Integrated Security in Steering Wheel of a Car

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Abstract -- Carelessness of the driver is the major factor in accidents. So, most of the countries force the car drivers to wear seat belts and to avoid usage of the vehicle in drunken conditions. In spite of the instructions by traffic authorities, the rules are violated. To overcome this, an automated intelligent system to authenticate the user of the car and to verify that he has non-alcoholic breath while driving is brought into place. This system also assists in vehicle theft detection and accident minimization. The proposed system makes use of Internet of things (IOT) platform which includes alcohol concentration detection sensor and also includes face authentication for increased security. The proposed system consists of an MQ-3 sensor used for calculating the breath alcohol level, a GPS module to detect the location of the vehicle and a camera for face recognition. Different types of safeguarding techniques such as Car locking, GPS, Alarm Trigger, etc. are provided as extra security features.

Indexed Terms: Alcohol Sensor, Raspberrypi, IoT, MQ3, Authentication, Security.

I. INTRODUCTION

A common slogan "Don't Mix Drink and Drive" stating the awareness of the occurrence of accidents is visible at every place during travelling. Drinking and driving is a serious societal problem, which needs to be avoided.

Car Safety concept started in the year 1934. The initial safety features for the car included the safety glass, four-wheel hydraulic brakes, seat belts, and padded dashboards. Progressively, the existing systems were stabilized followed by introduction of disc brakes and anti-lock braking system. To avoid vehicle robbery, main solid hostile to burglary gadget was introduced. Vehicle focal locking framework guaranteed an authentication system.

1.1. Current Security System:

Vehicle Safety Technology (VST) in the automotive industry refers to a special technology (advanced driver-assistance systems) developed to ensure the safety and security of automobiles and passengers. The term encompasses a broad umbrella of projects and devices within the automotive world. Some of the present passenger security systems include

a. Air-Bags: Airbags are a type of automobile safety restraint like seatbelts. They are gas-inflated cushions built into the steering wheel, dashboard, door, roof, or seat of your car that use a crash sensor to trigger a rapid expansion to protect you from the impact of an accident.
b. Anti-Lock Braking System (ABS): An anti-lock braking system (ABS) is a safety anti-skid braking system used on aircraft and on land vehicles, such as cars, motorcycles, trucks and buses. ABS operate by preventing the wheels from locking up during braking, thereby maintaining tractive contact with the road surface.
c. Theft Detection with Remote Engine Locking: Vehicle Theft Detection/Notification with Remote Engine Locking mainly aims to reduce vehicle theft to a great extent.
d. Central Locking: New cars are generally installed with a power-operated locking system that is connected to the alarm system of the vehicle. If the driver wants to lock the vehicle from the inside, he/she makes use of the key fob to lock the front doors. This automatically locks the remaining three doors of the car. Later if the driver manually unlocks his own door, the other doors will be unlocked as well.
e. Speed Sensing Door Lock: This automatically locks the doors of a car on crossing a speed limit of 10Km/Hr.
f. Car Tracking Systems: Car tracking systems requires a transmitter to be hidden in the car. If stolen, the vehicle can then be tracked and recovered.
g. Engine Immobilizer: An immobilizer is an electronic device which prevents a car from being

started by someone who doesn't have the proper key.

h. Car Alarm: Car alarms are about alerting you to the fact that some unscrupulous so-and-so could be meddling with your car motor or might have hit hard onto your car.
i. Seat Belts: A seat belt can add to the safety feature of the passenger. It guarantees the passengers to be intact even when hard-brakes are applied.
j. Image Capture Owner Identification: Recent advancements have included the camera to capture the image of the driver/owner, compare it with the database and then authenticate it. This authentication is associated with almost every feature of the car such as Engine Immobilizer, Theft control, etc.
k. Parking Sensors and Rear Camera: These sensors help the driver to park the vehicle in a reverse direction. The camera provides the rear image of the scene.

Some of the security features of the car are as mentioned in the figure 1.1 below.

