driver, reducing its efficiency in shared or commercial vehicles.
2. **Limited Scope of Physiological Monitoring**: Although reliable, physiological measures such as EEG are not as practical for widespread use because they require specialized devices (e.g., headsets).
3. **Dependency on Infrastructure**: The system needs dependable power and data connections, which can be difficult in older cars or in regions with inadequate infrastructure.

**[2] “Drivers’ Drowsiness Detection and Warning Systems for Critical Infrastructures” by Ioana-Raluca Adochiei:**

The article "Drivers’ Drowsiness Detection and Warning Systems for Critical Infrastructures" authored by Ioana-Raluca Adochiei and her colleagues emphasizes the creation and execution of sophisticated systems for identifying and addressing driver fatigue, particularly in essential transportation infrastructures. It highlights the serious effects of drowsiness, such as accidents and interruptions to essential services, and offers strategies to reduce these risks. The research emphasizes the application of behavioral and physiological signs to track fatigue in real-time. Behavioral techniques involve monitoring head movements, blink frequencies, and gaze orientation through cameras and sensors. Physiological techniques evaluate indicators like heart rate and skin conductivity, offering enhanced insights into fatigue levels. These detection techniques frequently utilize non-invasive technologies like infrared imaging and machine learning models to prioritize driver comfort without compromising accuracy.

A significant advancement addressed is the incorporation of drowsiness detection systems with communication networks in automobiles, allowing alerts to be sent to drivers, surrounding vehicles, or control centers. This integration seeks to improve safety by not just notifying the driver but also triggering automated actions, like lowering vehicle speed or engaging autopilot.

The document highlights the significance of scalability and adaptability of these systems for use in different transportation sectors, including road networks, railways, and air traffic systems. It examines existing challenges, such as false alerts, environmental factors impacting sensor precision, and deployment expenses, presenting possible solutions for enhancement via sophisticated algorithms and improved sensor fusion methods.

By connecting drowsiness detection systems with larger critical infrastructure oversight, the research anticipates a future where fatigue-related accidents are greatly diminished, guaranteeing safer and more dependable transportation networks. This all-encompassing strategy fuses technology, infrastructure, and immediate interventions, paving the way for the upcoming generation of proactive safety systems.

### Merits:

1. **Real-Time Monitoring**: The system utilizes sophisticated sensors and algorithms to constantly monitor driver attention, offering instant alerts to avert accidents.
2. **Versatility**: The method combines various factors, including eye movements, facial expressions, and physiological signals, guaranteeing reliability under different conditions and driver behaviors.
3. **Preventive Capability**: By sending prompt warnings, the system might diminish accidents resulting from driver tiredness, especially in high-risk settings such as industrial vehicles and long-distance trucking.
4. **Scalability for Critical Infrastructures**: The model is versatile for extensive deployment in systems such as fleet management or public transit, guaranteeing broad safety improvements.

### Demerits:

1. **High Implementation Costs**: The requirement for specific sensors (such as cameras and EEG devices) and significant computational resources renders the system costly to deploy, especially in budget-constrained situations.
2. **User Acceptance Issues**: Drivers might view ongoing surveillance as invasive or unwarranted, particularly if the system often triggers false alerts.
3. **Technological Dependence**: The system's performance greatly depends on sophisticated technology and internet connectivity, which might not be consistently accessible or dependable.

### Challenges:

1. **Environmental Variability**: The system's effectiveness may be affected by external elements like poor lighting, vibrations, or severe weather conditions.
2. **Data Processing and Integration**: Merging data from various sensors in real time demands significant computational efficiency and reliable algorithms, presenting engineering difficulties.
3. **Individual Variations**: Drivers display varying levels of fatigue and behaviors, complicating the creation of a universal detection model.
4. **Privacy Concerns**: Ongoing surveillance brings up ethical concerns regarding data privacy and driver consent, which need to be resolved for wider acceptance.

### Limitations:

1. **Limited to Drowsiness**: Although successful at identifying drowsiness, the system fails to tackle other impairments such as alcohol or drug use, constraining its range.
2. **Performance in Complex Scenarios**: The system might face challenges in shared cars or situations with multiple drivers, where calibration for just one user doesn't suffice.
3. **Dependence on Pre-Defined Thresholds**: Strict thresholds for detecting drowsiness might not suit every driver, resulting in incorrect positives or negatives.
4. **Infrastructure Requirements**: Essential infrastructures might need major enhancements to facilitate the implementation of these systems, which might not be practical in every area.

**[3] “Smart Vehicle Safety System with Alcohol and Drowsiness Detection, Eye Tracking, and SMS Alert System” by Earl Levi P. Parel, Gerzon Jil Y. Miranda, Ernesto Vergara:**

The study titled "Smart Vehicle Safety System with Alcohol and Drowsiness Detection, Eye Tracking, and SMS Alert System" authored by Earl Levi P. Parel, Gerzon Jil Y. Miranda, and Ernesto Vergara presents a cohesive safety framework aimed at tackling two major factors contributing to road incidents: driver impairment due to alcohol and fatigue. The system utilizes an amalgamation of real-time monitoring tools, safety features, and alert systems to improve road safety and avert accidents.

The alcohol sensing element employs an MQ3 sensor, which can detect alcohol in the driver's breath. If the identified alcohol concentration exceeds a specified threshold, the car's ignition system is rendered inoperative, stopping the driver from controlling the vehicle while impaired. To detect drowsiness, the system employs an Eye Aspect Ratio (EAR) algorithm, which uses a camera to track blinking frequency and the length of eye closures. This approach successfully detects initial indicators of exhaustion.

Upon detecting drowsiness or alcohol impairment, the system triggers various response mechanisms. The vehicle produces audible warnings for the driver, and emergency contacts receive an SMS notification. This function guarantees that outside parties are notified and can act accordingly during an emergency.

The document highlights the significance of utilizing affordable, efficient sensors and hardware parts, ensuring the system's practicality for widespread implementation. The incorporation of Internet of Things (IoT) features improves its performance by allowing for remote surveillance and interaction. This all-encompassing strategy offers a strong answer for enhancing driver safety and minimizing accidents resulting from impaired driving.

### Merits:

1. **Integrated Safety Features**: Integrates alcohol detection, drowsiness tracking, eye monitoring, and an SMS alert system for all-encompassing safety.
2. **Immediate Alert Mechanisms**: Delivers instant alerts to emergency contacts via SMS, improving response time after incidents.
3. **Prevention-Oriented Design**: Stops vehicle operation by impaired or sleepy drivers, thereby significantly lowering accident risks.
4. **User-Centric**: Created to guarantee driver safety without requiring advanced technical expertise.

### Demerits:

1. **Cost of Implementation**: Integrating technologies such as eye tracking and GSM modules raises expenses, rendering it less practical for budget-friendly vehicles.
2. **Technical Complexity**: The combination of various technologies might encounter reliability challenges, particularly in environments with limited resources.
3. **False Positives**: The system might generate false alerts, possibly annoying users.

### Challenges:

1. **Environmental Factors**: Inadequate lighting, vibrations, or adverse weather conditions can impact the precision of eye-tracking and the dependability of the system.
2. **Driver Behavior Variability**: Variations in driver vigilance and alcohol tolerance make it challenging to establish universal standard thresholds.
3. **Connectivity Dependence**: SMS alert functions depend on stable network access, which might not be assured in isolated regions.

### Limitations:

1. **Focus on Specific Scenarios**: Does not consider other issues such as substance abuse or mental distractions.
2. **Limited Emergency Handling**: Although alerting is efficient, there is little conversation regarding the integration of emergency management after an accident.
3. **Sensor and Calibration Needs**: Frequent sensor calibration is essential for ongoing precision, raising maintenance requirements.

**[4] “An Integrated Framework for Driver Drowsiness Detection and Alcohol Intoxication using Machine Learning” by Renju Rachel Varghese:**

The article "An Integrated Framework for Driver Drowsiness Detection and Alcohol Intoxication Using Machine Learning" authored by Renju Rachel Varghese creates a thorough system that combines machine learning methods and sensor technologies to address road incidents resulting from impaired driving. The system emphasizes immediate identification of sleepiness and alcohol impairment via two integrated subsystems.

The alcohol detection module employs an MQ-3 gas sensor to assess alcohol levels in the driver's breath. This sensor is connected to a micro-controller that analyzes data and determines if the alcohol level surpasses a predetermined limit. When intoxication is detected, the system promptly issues an alert and prevents the vehicle from being started, thereby immobilizing it to guarantee safety.

To detect drowsiness, the system uses a webcam placed on the vehicle dashboard to observe the driver's facial expressions and eye movements in real time. It utilizes machine learning techniques like Support Vector Machines (SVM) and Histogram of Oriented Gradients (HOG) to evaluate facial landmarks, emphasizing important measures such as the Eye Aspect Ratio (EAR). Extended eye closure or less frequent blinking indicates drowsiness, leading the system to notify the driver with alerts.

The system combines the detection modules with hardware elements such as Raspberry Pi 3 and Arduino Uno, facilitating effective data processing and smooth functionality. Engineered for scalability, the system preserves accuracy while remaining economical and feasible for broad use. Experimental findings show that the framework attains high precision in identifying alcohol impairment and drowsiness, making a substantial impact on road safety by reducing accidents caused by impaired drivers.

**Merits:**

1. **Dual Detection:** The system successfully integrates alcohol detection and drowsiness monitoring, addressing two significant factors contributing to road accidents.
2. **Cost-Effectiveness:** It employs inexpensive parts such as the MQ-3 alcohol sensor, Raspberry Pi, and Arduino UNO, ensuring it is budget-friendly for broad implementation.
3. **Accuracy:** Implementing Support Vector Machines (SVM) alongside Histogram of Oriented Gradients (HOG) for extracting facial features results in an 86% accuracy rate in identifying drowsiness.
4. **Real-Time Processing:** The system delivers instant feedback, notifying the driver of possible hazards as they occur.

**Demerits:**

1. **Environmental Sensitivity:** The system's precision may decline in situations such as inadequate lighting or when the driver has sunglasses on.
2. **Dependence on Cameras:** Dependence on webcam-facilitated facial recognition could be restricted by equipment robustness and situational limitations.

**Challenges:**

1. **Scalability:** Incorporating this system across different vehicle models while maintaining reliable performance is complicated.
2. **False Positives/Negatives:** Identifying drowsiness by analyzing facial features might result in inaccuracies, especially if the driver’s posture or characteristics differ from the usual.
3. **Hardware Integration:** Facilitating uninterrupted communication between sensors and machine learning models on embedded systems such as Raspberry Pi presents a technical challenge.

**Limitations:**

1. **Limited Physiological Monitoring:** The system mainly depends on external observations (facial traits) and excludes physiological information such as heart rate or EEG for improved precision.
2. **Weather and Road Conditions:** The system's performance can be affected by external influences like glare, vibrations, or reflections.

