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IMPLEMENTATION OF SMART VEHICLE CONTROL AND MONITOR SYSTEM USING IOT

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Abstract: This project presented an effective method for reducing the rise in road accidents instigated by driver's excessive alcohol consumption on roadways. Although speed restrictions and other preventative measures have been introduced, traffic accidents continue to occur daily. Over speeding, rash driving, and drunk driving are all significant contributors to motor vehicle accidents. To introduce this concept, this work has built an IOT-based in-vehicle alcohol detection, speed control, and passenger safety system using the Arduino UNO microcontroller connected to the alcohol, color, and smoke sensors, control switch, GSM, and GPS modules. The Blynk Cloud Server is also used for monitoring the status of vehicle. This system uses the alcohol (MQ-3) sensor to continuously monitor the blood alcohol concentration (BAC) and detect the presence of alcohol during breathing. This system can constantly monitor the alcohol content of the driver's breathing by installing a sensor in the steering wheel. This device could detect excessive speed and be programmed to alert with an SMS when fire accident or passengers panic situation. After testing, it was determined that the proposed system met the standards for starting a car's engine. Therefore, the proposed system offers a promising approach for future smart vehicle systems.

Keywords - Accident, Alcohol Detection, Smoke sensor, Arduino, IOT, Speed Control and Passengers safety

I.INTRODUCTION

Each day, our lives become more dependent on 'embedded systems', digital information technology that is embedded in our environment. More than 98% of processors applied today are in embedded systems, and are no longer visible to the customer as 'computers' in the ordinary sense. An Embedded System is a special purpose system in which the computer is completely encapsulated by or dedicated to the device or system it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few pre-defined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass-produced, benefiting from economies of scale.

The increasing use of PC hardware is one of the most important developments in high-end embedded systems in recent years. Hardware costs of high-end systems have dropped dramatically as a result of this trend, making feasible some projects which previously would not have been done because of the high cost of non- PC based embedded hardware. But software choices for the embedded PC platform are not nearly as attractive as the hardware.

Typically, an embedded system is housed on a single microprocessor board with the programs stored in ROM. Virtually all appliances that have a digital interface -- watches, microwaves, VCRs, cars -- utilize embedded systems. Some embedded systems include an operating system, but many are so specialized that the entire logic can be implemented as a single program.

Physically, Embedded Systems range from portable devices such as digital watches and MP3 players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants.

In terms of complexity embedded systems can range from very simple with a single microcontroller chip, to very complex with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

II. EXISTING SYSTEM

An embedded system is some combination of computer hardware and software, either fixed in capability or programmable, that is specifically designed for a particular function Since the embedded system is dedicated to specific tasks, design engineers can optimize it reducing the size and cost of the product and increasing the reliability and performance. Embedded systems are controlled by one or more main processing cores that are typically either a microcontroller or a digital signal processor (DSP). Embedded systems control many devices in common use today.

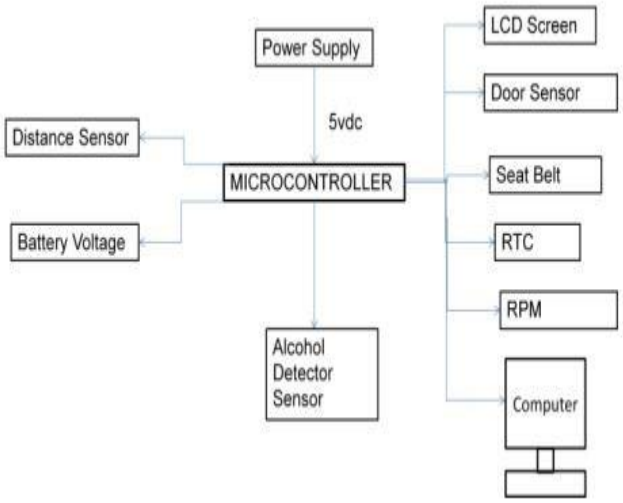


Figure 2.1 Block diagram of existing in-alcohol detection system

III.PROPOSE SYSTEM IT'S REQUIREMENT,WORKING AND FLOW CHART

This proposed system can be implemented by using advanced features like alcohol detection, accident identification, location tracking, use as a hands free device, fire detection. In case of an accident or passengers panic situations, it will send a message through GSM along with location with the help of GPS module.

