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Development of Intelligent Vehicle System to Detect Driver Drowsiness in Order to Reduce Accidents

Chanbasappa Patil[1]
[1] *Senior Scale Lecturer, Department of Electronics and Communication Engineering, Government Polytechnic Bidar, Karnataka, India.*

Abstract: *Research indicates that a significant factor contributing to traffic accidents is driver fatigue. The development of technologies that prevent sleepiness in real-time presents one of the most significant challenges in the field of accident avoidance. Advancements in computer technology have enabled the development of intelligent vehicle systems. This research aims to identify driver sleepiness to mitigate accidents and enhance highway safety. A system utilizing video analysis for the identification of driver fatigue or drowsiness is being introduced. A real-time face detection system is employed to determine the driver's facial area. A camera positioned directly at the driver's face captures video footage, which is utilized to develop a method for detecting driver fatigue. The system employs image processing technology to analyze video camera images of the driver's face as a detection method. The video has been captured, converted into a series of image frames, and the ocular and facial regions are analyzed to detect indicators of fatigue. The device is capable of monitoring the eyes to determine if they are open or displaying signs of drowsiness. This detection system employs a noncontact method to assess varying levels of attention, facilitating the early identification of decreased alertness during driving.*
Keywords: *Intelligent Vehicle System, Image Segmentation, Detect Driver Sleepiness, Reduce Accidents.*

I. INTRODUCTION

The primary objective of Intelligent Transportation Systems (ITS) is to enhance public safety and reduce the incidence of accidents. Driver fatigue and repetitive driving conditions are two of the primary factors that significantly contribute to accidents, especially on rural roadways. Fatigue reduces driver perceptions and decision-making abilities. Research indicates that a motorist frequently experiences fatigue after one hour of driving. Driver fatigue and drowsiness levels are significantly elevated during the afternoon, early morning, post-lunch period, and at midnight compared to other times of the day. Loss of consciousness can occur as a consequence of drug addiction, alcohol consumption, and the administration of hypnotic medications. Various countries have recorded data regarding accidents attributed to driver fatigue and distraction. Driver fatigue and inattention frequently account for 20% of collisions and 30% of fatal collisions. Research indicates that as much as 50% of collisions involving large vehicles or single-vehicle incidents—where only one vehicle sustains damage—are attributable to drivers exhibiting insufficient attention to their surroundings. Recent studies suggest that implementing driver face monitoring devices is expected to reduce accident rates by 10% to 20%. A driver face monitoring system is a real-time system designed to analyze photographs of a driver's face to assess their physical and mental health status. The assessment of the driver's condition can be conducted through the analysis of eye closure, eyelid distance, blinking frequency, gaze direction, yawning occurrence, and head rotation. In situations of hypovigilance, characterized by weariness and distraction, this mechanism will activate an alert. The driver face monitoring system consists of three primary components: intelligent software, a hardware platform, and imaging technology. The primary components of a driver monitoring system include the following: The initial five steps include face identification, eye detection, face tracking, symptom extraction, and driving state assessment. Face detection serves as the initial phase in image processing for most driver face monitoring systems. Face detection techniques can be categorized into two main types: Feature-based techniques and learning-based techniques. The concept of feature-based approaches involves the application of heuristic rules to specific characteristics, enabling the identification of the face depicted in the image. These techniques are commonly employed for the purpose of identifying an individual face within an image. A widely utilized and efficient method is color-based facial recognition. The face is identified based on its form and skin tone using these techniques. Color-based face recognition can be implemented using various color spaces, including RGB, YCbCr, and HIS. The performance of these algorithms is suboptimal in images characterized by low light conditions or elevated noise levels. Face detection based on learning methodologies utilizes training samples and statistical learning techniques to identify discriminative features. The techniques are derived from machine learning algorithms and statistical models. Learning-based approaches for face identification generally exhibit reduced error rates; however, they typically require increased computing power. A rapid and dependable method for object identification was presented by Viola and Jones. This method was utilized for face detection. The eye area is consistently analyzed in driver face monitoring systems due to the importance of eye-related symptoms for symptom extraction. Consequently, it is essential to perform eye recognition before proceeding with the analysis of the eye region. This study presents a new driver face monitoring system designed to adaptively extract signs of hypovigilance from the driver's facial features and eye movements. A fuzzy expert system subsequently evaluates the symptoms to determine the driving condition.

