Integration of Advanced Vehicle Monitoring and Alcohol Sensing System for Modern Vehicles to Prevent Road Accident

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Abstract—Road Traffic accident has become a very common issue in Bangladesh. There are several reasons behind those accident. But the most common reasons are unfit vehicle and drunk driver. For that reason, we have developed this project which detects the drunk driver and checks the document like vehicle fitness certificate. We have developed this project based on microcontroller where the microcontroller gets the input from Alcohol and eyeblink sensor. Multiple sensors are installed on the steering wheel and adjacent to the driving seat which can detect the alcohol level from the breath of the driver and monitor the eyeblink. If the level of alcohol crosses a certain level and eyes remain closed for certain time the microcontroller will stop the engine ignition. A document checking algorithm is formulated in the microcontroller which checks the fitness validity of the vehicle. A GSM and a GPS module is also integrated with the system which shares the location of vehicle with related personnel and authority if any anomaly is found. Implementation of this idea in our country, certainly can reduce a large number of vehicle accident due to drunk driver and unfit vehicle and at the same time can increase government revenue.

Keywords – Traffic accident; Arduino Uno; Alcohol sensor; Eye blink sensor; GSM module; GPS module; Document checking algorithm

I. INTRODUCTION

In recent days the road accident and traffic congestion problem in Bangladesh is increasing in an alarming rate. It has become one of the dangerous arenas almost all the cities in our country. Road accident is an unplanned incident that results in bodily harm to an inanimate or living structure. Particularly in the case of a traffic collision, rapid action is required to stop it or reduce the damage [1]. According to a Bangladesh Road Safety Foundation (RSF) annual report, there were at least 6,284 fatalities and 7,468 injuries on the country's roads between January and December 2021, compared to 5,431 fatalities and 7,379 injuries in the same period in 2020 [2]. A recent investigation by the Accident Research Institute (ARI) of Bangladesh University of Engineering and Technology (BUET) found that every year, on average, 12,000 people lose their lives in traffic accidents, which also cause close to 35,000 injuries [3]. The main reason behind the increased number of accidents is consumption of alcohol and drug which initiates reckless driving, over speeding, overtaking, violating laws, illegal and dangerous competition, and many other factors. Again, the number of highway and traffic police is not sufficient to check all the vehicle documents and driver's condition. As a result, the number of unregistered vehicles is increasing gradually which leads to fraudulent of government tax, increasing crime and road traffic jam. To minimize these problems the proposed system can be integrated with the vehicles which will check the necessary documents and driver's alcohol consumption level. The system can also track the location of the vehicle and share with the owner and Bangladesh Road Transport Authority (BRTA) if any anomaly is found. The system will be controlled by BRTA with secured password. Before every start of a vehicle the system will check the necessary parameters, if found okay only then the engine will ignite.

II. RELATRD WORKS

Number of works have been done on this topic few are stated below. "Arduino based accident prevention and identification system for vehicles" in this work they have combined the ultrasonic sensor for accident prevention with GSM system for remote notification [4]. In another work titled as "Design and implementation of a microcontroller-based driver impairment monitoring system", they have only monitored the driver condition using alcohol sensor, eye blink sensor and driver blood pressure monitor [5]. In another work named "Drunk and drive controller for vehicles" they only showed how to minimize road accident by preventing drunk and drive using MQ-3 alcohol sensor [6]. In another work titled as "Road accident prevention by detecting drowsiness & ensure safety issues" only driver was monitored by alcohol and eye blink sensor and vehicle monitoring system was not considered [7]. After studying the recent work, we found that is very important to innovate a system which can monitor the driver as well as the vehicle and notify the authority if any anomaly is found. That is why in our system we have integrated multiple sensors to monitor the driver and the vehicle with the GSM and GPS technology for remote notification.

