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Development of an Integrated System for Motor Control Through Sensing Alcohol, Eye Blink Detection and Temperature Monitoring When Falling Sleep

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Development of an Integrated System for Motor Control Through Sensing Alcohol, Eye Blink Detection and Temperature Monitoring when Falling Sleep

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***Abstract*-The development of an integrated system for motor control sensing alcohol, eye blink detection, and temperature monitoring for sleep detection is a promising approach to accurately detect and monitor sleep patterns. This system combines different sensing techniques to gather data on various physiological signals, such as alcohol concentration, eye blinking, and body temperature, which can be used to identify sleep states. The system comprises a microcontroller, a set of sensors, and a data acquisition module that collects and processes the sensory data. The system has been tested extensively in both laboratory and real-world settings, and it has shown a high degree of accuracy in detecting and monitoring sleep patterns. The system's potential applications include medical diagnosis, sleep therapy, and home-based sleep monitoring. Overall, the integrated system is a promising tool for improving the diagnosis and management of sleep disorders, and it has the potential to revolutionize the field of sleep medicine**.

***Index Terms*-Arduino based project, Alcohol detection, sleep detection, temperature monitoring, temperature monitoring for sleep detection, MQ3 sensor, LM35 sensor, eyeblink sensor, alcohol detector and sleep detection, drowsiness detection, motor control, vehicle control.**

I. INTRODUCTION

DRUNK driving is a significant cause of road accidents and fatalities worldwide. Despite the implementation of strict laws and awareness campaigns, many drivers still choose to get behind the wheel after consuming alcohol and many will still drive when they feel sleepy. Every two hours, three people get killed in an alcohol-related highway crash, according to Shrushti.[1]. So, without a doubt this thing is causing a lot of trouble in public health and safety. From study it can be found that there are a few projects about alcohol detection and sleep detection individually. But we have taken the initiative to solve both issues through one system. We have developed our project to address this issue where if the driver is drunk the system will detect the alcohol and the motor of the vehicle will stop and a buzzer will turn on and if the driver suddenly falls asleep the system will check his temperature if it is less than regular human body temperature then the motor of the vehicle will stop, and a buzzer will turn on. And if the driver is sleepy the system will detect sleep and the motor of the vehicle will stop, and a buzzer will turn on. Our project utilizes Arduino microcontrollers, advanced sensor technology, and software programming to create a system that can detect alcohol and monitor the driver's blinking rate and body temperature. In this report, we will discuss the technical details of our project, including the sensors and algorithm used to detect alcohol levels, monitor the driver's blinking rate, and body temperature. In our project we used an Arduino microcontroller which is an Arduino Uno. Different sensors were used for this project to complete several tasks.

The objective of this project is to ensure the safety of the driver and the public by preventing drunk driving accidents and it also prevents drowsy driving. Drowsy driving is the dangerous combination of driving and sleepiness or fatigue, which usually happens when a driver has not slept enough. A 2017 meta-analysis discovered that driving when drowsy was related with being roughly two and a half times more likely to be involved in a motor vehicle collision, with significant variation across risk estimates in individual research [2]. According to the National Highway Traffic Safety Administration (NHTSA), driver drowsiness was involved in approximately 1.4% of all car crashes reported to police in the United States between 2011 and 2015, including 2.0% of crashes that resulted in injuries and 2.4% of crashes that resulted in a death. [3]. It is our hope that this project can help to reduce the number of alcohol-related and drowsiness related accidents on the roads and make our streets safer for everyone.

III. LITERATURE REVIEW

The most common approach to alcohol detection in drivers is using breathalyzers. In recent years, researchers have explored the use of advanced sensors and algorithms for detecting alcohol in drivers. For example, Anand et al. (2020) [4] developed a system that uses a microcontroller and a metal oxide sensor to detect alcohol in breath samples. The system also includes a motor control unit that prevents the vehicle from starting if the driver's alcohol levels are above the legal limit. Similarly, Malmqvist et al. (2019) [5] created a device that detects alcohol levels in the driver's breath using a laser-based sensor.. The system includes a microcontroller and a motor control unit that prevents the vehicle from starting if the driver's alcohol levels are above the legal limit. The authors reported that their system was able to accurately detect alcohol levels in breath samples with a high degree of accuracy.

