VIGILANCE VISION

Final Year Project Proposal

Bachelor of Science in Software Engineering

By

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1 Abstract

In recent years driver fatigue is one of the major causes of vehicle accidents in the world. Sleep detection in cars is an innovative concept aimed at addressing the critical issue of driver drowsiness, a leading cause of road accidents with severe consequences. This project focuses on developing a system capable of monitoring driver behavior in real time. It utilizes advanced technologies to analyze facial expressions, track eye movements, assess head positioning and machine learning algorithms to enable accurate detection of driver drowsiness and timely alerts for enhanced road safety. By utilizing cutting-edge advancements in IoT, the project seeks to create a reliable and efficient solution to enhance road safety and reduce accidents caused by fatigue.

2 Introduction

The car accident is the leading cause of death, killing around 1.3 million people, and 20 to 50 million people suffer non-fatal injuries due to road accidents each year. Most of these accidents are caused by driver distraction or drowsiness. Drowsiness decreases the driver's concentration, activity, alertness and causes the driver to make slow decisions and sometimes not make decisions. Drowsiness affects mental alertness and reduces the driver's ability to drive a vehicle safely and increase the risk of human error, which can lead to death and injury.

Driver sleepiness is a major contributor to traffic accidents globally, resulting in serious injuries, fatalities, and economic losses. Long driving hours, monotonous road conditions, and insufficient sleep are all variables that might decrease a driver's attention, resulting in slower reaction times and poor decision-making. Despite advances in vehicle safety features, there is still a scarcity of effective solutions for proactively treating driver weariness in real time, particularly those that are non-intrusive, inexpensive, and widely deployable.

The project's goal is to create a sleepiness detection system simulation. The main goal will be to create a system that can precisely track whether the driver's mouth and eyes are open or closed. It is thought that by keeping a watch on the eyes, the signs of a drowsy driver can be identified early enough to prevent an automobile collision. One way to gauge a driver's level of weariness is through yawning detection.

In a country like Pakistan, where road accidents are a major concern, implementing driver sleep detection systems could save countless lives and reduce financial losses. By integrating advanced yet cost-effective technology, this system have the potential to address the specific challenges of local driving conditions, such as poor lighting and diverse driver profiles, while promoting safer transportation across the nation.

3 Problem Statement

Driver fatigue is a critical safety issue that significantly increases the risk of road accidents. Fatigue impairs attentiveness, reducing drivers' ability to respond effectively to road conditions and increasing the likelihood of collisions with other vehicles or structures. In Pakistan alone, fatigue-related driving causes over 100,000 accidents and 1,500 fatalities annually.

Commercial drivers, who endure long working hours, log substantial mileage, and operate under harsh environmental conditions, are particularly vulnerable to drowsiness. This rising concern highlights the urgent need for solutions to mitigate the risks associated with fatigue driving.

Driver inattention caused by fatigue or distraction poses a severe threat to road safety. While driver distraction occurs due to external stimuli diverting focus from driving, driver fatigue results in a gradual decline in concentration due to tiredness. Despite their different causes, both conditions lead to similar adverse outcomes, including reduced driving performance, delayed reaction times, and an increased likelihood of accidents.

Addressing the problem of driver fatigue through a robust sleep detection system is critical for improving road safety and reducing accidents caused by drowsiness.

4 Related Work

EEG-Based Systems

- **Approach**: EEG signals are used to detect micro-sleeps or early stages of drowsiness through brainwave analysis.
- **Limitations**:
  - High intrusiveness due to wearable devices or electrode placement on the scalp.
  - Impractical for real-world driving situations due to setup complexity and cost.

Wearable Technologies

- **Approach:** Devices like smartwatches or headbands measure physiological signals (heart rate, brain activity) to assess fatigue levels.
- **Limitations:**
  - Often intrusive and uncomfortable for prolonged use.
  - Expensive and not feasible for mass adoption.

Current driver drowsiness detection systems face limitations, including poor performance in low-light conditions, reliance on a single input like eye closure, intrusive designs requiring wearables, and lack of adaptive learning mechanisms. EEG-based systems, though accurate, are impractical for real-world driving due to bulkiness, data imbalance, and high false alarm rates. To address these issues, Vigilance Vision proposes a multi-modal approach combining eye-tracking, yawning detection, head tilt analysis, and vehicle data (e.g., steering behavior) with adaptive AI models for personalized monitoring. Using infrared or thermal imaging ensures effectiveness in low-light conditions, while a non-intrusive, dashboard-mounted design eliminates the need for wearables. The system also integrates graded, context-aware alerts to minimize false alarms and employs data-driven refinement with synthetic data and transfer learning for improved performance in detecting rare events like micro-sleeps.

5 Project Scope:

The Vigilance Vision system aims to provide an innovative, real-time solution for detecting driver sleepiness and fatigue, two leading causes of road accidents worldwide. Its core objective is to monitor the driver’s physiological signals, particularly their eye and mouth movements, to identify early signs of drowsiness and provide timely alerts to prevent accidents. The system is designed to be non-intrusive, affordable, and adaptable to a variety of driving environments, making it particularly suitable for regions like Pakistan, where road safety remains a pressing concern. Vigilance Vision leverages computer vision and machine learning to analyze visual cues, such as eye closure, blinking patterns, and yawning, to assess the driver's level of alertness.