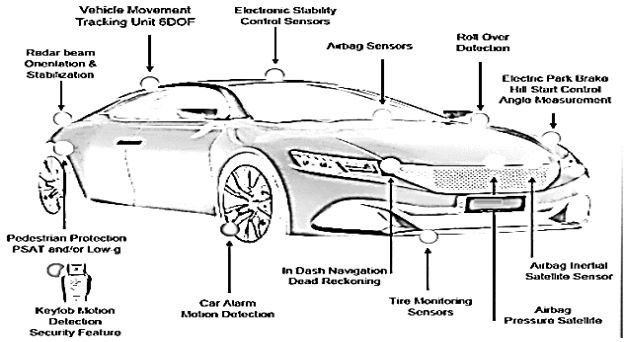


Fig 1.1 Security Features of a Car [1]

1.2. Alcohol Breath Testing

Drivers are initially tested for alcohol impairment at the roadside with a screening device. Screening devices are about the size of old-fashioned mobile phones. The driver blows into a disposable mouthpiece for each test. The whole process takes about a minute for the device to record the result. Screening devices offer four result categories: "zero," "pass," "warn," and "fail". A sample of the ambient air is tested as a blank check. This is followed by a check sample of an air/ethanol standard. This checks the calibration of the device. The concentration of alcohol in the standard sample is 35 µg/100 ml air, which is the UK drink-driving limit. Two samples of breath are then taken from the motorist and tested, each separated by a sample of air. The test ends with a final air and standard check. Fig 1.2 depicts the alcohol sensing as shown below.

Fig 1.2. Alcohol Breath Testing [2]

1.3. Objectives:

A system needs to be designed which includes all the above features to safeguard the vehicle. The objectives of the projects include:

- Alcohol sensing for the driver.
- Ignition / Kill-switch – Turn ON/OFF based on the alcohol identification.
- Intimate the current location of the vehicle.
- Prevention of vehicle theft using an lock/unlock key.
- Owner / driver identification and authentication based on the image capture and compare.
- Provide live image capture of the intruder and lock the vehicle.
- Instant intimation to the owner on occurrence of the unrecognized and unauthenticated incidents.

II. BACKGROUND

Various papers have been published under the same subject but different methods of whom some of the papers along with their results are being considered here for surveying purpose.

1. Name: "Drink and Drive Detection System", Ms. Rekha. M, Ms. Bharathi. K, Ms. Cynthia. A, International Journal of Innovative Research in Information Security, Issue 05, Volume 04, May 2017. [4]

   Its proven that more than 70% of road accidents in India is due to drink and driving. In this paper we propose an interlock system technology in vehicles that will prevent the driver from driving

if the alcohol content is above the legal limit (0.03% per 100ml in India). This technology will automatically detect the blood alcohol concentration (BAC) by means of two techniques a breath-based sensor and touch based sensor and if above the legal limit will not allow car ignition. The breath-based system will measure the alcohol concentration in the blood through the driver's exhaled air. Touch based sensor will read the alcohol level below the skin surface. If the driver chooses to switch off or tamper the system then the RFID tag will send information to the traffic control unit so that they can further take actions so as to prevent him from causing impairment.

2. Name: "Safe Driving Using IoT Sensor", A. Jesudoss, Muthuram.B, O.Lourdson Emmanuel.A, International Journal of Pure and Applied Mathematics, Volume 118, No. 20 2018. [5]

   The main concept of this paper is to prevent the road accident so to prevent the road accident we are using alcohol detection sensor, eye blink sensor, over speed control sensor. The alcohol sensors are used to detect the driver is drunk or not. The eye blink sensors are used to check the driver is sleepy or not with the help of the eyeball movement of the driver, if the driver is sleepy means it will trigger the alarm to conscious the driver. The over speed controller sensors is used to check the car is over speed or not and if the car is over speed means it will reduce the speed of the car & maintain the car speed into normal speed. In this process, the message or SMS will send to the relative of the driver if the driver is consuming alcohol & driving and the message will also send to the local police to prevent the accident.