Using the color sensor is used to detect the speed limit zone and the vehicle speed is automatically controlled by the microcontroller by sending pulse width modulation signals to motor driver module. Finally these all applications are monitored by the vehicle owner in his mobile application.

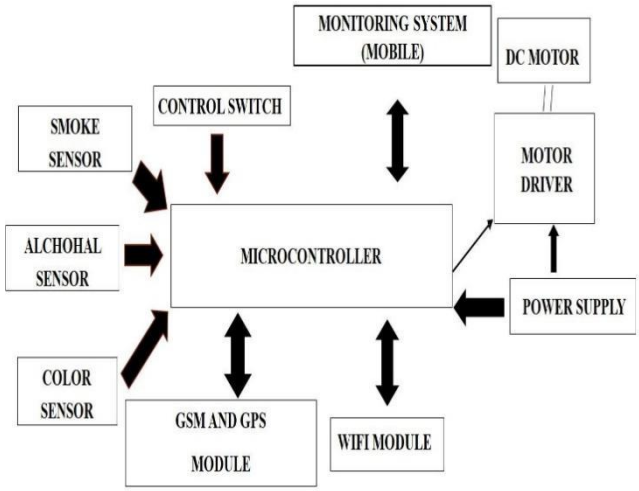


Figure 3.1 Block diagram of The Proposed system

3.1 The Hardware components required:

- Arduino UNO BOARD
- GSM and GPS module
- Wi-Fi Module
- MQ-4, MQ-3, Color and Control switch
- Motor Driver
- DC Motors
- Miscellaneous

3.2 ARDUINO BOARD:

It is a simple microcontroller board. It is an open source computing platform and has an environment for developing software for the Arduino board. It can be used to make computers. It is used to create interactive projects. It takes input from sensors or switches and controls the outputs. Arduino boards are inexpensive compared to other microcontroller based devices. It can stand-alone or can communicate with the software of the computer. Arduino software can run on Windows, Linux and Macintosh OSX. It provides an Integrated Development Environment (IDE) which is written on Java for programming microcontrollers. It supports C, C++ programming languages. So anyone who knows the basic programming C can easily access Arduino IDE. It is very simple. Arduino has built-in functions. It can access serial port. It does not need to access the register details. It can simply call the functions and easily perform the functions. So the coding and debugging are fast and efficient. Arduino IDE displays the data which is into and out of the serial port.

Arduino Uno is a microcontroller board based on 8-bit ATmega328P microcontroller. Along with ATmega328P, it consists other components such as crystal oscillator, serial communication, voltage regulator, etc. to support the microcontroller. Arduino Uno has 14 digital input/output pins (out of which 6 can be used as PWM outputs), 6 analog input pins, a USB connection, A Power barrel jack, an ICSP header and a reset button.

Figure 3.2 Arduino UNO Board

The 14 digital input/output pins can be used as input or output pins by using pinMode(), digitalRead() and digitalWrite() functions in arduino programming. Each pin operate at 5V and can provide or receive a maximum of 40mA current, and has an internal pull-up resistor of 20-50 KOhms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

- **Serial Pins 0 (Rx) and 1 (Tx):** Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
- **External Interrupt Pins 2 and 3:** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM Pins 3, 5, 6, 9 and 11:** These pins provide an 8-bit PWM output by using analogWrite() function.
- **SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK):** These pins are used for SPI communication.
- **In-built LED Pin 13:** This pin is connected with an built-in LED, when pin 13 is HIGH – LED is on and when pin 13 is LOW, its off.

