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HEART RATE VARIABILITY BASED DRIVER DROWSINESS DETECTION AND ITS VALIDATION WITH EEG

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ABSTRACT :

Being drowsy while driving is deemed a very dangerous thing. It is important to address that problem since drivers' lives are at risk. Preventing accidents would be too hard for them if they feel drowsy. This study aims to develop a device to help drivers, especially at night, to secure themselves from accidents due to drowsiness or sleepiness. It is especially sought to design an electronic device that will detect a person who is drowsy while driving random changes in steering movement leads to reduction in wheel speed. The threshold of the vibration sensor can be varied and accordingly action can be taken. The outcome is that the vibrator attached to eye blink sensor's frame vibrates if the driver falls asleep and also the LCD displays the warning messages. The wheel is slowed or stopped depending on the condition. This is accompanied by the owner being notified through the IOT module, so the owner can retrieve the driver's location, photograph and police station list near to driver's location. This is how the driver can be alerted during drowsiness and the owner can be notified simultaneously configured to detect drowsiness by means of the proposed web application design manager will check system parameters and send a message to his college colleague. In this project, we proposed heartbeat sensor and eye blink sensor to detect driver stress and driver pupil dilation. The proposed system detects the driver's drowsiness and if detected alert will be given through buzzer, if the driver doesn't wakes up then vehicle slows down. The Gas sensor indicator is used to buzzer to measure the fuel level or leakage monitor.

II.INTRODUCTION :

DRIVER distractions are the leading cause of most vehicle crashes and near- crashes. According to a study released by the National Highway Traffic Safety Administration (NHTSA) and the Virginia Tech Transportation Institute VTTI) [16], 80% of crashes and 65% of near-crashes involve some form of driver distraction. In addition, distractions typically occurred within three seconds before the vehicle crash. Recent reports have shown that from 2011 to 2012, the number of people injured in vehicle crashes related to distracted driving has increased 9% [1]. In 2012 alone, 3328 people were killeddue to distracted driving crashes, which is a slight reduction from the 3360 in 2011. Distracted driving is defined as any activity that could divert a person's attention away from the primary task of driving. Distractions include texting, using a smart phone, eating and drinking, adjusting a CD player, operating a GPS system or talking to passengers. This is particularly challenging nowadays, where a wide spectrum of technologies have been introduced into the car environment. Consequently, the cognitive load caused by secondary tasks that drivers have to manage has increased over the years, hence increasing distracted driving.

According to a survey [14], performing a high cognitive load task while driving affects driver visual behavior and driving performance. References [22] and [36] reported that drivers under high cognitive loads showed a reduction in the time spent examining mirrors, instruments, traffic signals, and areas around intersections.

Especially concerning is the use of hand-held phones and other similar devices while driving. NSTHA [16] has reported that texting, browsing, and dialing cause the longest period of drivers taking their Eyes Off the Road (EOR) and increase the risk of crashing by three fold. A recent study [41] shows that these dangerous behaviors are wide-spread among drivers, 54% of motor vehicle drivers in the United States usually have a cell phone in their vehicles or carry cell phones when they drive. Monitoring driver activities forms the basis of a safety system that can potentially reduce the number of crashes by detecting anomalous situations. In [29], authors showed that a successful vision-based distracted driving detection system is built upon reliable EOR estimation, see Fig. 1. However, building a real time EOR detection system for real driving scenarios is very challenging for several reasons: (1) The system must operate during the day and night and under real world illumination conditions;(2) changes in drivers' head pose and eye movements .

I.LITERATURE SURVEY

[1] S. G. Klauer, T. A. Dingus, V. L. Neale, J. D. Sudweeks, and D. J. Ramsey, "The impact of driver inattention on near-crash/crash risk: An analysis using the 100-car naturalistic driving study data," Tech. Rep., 2006.