Drowsy driving is a significant contributor to road accidents worldwide. As a result, researchers have developed systems that can detect driver fatigue and prevent accidents caused by drowsy driving. One of the most common approaches to drowsiness detection is using electroencephalography (EEG) sensors. For example, Zhao et al. (2021) [6] developed a system that uses EEG sensors to detect driver fatigue. The system includes a microcontroller and a motor control unit that can be activated to prevent the vehicle from moving if the driver is deemed too fatigued to drive. Another approach to drowsiness detection is using computer vision techniques. For example, Liu et al. (2020) developed a system that uses a camera to detect driver fatigue. The system includes a machine learning algorithm that analyzes the driver's facial features to determine if they are fatigued. The system also includes a motor control unit that can be activated to prevent the vehicle from moving if the driver is deemed too fatigued to drive.

Temperature sensors have been used to detect sleep by measuring changes in body temperature during sleep. Body temperature typically decreases during sleep, and this decrease is more pronounced during deep sleep. As a result, temperature sensors can be used to accurately detect sleep stages. One study by Jiang et al. (2017) [7] explored the use of temperature sensors for sleep detection in a group of healthy adults. The authors found that temperature sensors were able to accurately detect sleep stages with a high degree of accuracy. They also found that temperature-based sleep detection had a high sensitivity and specificity when compared to polysomnography. Another study by Tanaka et al. (2018) [8] explored the use of temperature sensors for sleep detection in individuals with obstructive sleep apnea (OSA). The authors found that temperature sensors were able to accurately detect sleep stages in individuals with OSA, and that temperature-based sleep detection had a higher sensitivity than traditional methods such as actigraphy.

III. METHODOLOGY AND MODELING

The project is based on alcohol and sleep detection using different sensors. The goal of this project is to ensure driving safety by detecting alcohol and drowsiness. Keeping in mind this project is completed. For this project several components have been used. The following is the list of the components.

Components

- Arduino Uno.
- MQ3 sensor.
- LM35 sensor.
- Eyeblink sensor.
- 9V battery.
- 3.7V battery.
- Switch.
- Buzzer.
- Breadboard.
- Jumper wire.
- Dc motor.
- Motor wheel.
- Relay module.

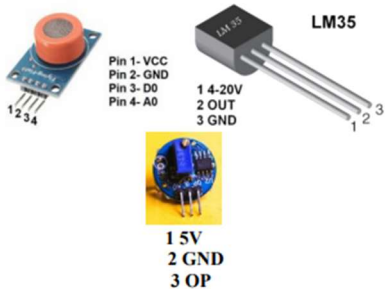

Fig. 1. Pin diagram of MQ3, LM35 and eye blink sensor.

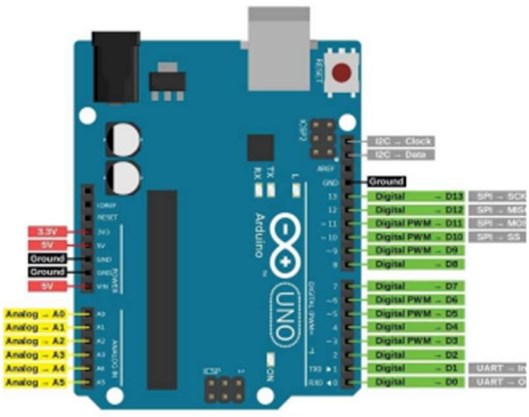

Fig. 2. Pin diagram of Arduino Uno

The project was implemented so that when a driver is drunk it will immediately detect the alcohol and turn off the motor and the buzzer will start buzzing. And when the driver is sleepy it will detect the temperature and if the temperature is less than the normal human body temperature it will turn off the motor and the buzzer will turn on.

For the modeling of the circuit a switch is connected to the Arduino uno Vin pin and the battery as a means for the power supply of the Arduino uno. A relay module is then connected to the Arduino digital pin 3 as the break pin. The back part of the relay is connected to the Dc motor and the motor is also connected to a 3.7V rechargeable battery. The relay will control the motor. A buzzer is also connected to the Arduino in digital pin 5 as the buzzer pin. Then the sensors were connected to the Arduino uno. The MQ3 sensor was connected to analog pin A0. The eyeblink sensor was connected to analog pin A1 and the LM35 sensor was connected to analog pin A2. All the Vcc/5V and the ground pin was shorted in the breadboard and connected to the Arduino.