Along with 14 Digital pins, there are 6 analog input pins, each of which provide 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using AREF pin with analog Reference() function.

- Analog pin 4 (SDA) and pin 5 (SCA) also used for TWI communication using Wire library.

Arduino Uno has a couple of other pins as explained below:

- **AREF:** Used to provide reference voltage for analog inputs with analogReference() function.
- **Reset Pin:** Making this pin LOW, resets the microcontroller.

3.3 GSM MODULE:

The words, “Mobile Station” (MS) or “Mobile Equipment” (ME) are used for mobile terminals supporting GSM services.

A call from a GSM mobile station to the PSTN is called a “mobile originated call” (MOC) or “Outgoing call”, and a call from a fixed network to a GSM mobile station is called a “Mobile Terminated Call” (MTC) or “Incoming call”.

GSM (Global System for Mobile communications) is an open, digital cellular technology used for transmitting mobile voice and data services.

Figure 3.3 GSM Module

GSM supports voice calls and data transfer speeds of up to 9.6 kbit/s, together with the transmission of SMS (Short Message Service).
GSM operates in the 900MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. The 850MHz band is also used for GSM and 3G in Australia, Canada and many South American countries.
By having harmonized spectrum across most of the globe, GSM’s international roaming capability allows users to access the same services when travelling abroad as at home. This gives consumers seamless and same number connectivity in more than 218 countries. Terrestrial GSM networks now cover more than 80% of the world’s population. GSM satellite roaming has also extended service access to areas where terrestrial coverage is not available.

3.4 GPS MODULE:

At the heart of the module is a NEO-6M GPS chip from u-blox. The chip measures less than the size of a postage stamp but packs a surprising amount of features into its little frame. t can track up to 22 satellites on 50 channels and achieves the industry’s highest level of sensitivity i.e. -161 dB tracking, while consuming only 45mA supply current.

Unlike other GPS modules, it can do up to 5 location updates a second with 2.5m Horizontal position accuracy. The u-blox 6 positioning engine also boasts a Time-To-First-Fix (TTFF) of under 1 second. One of the best features the chip provides is Power Save Mode(PSM). It allows a reduction in system power consumption by selectively switching parts of the receiver ON and OFF. This dramatically reduces power consumption of the module to just 11mA making it suitable for power sensitive applications like GPS wristwatch.

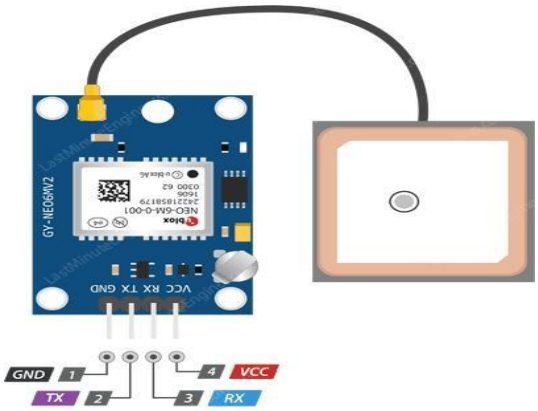


Figure 3.4: NEO-6M GPS Module

The necessary data pins of NEO-6M GPS chip are broken out to a 0.1″ pitch headers. This includes pins required for communication with a microcontroller over UART. The module supports baud rate from 4800bps to 230400bps with default baud of 9600. There is an LED on the NEO-6M GPS Module which indicates the status of Position Fix. It'll blink at various rates depending on what state it's in:

No Blinking – It's searching for satellites.
Blink every 1s – Position Fix is found (The module can see enough satellites).

The operating voltage of the NEO-6M chip is from 2.7 to 3.6V. But the good news is that, the module comes with MIC5205 ultra-low dropout 3V3 regulator from MICREL. The logic pins are also 5-volt tolerant, so we can easily connect it to an Arduino or any 5V logic microcontroller without using any logic level converter. The module is equipped with an HK24C32 two wire serial EEPROM. It is 4KB in size and connected to the NEO-6M chip via I^2C. The module also contains a rechargeable button battery which acts as a super-capacitor.