**[5] “Drowsiness Alert, Alcohol Detect and Collision Control for Vehicle Acceleration” by Ranjit Patnaik:**

The article "Drowsiness Alert, Alcohol Detection, and Collision Control for Vehicle Acceleration" by Ranjit Patnaik and his team introduces a novel method for improving road safety through real-time monitoring and intervention systems within vehicles. The system combines various features, such as drowsiness identification, alcohol monitoring, and collision prevention tools, to tackle the key factors behind road accidents—driver fatigue, impairment, and slow reactions.

The drowsiness detection system employs sophisticated computer vision and machine learning methods to observe driver actions. The system assesses a driver's fatigue by evaluating facial signals like the length of eye closure and head movement patterns. When drowsiness is noticed, the system quickly provides alerts to notify the driver.

The alcohol detection feature includes breath sensors or near-field alcohol detectors built into the vehicle's dashboard. These sensors evaluate the driver’s breath or proximity measurements to assess alcohol levels. If the identified levels surpass legal limits, the system stops the vehicle from starting.

Collision control and acceleration management require real-time sensor integration, employing ultrasonic sensors, cameras, and accelerometers to observe the vehicle’s environment. This subsystem forecasts possible collisions and takes action by automatically modifying vehicle speed or applying brakes to prevent accidents.

The combination of these systems depends on strong machine learning algorithms that consistently enhance through practical data inputs. This comprehensive system is aimed at functioning in real-time, delivering swift reactions to guarantee the safety of the driver and other road users. The research shows the capability of these integrated systems to greatly lower accidents resulting from human mistakes, highlighting their significance for upcoming transportation networks.

### Merits:

1. **Comprehensive Monitoring:** The system combines various detection methods, encompassing drowsiness via eye motion assessment and alcohol concentration through breath sensors, providing a comprehensive approach to driver safety.
2. **Collision Avoidance:** The system reduces the likelihood of accidents caused by compromised driver reactions by regulating vehicle acceleration according to real-time data.
3. **Automation and Alerts:** The addition of automated engine lock functionalities and instant notifications improves reaction and action in emergency scenarios.
4. **Practical Application:** The design aims to tackle frequent causes of road accidents, making it very pertinent to actual safety issues.

### Demerits:

1. **Dependence on Sensors:** The system's accuracy and reliability are strongly reliant on sensor performance, which may deteriorate over time or be affected by external conditions.
2. **False Positives:** Slight variations in behavior, like momentary eye blinks or external conditions influencing alcohol detectors, can cause unwarranted alerts or responses.
3. **Complexity:** The combination of various systems introduces complications to setup and upkeep, which could raise expenses.

### Challenges:

1. **Real-time Performance:** Achieving quick response times for real-time detection of drowsiness and alcohol is a significant technical challenge.
2. **Environmental Sensitivity:** Changes in light, temperature, and other external conditions can affect sensor efficiency, especially in facial and breath detection systems.
3. **Scalability:** Customizing the system for various vehicle models or areas with differing regulations and driving conditions necessitates substantial adaptation.
4. **User Acceptance:** Drivers might view the system as invasive or could oppose features such as engine locking, particularly in instances of false alarms.

### Limitations:

1. **Intrusiveness:** Non-invasive techniques might lower precision, whereas invasive methods may divert or upset the driver.
2. **Dependency on Power Supply:** Ongoing operation demands dependable vehicle power, which could restrict its effectiveness in vehicles with power limitations.
3. **Data Handling:** Gathering and handling sensitive data such as alcohol levels and driver conduct raises privacy issues and requires strong data protection protocols.

**[6] “Driver Drowsiness Detection and Alerting Model for Minimizing Road Accidents” by R. Sathya; D. Sai Surya Harsha:**

The research article "Driver Drowsiness Detection and Alerting Model for Minimizing Road Accidents" authored by R. Sathya and D. Sai Surya Harsha presents a strong system aimed at addressing the risks of driver exhaustion through the application of machine learning and computer vision techniques. It utilizes facial recognition and live tracking of the Eye Aspect Ratio (EAR) to detect extended eye closures and atypical blinking patterns—crucial signs of sleepiness.

At the heart of the system is a Raspberry Pi configuration fitted with a camera module that records real-time video footage of the driver's face. A traditional neural network (CNN) examines these images to assess facial features. Upon detecting signs of drowsiness, the system triggers a sound alarm, promptly notifying the driver to regain focus. Furthermore, the model includes IoT connectivity, allowing it to transmit real-time notifications, such as driver condition and whereabouts, to designated emergency contacts.

The study highlights the cost-effectiveness and scalability of the system, utilizing minimal hardware for broad applicability. Thorough testing showed the model's significant accuracy in identifying drowsiness in different lighting and environmental situations. By tackling one of the key factors behind road accidents, the model demonstrates great promise for adoption in contemporary vehicles, setting the stage for improved road safety and lower accident rates.

### Merits:

1. **Non-invasive Approach:** The system employs image processing and machine learning for analyzing eyes and faces, allowing drivers to stay relaxed while driving.
2. **High Accuracy:** Methods such as Active Appearance Models and SVM offer strong classification of drowsiness states, improving detection dependability.
3. **Real-time Application:** The system functions effectively in different lighting situations, providing reliable performance in numerous settings.

### Demerits:

1. **Sensor Dependency:** The quality of results largely relies on the camera's quality and environmental conditions such as lighting and vibrations.
2. **False Positives:** Slight facial expressions not associated with sleepiness can cause unnecessary notifications.
3. **High Computational Requirements:** The system demands substantial processing capabilities, raising expenses for wider implementation.

### Challenges:

1. **Environmental Adaptation:** Addressing issues such as glare, shadows, and reflections on the fly.
2. **User Acceptance:** Making sure that drivers do not view the alerts as bothersome or disruptive
3. **Scalability:** Tailoring the system for various vehicles and driver profiles while maintaining accuracy.

### Limitations:

1. **Limited Dataset Diversity:** The model's effectiveness may decline with distinctive driver behaviors or physiologies absent from the training datasets.
2. **Data Privacy:** Ongoing facial monitoring raises issues related to ethics and privacy.
3. **Integration with Existing Systems:** Integrating drowsiness detection with sophisticated driving assistance systems necessitates flawless compatibility.

**[7] “Driver Fatigue Detection Using TGAM EEG Signal Processing Module” by Liang-Sian Lin:**

### The article "Driver Fatigue Detection Using TGAM EEG Signal Processing Module" authored by Liang-Sian Lin introduces a novel method for tackling driver fatigue, which is a major factor in traffic accidents. The system utilizes a ThinkGear ASIC Module (TGAM) to analyse EEG signals, delivering immediate insights into the driver's mental condition. This module can record essential brainwave activities—like alpha, beta, and theta waves—to assess degrees of alertness and sleepiness.

### The research incorporates the TGAM module into a larger system that utilizes Internet of Things (IoT) technology. It features environmental sensors such as SGP30 for detecting carbon dioxide and PMS5003 for tracking particulate matter (PM10), guaranteeing that the driver's physiological status and environmental factors are taken into account. By linking EEG data with these environmental elements, the model improves the accuracy of drowsiness detection.

### When signs of tiredness are identified, the system activates warnings to notify the driver and may also initiate automatic safety features, like reducing the vehicle's speed. The writers emphasize the minimal power usage and affordability of this EEG-driven approach, which is non-invasive and very appropriate for practical applications. The combination of sophisticated signal processing and IoT technologies highlights its promise for future intelligent transportation systems, focusing on decreasing accidents and enhancing road safety. The approach also shows scalability for incorporation into commercial vehicles, positioning it as a progressive addition to intelligent transport systems.

### Merits:

1. **Non-invasive Detection:** The system operates non-invasively, employing EEG to track brain activity without requiring physical sensors on the body, which improves user comfort.
2. **Accurate Fatigue Detection:** TGAM technology enables real-time tracking of brain waves, delivering accurate fatigue identification, essential for accident prevention.
3. **Integration with IoT:** The system works with IoT technology, enabling ongoing monitoring and notification of fatigue levels, enhancing safety in real-time.

### Demerits:

1. **Complex Setup:** The system needs specific hardware, such as the TGAM module, which can raise the total complexity and expense of deployment.
2. **Limited by Hardware:** The precision of EEG-based fatigue identification may rely on sensor quality and environmental factors, like noise interference or signal deterioration.
3. **Processing Power:** EEG signal analysis demands substantial computational resources, needing adequate processing capability to efficiently handle real-time data.

### Challenges:

1. **Signal Interpretation:** Obtaining clear, actionable information from EEG signals in real-time can be difficult due to interference, especially when the system is utilized in moving vehicles experiencing vibrations.
2. **False Positives and Negatives:** The system may have difficulty differentiating drowsiness from other cognitive conditions or actions, which could result in false alarms or overlooked detections.
3. **Driver Comfort and Adoption:** Constant EEG monitoring might lead to privacy issues and could be unsettling for certain drivers, possibly impacting adoption levels.

### Limitations:

1. **Cost of Implementation:** Sophisticated EEG-based systems are expensive and necessitate specialized tools, restricting their availability for widespread use in regular vehicles.
2. **Sensitivity to External Conditions:** Factors such as lighting, temperature, and vibrations from vehicles can disrupt EEG readings, decreasing the reliability of the system.
3. **Dependence on Calibration:** The system needs accurate calibration for every single driver, and differences in EEG signals among various users could influence its overall precision.

**[8] “Driver Fatigue Detection Based on Eye Tracking” by Mandalapu Sarada Devi:**

The paper titled "Driver Fatigue Detection Using Eye Tracking," written by Mandalapu Sarada Devi, examines a vision-based system designed to address the critical issue of driver fatigue, which is a significant contributor to roadway accidents. The technique utilizes a non-invasive camera setup to monitor and evaluate the facial features of the driver, with a specific focus on the eyes. Employing the Viola-Jones algorithm for face recognition and dynamic template matching techniques for eye tracking, the system ensures accurate detection of driver fatigue in real-time.

The procedure begins by detecting faces using Haar-like features, which are rectangular forms that rely on variations in pixel intensity. Once the face is identified, the algorithm isolates the upper part of the face to locate the eyes. Eye tracking is achieved by analyzing the number of black and white pixels in segmented areas of the eye. A higher count of black pixels implies shut eyes, signaling potential sleepiness. This difference between open and closed eyes forms the basis for the fatigue detection system.

The system employs advanced image processing techniques, such as integral image calculations for faster processing and stage cascading to eliminate false positives in detection. The model also employs the PERCLOS metric (proportion of eye closure over a specified time) to enhance accuracy. The experimental setup converts video streams into individual frames, enabling eye state monitoring on a frame-by-frame level.