III. CONCEPT OF DESIGN

A. Block Diagram

The block diagram of our project is shown below in figure 1 where the arrow is showing the input and output direction.
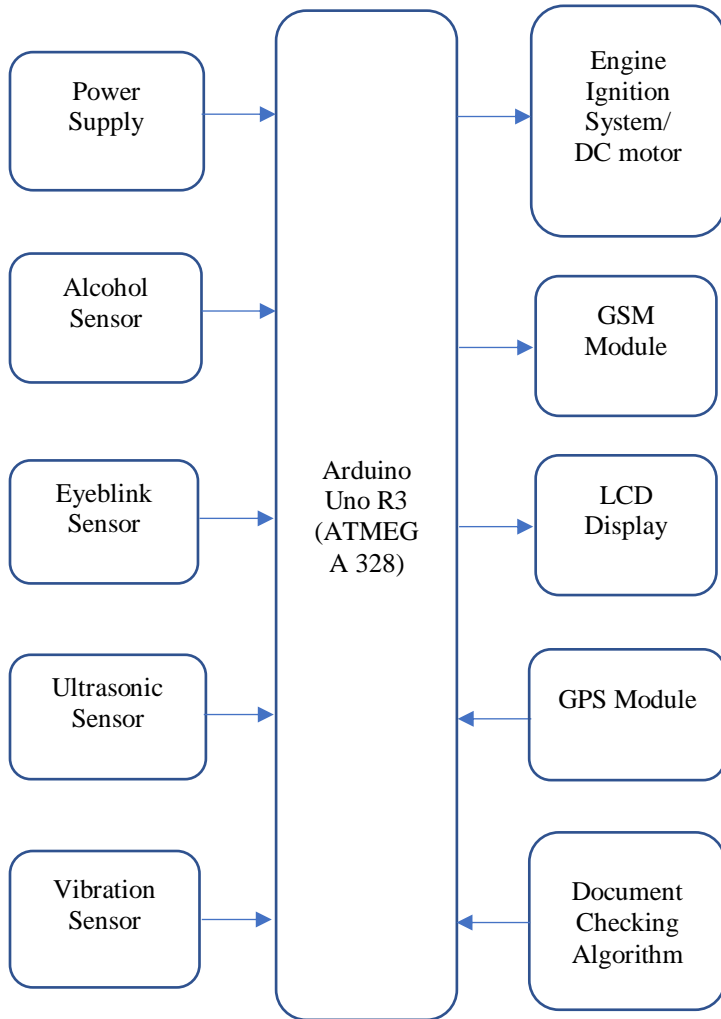

Fig. 1. Block Diagram of the System.

B. Principle of Operation

In this project the input devices are alcohol sensor, eye blink sensor, sonar sensor, vibration sensor, GPS module and the vehicle fitness validity date provided by BRTA. The output devices are the engine ignition system, GSM module and LCD display. Before every start of the vehicle the microcontroller checks the fitness validity date and wait for the input signal of the alcohol detector. All the alcohol sensors remain active and wait *for* the presence of alcohol from the driver's breath. If the presence of alcohol is found it sends an input signal to the microcontroller. The micro-controller gets the data from eye blink sensor weather the eye is open or closed. It also measures the level of alcohol and sends the output voltage to the ignition system and GSM module accordingly. The GSM module collects the location information from GPS module and share the data through a SMS using local carrier. A sonar sensor is also used to prevent head-to-head collision with another vehicle or object. Vibration sensor is used if the vehicle is hit by another vehicle or object. It can send the signal to the microcontroller which will notify the owner about the incident through the GSM module. The detail circuit diagram is given below in figure 2.
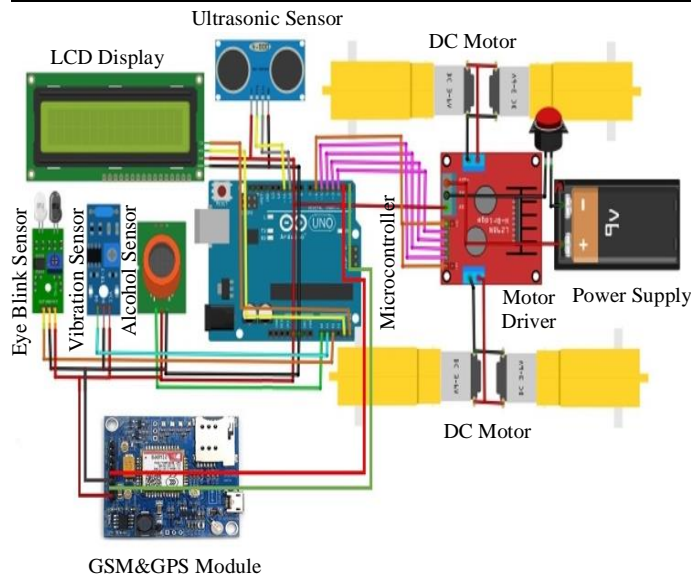
Fig. 2. Circuit Diagram of the System.

C. Alcohol Detector Sensor

An alcohol sensor detects the presence of alcohol in the air and generates an analogue voltage as output. With a power supply less than 150 mA the sensor can activate at temperature ranging from -10°C to 50°C. It is appropriate for breathalyzers since the sensing range is 0.04 mg/L to 4 mg/L. This sensor has a very high alcohol sensitivity and a very high tolerance to smoke, fog, and fuel disturbances [8]. The analogue and digital both the output will be taken from the sensor for the confirmation. In this project multiple MQ-3 alcohol sensor is used for better detection. Figure 3 shows the picture of alcohol sensor.