3. Name: "Drunk Driving Detection using Car Ignition Locking", Keerthana K, Ramya G, Dr. N. Bharathi, International Journal of Pure and Applied Mathematics, Volume 119, No. 16 2018. [6]

   Here, this paper have intended to plan a Drunk driving detection, which is integrated with the directing wheel. This framework is meant for making vehicle driving more secure than previously and shield the mishaps from happening due to the liquor utilization of the driver. The individual when he is at vehicle, this is necessary to infer the driver's condition continuously and here this work proposed the detection of alcohol utilizing alcohol sensor associated with Arduino. Alcohol sensor is installed on the steering of the car, with the end goal that when the level of liquor crosses a reasonable farthest point, where the start of vehicle will kill and the motor will stop. The Arduino always uses the alcohol sensor information to check drunk driving and works a bolt on the vehicle motor to stop the engine.

4. Name: "Drunk-Driver Detection and Alert System (DDDAS) for Smart Vehicles", Rajesh Kumar Jakkar, Roop Pahuja, Raj Kumar Saini, Bhagirath Sahu, Natwar, American Journal of Traffic and Transportation Engineering, Volume 2, Issue 4, July 2017, Pages: 45-58.[7]

   This paper discusses design, development and live-performance test of the prototype of drink and drive situation detection and alert cum vehicle control system to minimize road mishaps and enhance public safety on road. It also analyses the response of breath –alcohol semiconductor sensor with respect to variation in distance from source which is critical part of system design. Based upon the recent smart gas sensing and integration of satellite and cellular wireless communication technologies, the proposed device quickly senses the drunken state of the driver during start-up/driving by estimating the equivalent breath alcohol concentration level corresponding to the legally permissible state's threshold blood alcohol concentration level. On detection of such situation, on-vehicle siren/audio alarm is activated to warn the persons on road and vehicle control system is triggered to lock ignition or stop the fuel inflow to the vehicle. Additionally, 'alert SMS' indicating drunk driver location, tracked by onboard GPS receiver, along with vehicle number is communicated remotely to authorized (family members, traffic police) mobile user using GSM cellular network to take appropriate action thereafter. The live experiment results highlighted the successful working performance of the device in-housed at the steering wheel of the vehicle with the drunk driver.

5. Name: "Design of Alcohol Detection System for Car Users thru Iris Recognition Pattern Using Wavelet Transform", Lea Angelica Navarro, Mark Anthony Dino, Exechiel Joson, Rommel Anacan, Roberto Dela Cruz, International Conference on Intelligent Systems, Modelling and Simulation, 2016. [8]

   The purpose of this paper is to develop a system that captures the Iris image of the driver by detecting if the person is drunk and likewise to develop a reliable algorithm for Iris Recognition. This paper is composed of hardware and software system which focuses on the implementation of an algorithm based on Gabor Filter. The system consists of CCD Camera and Analog-to-Digital Converter, which is linked into a MATLAB program to simulate the captured image which then provides a signal going to the microcontroller and a relay circuit to manipulate the car ignition. If the MATLAB program detects that the driver is under the influence of alcohol, a bypass system follows through a password which is recognized by the MATLAB program then the car/vehicle starts.

6. Name: "Alcohol Detection System in Vehicle Using Arduino", Pranjali Ingalepatil, Priyanka Barhate, Bhagyashri Nemade, Vijay D. Chaudhari, International Research Journal of Engineering and Technology (IRJET), Volume 04, Issue 06, June 2017.[9]

   The aim of this research paper is to represent work which makes human driving safer and to overcome accidents. This product is developed by integrating alcohol sensor with Arduino board. Arduino processor ATmega328 is able to handle more functions than conventional microcontrollers. The alcohol sensor used in this project is MQ3 which to detect the alcohol content in human breath. Since sensor has fine sensitivity range around 2 meters, it can suit to any vehicle and can easily be hidden from the suspects. This product is fitted inside the vehicle.