3.5 MQ-2 SENSOR MODULE:

This gas sensor composed of micro Al2O3 ceramic tube and Tin Dioxide (SnO_2). Electrode and heater are fixed into a crust. The heater provides required work conditions for the work of sensitive components. The conductivity of sensor is higher along with the gas concentration rising. When the sensor, heated by 5V it reaches at high temperature, it cleans the other gases not adsorbed under low temperature. The MQ-2 have 6 pins in which 4 of them are used to fetch signals and other 2 are used for providing heating current.

Figure 3.5 MQ-2 Sensor

Two 'A' pins are shorted internally and two 'B' pins are shorted internally. H and H pins is heater coil of the sensor. The heater coil is used to heat up the air around the sensor, so that it can detect the chemical content in the air optimally. The sensor can take up to few minutes to heat up to reach optimal working condition. It not advisable to touch the sensor while operating because it can get pretty warm.

The sensor has an operating voltage of 5V; the sensor must be powered from external sources only, as it consumes about 200mA for heating. The Arduino voltage regulator can't deliver this much current. For testing, we can connect a ammeter in mA range at the output pin B and bring a cigar gas lighter. Try to leak the gas without igniting it near the sensor. As the concentration of gas rises around the sensor, the current flow through ammeter increases. If this works, our sensor is working. MQ-2 sensor is quite useful devices for controlling pollutants in the air. This is a robust Gas sensor suitable for sensing LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations in the air.

When a SnO2 semiconductor layer is heated to a high temperature, oxygen is adsorbed on the surface. When the air is clean, electrons from the conduction band of tin dioxide are attracted to oxygen molecules. This creates an electron depletion layer just beneath the surface of the SnO2 particles, forming a potential barrier. As a result, the SnO2 film becomes highly resistive and prevents electric current flow.

In the presence of reducing gasses, however, the surface density of adsorbed oxygen decreases as it reacts with the reducing gasses, lowering the potential barrier. As a result, electrons are released into the tin dioxide, allowing current to freely flow through the sensor.

The MQ2 gas sensor is simple to use and has two different outputs. It not only provides a binary indication of the presence of combustible gasses, but also an analog representation of their concentration in air. The sensor's analog output voltage (at the A0 pin) varies in proportion to the concentration of smoke/gas. The higher the concentration, the higher the output voltage; the lower the concentration, the lower the output voltage.The animation below shows the relationship between gas concentration and output voltage.

MQ-3 SENSOR:

MQ3 is one of the most commonly used sensors in the MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type of sensor. Metal oxide sensors are also known as Chemiresistors, because sensing is based on the change of resistance of the sensing material when exposed to alcohol. So by placing it in a simple voltage divider network, alcohol concentrations can be detected.

MQ3 alcohol sensor works on 5V DC and draws around 800mW. It can detect Alcohol concentrations anywhere from 25 to 500 ppm. MQ3 is a heater-driven sensor. That's why it is enclosed in two layers of fine stainless steel mesh called an Anti-explosion network. It ensures that heater element inside the sensor will not cause an explosion, as we are sensing flammable gas (alcohol). It also provides protection for the sensor and filters out suspended particles so that only gaseous elements are able to pass inside the chamber. This is what the sensor looks like when outer mesh

is removed. The star-shaped structure is formed by the sensing element and six connecting legs that extend beyond the Bakelite base. Out of six, two leads (H) are responsible for heating the sensing element and are connected via a Nickel-Chromium coil (a well known conductive alloy).

The remaining four leads (A & B) responsible for output signals are connected using Platinum Wires. These wires are connected to the body of the sensing element and convey small changes in the current that passes through the sensing element. The tubular sensing element is made up of Aluminum Oxide (AL2O3) based ceramic and has a coating of Tin Dioxide (SnO2). The Tin Dioxide is the most important material being sensitive towards alcohol. However, the ceramic substrate only increases the heating efficiency and ensures that the sensor area is continuously heated to the working temperature. So, to summarize, the Nickel-Chromium coil and Aluminum Oxide based ceramic forms a Heating System; while Platinum wires and coating of Tin Dioxide forms a Sensing System.

