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Intelligent Road Safety: IoT-enabled Drunk Driving and Accident Detection System

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Draft Version

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***Abstract*—Drunk driving has long been a severe problem for public safety due to the large number of road accidents around the world. To address this issue, numerous methods for detecting drunk drivers and accidents have been developed. The objective of this paper is to propose a low-cost automated system for detecting drunk drivers and turning off the ignition system to prohibit the driver from operating the vehicle. Our proposed prototype consists of multiple sensors and a microcontroller along with GPS and WCDMA for simultaneous communication. The sensors monitor the vehicle in real-time to detect any kind of catastrophe, if anything gets detected the user gets a notification and alert through the Mobile app and text message. The purpose of this research is to develop ongoing initiatives to reduce accidents with the goal of adopting system advancements in the real world to ensure road safety.**

***Index Terms*—Arduino, NodeMCU, SIM900A, GPS, MQ-135, MPU6050, Water Sensor, DHT22, Eye Blink sensor.**

I. Introduction

The issue of drunk driving affecting road safety is getting worse as the number of motor vehicles in countries throughout the world keeps increasing. Drunk drivers cause 4.13 times as many traffic collisions than sober drivers [1]. Following in-depth investigation, it has been determined that the majority of incidents result in fatalities due to poor communication with the relevant medical authorities and the consequent lack of timely emergency treatment. Therefore, improving and inventing new procedures is required to lower the massive loss of life. By responding quickly, the emergency services can prevent an accident from happening and save a life.

This study inspects the design of a comparable system that is contextualized for the local markets in least developed and low to middle income countries, keeping in mind the present economic, social, and development characteristics with respect to under-developing countries. This prototype seeks to increase both public and vehicular safety. Along with fewer accidents caused by drunk drivers, the system should see a significant rise in public awareness. A severe accident can be identified by tracking the data from the microcontroller and different sensors used in this system.

This paper also serves as the extension to the work done by Hossain et al. [2] where we make our idea better. Any vehicle that is detected to have crashed will also receive a brief notification from the device. Through 3-axis position detection, we can identify any potential accidents [3]. We used a water sensor to detect water level where the pressure on the sensor's front surface is translated into the water level height according to the water level sensor's operating principle when the sensor is immersed into the liquid to be measured at a specific depth [4]. Temperature and Humidity sensor (DHT22) has been utilized to identify a vehicle fire [18]. Using both sensors together, the system is able to identify fire situations and warn the user in real time. The eye blink is typically the fundamental characteristic used to assess weariness [6][17]. In this paper, we pay more attention to traffic safety, hence we have worked to make driving safe in all circumstances.

A. Related work

Alcohol detection system was developed by M.A Hossain [2]. Our previous prototype [2] combined a system with real-time location tracking and an alcohol detection device for vehicles. The recommended prototype consisted of an Arduino UNO, MQ-3 sensor, SIM900, and GPS Module. The processor automatically stops the system ignition by stopping the motor if the driver is drunk. Later, the current latitude and longitude values are retrieved using the GPS and with the use of SIM900A GSM module, the exact locations are sent via SMS (Short Message Service) and app notification to any rescue

team or police control room. As a result, as soon as they receive the emergency notification, the police can locate the accident's site and take the appropriate action.

That prototype ensured road safety by detecting drunk drivers with the vehicle's location tracking and engine locking system, though it couldn't sense the vehicle's position, temperature and water, and eye blink of the driver to detect vehicle accidents[7]. The further research seeks to advance ongoing efforts to prevent accidents. This work has been modified to address these issues. As far the earlier studies that were conducted on alcohol detection, a few authors proposed their ideas. Among them:

A.Mateen et al. [8] focused on Autonomous Accidents Detection and alert systems for vehicles where they worked on an Autonomous algorithm for accident detection. C.N.GireeshBabu et al. [9] worked on a Real time alert system to prevent car accidents using Intelligent Transportation Systems. S.Rathor et al. [10] focused on Smart Automatic Accident Detection and Information System. They identify alcoholic drivers and get notified location through msg. S. N. Razali et al. [11] proposed an IOT based Accident Detection and Tracking Systems (AD Tracksys) using node MCU, GSM, and IFTTT protocol which allow the system to detect an accident and send notifications in real time via Telegram or SMS.