7. Name: "A Review on Smart IOT Car for Accident Prevention", S. Vimalkumar , P. Hemalatha and J. Kalaivani, Asian Journal of Applied Science and Technology (AJAST), Volume 2, Issue 2, Pages 351-356, 2018.[10]

   Car automation is an IoT innovation by which we can control distinctive things or can keep a track on a vehicle for the (i) Security, (ii) solace and (iii) proficiency. The ease liquor sensor is prepared in the auto for liquor location to stay away from mishaps because of liquor utilization controlling the speed of the auto utilizing sonic sensor while confronting the hindrances. The safety belt comprises of an inbuilt heart beat sensor to mechanize the start of the auto amid therapeutic crises. Edge restrict is set by the age of the drivers which are gathered while enrollment itself. All controls are accessible in auto proprietors' dash board accessible both in auto and furthermore in versatile application. The intermittent information is sent through web and put away in cloud for advance investigation and basic leadership. The Dash board comprises of ON/OFF switch with the goal that the start is controlled remotely amid burglaries and break disappointments.

8. Name: "Vehicle security using Raspberry-Pi", Pavithra .M, S. Jyothi, International Journal of Advance Research, Ideas and Innovations in Technology, Volume 4, Issue 3, 2018. [11]

   The proposed system gives an alarm which represents vehicle tracking and accident detection when theft and accident identifying. Raspberry-pi is the heart of the system, which is connected to any moving vehicle, these make an easy option to track any moving vehicle for that it matters in real time on Google-maps. An alert will be received to the authorized person, the vehicle will be moved to stop mode through the GSM-GPRS connected to the raspberry-pi kit which is kept on inside of the vehicle. Which consist of rasp-pi-camera, sensors, and android phone. The camera is used to take pictures when the vehicle is open or closed mode. This system helps find-out the exact location of an accident with the server and sent the information to an authorized person, give an alarm signal to save the human life. This system also detects the behaviour of the driver through the sensors whether he/she drowsy/drunk, the

speed vehicle is stopped. This system more securable reliable and economical.

9. Name: "Intelligent Vehicle Control Using Wireless Embedded System in Transportation System Based On GSM and GPS Technology", M. Abinaya, R. Uthira Devi, IJCSMC, Vol. 3, Issue. 9, September 2014.[12]

   Vehicle security enhancement and accident prevention system can be developed through the application of ignition control (tracking and locking), fuel theft, accident detection and prevention, driver fatigue, pollution control and speed limiting with efficient vehicle management system. The need for this project is to provide security to the vehicles by engine locking system which prevents the vehicle from unauthorized access. This technique helps to find out the exact location of the accident and with the help of server an emergency vehicle can be sent to the exact location to reduce the human life loss. It also detects the behaviour of the driver through sensors whether he/she is drowsy or drunk, so that occurrence of accident can be prevented. The place of the vehicle identified using Global Positioning system (GPS) and Global system mobile communication (GSM). This is more secured, reliable and low cost.

10. Name: "Accident Prevention By Alcohol Detection System In Vehicle", A.A.Marathe , F.H. Mansuri, Y.W. Shaikh, D.R. Mahajan , G.D.Wagh, ICSTM, 2017.[13]

    This paper is all about making safe driving system of vehicle for drunk drivers. This system aims to minimize road accidents due to drunk driving and making vehicle driving safer than before. This is implemented using alcohol detection sensor, motors and mechanical linkages. The proposed system is compact and less costly with the mere need in future. The purpose of this project is to develop vehicle accident prevention by method of alcohol detection in an effort to reduce drunk and drive under the influence of alcohol. The system provides unique method to curb drunken people. Before the authors researched and work on system many accidents occurred nearby 68% accidents occurred in the world due to drunk driving, which caused loss of valuable human life. It is unique method to curb drunken drivers by means of alcohol detection system. The system usesMQ3 sensor, stepper motor, linkages and buzzer etc. In the world nearby 0% vehicle are using this system for road safety.

III. DESIGN

3.1. Initial Design

A block diagram depicting the complete process is as shown in the fig 3.1. The image of a person is captured using a steering-mounted camera which is then processed by comparing the image of a person with the data stored in the database. Once the person is identified, a level of breath analysis of the person is done to check whether the alcohol level is beyond the threshold. If yes, then the ignition is turned off, location is tracked and intimated to the emergency number via SMS.