II. SYSTEM OVERVIEW

This chapter discusses the many components, both hardware and software, that were used in the making of this project. A list of the hardware components may be seen below. Block diagrams, such as the one seen below, are being used for this project.

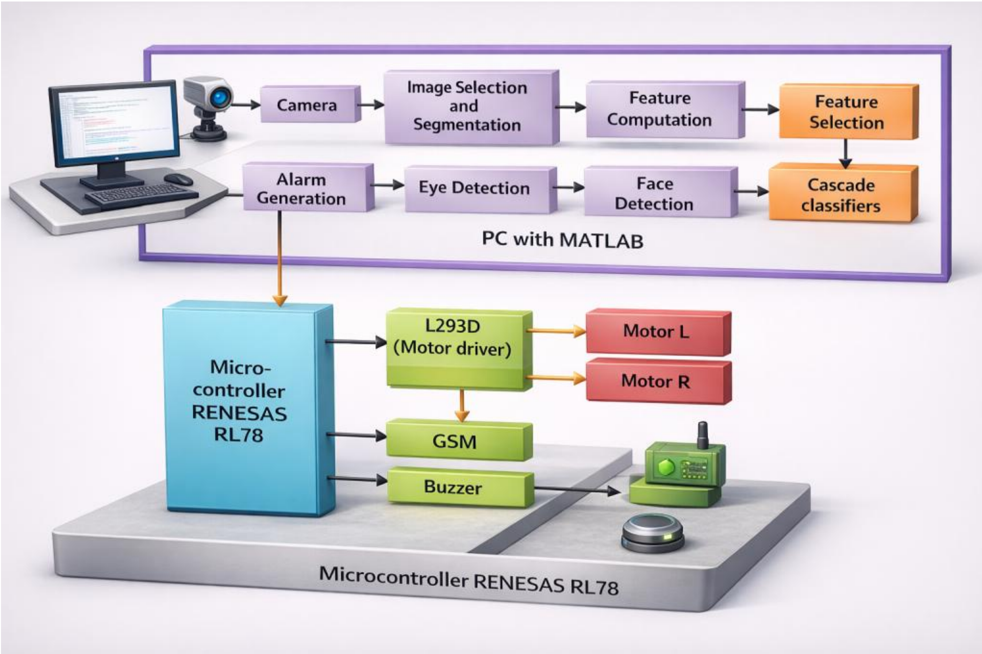

Fig 1: Facial features detection and motor control system

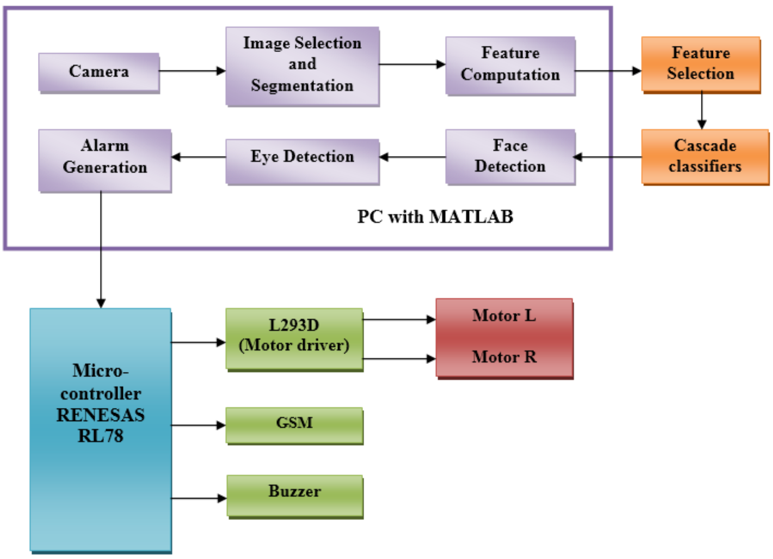

Fig 2: Proposed system block diagram

To construct a working driver monitoring system, choose, investigate, evaluate, design, and test the following submodules. Obtain Images: A video camera with infrared LEDs in front of the driver records the driver. A sophisticated face identification module detects the driver's face to better monitor them. The face detection method uses Viola-Jones face detection. Eyes Detection: A HAAR Classifier module locates the driver's eyes. The main block for eye distraction detection. It compares the results to safe driving eye conditions. Visual Cues Extraction: facial and eye coordinates are used to extract the driver's eyelid movement, facial alignment, and gaze direction. Visual Cues Tracking: Every frame, the recovered visual cues' locations and movements are tracked. Visual cues are combined to form the driver's condition. An alarm is generated if