Similar output has been achieved very simply by our proposed prototype with low equipment, low computational complexity and cheaply. In previous methods, very sophisticated hardware was used. We have used simple but effective components to achieve equivalent accuracy that is cheaper and easier to implement in developed countries. To the best of our knowledge, however, there has not been a lot of work suggested for developing smart accident detection frameworks that are specifically designed to detect vehicle crashes. We have worked with five sensors and multidimensional data to secure road safety.

B. Our Contribution

This paper's primary objective was to utilize particular modules such as the SIM900A, GPS, including the MCU, and MQ-3 sensor to detect alcohol and track the vehicle's absolute location. We have worked on it more efficiently to ensure road safety. Adding the MPU6050 sensor module, a water sensor, a DHT22 (Digital Temperature and Humidity Sensor), MQ-135 gas sensor and an eye blink sensor to the system in order to detect accidents. Our main contributions can be summed up as follows:

- This paper expands and improves upon the work of M. A. Hossain et al. [2], in which we were able to identify alcohol throughout the breath of a drunk driver, track the exact location of that car, send the location and an alert message to the appropriate parties using the Blynk app.
- We added a few unique features to our previously developed prototype to ensure road safety. With the help of this prototype, accident detection is also possible. The system sends a quick notification of any vehicle that has been detected to have crashed. We can detect any probable accidents using 3-axis position detect. For accident detection as well as water level detection, we used water sensors.
- We added some temperature sensors inside the vehicle as well as in the engine section, to monitor the vehicle's overall temperature inside and outside. This sensor is very effective for pre-fire detection also it sends alert to the user if the temperature data rises up-to critical point
- Smoke sensor is used to measure smoke data inside the vehicle. So that the data can be used later to identify pre-fire and fire situations in the vehicle.
- Additionally, a sensor that monitors eye blinks was included. To determine whether someone's eye is closed, a simple infrared sensor is used. There are two components to it: a sender and a recipient. The eye is constantly exposed to infrared rays from the transmitter. While the receiver keeps an eye out for changes in the reflected waves that indicate an eye blink. If the eye is closed, a high output is expected. The output will be lower if the eye is open.

II. PROTOTYPE DEVELOPMENT

The core philosophy behind this prototype is accident detection as well as road safety. Our prototype focuses on road safety by using a water sensor to detect water level [12]. The pressure on the sensor's front surface is translated into the water level height when the sensor is immersed into the liquid to be measured at a specific depth.The MQ135 Smoke sensor and Humidity sensor and the DHT22 Temperature are directly connected to the main processing unit [18]. Initially, we utilized a single unit of each sensor, but in the complete version of the product, there must be several sensors in different locations on the vehicle. Continuously, the central processing unit analyzes sensor data to determine if the sensor readings are normal or not. If any changes are detected by the MPU, the vehicle user would be automatically notified via the Blynk app. Additionally, if the situation becomes critical or the MPU detects a fire, the MPU sends an emergency text message to the user's mobile device with the exact GPS location and vehicle sensor parameters. The eye blink is used to identify sleep apnea symptoms and the beginning of driver tiredness [13][17]. This prototype works to make driving safe in all circumstances.

The figure 1 gives an overview of whole system. Column 1 of the figure shows the existing work and Column 1 presents the framework of the system developed in this work. Our experimentation's findings are shown in column 3 of the Figure 1.

III. HARDWARE MODULE

MPU6050 Module The MPU6050 sensor module is a comprehensive 6-axis motion tracking device. In a compact size, it includes a 3-axis gyroscope, 3-axis accelerometer, and a digital motion processor. Additionally, it incorporates an on-chip temperature sensor as an extra function. To connect