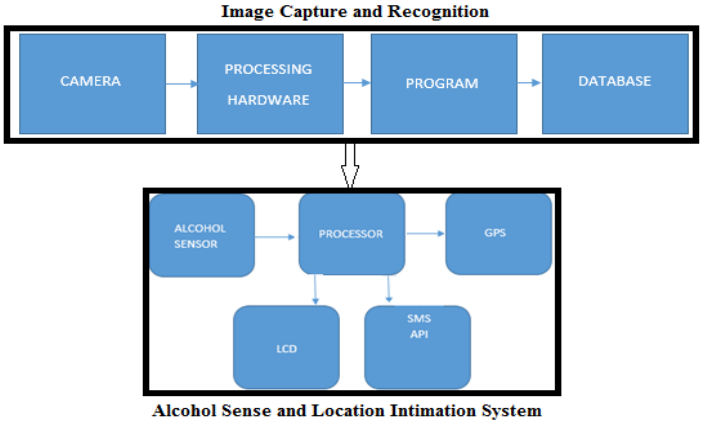


Fig 3.1. Initial Design

3.2. Design

NodeMCU:

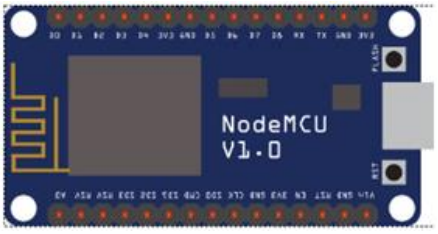


Fig 3.2. NodeMCU

The ESP8266 NodeMCU CP2102 Wi-Fi plug and play board has ESP8266 which is a highly integrated chip designed for the needs of a new connected world via Wi-Fi. ESP8266 has powerful onboard processing and storage capabilities that allow it to be integrated with the sensors and other application specific devices through its GPIOs to fetch the data occupying a minimal size on the PCB.

3.2.1. NodeMCU with Arduino IDE:

Every external pin of NodeMCU maps to an internal pin onboard for user convenience. For example, the D0 pin on the NodeMCU Dev kit is mapped to the internal GPIO pin 16 of ESP8266. The mapping of the external to internal mapping of GPIO's can be seen as shown below in the figure 3.3.

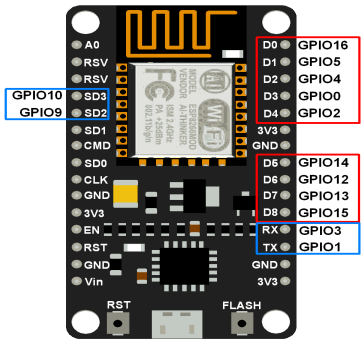


Fig 3.3. NodeMCU with Arduino IDE

ESP8266 is a system on a chip (SoC) design with components like the processor chip of which some of which are used internally to interface with other components of the SoC, like flash memory with 11 GPIO pins for fetching the data with Tx and Rx as 2 pins for communication dropping on to usable GPIO pins to 9. i.e. D0 to D8. D0/GPIO16 pin are used as GPIO read/write the data.

3.2.2. Alcohol Sensor Interfacing:

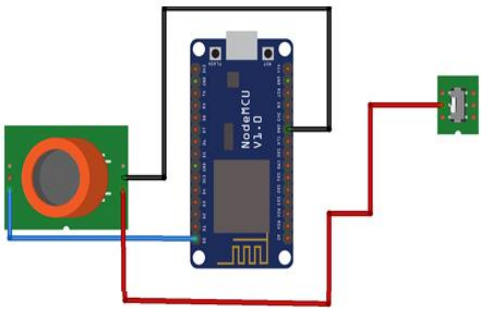


Fig 3.4. MQ-3 Interfacing with NodeMCU

The A0 pin on the MQ-3 sensor is interfaced with the A0 pin on the NodeMCU board and GND is connected to the GND pin.

Basically MQ-3 sensor is a low cost SnO_2 semiconductor alcohol gas sensor capability of alcohol detection even at lowest concentration of 0.05mg/L to 10mg/L. The conductivity of the sensor increases as the alcohol content increases and accuracy and response time of which never hampers due to the smoke, vapor or gasoline content in the air. The output of whose detection is analog and digital signals corresponding to the level of alcohol detection in the breath exhaled.