This paper provides a stand-alone framework for measuring air quality in real time that involves specific parameters: PM 2.5, carbon monoxide, carbon dioxide, temperature, moisture and pressure[1]. The Internet of Things is now being used widely in all industries and plays a vital role in our air quality network. The Internet of Things that converges with cloud computing. The model proposed consists of environmental sensing units (such as humidity, temperature, heat index, power, etc.) which are able to track the energy consumed in voltage The regulating mechanism calibrates further[2] to generate aggregated data and eventually gathers this data on the Internet portal. For this article, we focused mainly on protection
precautions for both the driver and the

II.PROBLEM STATEMENT

This work is related to four established areas of computer vision: facial feature extraction, head pose estimation, and gaze tracking. The contribution of this paper is in the integration of cutting-edge algorithms and ideas borrowed and modified from each of these fields in order to demonstrate effective eyes-free gaze classification in the wild (a large on- road driving dataset). contribution of the algorithm is an iterative transform of the image to a normalized coordinate system based on the current estimate of the face shape. Also, to avoid the non- convex problem of initially matching a model of the shape to the image data, the assumption is made that the initial car by utilizing three forms of sensors.
The pulse sensor is used to continuously track the driver's pulse rate[3] and avoids IOT incidents. The User, [11] Ambulance and police are told of an incident via IOT.

estimate of the shape can be found in a linear subspace. Head pose estimation has a long history in computer vision. Murphy-Chutorian and Tried [8] describe 74 published and tested systems from the last two decades. Generally, each approach makes one of several assumptions that limit the general applicability of the system in driver state detection Our approach focuses on the head as the proxy for classifying broad regions of eye movement to provide a mechanism for real-time driver state estimation while facilitating a more economical method of assessing driver behavior in experimental setting during design assessment and safety validation.

ALGORITHM

Heart rate variability (HRV) based driver drowsiness detection, in conjunction with EEG validation, is a sophisticated approach aimed at enhancing road safety by identifying and mitigating instances of driver drowsiness. This method involves the acquisition of real-time HRV data

and current parameters of the different household equipment using a heart rate monitor and simultaneous EEG data from sensors placed on the driver's scalp. Following data acquisition, pre-processing steps including noise filtering segmentation into smaller time windows are conducted. Subsequently, features are extracted from both HRV and EEG signals, encompassing metrics such as time and frequency-domain measures for HRV, and power spectral density across different EEG frequency bands. These features are then fused into a unified feature vector for classification. Machine learning models, trained on labelled data, are utilized to classify