When SnO2 semiconductor layer is heated at high temperature, oxygen is adsorbed on the surface. In clean air, electrons from the conduction band in tin dioxide are attracted to oxygen molecules. This form an electron depletion layer just below the surface of SnO2 particles and forms a potential barrier. As a result, the SnO2 film becomes highly resistive and prevents electric current flow.

In the presence of alcohol, however, the surface density of adsorbed oxygen decreases as it reacts with the alcohols; which lowers the potential barrier. Electrons are then released into the tin dioxide, allowing current to flow freely through the sensor.

Since the MQ3 alcohol sensor is not breadboard compatible, we recommend this handy little breakout board. It's very easy to use and comes with two different outputs. It not only provides a binary indication of the presence of alcohol but also an analog representation of its concentration in air.

Figure 3.6 MQ-3 Alcohol Sensor

The analog output voltage provided by the sensor (at AO pin) varies in proportion to the alcohol concentration. The higher the alcohol concentration in the air, the higher the output voltage; whereas lower concentration gives lower output voltage. Start by connecting VCC pin to the 5V pin on the Arduino and connect GND pin to the Ground pin on the Arduino. Finally, connect AO output pin on the module to Analog pin#0 on the Arduino.

3.7 COLOR SENSOR:

Color sensors provide more reliable solutions to complex automation challenges. They are used in various industries including the food and beverage, automotive and manufacturing industries for purposes such as detecting material, detecting color marks on parts, verifying steps in the manufacturing process and so on.

While expensive color sensors are used in industrial applications, inexpensive sensors such as TCS230 color sensor can be used for less stringent applications.

The TCS230 color sensor (also branded as the TCS3200) is quite popular, inexpensive and easy to use. Before we use this color sensor in our Arduino project, it would be good to see how a color sensor actually works. White light is made up of three primary colors (Red, green and blue), which have different wavelengths. These colors combine with each other to form different shades of colors.

When white light falls on any surface, some wavelengths of light are absorbed and some are reflected, depending on the properties of the surface material. The color we see is a result of which wavelengths are reflected back into our eyes.

At the heart of the module is an inexpensive RGB sensor chip from Texas Advanced Optoelectronic Solutions – TCS230. The TCS230 Color Sensor is a complete color detector that can detect and measure an almost infinite range of visible colors.

The sensor itself can be seen at the center of the module, surrounded by the four white LEDs. The LEDs light up when the module is powered up and are used to illuminate the object being sensed. Thanks to these LEDs, the sensor can also work in complete darkness to determine the color or brightness of the object. The TCS230 operates on a supply voltage of 2.7 to 5.5 volts and provides TTL logic-level outputs.

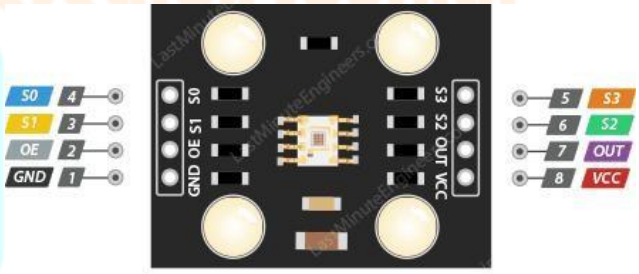


Figure 3.7 Color Sensor

The sensor has two more control pins, S0 and S1, which are used for scaling the output frequency. The frequency can be scaled to three different preset values of 2%, 20% or 100%. This frequency-scaling function allows the sensor to be used with a variety of microcontrollers and other devices. We can get different scaling factor by different combinations of S0 and S1. For the Arduino most applications use the 20% scaling.