3.2.3. Software Design for Alcohol-Interfacing

Analog to Digital Converter (ADC) is used to convert analog signal into digital form. ESP8266 has inbuilt 10-bit ADC with only one ADC channel i.e. it has only one ADC input pin to read analog voltage from external device. The external pin is interfaced from the alcohol-sensor onto the ADC pin (A0). The ADC channel on ESP8266 is multiplexed with the battery voltage. The input voltage range for ADC pin is 0–1.0V while reading external voltage.

The setting for ADC mode is dependent on the voltage measured at 107th byte of "esp_init_data_default.bin" (0-127 byte) of firmware whose 107th byte corresponds to "vdd33_const" with value set to 0xFF (i.e. 255) to read system voltage on VDD pin. i.e. whether system voltage or external voltage is being measured. And to read external voltage on ADC pin it must be set to power supply voltage on VDD pin of ESP8266. The working power voltage range of ESP8266 is between 1.8V and 3.6V, and the unit of "vdd33_const" is 0.1V, therefore, the value range of "vdd33_const" is 18 to 36.

NodeMCU Dev Kit has on board register divider network which provide 1.0V from 3.3V to the ADC pin of ESP8266. Hence, we can use 0–3.3V range for ADC input voltage and since it has 10-bit ADC, the detected alcohol sense ranges from 0-1023 bits. To read and sense the analog voltages the following functions are made use of:

- `analogRead(A0)` : This function is used to read external voltage applied on ADC pin of module.

- ESP.getVcc() : This function is used to read NodeMCU module VCC voltage. ADC pin must be kept unconnected. Note that ADC mode should be changed to read system voltage before reading VCC supply voltage. To change ADC mode use ADC_MODE (mode) just after #include lines of your sketch. Modes are ADC_TOUT (for external voltage), ADC_VCC (for system voltage). By default, it reads external voltage.

3.2.4. LED Interfacing

A Light Emitting Device (LED) / Buffer to be interfaced so as to indicate the excess level of alcohol in the breath of the person. In electronics, an LED circuit or LED driver is an electrical circuit used to power a light-emitting diode (LED). The circuit must provide sufficient current to light the LED at the required brightness, but must limit the current to prevent damaging the LED. The voltage drop across an LED is approximately constant over a wide range of operating current; therefore, a small increase in applied voltage greatly increases the current. Fig below shows the interfacing of the LED with the Node MCU board. The anode of the LED is connected to the D3 pin and GND is connected to GND so as to transfer the data and switch on whenever the detected levels crosses the threshold.

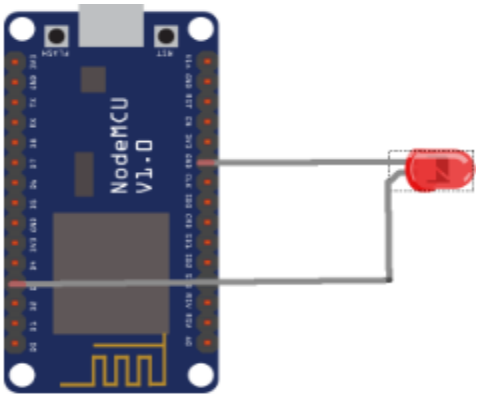


Fig 3.5. LED Interfacing with NodeMCU

3.2.5. Buzzer Interfacing

The piezo buzzer produces sound based on reverse of the piezoelectric effect. The generation of pressure variation or strain by the application of electric potential across a piezoelectric material is the underlying principle. These buzzers can be used alert a user of an event corresponding to a switching action, counter signal or sensor input. They are also used in alarm circuits.

The buzzer produces a same noisy sound irrespective of the voltage variation applied to it. It consists of piezo crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave. Most buzzers produce sound in the range of 2 to 4 kHz and operating at 50-60 voltage cycles stepped down from the AC Line. The connections of the buzzer is as shown in the figure below. The positive lead of the LED is connected to the ignition switch and the negative to the data pin D6.