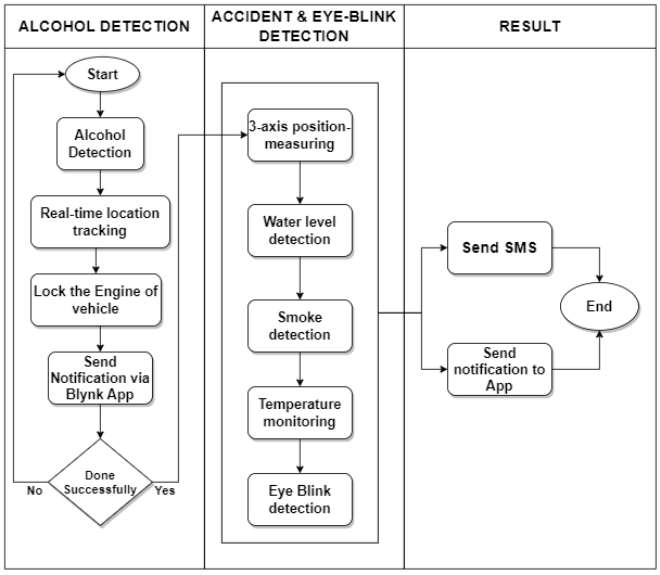

Fig. 1. Flowchart of system operation

Algorithm 1:

Step-1: Start
Step-2: Check alcohol level through MQ-3 sensor.
Step-3: If alcohol can be detected, it locks the engine of the vehicle otherwise the system lets the engine run.
Step-4: Track the absolute location using GPS.
Step-5: Track other sensors (Water, Smoke, Temperature,) attached to the MPU.
Step-6: 3-axis position measures using MPU6050 sensor.
Step-7: If the vehicle gets into any critical situation, a notification is sent immediately via the blynk app.
Step-8: If the vehicle is in an emergency situation the system will send an alert to the Emergency Contact number along with vehicle sensor data and GPS coordinates.
Step-9: If the driver falls asleep, A buzzer module is attached with the MPU to alert the driver in this kind of situation.
Step-10: End.

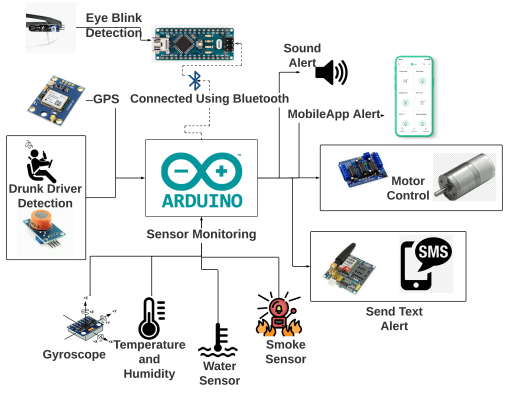

Fig. 2. Block Diagram of the prototype

with the microcontrollers, it has an I2C bus interface. To interface with other sensor devices like a 3-axis magnetometer, a pressure sensor, etc., it features an auxiliary I2C bus. It is used to measure rotational velocity along the X, Y, and Z axes [15].

Water Sensor The operating voltage and operating current of the Water Level Depth Detection Sensor for Arduino are DC3-5V and less than 20mA, respectively. The Water Level Sensor uses a number of parallel wires with exposed traces to measure the volume of the droplets of water in order to determine the water level. To produce the level warning effect, a straightforward conversion of water to an analog signal is required. The output analog values can also be received directly from an Arduino development board [16].

MQ-135 Gas Sensor The MQ135 sensor is a gas sensor capable of detecting a variety of air contaminants, including ammonia, sulfide, benzene, and alcohol. It is typically employed in air quality monitoring systems, indoor air quality monitoring devices, and gas leak detecting systems. The MQ135 sensor detects changes in its sensing element's resistance when it comes into contact with specified gases. It is a low-cost, portable sensor that is readily accessible on the market and may be interfaced with microcontrollers or other electrical devices with relative ease [17].

Temperature and Humidity Sensor (DHT22) The DHT22 sensor is a digital temperature and humidity sensor used in a variety of applications, such as weather stations, HVAC systems, and interior environmental monitoring. With its excellent precision and broad measurement range, the DHT22 sensor is suited for a variety of environmental monitoring applications. It is also an inexpensive and user-friendly sensor that can be interfaced with microcontrollers utilizing a straightforward 1-wire protocol [18].