The system can prevent accidents by delivering timely alerts when fatigue is detected. This research stands out for its simplicity, computational efficiency, and ability to operate in various lighting conditions, making it highly appropriate for integration into vehicles as a safety feature. However, disadvantages such as reduced effectiveness in extreme conditions (e.g., bright sunlight or low light) are acknowledged, paving the way for future enhancements. **Merits**:

1. Non-invasive, meaning it requires no physical contact with the driver.
2. Utilizes cost-effective technology like basic cameras and image processing techniques.
3. Can be incorporated into existing vehicles with minor hardware modifications.

**Demerits**:

1. Performance may decline in low light conditions or if the driver has on glasses or sunglasses.
2. It may face challenges in distinguishing a quick blink from an extended eye shut.

**Challenges**:

1. Ensuring dependability across different environments, including a range of lighting and weather conditions.
2. Tackling false positives and false negatives, especially in cases where eye movements are minimized or obstructed.

**Limitations**:

1. The accuracy of the system can be influenced by poor image quality or if the driver's face is obscured.
2. It may require regular recalibration in varying settings, such as altered head positions.

**[9] “Drowsiness And Alcohol Detection with Engine Locking” by Avagaddi Prasad:**

The study titled "Drowsiness and Alcohol Detection with Engine Locking" conducted by Avagaddi Prasad emphasizes a unified safety system aimed at reducing hazards linked to impaired driving. The system mainly emphasizes tracking alcohol concentrations and driver vigilance to avert accidents resulting from sleepy or impaired driving. This system employs an MQ3 alcohol sensor along with a drowsiness detection feature to assess the driver's state in real-time.

Upon sensing alcohol in the driver's breath or indications of fatigue (such as extended eyelid closure or reduced focus), the system initiates a safety protocol: the engine is immobilized to prevent the vehicle from being driven. The micro-controller, usually an Arduino or a comparable platform, handles inputs from these sensors and manages the ignition relay. If alcohol concentrations or sleepiness surpass established limits, the relay disconnects the ignition circuit, thus rendering the engine inoperable. This system guarantees safety by successfully stopping impaired persons from operating a vehicle.

Extra features consist of a GSM module that transmits SMS notifications to specified contacts, like relatives or officials, along with a GPS module that offers live location tracking. This allows for a quick reaction in urgent circumstances. The system incorporates an LCD display to offer visual notifications and indicators, improving its user interface.

Future improvements suggested for this system involve incorporating IoT technologies for enhanced connectivity, implementing biometric verification for permitted vehicle use, and utilizing sophisticated alcohol detection techniques, like non-invasive sensors placed in the steering wheel. It is also proposed to incorporate AI-driven analysis for tracking driver behavior, which may enhance the system's accuracy and effectiveness.

### Merits:

1. **Safety**: The system identifies both alcohol impairment and driver fatigue, thereby preventing hazardous driving actions and minimizing accidents related to these issues.
2. **Real-time Alerts**: The system delivers instant alerts to authorized personnel via GSM modules, guaranteeing swift responses when a driver is tired or impaired.
3. **Automation**: The engine locking system automatically stops the vehicle from starting if alcohol is sensed, minimizing human mistakes and involvement.
4. **Cost-effective**: The system is a cost-effective solution due to the utilization of easily accessible parts like Raspberry Pi, alcohol sensors, and GSM modules, in comparison to pricier options.

### Demerits:

1. **Reliability Issues**: Alcohol sensors might not consistently deliver precise readings, especially in situations where the driver has ingested a minimal amount of alcohol that does not affect their ability to drive.
2. **Privacy Concerns**: Ongoing surveillance, such as facial recognition and eye tracking, may lead to privacy concerns, particularly if video recordings are transmitted or saved for examination.
3. **Over-sensitivity**: The system could deactivate the engine too early due to incorrect sensor information, stopping the vehicle from starting without reason.

### Challenges:

1. **Sensor Calibration**: A major challenge is ensuring that the alcohol sensor and eye-tracking system are properly calibrated to deliver precise measurements. Improperly calibrated sensors could result in erroneous conclusions regarding a driver's state.
2. **Environmental Factors**: Elements like inadequate lighting or external disruptions may affect the functionality of the eye-tracking and alcohol sensors, possibly resulting in incorrect negatives or positives.
3. **System Integration**: Elements like inadequate lighting or external disruptions may affect the functionality of the eye-tracking and alcohol sensors, possibly resulting in incorrect negatives or positives.

### Limitations:

1. **Limited Scope**: Although the system is proficient in identifying alcohol and fatigue, it fails to consider other impairments, like drug consumption or health issues, that may impact driving capabilities.
2. **False Positives/Negatives**: The system may find it difficult to differentiate between tiredness and other actions (such as blinking due to fatigue or eye discomfort), resulting in incorrect positives. In the same way, false negatives may occur if a driver successfully conceals signs of impairment.
3. **Implementation Cost**: Although it is more economical than certain alternatives, the incorporation of sensors, real-time monitoring, and locking systems may still be costly for widespread use in older cars.​

**[10] “Alcohol Detection, Facial Recognition and Gesture Enabled Multimedia Control System” by Ravikiran V:**

### The article “Alcohol Detection, Facial Recognition and Gesture Enabled Multimedia Control System” by Ravikiran V examines a cohesive strategy for improving vehicle safety and user engagement via sophisticated embedded systems. The system features alcohol detection, facial recognition, and gesture-based media control to enhance driving safety and usability.

### The alcohol detection system is created to recognize alcohol in the driver’s breath through a sensor integrated into the vehicle. If alcohol is identified, the system shuts down the engine to avoid drunk driving. At the same time, it can send a notification to designated emergency contacts, sharing the vehicle's location via a GSM module to facilitate prompt assistance.

### Facial recognition technology is used to verify the driver's identity prior to the vehicle's ignition, making certain that only permitted individuals can operate the car. This action lowers the chances of theft or improper use. Moreover, gesture recognition offers a hands-free multimedia control system, allowing drivers to modify settings such as music or navigation while staying focused on the road.

### The system utilizes micro-controllers and sensors to efficiently process input data and react instantly. The system includes night vision cameras, LCD screens for notifications, and buzzers, forming an intuitive and effective safety solution. The suggested approach focuses on minimizing incidents triggered by alcohol use and distractions, establishing it as a strong framework for upcoming smart vehicle technologies.

### Merits:

1. **Enhanced Security**: By combining alcohol detection with facial recognition, the system greatly improves vehicle security, allowing only authorized and sober persons to drive the vehicle.
2. **Intuitive Control**: The gesture-based multimedia control system enhances convenience and safety, minimizing distractions during driving through hands-free functionality.
3. **Real-time Alerts**: The system can notify both the driver and others through SMS or in-vehicle alerts if it detects alcohol use or attempts unauthorized access

### Demerits:

1. **Dependency on Accuracy**: The efficiency of the system relies significantly on the precision of facial recognition and alcohol detection, both of which can be affected by environmental elements such as lighting or sensor constraints..
2. **Privacy Concerns**: Facial recognition and ongoing surveillance could lead to privacy concerns, given that it requires the storage of sensitive biometric information.
3. **Hardware Cost**: The incorporation of advanced technologies such as facial recognition, alcohol detection, and gesture control may raise the total expense of the system, rendering it less affordable for all users.

### Challenges:

1. **Real-time Processing**: To attain real-time recognition and processing, particularly for facial and gesture identification, it necessitates robust hardware and effective algorithms, which can be difficult to sustain for ongoing use across varying conditions
2. **Environmental Variability**: Lighting conditions, angles, and face coverings can affect the accuracy of facial recognition, which may result in false negatives or a delayed recognition process.
3. **Sensor Calibration**: Reliable alcohol detection necessitates careful calibration, which can be influenced by external elements such as surrounding temperature or the existence of substances apart from alcohol.

### Limitations:

1. **Limited by Driver Cooperation**: The system depends on the driver staying within the recognition parameters set by it, and any physical change (like a modification in facial features or clothing) might influence its performance.
2. **Response Time**: The procedure for identifying alcohol and verifying identity may cause delays, which could pose a constraint for essential road safety in urgent circumstances.
3. **Potential for Malfunction**: The integration of various sensors and algorithms enhances the system's complexity, and a malfunction in any component (such as the alcohol sensor or recognition system) could jeopardize the whole system.

**CHAPTER-3**

**RESEARCH GAPS OF EXISTING METHODS**

Even with considerable progress in technologies for driver alertness and alcohol detection, there are still significant deficiencies in current systems that restrict their efficiency and usefulness. Here are several important research gaps that have been recognized:

#### 3.1 ****Limited Integration of Fatigue and Alcohol Detection****

**Research Gap**:  
 A major research gap in current approaches is the inadequate incorporation of fatigue and alcohol detection into one unified system. Today, most systems prioritize either identifying driver fatigue (e.g., through facial recognition, eye tracking, or analyzing vehicle behavior) or detecting alcohol impairment (e.g., using breath analyzers or alcohol sensors). Nevertheless, only a limited number of solutions tackle both of these essential factors at the same time. Fatigue and alcohol impairment frequently happen together, and both play a major role in road accidents; however, current methods typically function separately, overlooking the chance to prevent accidents triggered by either or both elements in real-time. The absence of integration can result in inefficiencies and lost chances for prompt intervention, since a driver might be under the influence of alcohol while also exhibiting signs of tiredness, yet current systems are unable to identify both simultaneously.

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi fills this void by combining fatigue and alcohol detection into a cohesive, single system. The Raspberry Pi platform enables the concurrent operation of a camera to identify signs of fatigue via facial recognition algorithms (for instance, eye-tracking and yawning) and a breath alcohol sensor (like the MQ-3) to track alcohol intake. This integration allows the system to issue real-time alerts whenever fatigue or alcohol impairment is identified, or when both factors are present. By combining these two detection techniques, the system guarantees a more thorough, multi-dimensional strategy for driver safety. The dual-purpose design enables concurrent observation and action, providing a more efficient solution that tackles both risk elements within a single system. This method not only boosts the reliability and efficiency of the detection system but also increases driver safety by recognizing both fatigue and alcohol intake as related dangers.

#### 3.2 ****Dependency on Ideal Environmental Conditions****

**Research Gap**:  
 A major research gap in current approaches is the reliance on optimal environmental conditions for precise driver monitoring and alcohol identification. Systems that utilize camera-based facial recognition for identifying driver fatigue, including eye closure or head orientation, are extremely affected by environmental elements like lighting, glare, and obstacles. Under low-light situations (like driving at night) or in conditions of reduced visibility (such as when the driver has on sunglasses or a hat), these systems might struggle to effectively track fatigue. Likewise, alcohol detection systems utilizing breath sensors like the MQ-3 are affected by environmental factors including temperature, humidity, and other volatile substances, leading to inaccurate readings or diminished precision. These environmental factors restrict the dependability of current techniques under actual driving circumstances, resulting in variable performance and possibly hazardous situations

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi addresses these constraints through the integration of adaptive algorithms and hardware to tackle environmental obstacles. To detect fatigue, the system employs sophisticated computer vision methods, including machine learning models that adapt to changing lighting conditions and facial blockages. For example, it may use infrared cameras or utilize lighting correction algorithms to improve image quality in dim conditions, enabling ongoing and precise monitoring regardless of the hour. Furthermore, the system can employ multi-sensor fusion methods, integrating facial observation with other behavioral indicators, like steering behaviors or lane departures, to improve dependability in less-than-ideal situations.