the driver's attention is extremely low, depending on their state as determined in previous blocks. If conditions are normal, monitoring continues. After receiving the data, the microcontroller sends the driver an SMS over GSM when they start to sleep.

2.1 Renesas microcontroller:

These increasingly popular MCUs allow ultralow-power applications by offering system designers greater power-saving and high-performance operation. RL78 MCUs are superior for many battery-powered applications because they provide an innovative Snooze mode that allows serial connection and ADC operation while the CPU is off.

Best-in-class performance due to reduced power consumption and excellent designs.

Package, memory, and peripheral feature scalability.

Cost-saving characteristics of the system.

Operation at a wide voltage and temperature.

Features for on-chip safety.

The Renesas controller group is perfect for a variety of consumer and industrial applications, including motor control and sensor systems, that call for high-performance timer and analog capabilities in tiny packages.

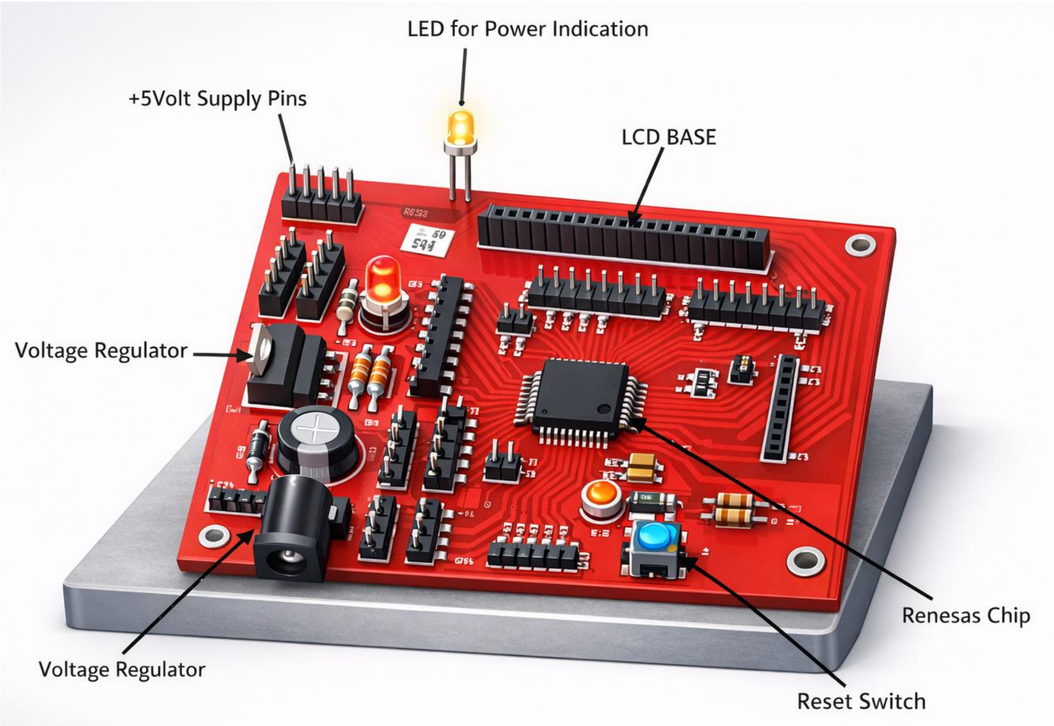

Fig 3: PCB with labeled components

2.2 L293 Motor Driver

Two tiny motors may be controlled simultaneously and in both directions using the L293 integrated circuit motor driver.