Fig. 3. MQ-3 Alcohol Sensor.

D. GSM and GPS Module

In this system SIM868 GSM/GPRS/GPS module is used. This module is composed of UNV-SIM868 development board, which uses the superior-performing SIMCOM SIM868 module. It also includes reserved headphone microphone solder interface and onboard MICRO SIM card socket. It is easy to connect a variety of antennas to the IPEX-MINI antenna interface because of its tiny size. It has a built-in high-efficiency DC-DC power supply module that supports 5V to 18V. Level matching has been done on the primary serial port, which supports 3.3V to 5V microcontrollers or other control systems. GPS module collects the exact location of the vehicle, and the GSM module shares the location through a SMS using the local mobile network [9]. Figure 4 shows the picture of sim 868 GSM module.

Fig. 4. SIM868 GSM/GPRS/GPS module.

E. Microcontroller

The Arduino UNO is an open-source MC board made by Arduino.cc that is based on the ATmega328P MC. The board features 6 analog pins and 14 optical pins [10]. We have used the open-source IDE for programming (currently for Windows, Linux and Mac OSX). In our project this microcontroller functions as the motherboard. All the inputs are taken to Arduino Uno. It analyzes the inputs and provides the logical outputs. Figure 5 shows the picture of Arduino uno microcontroller.

Fig. 5. Arduino UNO Microcontroller.

F. Eye Blink Sensor

Eye Blink Sensor basically an infrared sensor mounted on a glass which detect whether the eye is open or closed. This sensor uses a differentiator and a phototransistor circuit, infrared light illuminates the eye and eyelid and from the reflected light it detects the condition of eyes [11].

If the eyes remain closed for a certain period of time it sends a signal to the microcontroller. Microcontroller processes signal and stops the vehicle and send SMS to the owner of the vehicle. Figure 6 shows the picture of eye blink sensor module.

Fig. 6. Infrared Eye Blink Sensor Module.

G. Ultrasonic Sensor

The sonar sensor is used to detect any kind of obstacle in-front of the vehicle thereby it saves the vehicle from head-to-head collision. The sensor generates an ultrasonic sound wave and receives the reflected wave from the object. By measuring the time interval between the emission and reception, it calculates the distance to the object. Figure 7 the picture of HC-SR04 ultrasonic sensor.

Fig. 7. Ultrasonic Sensor.

H. Vibration Sensor

In our project we have used SW-420 NC Vibration Sensor Module. If for any unforeseen the vehicle is hit by any object or any other vehicle it will send the signal to microcontroller. According to the input signal microcontroller will send another signal to GSM module and thereby the GSM module will send a SMS to the related personnel informing the incident. Figure 8 shows the picture of SW-420 NC vibration sensor module.

Fig. 8. SW-420 NC Vibration Sensor Module.

I. Document Checking Algorithm

For the checking of various documents an algorithm is formed basing on Arduino code (C++). The registration number and the fitness date will be updated only by the authority (BRTA) after completion of necessary formalities. This process is very secured (Authentication is required) so that the hackers cannot manipulate the information. The program algorithm is given below and figure 9 shows the flow diagram of document checking algorithm:

Step 1: Start

Step 2: Read Alcohol sensor value, Alcohol limiting value,

Fitness validity date, Present date, GPS location

Step 3: If Fitness validity date > present date

Print stop ignition, send GPS location

Else if Alcohol sensor value > Alcohol limiting value

Print stop ignition, send GPS location

Else if Fitness validity date – 10 = Present date

Print Send notification every after 24 hrs

Else

Print Start ignition
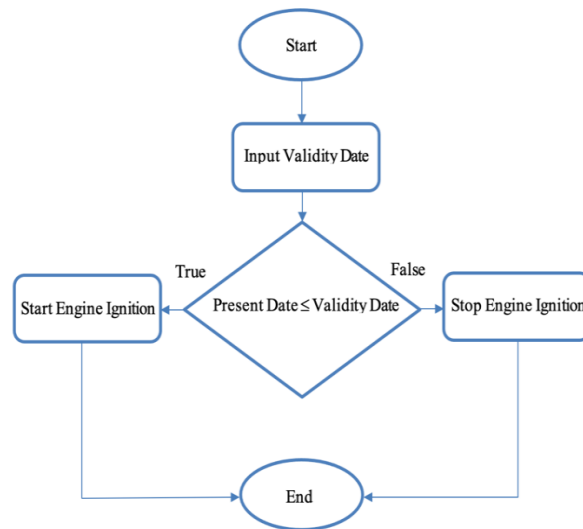
Step 4: Go to step 2