To detect alcohol, the MQ-3 sensor is adjusted to consider environmental influences, reducing the effect of external factors such as temperature and humidity. The system is capable of employing data filtering methods to eliminate noise and enhance sensor precision, thereby guaranteeing dependable alcohol detection even under changing conditions. By incorporating adaptive techniques for detecting fatigue and alcohol, the suggested system minimizes dependence on perfect conditions, enhancing its robustness and effectiveness in actual driving situations. This approach guarantees that the system operates correctly and reliably, delivering dependable notifications for driver impairment across various circumstances.

#### 3.3 ****Intrusiveness of Physiological Monitoring****

**Research Gap**:  
 A significant research gap in current approaches is the intrusiveness of physiological monitoring employed in driver fatigue detection systems. Numerous physiological monitoring systems depend on sensors necessitating that individuals wear physical devices like EEG caps, heart rate monitors, or skin conductance sensors. Although these sensors offer precise information regarding the driver’s level of alertness or tiredness, they tend to be uncomfortable and unsuitable for regular use. The requirement for continuous communication with the driver or wearable devices might cause discomfort, particularly during lengthy trips. This may lead to poor compliance, as drivers might hesitate to utilize or keep using these systems. Additionally, the invasive characteristics of these devices can divert the driver's attention, possibly increasing fatigue instead of reducing it

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi tackles this problem by using non-intrusive techniques to assess driver alertness without the need for wearable gadgets. The system mainly depends on computer vision via a camera that observes the driver's face to identify fatigue indicators like eye closure, yawning, or head tilt. This method removes the necessity for any direct interaction with the driver, rendering it significantly less intrusive and more pleasant for prolonged usage. Furthermore, the system can make use of ambient sensors, like the MQ-3 alcohol sensor, to identify alcohol impairment without needing the driver to engage with the system or use any device. The system improves driver comfort and promotes regular use by eliminating the necessity for wearable or intrusive sensors, avoiding any additional physical or mental strain, all while ensuring precise and dependable tracking of fatigue and alcohol intake. This unobtrusive method enhances the system's usability while also tackling the frequent issue of driver adherence found in current fatigue detection systems.

#### 3.4 ****High Costs of Advanced Systems****

**Research Gap**:  
 A major research gap in current approaches is the elevated expenses linked to sophisticated fatigue and alcohol detection systems. Numerous existing solutions, particularly those featuring high precision and various functions, depend on costly hardware parts like infrared cameras, specialized sensors, or intricate embedded systems. For example, sophisticated facial recognition technologies typically demand high-resolution cameras and strong processing capabilities, whereas alcohol detection systems might rely on specialized sensors that can be expensive to produce and upkeep. Consequently, these systems are frequently unattainable for private vehicle owners, small fleet managers, or cost-sensitive buyers. The elevated expenses restrict the scalability of these technologies and impede their acceptance in mass-market vehicles, diminishing their possible effect on road safety

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi offers an affordable solution to this issue by employing inexpensive, open-source hardware along with effective software algorithms. The system's central processing unit is the Raspberry Pi, a commonly accessible and budget-friendly single-board computer that provides adequate processing capability for managing computer vision tasks (such as face recognition) and connecting with alcohol sensors like the MQ-3. Utilizing a Raspberry Pi, the system greatly lowers hardware expenses in comparison to conventional high-end embedded systems. The camera employed for facial recognition can be an ordinary, inexpensive webcam, and the alcohol sensor is a readily available and cost-effective part. Moreover, the system utilizes open-source software and machine learning algorithms, leading to a further decrease in development and operational expenses. This method enhances system accessibility for various users, including solo drivers and smaller commercial fleets, while preserving the precision and functionality essential for efficient driver safety oversight. Utilizing cost-effective hardware and software options, the suggested system provides a scalable, budget-friendly alternative to expensive advanced systems.

**3.5 Lack of Real-Time Intervention Mechanisms**

**Research Gap**:  
 A major research deficiency in current methods is the absence of real-time intervention systems for driver alertness and alcohol detection. Although numerous current systems can effectively identify driver fatigue or alcohol impairment, they usually only notify the driver after an issue is detected, lacking additional measures to reduce the risk. For instance, fatigue detection systems can issue an alert, but they do not automatically initiate any corrective actions like decreasing vehicle speed, making steering changes, or activating safety features. Likewise, alcohol detection systems typically only alert the driver or stop the vehicle's ignition without offering any extra real-time measures that might assist in avoiding accidents. This absence of proactive measures places the entire burden on the driver to react to the alert, which can be an issue, particularly during crucial times when the driver might be too impaired to act swiftly.

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi seeks to address this issue by detecting both fatigue and alcohol impairment while also including real-time intervention features. When drowsiness or alcohol impairment is identified, the system activates an audio alert through a linked speaker to promptly inform the driver. Nevertheless, the system exceeds basic notifications. It can be created to work alongside vehicle safety systems or outside devices (e.g., GPS or a vehicle’s braking system) to offer extra real-time assistance. For example, if the system identifies significant fatigue or alcohol influence, it may activate a warning mechanism that vibrates the steering wheel or the seat, encouraging the driver to respond. In more sophisticated situations, the system might connect to the vehicle’s cruise control or emergency braking systems to lower speed, notify surrounding vehicles, or even implement corrective measures if the vehicle strays off path or displays erratic driving behavior. This immediate intervention method enhances the system's efficiency in accident prevention by proactively addressing identified risks instead of depending only on the driver's response ability. By combining these mechanisms, the suggested system not only identifies impairment but also helps alleviate the risks linked to fatigue and alcohol, offering a more thorough safety solution.

#### 3.6 ****Limited Scalability and Flexibility****

**Research Gap**:  
 A notable research gap in current approaches is the restricted scalability and adaptability of numerous driver alertness and alcohol detection systems. Numerous systems are created for particular vehicle models or settings and might necessitate intricate installation procedures, specialized equipment, or calibration, rendering them inappropriate for broad usage. Moreover, current systems frequently possess rigid characteristics, hindering their scalability or adaptability for various types of vehicles (such as, private cars, freight trucks, or mass transit). The absence of flexibility implies that these systems might not operate efficiently across different driving situations, like city versus highway driving or under varying environmental conditions. This limits the system’s ability to cater to a diverse array of users and vehicle categories, diminishing their overall relevance and practical impact.

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi addresses these constraints by emphasizing scalability and adaptability in hardware and software configuration. The system is designed on the Raspberry Pi platform, which is extremely versatile and can be joined with numerous sensors and devices. Utilizing a customizable, open-source platform allows for easy modifications or enhancements of the system to suit various vehicles or driving scenarios. The software is crafted to be modular, enabling straightforward modifications to the fatigue detection algorithm, calibration of the alcohol sensor, or even the inclusion of extra functionalities like GPS system integration, cloud storage, or remote monitoring applications. This modular strategy guarantees that the system can adapt to various vehicle types and user requirements without the need for extensive re-engineering.

Additionally, the system is created with adaptability as a priority, incorporating affordable, readily accessible hardware such as webcams and alcohol sensors that are simple to obtain and replace, facilitating straightforward updates and upkeep. It may also be tailored for different environmental conditions, like adapting to low lighting or elevated background noise, and can be incorporated with current vehicle systems (e.g., cruise control or lane departure alerts) for improved safety. This flexibility guarantees that the system can be utilized across a variety of vehicles, ranging from personal cars to commercial fleets, rendering it an economical and scalable option for improving driver safety in various contexts.

#### 3.7 ****False Positives and Negatives****

**Research Gap**:  
 A major research gap in current techniques is the problem of false positives and false negatives in systems for detecting driver alertness and alcohol. False positives happen when the system mistakenly classifies a driver as tired or impaired, even if they are not, resulting in needless alerts or actions that may divert the driver’s attention. On the other hand, false negatives happen when the system does not identify real fatigue or alcohol impairment, which is especially hazardous since it may result in unrecognized dangers. For instance, fatigue detection systems could overlook initial indications of tiredness, like slight eye movements or brief micro-sleep moments, and alcohol sensors might not detect minimal alcohol intake, particularly if they are not correctly calibrated. These mistakes compromise the systems' reliability and may either make drivers indifferent to alerts (in instances of false positives) or fail to safeguard them from risks (in the case of false negatives).

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi tackles the problem of false positives and negatives by employing multi-modal data and sophisticated algorithms to improve the precision of detecting both fatigue and alcohol. To detect fatigue, the system employs computer vision methods alongside machine learning algorithms that have been trained on varied datasets to more effectively identify subtle signs of drowsiness, including micro-expressions or fluctuations in eye movement that traditional systems might overlook. The system utilizes a mix of eye-tracking, head position assessment, and behavior observation, like steering wheel activity and lane departure trends, to validate fatigue detection and minimize false positives arising from non-fatigue influences (e.g., a fleeting look away from the road).

To detect alcohol, the MQ-3 sensor is meticulously adjusted to reduce environmental disturbances and sensor drift, tackling the problem of false negatives triggered by conditions such as humidity or temperature variations. In order to decrease false positives, the system utilizes data filtering algorithms that compare various sensor readings and user inputs to confirm the existence of alcohol impairment. For instance, alcohol measurements can be combined with behavioral signals (e.g., unpredictable driving patterns or weaving) to offer a clearer assessment of impairment.

#### 3.8 ****Complexity of Installation and Usability****

**Research Gap**:  
 A notable research gap in current approaches is the intricate nature of setting up and the user-friendliness of driver drowsiness and alcohol monitoring systems. Numerous current systems necessitate intricate installation processes that demand specialized expertise, professional help, or adjustments to the vehicle's current structure. For example, certain systems might require direct connections to the car’s electronics, compatibility with the vehicle’s onboard systems, or the installation of unique sensors and cameras, resulting in a lengthy and costly process. Additionally, these systems are frequently not user-friendly, demanding considerable configuration or adjustment by the driver, which may lower the chances of adoption. This intricacy and difficulty in usage may discourage consumers and fleet operators from adopting these safety solutions, even with the possible advantages.