Eye Blink Sensor The eye blinking system can be used for different purposes, such as detecting blinks, checking driver drowsiness, and checking when patients gain consciousness. It can be used with all modes of transport and can be used in hospitals to inform nurses when patients open their eyes. The output of the sensor must be constantly high in this case as the patient is unconscious, and when the output goes low, the Arduino should command the buzzer to ring [19].

IV. IMPLEMENTATION

A. Hardware Setup:

The complete setup of our prototype is shown in figure 3. There are two different sections in our project. One is the MPU(Main Processing Unit) and the eye blink detection system which is connected to the MPU using Bluetooth communication. There are in total three Microcontrollers One is the Arduino Uno (Man Processing Unit), Arduino Nano (Eye glass) and an ESP8266 (Connected to Blynk). The MPU gets all the data from every section. First it gets data from the MQ-3 to determine if the Driver is drunk or not. If the driver is not drunk only then the motor can be turned on. After that, the vehicle monitors Gyroscope sensor (MPU6050), Temperature and Humidity sensor(DHt22), Gas sensor(mq135), and Water

Fig. 3. Hardware Setup. Showing interconnection of Arduino, NodeMCU, MQ-3, MQ-135, SIM900A, GPS, Motor Driver, MPU6050, Water Sensor, DHT22, Eye Blink sensor.

level sensor. Using all the sensor data, the MPU determined vehicle conditions. The MPU can detect almost every common accident situation like Vehicle collided with something, vehicle fell from cliff/bridge or flipped upside down, Vehicle got Engine burn situation, Vehicle fell into water and can take necessary actions within seconds. In the other section the Arduino nano monitors the eye blink sensor every second to detect drowsiness/tiredness of the driver independently. If it detects any, it sends the data to the MPU through bluetooth. From where the MPU triggers an alert for the driver and also sends notification to the Mobile app. The MPU gets GPS data from (Ublox NE0 8MN) sensor continuously, which it forwards to the ESP8266 along with the vehicle other data to show in the Mobile app. For emergency accident situations a GSM module (SIM 900A) is connected with the MPU to take actions in the emergency situation by sending vehicle data as a text message to the Emergency contact.

B. Software Interface:

The Software interface of our project is shown in figure 4. Blynk is an IoT platform for iOS or Android smartphones that allows users to remotely operate devices like Arduino and NodeMCU. Using the simple and effective no-code application builder known as Blynk, we have created, and managed a network of connected our system. Blynk app sends notifications if the vehicle is detected to have crashed and if the driver takes alcohol.

V. Prototype Evaluation

The result segment has been split into two sub sections. Performance evaluation analysis has been done in first section and in the second section, a comparison between the prototype and existing work has been shown.

A. Result and Analysis

Performance analysis of alcohol detection: In this paper, alcohol detection has been shown under three baselines, those are 95%, 50%, 20%. Three attempts for different percentage of alcohol from 0 to 50 second. We have noticed that the system takes 17sec to react and immediately the values goes

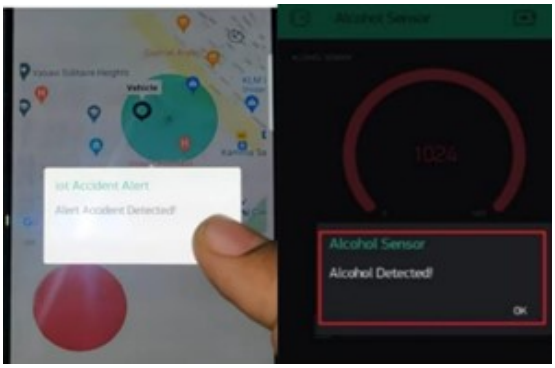

Fig. 4. Software Interface of detecting accidents and alcohol.