3.8 DC MOTORS:

A DC motor is an electric motor that runs on direct current power. In any electric motor, operation is dependent upon simple electromagnetism. A current carrying conductor generates a magnetic field, when this is then placed in an external magnetic field, it will encounter a force proportional to the current in the conductor and to the strength of the external magnetic field. It is a device which converts electrical energy to mechanical energy. It works on the fact that a current carrying conductor placed in a magnetic field experiences a force which causes it to rotate with respect to its original position.

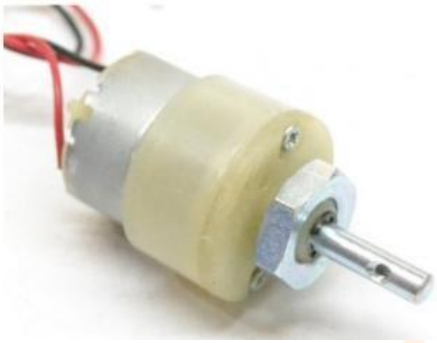


Figure 3.8 DC Motor

A DC motor consists of an stator, an armature, a rotor and a commutator with brushes. Opposite polarity between the two magnetic fields inside the motor cause it to turn. DC motors are the simplest type of motor and are used in household appliances, such as electric razors, and in electric windows in cars.

3.9 MOTOR DRIVER:

Motor drives are circuits used to run a motor. In other words, they are commonly used for motor interfacing. These drive circuits can be easily interfaced with the motor and their selection depends upon the type of motor being used and their ratings (current, voltage).

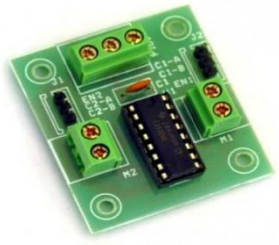


Figure 3.9 Motor Driver

The major motor drive components for DC motors are: a controller, a motor driver IC or a motor driver circuit, the desired DC motor being used, power supply unit and the necessary connections to the motor.

1. ***Controller:*** The controller can be a **microprocessor** or a microcontroller

2. ***Motor Driver IC or Motor Driver Circuits:*** They are basically current amplifiers which accept the low current signal from the controller and convert it into a high current signal which helps to drive the motor.

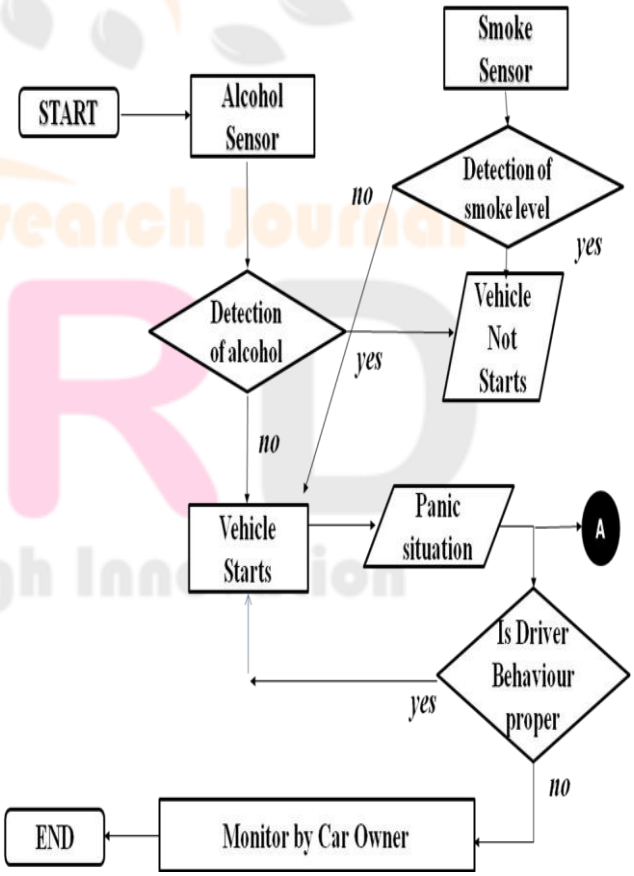
3. ***Motor***: Motor is defined as an electric or mechanic device that can create a motion. While interfacing with the **controller**; some of the motors like DC motor**,**