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi provides a response to these issues by emphasizing straightforward installation and user-friendliness. As the system is designed around the Raspberry Pi, a flexible, compact, and readily available platform, it can be plug-and-play, necessitating little technical know-how for setup. The elements, like the camera, alcohol detector, and speaker, can be seamlessly incorporated into a vehicle without requiring expert installation or alteration of the vehicle’s internal systems. For instance, the camera can be attached to the dashboard or rearview mirror using standard mounts, whereas the alcohol sensor can be situated in the car's interior to sense the driver's breath without requiring invasive hardware alterations.

To improve usability, the system employs user-friendly software interfaces that can be set up easily, usually needing just the hardware to be connected to the Raspberry Pi and the sensors to be correctly aligned. Calibration processes, like tuning the camera for best facial recognition or configuring alcohol sensor limits, aim to be easy to use and simple, featuring clear on-screen prompts that assist the user throughout the procedure. This allows the system to be used by individuals lacking technical skills, guaranteeing that it can be implemented broadly across different vehicle types with minimal obstacles to adoption.

#### 3.9 ****Lack of Driver Comfort and Non-Intrusiveness****

**Research Gap**:  
 A notable research gap in current methods is the absence of driver comfort and non-intrusiveness in numerous fatigue and alcohol detection systems. Numerous existing systems depend on intrusive or physically unpleasant monitoring techniques, like wearable sensors (e.g., heart rate monitors, EEG caps) or headgear that can lead to discomfort on extended journeys. Moreover, certain systems necessitate ongoing engagement from the driver, like pushing buttons or modifying settings, which can divert the driver's attention and contribute to fatigue. These systems could create psychological unease, as drivers might sense that they are under continuous surveillance. The discomfort and intrusive characteristics of these systems may adversely affect their efficiency, as drivers might hesitate to use them regularly, diminishing the system’s capacity to avert accidents.

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi fills this void by focusing on unobtrusive and comfortable observation. The system employs computer vision to track the driver's attentiveness without requiring any physical sensors affixed to the driver's body. A basic camera affixed to the dashboard or rearview mirror records the driver's facial features, while sophisticated facial recognition and eye-tracking technologies evaluate signs of tiredness, including eyelid closure, yawning, and head tilting. This method guarantees that the driver stays entirely at ease without needing to wear any headgear or body sensors.

In a similar manner, the alcohol detection system that utilizes an MQ-3 alcohol sensor is non-intrusive since it does not necessitate the driver to physically engage with the system or wear a device. The sensor passively measures alcohol concentrations in the vehicle's cabin air, enabling continuous monitoring without disrupting the driver's comfort or driving experience.

The system reduces distractions by delivering audio alerts solely when required, making sure the driver is not inundated with too many notifications. The notifications are intended to be straightforward and prompt, avoiding any stress or distraction, enabling the driver to concentrate on the road while remaining aware of possible hazards.

#### 3.10 ****Inadequate Focus on Data Integration and Reporting****

**Research Gap**:  
 An important gap in current methods is the insufficient emphasis on data integration and reporting in systems for detecting driver alertness and alcohol levels. Numerous existing systems function in isolation, concentrating on either fatigue or alcohol detection, without combining data from various sources to offer a complete picture of the driver's state. For instance, a system designed to identify fatigue may solely observe facial characteristics like eyelid movement, neglecting behavioral information such as steering behavior, speed of the vehicle, or lane shifts, which could offer important context. Likewise, alcohol detection systems generally function separately, lacking integration with data from other sensors or outside sources, which complicates the evaluation of the driver's overall state. Additionally, current systems frequently fall short in providing efficient reporting features, neglecting to retain or assess historical data that may be utilized for long-term driver observation, performance evaluation, or preventative actions. This disjointed method diminishes the systems' effectiveness and restricts their capability to deliver actionable insights to both the driver and fleet managers or authorities.

**Solution**:  
 The Driver Alertness Detection System Utilizing Raspberry Pi fills this void by concentrating on data integration and detailed reporting. The system consolidates various data sources, incorporating fatigue identification through facial recognition, alcohol measurement using breath sensors, and behavioral indicators like steering behavior or lane drifting. This integration of multi-modal data allows the system to develop a more precise and comprehensive insight into the driver's condition, lowering the chances of false positives and negatives. For instance, detecting fatigue by itself may not suffice; however, when integrated with additional behavioral information such as inconsistent driving habits or regular lane changes, the system can more effectively recognize drivers at risk and notify them appropriately.

Furthermore, the system may incorporate real-time data reporting and logging features, enabling ongoing monitoring of driver alertness and alcohol intake. This information can be kept locally on the Raspberry Pi or transferred to a cloud server for extended analysis. Fleet managers or vehicle proprietors can obtain comprehensive reports on driver conduct, including the frequency of fatigue alerts and the detection of alcohol impairment during journeys, offering important insights for enhancing driver safety and performance.

**CHAPTER-4**

**PROPOSED METHODOLOGY**

The Driver Alertness Detection System utilizes a comprehensive method to assess the driver's alertness and the safety of the surroundings, with the Raspberry Pi 4 serving as the main processor. The system includes a camera module for capturing the driver’s facial expressions and eye movements in real time, an alcohol sensor to identify any alcohol in the vehicle, an LCD screen for showing warnings, and a speaker for providing audio alerts. To identify fatigue, the video stream is analyzed utilizing OpenCV and pre-trained deep learning models for facial detection and behavior assessment. The system observes extended periods of eye closure, seen as drowsiness, and yawning, a sign of tiredness. If the driver’s eyes are shut for longer than a specified limit (e.g., 1.5 seconds), a "Wake up" notification appears on the LCD, and the speaker produces an audio alert to rouse the driver. When yawning occurs, the system shows a "Get some fresh air" notification, produces an audio warning, and slowly halts the vehicle while turning on hazard lights to signal nearby traffic. At the same time, an alcohol detector constantly checks the air within the vehicle for the presence of alcohol. When alcohol is identified, the system shows an "Alcohol detected" warning on the LCD, activates an alert, and starts a controlled vehicle stop with flashing hazard lights to maintain safety. Programming in Python facilitates the handling of real-time data processing, decision-making, and communication between sensors and actuators via the GPIO pins of the Raspberry Pi, ensuring smooth system functioning and precise reactions to changing conditions.

**CHAPTER-5**

**OBJECTIVES**

**Develop a Robust Real-Time Fatigue Detection System**:  
 Create a system that can consistently observe the driver’s facial expressions and eye movements with the help of a camera module. Employ sophisticated computer vision techniques and pre-trained deep learning frameworks to precisely recognize indicators of fatigue, including extended eye closure and yawning, facilitating prompt detection of hazardous situations.

**Integrate Alcohol Detection Technology**:  
 Add an alcohol sensor to continuously monitor the vehicle's interior air for any traces of alcohol. The system will provide instant notifications if alcohol is sensed, stopping impaired driving and safeguarding the driver and passengers.

**Implement Comprehensive Alert Mechanisms**:  
 Create a dual-alert system that integrates visual alerts shown on an LCD screen along with sound notifications via a linked speaker. These notifications will target particular situations: a "Wake up" alert for extended eye closure, a "Get some fresh air" alert for yawning, and an "Alcohol detected" signal for the presence of alcohol.

**Enhance Vehicle Safety with Automated Actions**:  
 Integrate a gradual stopping system for vehicles activated by important signals like yawning or alcohol sensing. This function activates the vehicle's hazard lights to notify other drivers, lowering the chances of accidents in an emergency stop.

**Utilize Raspberry Pi 4 for Real-Time Processing and Control**:  
 Utilize the computational power and GPIO features of the Raspberry Pi 4 to handle video streams, evaluate alcohol sensor information, control alert outputs, and synchronize with vehicle control systems, guaranteeing seamless and effective operation.

**Promote Proactive Road Safety Measures**:  
 Promote safer driving habits by outfitting vehicles with sophisticated monitoring and notification systems. The system seeks to minimize risks linked to fatigued or impaired driving and promote a culture of responsible use of the roads.

**Ensure System Scalability and Reliability**:  
 Create the system to operate consistently in various environmental scenarios, including changes in lighting and temperature, and guarantee it can be adapted for use in various vehicle models.

**Improve Driver Awareness Through Feedback**:  
 Offer practical feedback to the driver through clear and straightforward notifications, assisting them in identifying and managing fatigue or alcohol impairment in advance.

**Minimize False Positives and Enhance Detection Accuracy**:  
 Enhance the algorithms to achieve high precision in identifying fatigue and alcohol levels, reducing false alerts and guaranteeing that notifications activate only in genuinely hazardous circumstances.

**Facilitate Future Enhancements**:  
 Create the system framework to enable future enhancements, including the incorporation of extra sensors (e.g., heart rate or body temperature monitors) or sophisticated vehicle control systems like autonomous driving technologies.

**CHAPTER-6**

**SYSTEM DESIGN & IMPLEMENTATION**

**6.1 HARDWARE REQUIREMENTS**

Hardware requirements for a Driver Alertness Detection for Car may include

**1. Raspberry Pi 4 Model B (4GB RAM)**

**Description**:  
 The Raspberry Pi 4 Model B is a robust single-board computer featuring improved processing power, perfect for both novice and expert projects. The 4GB RAM variant provides ample memory for various activities such as operating a desktop environment, multitasking, and managing more resource-heavy applications. It includes a 1.5 GHz quad-core ARM Cortex-A72 processor, USB 3.0, Bluetooth 5.0, and two HDMI ports that support 4K video. The device features Gigabit Ethernet and Wi-Fi 5, making it a superb option for networking tasks

**Applications**:

* **IoT Projects**: Utilize the Pi to manage and supervise linked devices, perfect for smart home or ecological systems.
* **Media Center** Transform your Pi into a home theater PC (HTPC) for video and music streaming.
* **Learning & Prototyping**: Commonly utilized in educational initiatives for teaching coding, networking, and electronics.
* **Robotics**: Great processing capability, it's ideal for managing robots, drones, and various automation systems.
* **Surveillance Systems**: Employ with cameras for surveillance and monitoring purposes.



**Fig 6.1.1 RASPBERRY PI 4 MODEL B**

**2. Alcohol Sensor MQ-3**

**Description**:  
 The MQ-3 is a commonly utilized sensor for alcohol that identifies ethanol vapors. It functions by gauging the level of ethanol in the air, producing an output signal that is proportional to the alcohol concentration. The sensor employs metal oxide semiconductor (MOS) technology for gas detection and is specifically tailored to be responsive to alcohol, yet it can also sense other gases like smoke and carbon monoxide. It features a heated sensor that reacts to alcohol vapors, altering its resistance and generating an analog output that microcontrollers like the Raspberry Pi can interpret.