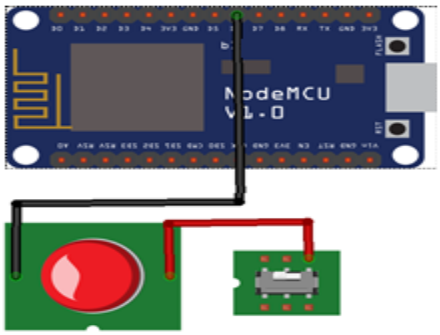


Fig 3.6. Buzzer Interfacing

3.2.6. Interfacing of Bluetooth HC-05 Module

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use either receiving nor transmitting data.

The Bluetooth module interfaces with the NodeMCU so as to verify the key obtained for unlocking purpose via a mobile. The interfaces for the Bluetooth module can be shown as in Fig 3.7 below.

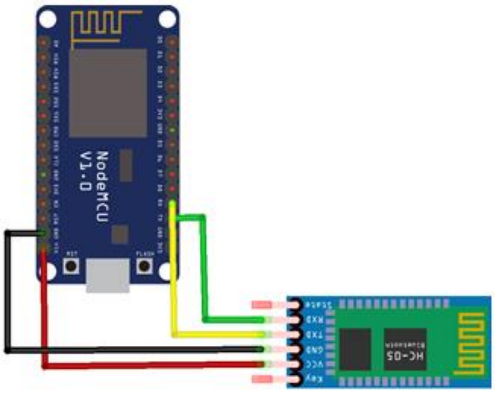


Fig 3.7. HC-05 Bluetooth Interfacing with NodeMCU

The Key pin is nowhere connected. The Bluetooth module works with a voltage range of 5V and the power to be utilized has to be fetched from the NodeMCU module which works on 5V, thus VCC pin of NodeMCU is interfaced with VIN pin, GND pin has to be commonly grounded. The TX pin from the NodeMCU is interfaced with RX pin and vice versa for the transmission and the reception of the Key string Transmitted from the mobile.

3.2.7. Interfacing of Servo Motor for Door Locking / Unlocking Purpose:

A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through servo mechanism. Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motors shaft, the greater the distance the lesser the weight carrying capacity. The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

It is a closed loop system where it uses positive feedback system to control motion and final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal. Here reference input signal is compared to reference output signal and the third signal is produces by feedback system. And this third signal acts as input signal to control device. This signal is present as long as feedback signal is generated or there is difference between reference input signal and reference output signal. So the main task of servomechanism is to maintain output of a system at desired value at presence of noises.

Servo motors have three wires: power, ground, and signal. The power wire is typically red, and should be connected to the 5V pin. The ground wire is typically black or brown and should be connected to a ground pin. The signal pin is typically yellow, orange or white and should be connected to a digital pin (D5). The Interface is as shown below in fig 4.8.

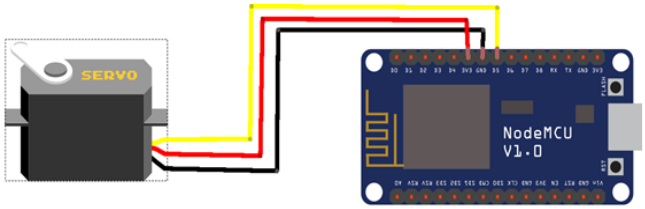


Fig 3.8. Servo-Motor Interfacing with NodeMCU

Similarly, on a non-authentication of a person based on the image captured, the door should be locked and thus the same servo motor is to be interfaced to the Raspberry Pi board too and thus the connection may be shown as in the figure 4.9 below.

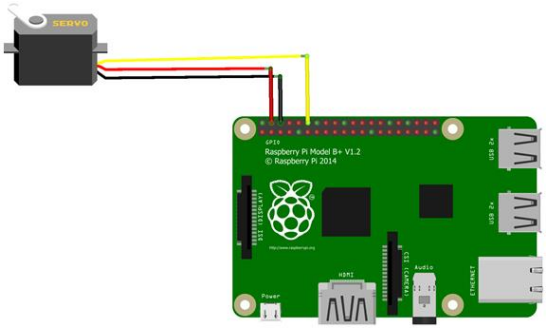


Fig 3.9. Servo-Motor Interfacing with Raspberry-Pi

The control (Yellow) wire should be attached to the GPIO 18th Pin, red wire to be connected to the Vcc (5V) and GND pin to be connected to the GND.