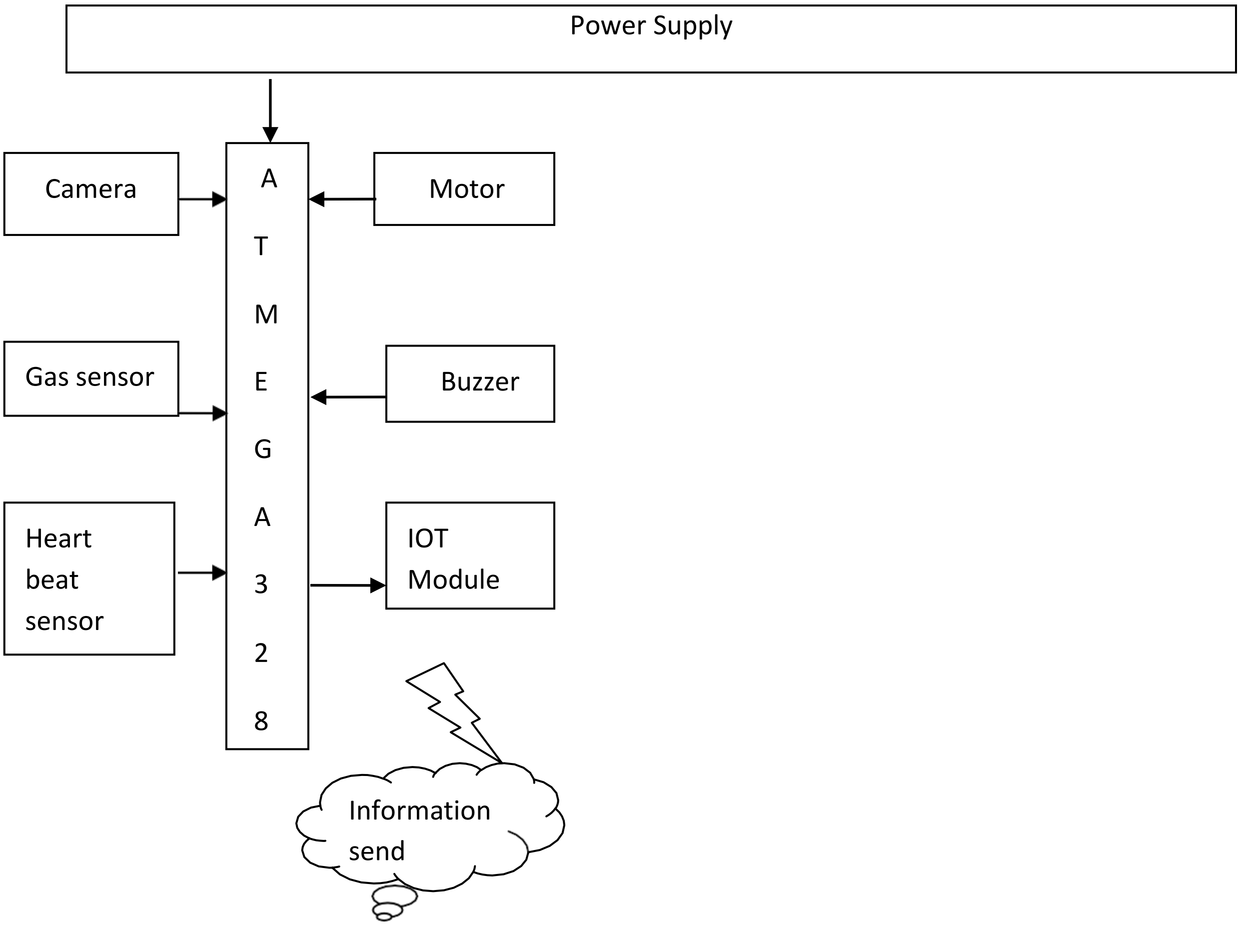
Advantages :

- Very compact and light. Low power consumption. On average, 50-70% less energy is drowsiness states based on the feature vector. Validation of the model is crucial, involving testing with separate datasets or through cross-validation techniques to ensure robustness and reliability. Real-time detection implementation is the carried out, incorporating threshold settings for triggering drowsiness alerts and defining appropriate actions. Continuous testing, optimization and eventual deployment into vehicles or driver assistance systems complete the process, with ongoing monitoring and updates essential for sustained effectiveness and safety assurance. Ethical considerations, privacy regulations, and safety protocols must be adhered to throughout the development and deployment phases to ensure responsible and ethical use of such technology.

- consumed than CRT monitors. No geometric distortion. The possible ability to have little or no flicker depending on backlight technology.
- Usually no refresh-rate flicker, as the LCD panel itself is usually refreshed at 200 Hz or more, regardless of the source refresh rate. Is very thin compared to a CRT monitor, which allows the monitor to be placed farther back from the user, reducing close- focusing related eye-strain. Razor sharp image with no bleeding/smearing when used at native resolution.
- Emits less electromagnetic radiation than a CRT monitor.
- Not affected by screen burn-in, though an identical but less severe phenomenon known as image persistence is possible. Can be made in almost any size or shape. No theoretical resolution limit.

Block Diagram

Power Supply: This block provides Electrical power to all other Components in the system. It might Include batteries, a DC power source, Or an AC adapter. Motor: The motor block represents a device that converts electrical energy into mechanical energy to perform some physical action. For example, it could be a motor used to drive a vehicle or rotate a mechanical arm. Gas Sensors: These sensors detect the presence of certain gases in the environment. They might be connected to a monitoring system or controller to provide feedback or trigger actions based on the gas levels detected. Heartbeat Sensor: This sensor detects the heartbeat of a person and provides data related to their heart rate or rhythm. It could be used for health monitoring or fitness applications. Buzzer: The buzzer block represents a device that produces audible alerts or alarms. It could be activated by various triggers, such as detecting high levels of gas or abnormal heartbeats. The specific connections between these components will depend on the requirements and functionality of your system. For example the gas sensors might be connected to a microcontroller or processor that analyzes the sensor data and decides whether to activate the buzzer or control the motor based on predefined conditions.