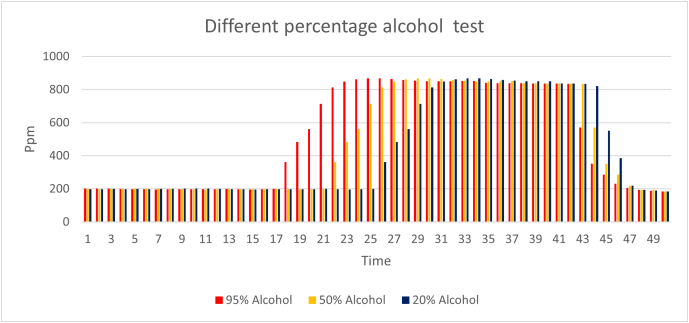

Fig. 5. Alcohol test. Checking 95%,50%,20% alcohol from 1-50s.

up for 95% of alcohol. However, the system activates at 21sec for 50% of alcohol and it gets activated at 25sec for 20% of alcohol. Hence, the amount of alcohol has a great effect on the system response time.

Position analysis We have measured acceleration, angular velocity, and temperature through MPU 6050. By combining information from accelerometers, gyroscopes, and occasionally magnetometers, an IMU is used to detect the orientation and position of a device. The accelerometer measures the device's linear acceleration, which is used to determine the tilt angle of the object in relation to the ground. The device's position over time is calculated using data from the accelerometer and gyroscope together. We have measured linear acceleration, which integrated over time to get velocity and integrated once more to determine location.

In Fig 6, we're using x, y, and z data on three axes. This graph appears when the vehicle movement changes the straight graph to an up-down plot continually.

Water level detection To measure the level of water over time, the sensor is dipped into the liquid to a specific depth.

Water level sensor graph We take two data, time and water level.To verify the level of water. Here Fig 7, we have attempted to verify the water sensor. This graph demonstrates how the water level rises over time.

Performance analysis of eye blink sensor Through the use of our algorithms Table 1, where we conducted tests on real people, we are able to provide the typical execution time of a single frame. When we lose the sight of our eyes, we

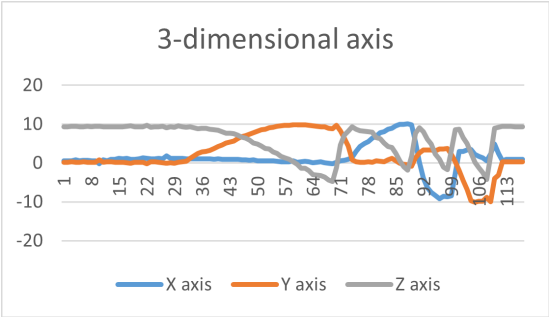

Fig. 6. Vehicle positioning graph showing up-down plot when vehicles are rotating.

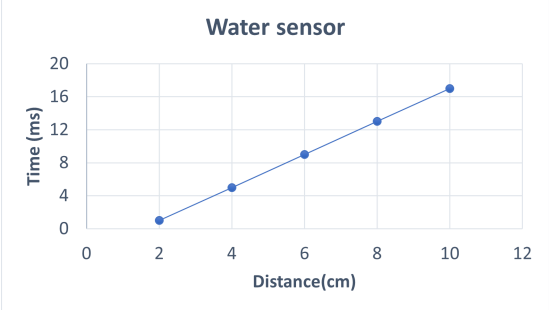

Fig. 7. Water sensor graph showing water level rise over time.

require analysis. Every computation for a frame makes use of the other three algorithms. Consequently, our approach can function in real time.

TABLE I
THE RESULT OF BLINK DETECTION

Algorithms	*Time (ms)*
First time eye blink detection	22.210
Face tracking	0.022
Eye detection	14.619

According to the study, inter-blink times of varying lengths alternate between being shorter and longer in the usual human blink, which was determined by graph analysis of four sets of 45-minute samples.

In the experiment, we see the exact location of where the proposed system is. It displayed accurate data from the sensor. We see 5 real-time locations in apps.

B. Comparison with Related Work

In our earlier research [2], we found evidence of alcohol use while the driver was intoxicated. The Blynk app would send a location notification to the closest police station and lock the engine. But suppose an accident does happen! We have no way of being informed. We are attempting to improve our project in this paper. If there is a notification, the hospital is informed. We use the 3 axis MPU6050 dimension to detect accidents. The DHT22 temperature and humidity sensor is used to detect a vehicle fire. The system is capable of identifying fire