4. **Stepper motor** and brushless dc motor may require a driver IC or driver circuit. DC motor is a type of motor that can convert DC into a mechanical power. In a brushless DC motor, it consists of a DC power source, an inverter producing an AC signal to drive the motor. While stepper motor is a brushless DC electric motor that converts electrical pulses into discrete mechanical motions.

5. ***Power Supply Unit***: Provides the required power to the motor drive.

Servo motor is a type of actuator device that consists of a motor and a sensor to control velocity, acceleration etc. The major motor drive components for **a servo motor** are a controller, power supply unit, servo motor and the necessary connections with the motor. Commonly, motor drive for a servo motor is also known as Servo motor controller or Servo Motor Driver. Usually, 8051 controllers are used for controlling a servo motor driver with a single servo motor. If there are multiple servo motors; then **PIC, ATMEGA** etc.

FLOW CHART:



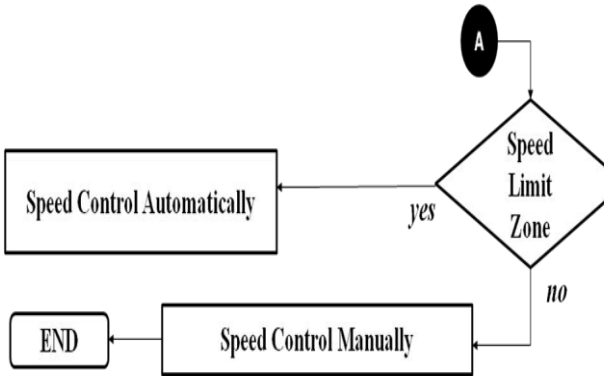


Figure 3.10 Flow chart of proposed system

IV.RESULTS AND DISCUSSIONS

A smart vehicle is designed using Arduino with sensors (Figure 4.1). If alcohol concentration is present in human breath then it displays the signal on Vehicle owner mobile App and Ignition of vehicle is OFF.

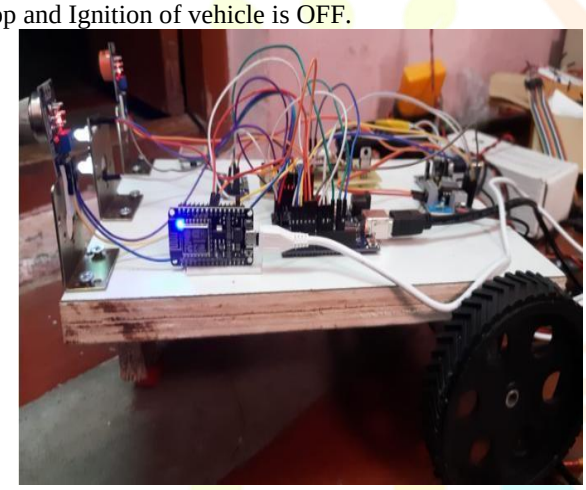
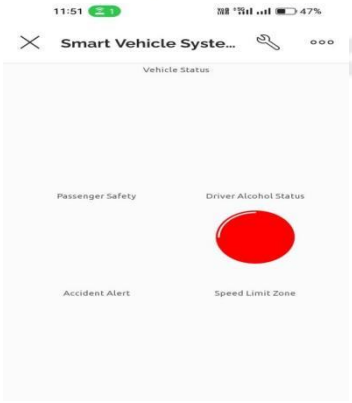
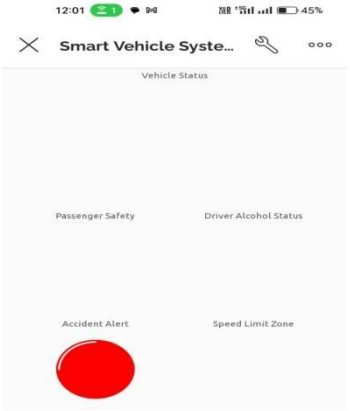