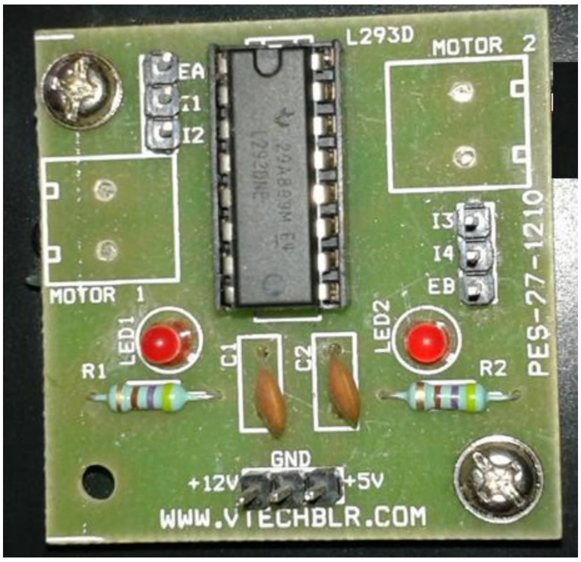

Fig 4: L293D Motor driver

The four-channel, monolithic integrated high voltage, high current driver drives switching power transistors and inductive loads such relays, solenoids, DC motors, and stepper motors. Normal DTL or TTL logic levels are supported. Each pair of channels includes an enabled input for easy two-bridge use. The logic incorporates a separate supply input and internal clamp diodes for reduced voltage operation. In switching applications, this device can operate at 5 KHz.

The L293D is assembled in a 16-lead plastic box with four connected heat sink center pins. As an integrated circuit motor driver, the L293D can operate two small motors in opposite directions. Limit is 600 mA for L293D.

2.3 GSM

GSM stands for Global System for Mobile Communications. The European Telecommunications Standards Institute (ETSI) produced these standards to describe "2G" digital cellular network technology. GSM initially specified switched circuit networks for full duplex voice transmission to replace first-generation analog cellular networks.

Fig 5: GSM Module

The majority of 2G GSM networks utilize the 900 MHz or 1800 MHz bands, however GSM networks employ a number of carrier frequency ranges. The US and Canada utilized the 850 MHz and 1900 MHz frequencies since they were already allocated. Some governments allocate the 400 and 450 MHz frequency bands since they were utilized for first-generation systems.

2.4 Buzzer

Fig 6: buzzer module

Buzzers are used for timers, notifications, and confirming user input such keyboard or mouse clicks. A microcontroller buzzer alerts the user of an LPG gas leak. Operating Current: 40mA, 5V DC

III. RESULTS & DISCUSSION

Fig 7: Human detection

MATLAB was used to build and test the driver monitoring system prototype module. Each module is assessed and tested before assembly. Figure 8 shows a working module.