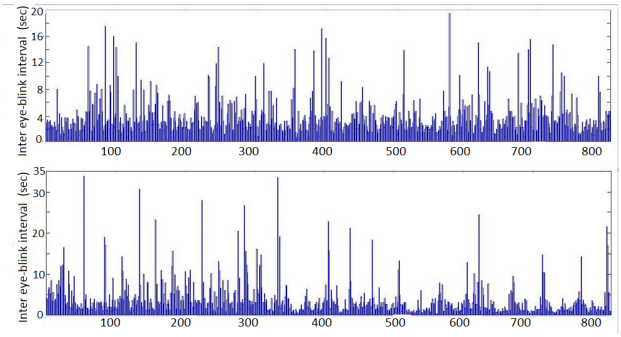

Fig. 8. The inter-eye-blink interval graphs of 2 volunteers .It took time near about 45 min

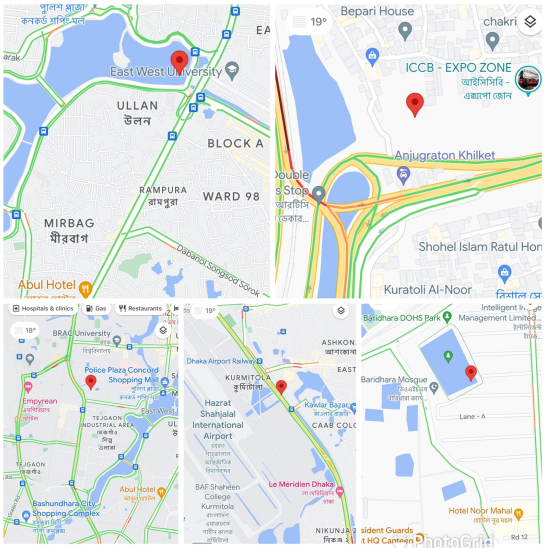

Fig. 9. Real-time location at different 5 places.

conditions and notify the user in real time by combining the data from the two sensors. An eye blink sensor is also included to check driver drowsiness. That is how we are implementing road safety.

Total cost of this project in USD Table II and Table III

TABLE II
TOTAL COST OF THE PREVIOUS PROJECT IN USD

Product List	Price (USD Approx)
Arduino Nano (1)	7.92
Node MCU v3(1)	4.96
MQ3(l)	2.09
Breadboard (1)	1.30
Sim 900A (1)	4.90
GPS (1)	5.84
Motor driver (1)	3.90
Jumper Wire (3 set)	3.01
Cable (1)	1.65
Total	**35.57**

This price list demonstrates that our next project will cost an additional approximately USD 10. But if we put this into practice, accident detection will go down. Patients can be

TABLE III
TOTAL COST OF THE PROPOSED PROJECT IN USD)

Product List	Price (USD Approx)
Arduino Nano (1)	7.92
Node MCU v3(1)	4.96
MQ3(l)	2.09
Breadboard (1)	1.30
Sim 900A (1)	4.90
GPS (1)	5.84
Motor driver (1)	3.90
Jumper Wire (3 set)	3.01
MPU6050 (1)	5.50
Water sensor (1)	1.20
Eye blink sensor (1)	1.20
Smoke sensor (1)	0.30
DHT22 sensor (1)	2.70
Cable (1)	1.65
Total	**45.67**

saved. The level of road safety will rise. We can make sure that this paper's enhanced version [2] will increase traffic safety.

VI. CONCLUSION AND FUTURE WORK

The proposed system based on accident detection and monitoring, it is possible to draw the conclusion that using technology significantly enhances people's safety in a variety of settings. Accidents may now be detected in real-time, allowing for quick emergency responses.The development of intelligent systems like sensors, cameras, and machine learning algorithms.

Despite the potential advantages of accident detection and monitoring systems, some difficulties still exist, such as privacy issues and the requirement for high accuracy in accident detection. More study and improvement are therefore required to overcome these issues and raise the dependability and efficiency of accident detection and monitoring systems. Moreover we can develop our mobile apps creating our new database.

Enabling remote monitoring and management, the Internet of Things (IoT) devices' integration with accident detection and monitoring systems has enhanced their functionality even more. The adoption of wireless communication technologies, such as 5G, has improved connectivity and speed of communication, enabling quicker reactions in the event of accidents.

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