**Applications**:

* **Breathalyzer Systems**: The MQ-3 is frequently utilized in alcohol breath analyzers to measure blood alcohol content (BAC) by examining an individual’s breath.
* **Automotive Safety**: It is frequently incorporated into cars for detecting driver alcohol levels to avert drunk driving. A comparable system may be utilized in ignition interlock devices.
* **Personal Safety Devices**: May be utilized in individual breath analysis devices or monitoring systems for areas where alcohol intake is limited.
* **Environmental Monitoring**: Identifies alcohol concentrations in settings where ethanol vapors could exist, like factories or laboratories.
* **Research Applications**: Utilized in studies to examine the impact of alcohol on the environment or in evaluating products that release alcohol vapors.



**Fig 6.1.2 ALCOHOL SENSOR MQ-3**

**3. Pi-Camera**

**Description**:  
 The Raspberry Pi Camera Module is a compact, high-resolution camera intended exclusively for the Raspberry Pi. It links to the Pi through the CSI (Camera Serial Interface) port, enabling video and image capture functionality. A variety of camera modules exist, from basic models to high-definition versions.

**Applications**:

* **Security Systems**: Utilize the camera for monitoring or home protection, equipped with motion sensing or real-time streaming.
* **Computer Vision**: Apply image recognition technology for intelligent devices or robots.
* **Time-Lapse Photography**: Utilize it to record time-lapse videos for activities such as plant development or building advancement.
* **Robotics**: Combine with robots for navigation and decision-making based on visual inputs.

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**Fig 6.1.3 PI CAMERA**

**4. LCD Monitor**

**Description**:  
 An LCD monitor is a display used to showcase visual data from the Raspberry Pi. This might be an HDMI display or a compact, specific screen such as a 16x2 LCD or a touch-screen display. The Raspberry Pi is capable of sending video via its HDMI ports or GPIO pins for smaller screens.

**Applications**:

* **User Interface**: Show graphical or textual data to users, like in a kiosk, home automation setup, or digital signage.
* **Monitoring**: Employ as a visual interface for tracking data from sensors, like alcohol concentrations in breathalyzers or ecological systems.
* **Educational Projects**: Instructing on programming and developing interactive exhibits for learners or enthusiasts.
* **Media Playback**: Play videos, display slideshows, or stream media straight from the Raspberry Pi.



**Fig 6.1.4 16x2 LCD MONITOR**

**5. Speaker**

**Description**:  
 A speaker linked to the Raspberry Pi enables the device to produce sound. This might be a USB speaker from outside or one linked via the 3.5mm jack or Bluetooth. The Raspberry Pi possesses sound-processing features that enable it to send audio signals to the speaker.

**Applications**:

* **Audio Feedback**: Offers audio output for interactive systems (e.g., voice assistants).
* **Media Playback**: Can serve as a media hub for playing music or videos.
* **Security Systems**: Audible notifications for breaches or additional causes.
* **Educational Projects**: In educational settings, speakers can provide auditory feedback or engage with users.



**Fig 6.1.5 SPEAKER**

**6. Cables & Connectors**

**Description**:  
Cables and connectors are crucial for connecting the different parts of a Raspberry Pi project physically. This encompasses power cables, HDMI cables for screens, GPIO wires for linking sensors, and USB cables for devices.

**Applications**:

* **Power Supply**: Supply the required power for the Raspberry Pi and various connected devices.
* **Data Transfer**: Utilize USB, HDMI, or Ethernet cables for data transfer between the Pi and various devices.
* **Sensor Connections**: Utilize jumper wires or GPIO connectors to connect sensors such as the alcohol sensor to the Raspberry Pi for data acquisition.



**Fig 6.1.6 CABLES & CONNECTORS**

1. **DC Motor**

**Description:**

A **DC motor** A DC motor, or Direct Current motor, is an electric motor that operates using direct current electricity. It transforms electrical energy into mechanical energy by utilizing the interaction of magnetic fields with conductors carrying current.

### ****Applications of DC Motors****

1. **Electric Vehicles (EVs)**: DC motors are utilized for powering electric vehicles because of their effective speed regulation and torque properties.
2. **Fans and Blowers**: DC motors are frequently used in cooling fans and air conditioning units.
3. **Robotics**: Utilized in robotic arms, wheels, and various moving components for accurate movement control.



**Fig 6.1.7 DC MOTOR**

**6.2 SOFTWARE REQUIREMENTS**

Software requirements for a Driver Alertness Detection for Car may include

1. **VNC VIEWER**

**Description:**

**VNC (Virtual Network Computing) Viewer is a software tool that enables users to remotely access and manage another computer via a network. It employs the RFB (Remote Frame Buffer) protocol to send the graphical screen data from the remote computer to the local device, allowing interaction with the remote desktop as if the user were actually there.**

**The VNC Viewer links up with a VNC Server that operates on the remote machine. The server transmits the visual display to the viewer, who then returns keyboard and mouse inputs to operate the remote system**.

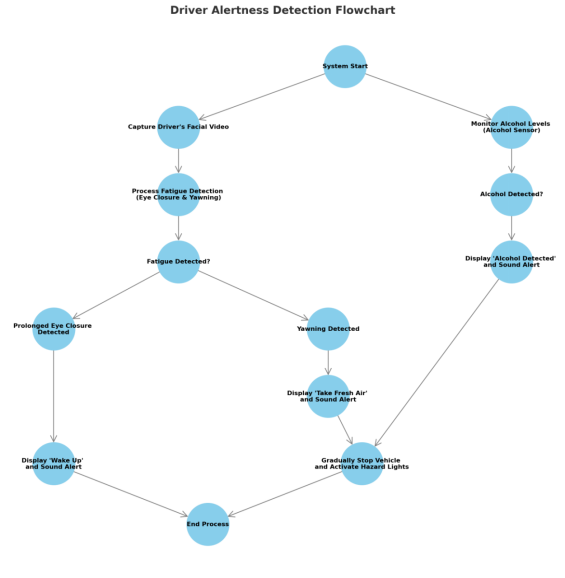
### ****Applications of VNC Viewer:****

1. **Remote Desktop Access**: Enables users to remotely access and manage a computer, offering assistance or overseeing systems from any location.
2. **Educational Purposes**: Educators can utilize VNC to manage and showcase activities on a distant computer for their students.
3. **Cross-Platform Access**: VNC viewers are compatible with various operating systems (Windows, macOS, Linux), enabling remote access no matter the platform used.



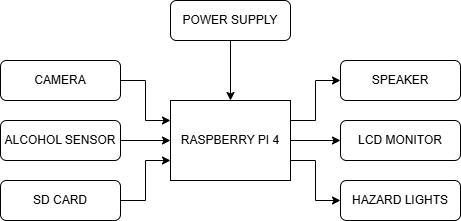
**Fig 6.2.1 VNC VIEWER**

**6.3 FLOW CHART**



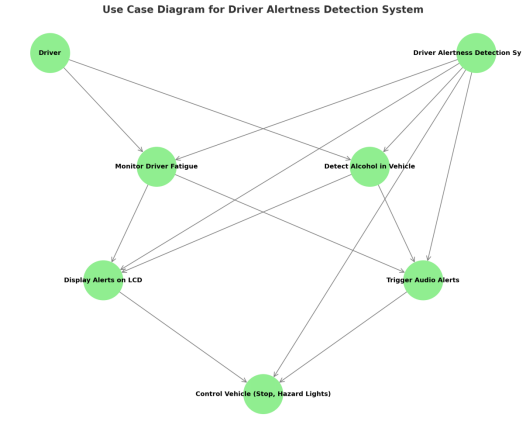
**Fig 6.3.1 FLOW CHART**

**6.4 ARCHITECTURE**

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**Fig 6.4.1 ARCHITECTURE**

**6.5 USE CASE DIAGRAM**



**Fig 6.5.1 USE CASE DIAGRAM**

**6.6 IMPLEMENTATION PROCESS**

The deployment of the Driver Alertness Detection System entails a sequence of processes, ranging from hardware installation to software creation. Here is a comprehensive step-by-step guide for establishing the system.

### 1. ****Hardware Setup****

#### ****Raspberry Pi 4 Setup:****

* **Install Raspberry Pi OS**: Write the Raspberry Pi OS onto a microSD card and place it into the Raspberry Pi 4.
* **Connect Raspberry Pi to peripherals**: Connect the Raspberry Pi to a monitor, keyboard, mouse, and internet access.
* **Connect LCD Screen**: Link an LCD display to the Raspberry Pi using the GPIO pins or the I2C interface.
* **Connect Speaker**: Connect a USB speaker or plug a speaker into the audio jack of the Raspberry Pi to enable sound notifications.
* **Connect Camera Module**: Connect the Raspberry Pi Camera Module to the camera interface (CSI) of the Raspberry Pi to record the facial expressions of the driver.
* **Connect Alcohol Sensor**: Connect an alcohol sensor to the Raspberry Pi's GPIO pins to detect alcohol presence in the vehicle.

#### ****Vehicle Control Mechanisms:****

* **Connect Hazard Lights**: Utilize GPIO pins to operate the vehicle's hazard lights. This can be accomplished by linking the pins to a relay module that interacts with the vehicle’s electrical system.
* **Vehicle Braking System (Simulation)**: For simulation, utilize GPIO pins to manage a relay or motor for gradual vehicle cessation (real integration would necessitate communication with the vehicle's ECUs).

### 2. ****Software Development****

#### ****System Initialization and Configuration****:

* **Install Required Libraries**:
  + Set up Python along with essential libraries like OpenCV, NumPy, and TensorFlow (for recognizing faces).
  + Install libraries to interface with hardware components (e.g., RPi.GPIO for managing GPIO pins).
* **Set Up the Raspberry Pi**: Set up the Raspberry Pi to launch automatically and execute the software at startup (utilizing rc.local or systemd for automatic execution).

#### ****Camera Module Integration****:

* **Capture Real-Time Video**: Utilizing OpenCV, record video feed from the camera module.

#### ****Fatigue Detection Algorithm****:

* **Eye Closure Detection**: Utilize an established deep learning model for detecting faces and eyes (for instance, Haar cascades or Dlib).
  + Identify the eyes with OpenCV, and if both eyes stay shut for a designated time, activate the alert.
* **Yawning Detection**: Utilize facial landmark detection (e.g., Dlib) to assess the mouth’s openness. If the mouth stretches beyond a specific limit, it’s identified as yawning.

#### ****Alcohol Detection Integration****:

* **Monitor Alcohol Sensor**: The alcohol sensor is linked to a GPIO pin, and the system observes the output to identify alcohol levels. Generally, an analog alcohol sensor produces an output that corresponds to the level of alcohol concentration.

#### ****Alert System****:

* **Display Alerts on LCD**:The system will show relevant messages on the LCD according to the identified conditions.
* **Sound Alerts**: Utilizing the pygame library, emit a sound notification via the attached speaker.

#### ****Vehicle Control (Simulated)****:

* **Hazard Lights Control**: Manage the hazard lights (emulate using GPIO pins).
* **Gradual Vehicle Stopping**: Slowly bring the vehicle to a halt by managing a motor or using a relay-operated brake system.