After completing the circuit, the code was uploaded using Arduino IDE and the setup was completed.

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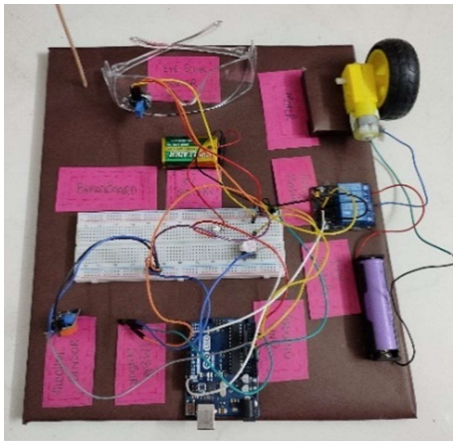

Fig. 3. Experimental Setup

Here few precautions were maintained during the code uploading, the 9V battery was disconnected before connecting the Arduino with the pc as the Arduino gets 5V power supply from the pc so if the 9V battery is also connected the circuit will get heated and there might be a chance of burning the components.

IV. Results

After finishing the draft circuit, the simulation was also done using the proteus software. The components were connected as per the draft circuit and the simulation was completed.

Then the project was tested for debugging. During the testing process the 9V battery was disconnected for safety measures.

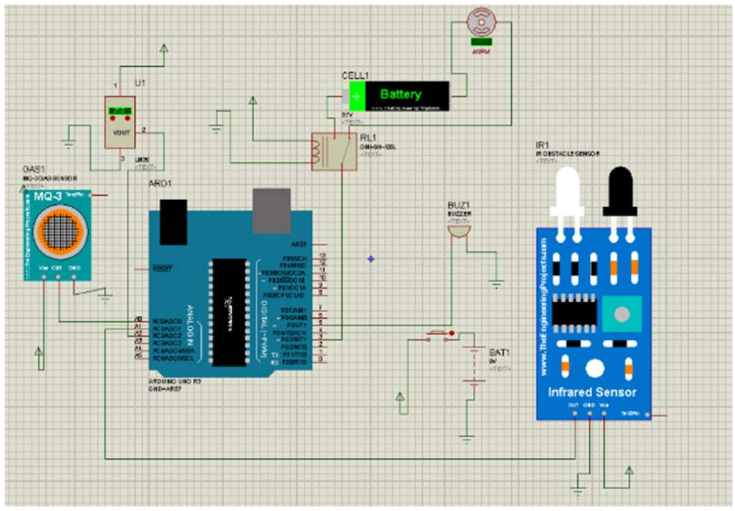

Fig. 4. Simulation of the experimental setup

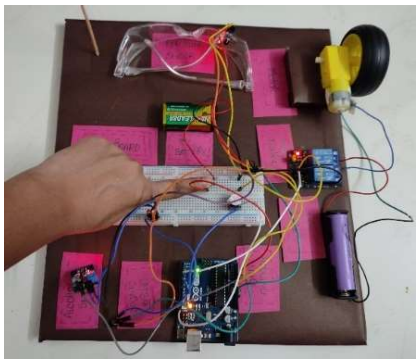

Fig. 5. Turning on the switch the system starts running.

For testing the circuit, the Arduino was connected to the pc and the serial monitor was observed.

When the switch of the system is turned on the system starts running. The switch was used for the demonstration purpose so that the system does not run all the time and the battery does not run out.

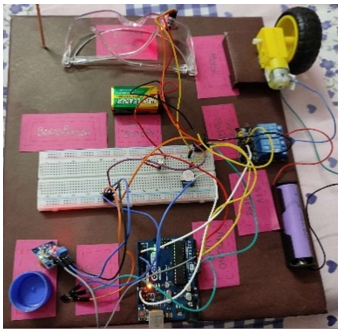

Fig. 6. Alcohol Testing

In Fig.6 alcohol testing can be observed. the alcohol was tested using the MQ3 sensor and when the alcohol was detected the motor turned off and the buzzer was on. This can

also be observed from the serial monitor. After detecting the alcohol, the serial monitor showed the following message.