Figure 4.1 Working model of a smart in-vehicle alcohol detection and speed control system is designed

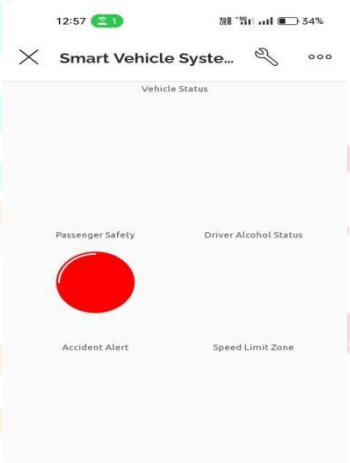
- **Driver alcohol detection status monitoring through blynk app**



- **Fire accident detection status monitoring**

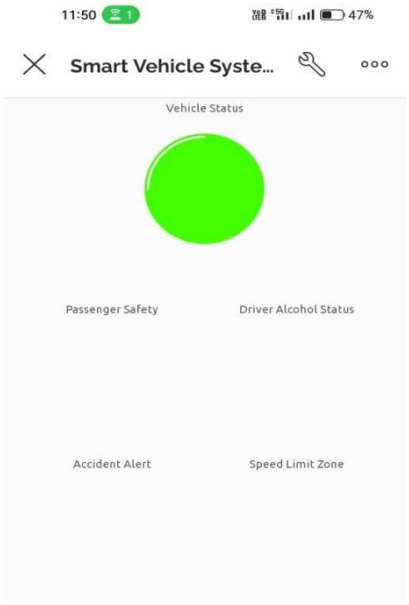


- **Panic switch status monitoring**

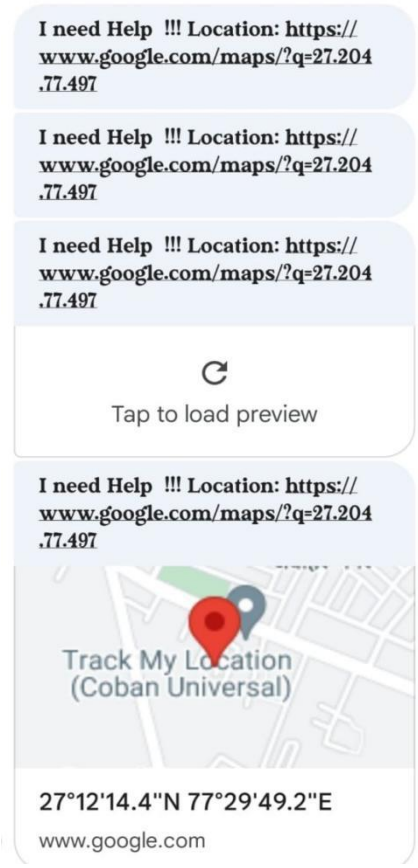


- **Speed limited zone status monitoring**

- **Normal state when vehicle is in good state**



- **Display of messages send to the registered mobile number**



V.CONCLUSION AND FUTURE WORK

The designed Smart vehicle system ensures the safety of the passengers, and also ensures that the rider hasn't consumed alcohol more than the permissible limit. If any of these prime safety rules are violated, the proposed system will prevent the driver from starting the vehicle. The system also helps in efficient handling of the aftermath of accidents by sending a SMS with the location of the vehicle to the vehicle owner. This ensures that the victims get proper and prompt medical attention, if he/she met with an accident. In future if there is a large demand of this type of sytems we can manufacture the whole circuit in printed circuit board, so that circuit becomes smaller and can be easily fitted into vehicle. The circuit can also be powered by solar energy so that it uses green energy and does no harm to environment . The flexible solar panels can fixed all along surface of vehicle.

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