Proposed solution:

The Vigilance Vision system detects tiredness by tracking key facial features including the eyes and mouth using computer vision, deep learning, and real-time facial analysis. By assessing these attributes, the system may detect sleepy behaviors such as extended eye closure, heavy blinking, and yawning. This data is processed by a machine learning model that has been trained to spot fatigue patterns. When drowsiness is detected, the system informs the driver using visual signs, audio alarms, or haptic input via the vehicle's steering wheel or seat. The system uses a camera or sensor installed inside the car for non-intrusive detection.

Value proposition:

- **Cost-Effective**: Vigilance Vision provides an affordable solution compared to existing systems, which often rely on expensive hardware or external sensors.
- **Non-Intrusive**: The system uses in-car cameras or basic sensors, making it non-intrusive and easy to implement without requiring the driver to wear any devices or modify their behavior.
- **Environmental Adaptability**: Vigilance Vision is designed to work effectively in different environmental conditions, such as poor lighting or when the driver wears glasses or masks.

Differentiation from others:

The Vigilance Vision system distinguishes itself from other drowsiness detection systems by offering three major advantages. It is cost-effective, depending on in-vehicle cameras or basic sensors rather than expensive technology such as EEG or heart-rate monitors, making it appropriate for widespread deployment in resource-constrained areas. The solution is non-intrusive, integrating smoothly with existing vehicle interiors and requiring no new equipment, ensuring driver comfort. Its environmental adaptability enables it to operate efficiently in a variety of settings, including poor lighting, various driver profiles, and external elements such as fog or rain, making it more dependable than many existing alternatives. Unlike systems that collect data after a fatigue event, Vigilance Vision provides real-time alarms, allowing for early intervention to reduce accident risk. Furthermore, the system combines machines.

Final project output:

The final output of vigilance vision project will be:

1. Real-Time Detection system:
   A functional system that uses a webcam to monitor the driver’s face in real time. Drowsiness detection based on closed eyes or yawning.
2. Web-Based Dashboard:
   A responsive and intuitive dashboard accessible via browser.
3. Event Logging System:
   All detection events are stored in firebase. All timestamps and types of drowsiness detected.
4. Hardware Integration:
   Seamless operation with standard hardware setups. The output will provide a robust, user-friendly to enhance road safety. Along with potential for further enhancements.

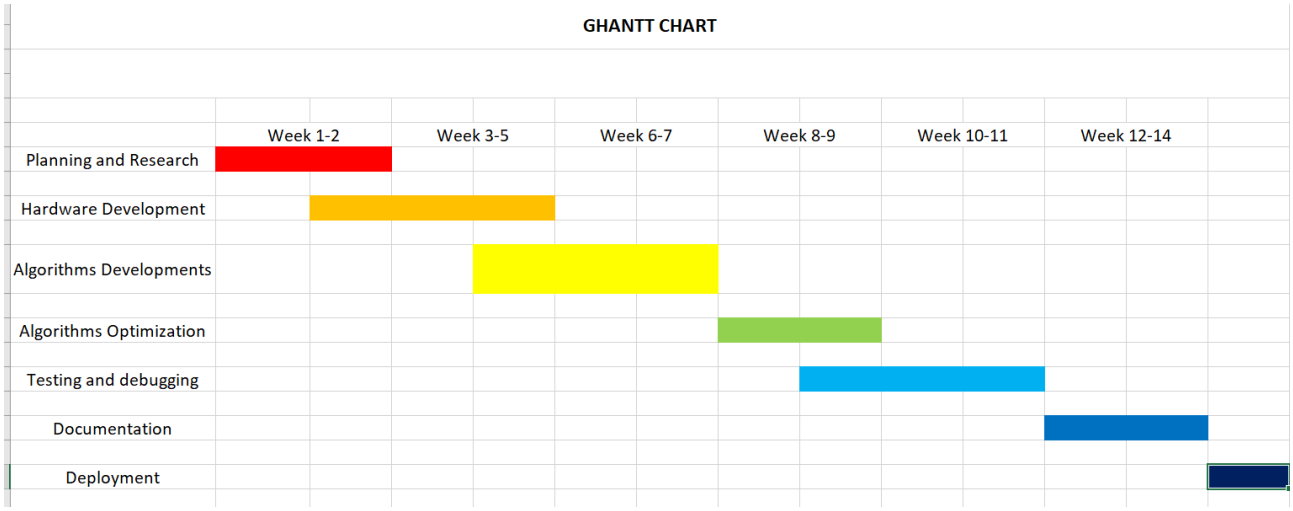
6 Project Development Methodology

- Tools and Technologies:
  - Programming language: Python
  - Framework and Libraries:

1. YOLOv5
2. Media Pipe
3. Flask
4. Deep learning model

- Database: Firebase
- Front end: Html & Tailwind CSS
- Hardware Requirement:
    1. Laptop
    2. Webcam
    3. Alarm

7 Project Milestones and Deliverables



8 References (Optional)

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