Step 5: Stop

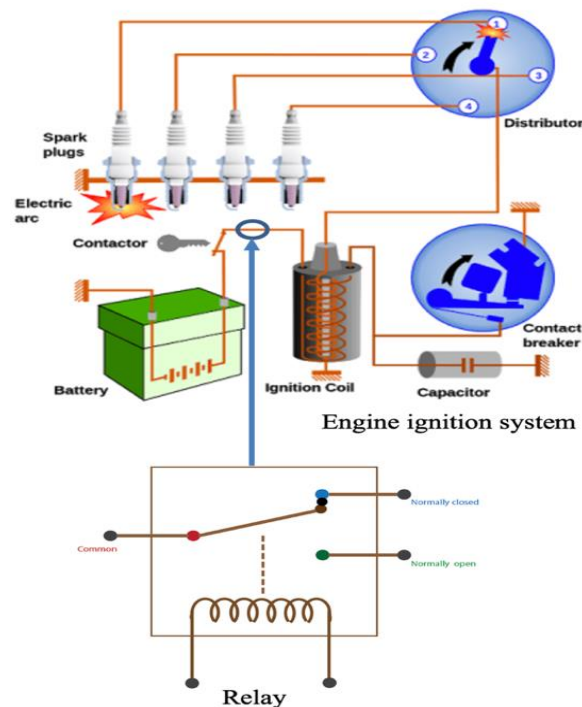Fig. 9. Flow diagram of document checking algorithm.

Fig. 10. Engine Ignition System.

J. Engine Ignition system

Engine ignition done by the power supplied from the battery. The key of the vehicle works as the switch to connect the ignition coil to the battery. We have tested this system with DC motor and close type relay both. For testing purpose, we installed the DC relay adjacent to the ignition coil which is shown in Figure 10. When the relay coil is energized from the output voltage of the microcontroller, it disconnects the ignition coil from the battery and the vehicle stops. Figure 10 shows the engine ignition system and location of relay to be installed.

IV. RESULTS

The main objective of our project was to monitor the driver's and vehicle condition and share the information with the authority. We could successfully monitor the alcohol level by the MQ-3 alcohol sensor and drowsiness by eye blink sensor. The ultrasonic and vibration sensor also responded without any delay. We have tested our project multiple times in different condition and found the result shown in table 1.

Table 1: Evaluation of performance

Condition	Sensor Involved	Response
Alcohol Spray	MQ-3 Alcohol Sensor	Relay operated/Motor stopped, and SMS sent
Eye closed for 1sec	Eye Blink Sensor	Relay operated/Motor stopped, and SMS sent
Obstacle placed Infront of the Vehicle	Ultrasonic Sensor	Relay operated/Motor stopped, and SMS sent
Vehicle falls from 200cm height	Vibration Sensor	Relay operated/Motor stopped, and SMS sent

After testing the system several times, we have found that the microcontroller, different sensors, and the relays are responding quickly. Utilizing an efficient Arduino ATmega328 microprocessor and numbers of sensors, the system gave an optimum output. The system's alcohol sensor can also run for extended periods of time and can detect from a distance of up to two meters. With the inclusion of a GSM module, this device not only stops the car if the driver is intoxicated but also communicates the position of the stopped car to its owner and the police. The technology is effective enough to turn off the engine and find the location from where the unfit vehicle can be picked up. Figure 11 shows the final structure of the project.
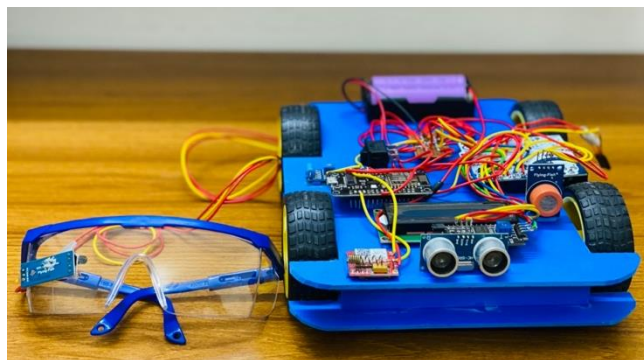

Fig. 11. Final structure of the project.

V. CONCLUSION

The system can stop the car from moving and lessen the risk to people's lives by avoiding head-to-head collision by monitoring driver eyes and detecting alcohol on the driver's breath. Using multiple sensors, we have increased the reliability which can be implemented all over the country. In recent days people are more cautious about road safety. So, we hope that in future our proposed system can bring a new innovative change in automobile industry. This device can be made inbuilt or attached by BRTA, which will add multiple safety features, there by opening a new horizon in the automobile technology.

ACKNOWLEGDEMENT

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