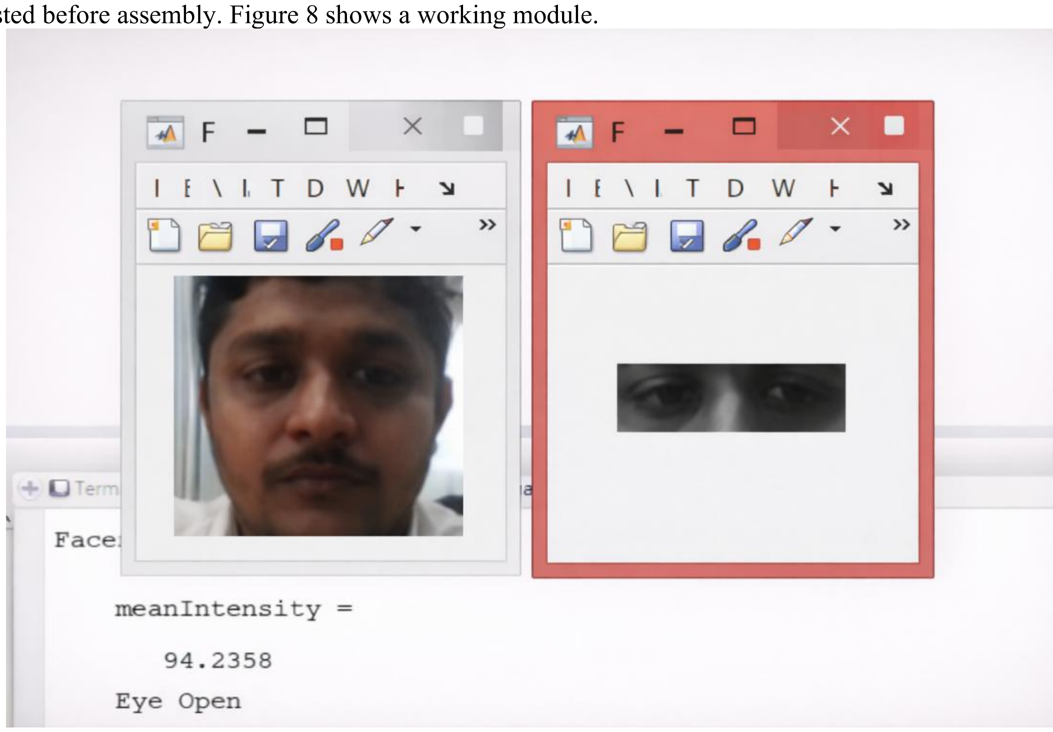

Fig 8: Recognition of face

One frame out of every frame is shown graphically here. The intensity increases while the eyes are open and decreases when they are closed. Additionally, its intensity peaks between two places. We reiterate these two points. The eyes will be open between these two positions, according to the analysis of every picture of the ocular area alone.

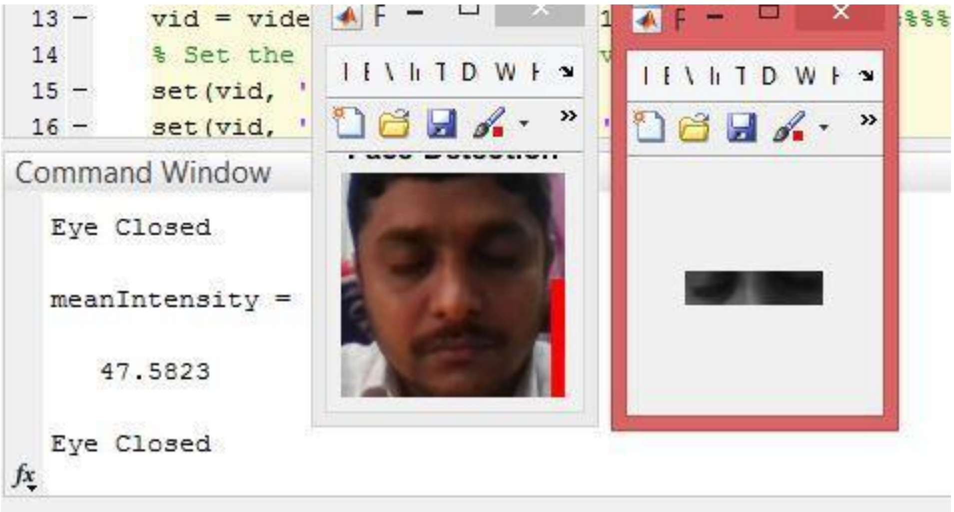

Fig 9: Resulted image of drowsiness

This indicates that the driver is feeling sleepy, which is why the intensity is different from the prior record. Different self-developed image processing algorithms are used to collect information about the location of the face and eye. The device can determine if the eyes are open or closed throughout this operation.

Fig 10: Displaying person's state as drowsiness

As can be seen in picture 8, this particular interface is indicating that the driver is experiencing drowsiness.

IV. CONCLUSIONS

This research was able to meet its major aim, which was to develop a Driver monitoring system that was reliable, cheap in cost, and low in power consumption. This was accomplished by the effective execution of the work that was presented before the audience. Facial expressions are extremely reliable indicators of a driver's degree of fatigue, and this approach reveals that facial expressions can be used to conduct fine discriminating in a range of sleepiness levels. Facial expressions may also be utilized to determine whether or not a motorist is exhausted. When seen in this light, it requires the use of highly developed image processing algorithms in order to recognize the facial expressions of drivers, which in turn decreases the amount of hardware that is necessary. Furthermore, it is able to discern with a great degree of precision whether the eyes are open or closed, in addition to determining the extent of the intensity.

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