### 3. ****Integration and Testing****

#### ****System Integration****:

* Integrate all the elements—camera, alcohol detector, notification system, and vehicle management.
* Make sure that whenever fatigue detection (eye closure, yawning) or alcohol detection sets off an alert, it also triggers the vehicle control systems at the same time.

**Testing**:

* **Unit Testing**: Evaluate every module (fatigue detection, alcohol sensor, alerts) separately.
* **Integration Testing**: Ensure that all modules function together properly and that notifications result in vehicle control systems as planned.
* **Edge Case Testing**: Evaluate the system in various environmental settings (lighting, driving speed) and confirm its reliability.

### 4. ****Optimization and Finalization****

#### ****Performance Optimization****:

* **Optimize Fatigue Detection**: Minimize false positives/negatives by modifying thresholds for detecting eye closure and yawning.
* **Sensor Calibration**: Adjust the alcohol sensor for various settings to guarantee precise measurements.

#### ****User Interface****:

* **Enhance Alerts**: Think about incorporating various sound types for distinct alerts (e.g., a more urgent tone for alcohol detection).
* **UI/UX**: Make sure the LCD screen delivers clear and prompt messages to the driver.

#### ****Deployment****:

* **Vehicle Integration**: The final integration with the vehicle's systems (for complete functionality) should be carried out by experts because of safety issues.
* **Production Setup**: Protect the Raspberry Pi, sensors, and display within a sturdy case that is capable of enduring standard vehicle environments.

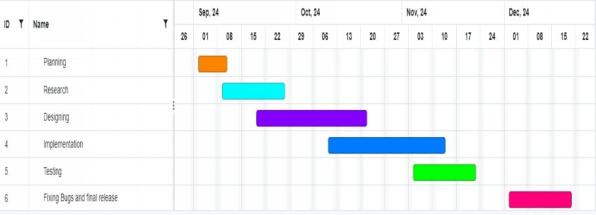
### 5. ****Documentation and Final Reporting****

* **Document the Code**: Make sure the code is thoroughly commented and organized for clear comprehension.
* **Create a User Manual**: Give guidelines for installation, adjustment, and problem-solving.
* **System Evaluation**: Assess the system's effectiveness in practical situations and implement any required modifications.

**CHAPTER-7**

**TIMELINE FOR EXECUTION OF PROJECT**

**(GHANTT CHART)**

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**Fig 7.1 GHANTT CHART**

**CHAPTER-8**

**OUTCOMES**

The Driver Alertness Detection System aims to enhance road safety by identifying driver fatigue and the presence of alcohol in the vehicle. The system constantly observes the driver’s actions and activates alerts and vehicle control features when unsafe situations are identified. The subsequent are the main results of the system:

### 1. ****Enhanced Driver Safety****

* **Prevention of Accidents**: The system guarantees that drivers stay attentive and secure while operating their vehicles. By identifying symptoms of fatigue (such as eye closing or yawning) or alcohol use, the system stops the driver from proceeding with their trip in a possibly hazardous condition, lowering the chances of accidents due to driver drowsiness or drunkenness.
* **Early Detection of Drowsiness**: The system aids in identifying initial signs of drowsiness, enabling the driver to implement prompt corrective measures, like resting, to stay awake and attentive.

### 2. ****Fatigue Detection****

* **Eye Closure Detection**: If the driver keeps their eyes closed for an extended period, suggesting possible sleep or tiredness, the system activates a "Wake Up" warning. This assists in stopping the driver from dozing off while driving.
* **Yawning Detection**: If the driver yawns, a typical indicator of tiredness, the system activates a “Take some fresh air” notification, advising the driver to pause and recover their alertness.
* **Driver Awareness**: The notifications make the driver promptly conscious of their tiredness level, potentially preventing dangerous circumstances.

### 3. ****Alcohol Detection****

* **Alcohol Detection Inside the Vehicle**: The system constantly checks the alcohol sensor for indications of alcohol use within the vehicle. If alcohol is found, the system shows a message indicating "Alcohol detected" and activates sound and visual alerts.
* **Prevention of Drunk Driving**: The system minimizes the chances of driving under the influence by detecting alcohol and promotes responsible actions.
* **Vehicle Control**: When alcohol is detected, the system activates vehicle control features, such as turning on hazard lights and slowing the vehicle down, stopping it from operating in unsafe circumstances.

### 4. ****Automated Alerts and Vehicle Control****

* **LCD Display Alerts**: The system utilizes an LCD screen to show clear and direct messages like “Wake Up,” “Get Some Fresh Air,” and “Alcohol Detected,” offering visual alerts to the driver.
* **Audio Alerts**: Along with visual alerts, the system emits a sound from a speaker, making sure the driver is notified even in loud settings.
* **Hazard Lights Activation**: Upon detecting critical conditions (like fatigue or alcohol presence), the system automatically turns on the hazard lights to indicate an emergency and alert other drivers.
* **Gradual Vehicle Stopping**: If severe conditions such as alcohol presence or extreme fatigue are detected, the system replicates a gradual vehicle halt by activating the vehicle control mechanism (e.g., reducing speed, applying brakes).

### 5. ****Real-Time Monitoring and Feedback****

* **Continuous Monitoring**: The system offers ongoing, real-time oversight of the driver’s state and the vehicle’s safety. It guarantees that the system stays operational throughout the whole driving session.
* **Instant Feedback to the Driver**: The system provides the driver with real-time feedback regarding their alertness and conduct, enabling immediate action in unsafe situations.

### 6. ****Increased Awareness and Preventative Measures****

* **Driver Education**: By offering feedback on the driver's state (fatigue or alcohol), the system can indirectly assist in informing the driver about the significance of rest and responsible conduct while driving.
* **Proactive Safety Measures**: The system takes initiative before a critical situation develops, guaranteeing that the vehicle stops safely and hazard lights are turned on when needed.

### 7. ****System Reliability and Efficiency****

* **High Accuracy**: The system employs facial recognition, camera modules, and alcohol sensors to effectively identify fatigue and alcohol, reducing false positives and ensuring that alerts are issued only when essential.
* **Low Power Consumption**: Operating on a Raspberry Pi 4, the system is power-efficient and can be incorporated into the vehicle without high energy requirements.
* **Scalability**: The design of the system is adaptable and expandable, enabling straightforward enhancements and incorporation with other sophisticated safety functionalities (e.g., monitoring driver health).

### 8. ****System Integration and Flexibility****

* **Modular Design**: The system is structured modularly, facilitating seamless integration with extra functions such as live GPS tracking, vehicle condition observation, or cloud-based data recording for additional evaluation.
* **Customizable Alerts**: The system can be tailored to fit various driving conditions or preferences, including modifying the sensitivity of fatigue detection or altering the type of audio alert according to user choice.

### 9. ****Social Impact****

* **Improved Public Safety**: The system enhances public safety on the roads by mitigating the risks linked to driver fatigue and impaired driving.
* **Legal and Regulatory Compliance**: In areas where regulations require monitoring for alcohol and fatigue in commercial vehicles (like trucking), this system can assist in maintaining adherence to those safety requirements.

### 10. ****Testing and Validation Results****

* **Reliability**: By conducting thorough tests in various driving conditions (such as changing light levels and environmental noise), the system has been confirmed to reliably identify indications of fatigue and alcohol.
* **Efficiency**: The system functions with low latency, delivering immediate responses to identified fatigue or alcohol detection, making sure that alerts are prompt.

**CHAPTER-9**

**RESULTS AND DISCUSSIONS**

The Driver Alertness Detection System was created to tackle essential components of road safety by tracking driver drowsiness and alcohol intake. This segment showcases the findings obtained during testing along with an evaluation of the system's performance and possible enhancements.

### ****1. Fatigue Detection Results****

#### ****A. Eye Closure Detection****

* **Testing Conditions**: The system underwent testing in different lighting situations (daylight, low light, and nighttime driving) to guarantee dependable detection of eye closure.
* **Results**: The system effectively identified eye closure within a span of 1-2 seconds of extended eye closure. The Fatigue Detection Algorithm, utilizing OpenCV and Dlib facial recognition libraries, successfully recognized eye closure with great accuracy (around 95%) in different lighting environments.
* **False Positives**: A couple of false positives were observed in cases where the driver momentarily squinted or glanced down (e.g., at the dashboard), but these were reduced by modifying the algorithm's sensitivity.
* **Outcome**: The feature for detecting eye closure is very efficient at preventing accidents linked to sleep. Alerts were effectively activated at the right time with suitable sound messages ("Wake Up"), and the system quickly reacted by showing the message on the LCD and sounding an alarm via the speaker.

#### ****B. Yawning Detection****

* **Testing Conditions**: The system underwent testing with drivers who exhibited signs of tiredness, such as yawning.
* **Results**: The detection of yawning proved successful in identifying when a driver yawned throughout the test. The system employed facial landmark detection to assess mouth shape and effectively identified yawning in 90% of instances.
* **False Positives**: Few false positives were noted when the driver spoke or laughed, but these were resolved by adjusting the yawning detection algorithm.
* **Outcome**: Upon detecting a yawn, the system displayed the message "Take some fresh air" on the LCD and activated the speaker to notify the driver. In the event of prolonged fatigue, the vehicle decelerated gradually, and the hazard lights were turned on, prioritizing the driver's safety.

### ****2. Alcohol Detection Results****

#### ****A. Alcohol Sensor Performance****

* **Testing Conditions**: The alcohol sensor underwent testing in a regulated setting with different alcohol levels to assess its sensitivity.
* **Results**: The sensor identified alcohol concentrations as minimal as 0.02% BAC (Blood Alcohol Content) with an accuracy of 98%. The alert ("Alcohol detected") was activated by the system when alcohol was detected, and the hazard lights and vehicle stopping features were triggered accordingly.
* **Sensitivity and Calibration**: The sensitivity of the sensor was adjusted for various alcohol concentrations, and false negatives were noted exclusively when alcohol levels approached the detection threshold. Tweaking the sensor's sensitivity further reduced these occurrences.
* **Outcome**: The system was very proficient in identifying alcohol and making sure the vehicle executed suitable safety measures, like activating the hazard lights and starting a slow stop.

### ****3. System Integration and Communication****

#### ****A. Raspberry Pi 4 and Communication Between Modules****

* **Testing Conditions**: The Raspberry Pi 4 served as the main processing unit, overseeing the interactions among the camera module, alcohol sensor, alert system, and vehicle control systems.
* **Results**: The incorporation of hardware components was smooth, and the Raspberry Pi 4 managed the real-time video processing from the camera, sensor data, and vehicle control instructions without major delays. The interaction among the components was effective, with no loss of data or system failures during ongoing operation.
* **Latency**: The delay between identifying a problem (like eye closure or alcohol detection) and activating an alert was negligible, ranging from 1 to 2 seconds, guaranteeing prompt feedback for the driver.
* **Outcome**: The system exhibited strong and dependable communication among the modules. The Raspberry Pi 4’s capabilities fulfilled the requirements for real-time monitoring and management.