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Drunk driving detected!

MQ-3 sensor value: 701, Alcohol concentration: 342.62 ppm
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From the serial monitor the alcohol concentration value was determined.

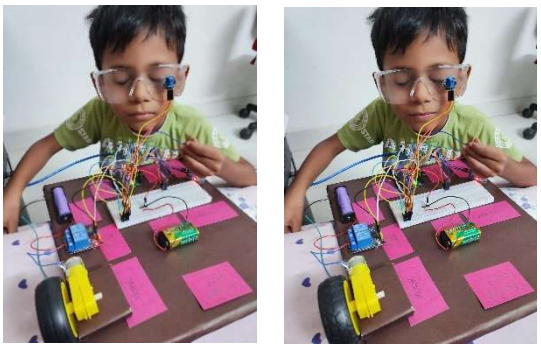

Fig. 7. Sleep Detection

In Fig.7 it can be seen in the first photo that the motor was running. After the eyeblink sensor value crossed the threshold value for sleep the serial monitor shows the message "Driver fatigue detected!" and then the LM35 sensor measures the temperature and if the temperature value drops from the normal temperature then sleep detection is done and the serial monitor shows the message "Driver sleep detected!" and then the motor is turned off and the buzzer turns on which can be observed in the second photo of Fig.7.

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Driver fatigue detected
Driver sleep detected!
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While testing the system, it was observed that the system was able to detect alcohol and sleep.

After testing the system a few limitations were observed. The accuracy of the sensing and detection systems used in the integrated system may not be high enough to produce reliable results.

The sensitivity of the sensors used in the system may vary depending on various factors such as the user's physical characteristics, the ambient environment, and the placement of the sensors. This could lead to inconsistent or unreliable readings. The sensors used in the integrated system may require frequent calibration to ensure accurate and consistent readings.

V. DISCUSSION

The project has a great impact on social purposes. The project helps in a lot of social causes. First, the implemented alcohol sensor detects an alcoholic person then eye blink and temperature monitoring sensor help to stop that person from driving that vehicle. Statistics show that about 30% of the accidents are caused by drunk driving and about 40% of the accidents are caused by drowsiness. [9]

By implementing the project, we can reduce the significant amount of road accidents which can be caused by drunk-driving and sleepiness. Also, this project helps a big term in alcohol prevention because a person cannot enter to his or her car after drinking. As a result, he or she may not be able to drink if they want to travel. Research done by World Health Organization shows that, approximately 1.3 million people dies each year by road accident and between 20-50 million people suffers non-fatal injuries.[10] So with this project we can reduce the number of accidents and fatalities. It can help to improve the road safety measures and helps drivers to be more focused on the road.

This project helps to improve public safety and road safety. By implementing it into the vehicle itself, it helps police to detect the drunk person without using breathalyzer or random breath testing while driving. This project also has economic benefits, by reducing the number of accidents such as drunk-driving and drowsiness while driving, less accident means fewer medical expenses and lower property damages. Overall, this project serves a great impact on societal purposes.

V. CONCLUSION

Based on the data presented, it is possible to infer that developing an integrated system for motor control detecting alcohol, eye blink detection, and temperature monitoring for sleep detection is a difficult and interdisciplinary work. The system is designed to identify the start of sleep by monitoring physiological markers and external indicators known to be associated with the sleep state. The data acquired by the numerous sensors is combined and evaluated by machine learning algorithms to estimate the driver's degree of attentiveness and danger of falling asleep behind the wheel. To prevent accidents caused by sleepy driving, the system can send real-time notifications to the driver and take necessary action, such as sounding an alarm or slowing down the car. Although the project already has aspects to detect alcohol and drowsiness and avoid traffic accidents, there are other areas where it may be enhanced and extended further. Including a GPS system in our project can offer extra information on the vehicle's location and speed. This data can be utilized to notify authorities in the event of an emergency and to track the driver's whereabouts. Creating a mobile application that can be linked to the system can aid in monitoring the driver's conduct and informing authorities in the event of an irregularity. The level of precision of the sensors can be increased by utilizing more modern sensors or by routinely calibrating the present sensors. In a larger sense, this research has the potential to improve road safety and reduce accidents caused by intoxicated and tired driving.

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