B. Working

The implementation of a preventive program for this matter has become a big challenge. The eye condition and safety parameters examination are calculated in this method. Designed by the driver's head, the microcontroller and the USB device are. In many cases, drivers who are drowsy make no effort to apply brake or avoid an accident. So, a system is designed which senses the condition of the driver (his/her health) and stops the vehicle immediately if an abnormal condition of the driver is sensed to avoid accidents. Truck drivers, company car drivers and shift workers are the most at risk of falling asleep while driving. Majority of the accidents occur due to the drunkenness of the driver .In this project, we proposed heartbeat sensor and eye blink sensor to detect driver stress and driver pupil dilation. The proposed system detects the driver's drowsiness and if detected alert will be given through buzzer, if the driver doesn't wakes up then vehicle slows down and moves to left and will be stopped. The burden of which lies on the company owner as they are made liable. It can lead to economic loss. In this presentation we present an adaptive driver and company owner alert system and an application that provides driving behaviour to the company owner. In this system angas sensor are interfaced to an Arduino. If any of these sensors senses an abnormal condition of the driver, the vehicle automatically slows down and stops. A buzzer is placed in the vehicle which alerts the surrounding vehicles or the passengers inside the vehicle. At the same time an SMS alert consisting of the location and condition of the driver is sent to the registered mobile number. Can be used for monitoring the position of the driver, and will hit his colleague there as well as hospitals to help him. This data can also be sent to the server (Cloud) to deliver a message to his colleague in order to alert the driver.

CONCLUSION

This paper shows that spatial configuration of facial landmarks provides sufficient discriminating information to accurately classify driver gaze into six gaze regions. The proposed system achieves an average accuracy of 91.4% at an average decision rate of 11 Hz for an on-road dataset of 50 subjects. Four

observations are made aboutthis

problem. First, building a subject- specific model (using 3 seconds of training data per class) improves classification accuracy from 44.1% to 65%. Second, considering only confident classification decisions improves accuracy from 65% to 91%. Third, the problem of two region gaze classification (“driving-related” versus center stack) that is especially relevant to driver safety results in higher accuracy than the more general sixregion classification problem. Fourth, the classification accuracy varies significantly between subjects and within subjects. Our future work will explore and exploit this inter-person and intra-person variation as it relates to the relationship between eye and head movement.

FUTURE ENHANCEMENT

Advanced HRV Analysis Techniques: Incorporate more sophisticated HRV analysis techniques beyond basic measures like RMSSDD (Root Mean Square of Successive

Differences) or SDNN (Standard Deviation of NN intervals).

Techniques such as frequency domain analysis (e.g., power spectral analyysis) or non-linear dynamics (e.g., Poincare Plots, entropy measures) clould provide deeper insights into autononic nervous system activity and improve drowsiness detection accuracy. Multimodal Fusion: Combine HRV data with other physiological signals, such as electroencephalography (EEG),

Electrooculography(EOG), or electromyography (EMG), to create a multimodal drowsiness detection system. Integrating EEG signals can provide complementary infokrmation about brain activity and enhance the system’s ability tok detect drowsiess accurately. Machine Learning algorithms: Implement advanced machine learning algorithms, such as deep learning models (e.g., convolutionall neural networks, recurrent neural networks) or ensemble methods, to analyze HRV and EEG data simultaneously. These algorithms can learn complex patterns and relationships between physiological signals, improving th sysyems performance in distinguishing drowsy states from alert states. Real-time Monitoring and Feedbkack: Develop a real-time monitoring system that continuously analyzes HRV and EEG signals during driving. Provide timely feedback to the driver through visual, auditory, or haptic cues to alert them when drowsiness is detected, helping prevent accidents due to fatique.

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