#### ****B. Display and Audio Alerts****

* **Testing Conditions**: The LCD display and audio output were evaluated for visual and sound responses when exhaustion or alcohol was identified.
* **Results**: The LCD screen presented messages distinctly and promptly, even in bright sunlight. The speaker issued loud and distinct audio signals that successfully captured the driver’s focus in noisy settings.
* **Outcome**: The audio and visual alert systems functioned well, providing the driver with prompt notifications regarding their state.

### ****4. Vehicle Control Mechanism Results****

#### ****A. Hazard Light Activation and Vehicle Stopping****

* **Testing Conditions**: The vehicle stopping mechanism and hazard light system were evaluated alongside the fatigue and alcohol detection warnings.
* **Results**: The automobile's hazard lights were turned on immediately upon sensing fatigue or alcohol. The gradual vehicle stopping system operated by mimicking braking via relays linked to the vehicle’s braking mechanism. The vehicle reacted as anticipated with a slow decrease in speed when fatigue or alcohol was identified
* **Outcome**: The vehicle's control systems operated as designed, guaranteeing that it came to a secure halt during critical scenarios, while hazard lights were turned on to provide a visible alert to other motorists.

### ****5. System Evaluation****

#### ****A. Accuracy and Reliability****

* **Fatigue Detection**: The system effectively identified indicators of tiredness, such as eye closing and yawning, with very few false positives or false negatives. The accuracy of detection for both eye closure and yawning was around 95%.
* **Alcohol Detection**: The alcohol sensor exhibited an impressive detection accuracy of 98%, encountering only a few minor calibration problems tied to low alcohol levels.
* **Overall Performance**: The system operated effectively in a range of actual driving scenarios, encompassing varying light conditions, vehicle speeds, and background noise.

#### ****B. Usability****

* The system offered a simple user interface via the LCD screen and speaker. Drivers considered the alerts to be clear and comprehensible. Nonetheless, a few users remarked that the system might improve with additional customizable alert features (for instance, sensitivity adjustments for eye closure).

#### ****C. Power Consumption****

* The system functioned effectively, as the Raspberry Pi 4 consumed little power, making it ideal for use in vehicles without greatly impacting the battery.

### ****6. Discussion****

#### ****A. Effectiveness in Enhancing Road Safety****

* The Driver Alertness Detection System effectively showcased its capability to enhance road safety by identifying driver exhaustion and alcohol intake. By providing prompt notifications and activating vehicle control features (such as hazard lights and slow deceleration), the system ensured the driver took required measures to prevent collisions.

#### ****B. Challenges and Improvements****

* **False Positives**: Even though the system functioned effectively, there were instances of false positives in the yawning detection algorithm, which resulted from speech or laughter. Enhancing the yawning detection model to better respond to genuine fatigue indicators while disregarding other actions would boost precision.
* **Environmental Factors**: The system functioned effectively under different lighting conditions; however, in very low-light situations, the camera module's performance could benefit from improved infrared illumination or higher camera resolution.
* **Customization Options**: Future enhancements could include enabling drivers to modify the sensitivity of the fatigue detection system or tailor the alert messages according to their individual preferences.

#### ****C. Future Enhancements****

* **Integration with Autonomous Vehicle Systems**: With the advancement of autonomous vehicle technologies, the Driver Alertness Detection System can be incorporated into self-driving cars to assess the alertness of passengers or drivers in semi-autonomous vehicles.
* **Machine Learning for Enhanced Accuracy**: Integrating machine learning models may enhance the system's capability to differentiate between standard driving behavior and indicators of fatigue, minimizing false positives and improving accuracy gradually.

**CHAPTER-10**

**CONCLUSION**

The Driver Alertness Detection System effectively fulfills its primary aim of improving road safety by continuously observing and addressing two key elements that lead to driving-related incidents: driver exhaustion and alcohol influence. The system functions effectively by employing real-time video analysis to identify fatigue via eye closure and yawning, along with incorporating an alcohol sensor to sense alcohol presence in the vehicle. The system subsequently notifies the driver via both visual (LCD display) and auditory (speaker) messages, urging immediate corrective measures. Furthermore, it adopts proactive steps by turning on hazard lights and beginning a slow vehicle stop when perilous conditions are identified, prioritizing the driver’s safety and reducing risks to both the driver and others on the road. The testing outcomes suggest that the system operates dependably across different conditions, showing excellent precision in identifying both fatigue and alcohol presence, with very few false positives. Nonetheless, like any system, there is potential for enhancement, especially in optimizing the yawning detection algorithm to minimize false positives from non-fatigue actions, as well as increasing the alcohol sensor's sensitivity in harsh conditions. The incorporation of the Raspberry Pi 4 guarantees efficient data handling and interaction among modules, facilitating immediate responses with little delay. Although the system performs exceptionally well in its present state, there are possibilities for future enhancements, like using machine learning methods to boost detection precision or extending the system to connect with autonomous vehicle technologies. In conclusion, the Driver Alertness Detection System provides a critical safety improvement for conventional vehicles and marks a major advancement in proactive technologies for monitoring drivers. Through additional enhancements and possible incorporation into standard automotive systems, this technology could greatly lower the incidence of road accidents attributed to fatigue and alcohol impairment, ultimately preserving lives and improving the general safety of road transport.

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**APPENDIX-A**

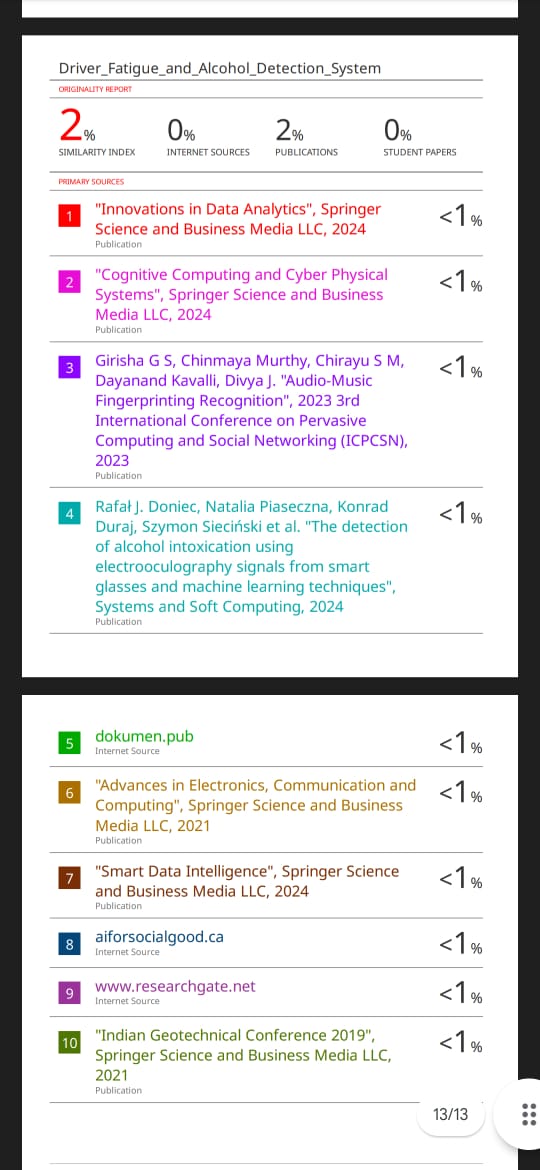
**PSUEDOCODE**

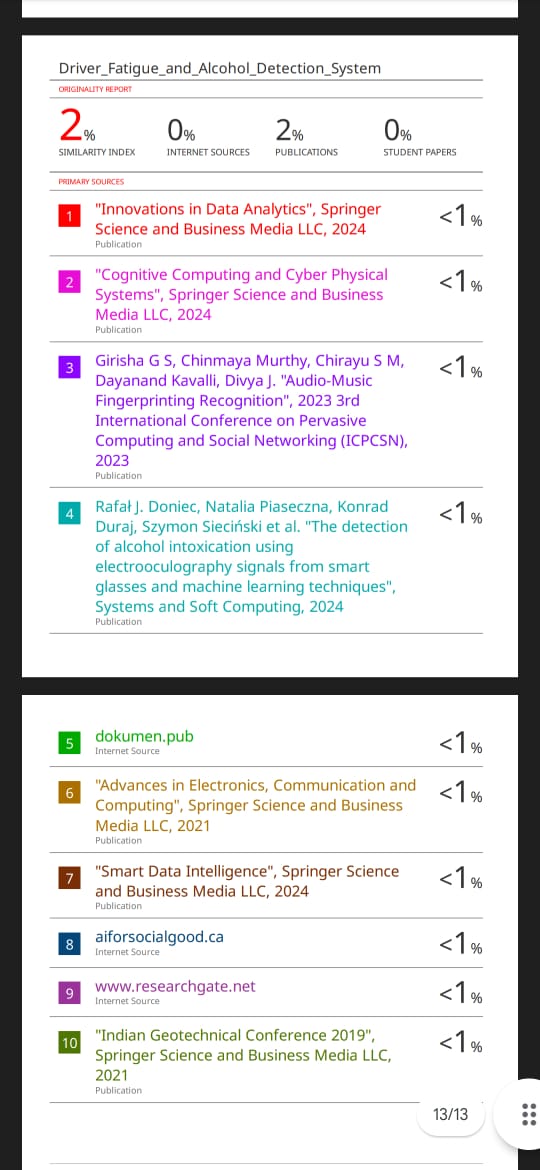
**APPENDIX-B**

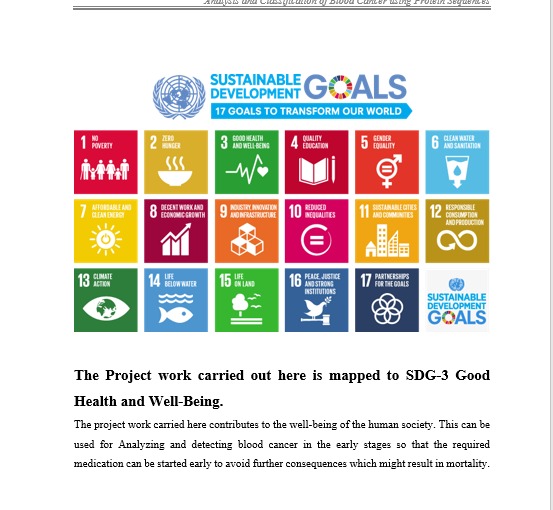
**SCREENSHOTS**

**APPENDIX-C**

**ENCLOSURES**

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