3.2.8. Interfacing of GPS Module with Raspberry Pi:

Similarly, the GPS trackers is needed to locate the position of the user. Thus, a GPS modem is interfaced to the Raspberry Pi.

3.2.9. Interfacing of a Camera for Image Identification for Raspberry Pi:

The term "webcam" is a video camera connected to the Web continuously for an indefinite time that feeds or streams its image in real time to or through a computer to a computer network. Webcams typically include a lens (Fixed-focused Lenses), an image sensor (CMOS / CCD), support electronics, and may also include one or even two microphones for sound.

Digital video streams are represented by huge amounts of data, burdening its transmission (from the image sensor, where the data is continuously created) and storage alike. Most if not all cheap webcams come with built-it ASIC to do video compression in real-time. Support electronics read the image from the sensor and transmit it to the host computer. The camera pictured to the right, for example, uses a Sonix SN9C101 to transmit its image over USB. Typically, each frame is transmitted uncompressed in RGB or compressed as JPEG. Some cameras, such as mobile-phone cameras, use a CMOS sensor with supporting electronics "on die", i.e. the sensor and the support electronics are built on a single silicon chip to save space and manufacturing costs. Most webcams feature built-in microphones to make video calling and video conferencing more convenient.

Typical interfaces used by articles marketed as a "webcam" are USB, Ethernet and IEEE 802.11 (denominated as IP camera). The USB video device class (UVC) specification allows inter-connectivity of webcams to computers without the need for proprietary device drivers. The interface of the camera with the Raspberry Pi board is as shown below

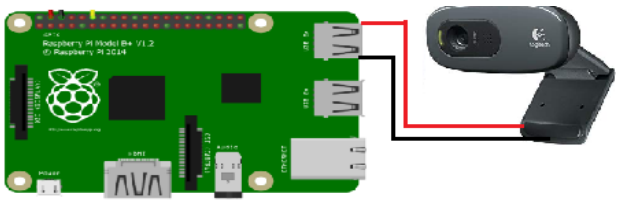


Fig 3.10. Camera Interface with Raspberry Pi Board

3.2.10. Connection of the LCD using I2C to Raspberry Pi and NodeMCU:

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. In this prototype we make use of LCD to display the alcohol level and status of the user and also for displaying the status of the car if locked or unlocked. The LCD's registers from D0 to D7 and Vcc, GND, RS, R/W pins will be connected to I2C.

The USB-I2C module provides a complete interface between your PC and the I2C bus. The module is self-powered from the USB cable and can supply up to 70mA at 5v for external circuitry from a standard 100mA USB port. The module is an I2C master only, not a slave.

- GND: The 0v Gnd pin must be connected to the 0v (Ground) on your I2C device.
- SDA and SCL: These pins are the I2C bus connections. They should be connected directly to the SCL and SDA pins on your I2C device. The USB-I2C module is always a bus master and is fitted with 4.7k pull-up resistors on the PCB.
- VCC: The +5v supply from the USB-I2C module can supply up to 70mA to external devices. If the I2C device requires more than this, or has its own supply, then the +5v pin is left unconnected. Do not apply your own 5v supply to this pin. Fig and Fig shows the interfacing of the LCD and I2C with NodeMCU and Raspberry Pi.

The Serial Clock Line (SCL) and Serial Data Address (SDA) are interfaced with the data lines of the NodeMCU (D1 and D2). The devices are commonly grounded and VCC is connected in common.

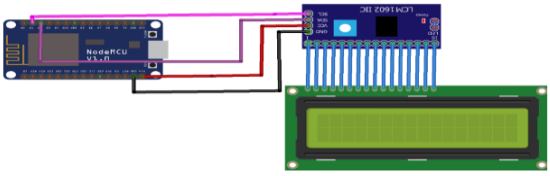


Fig 3.11. LCD interface via I2C with NodeMCU

Similarly, when connecting the display to the Raspberry Pi board, The Serial Clock Line (SCL) and Serial Data Address (SDA) are interfaced with GPIO3 and GPIO2 pins of the pi and rest connections are commonly grounded.

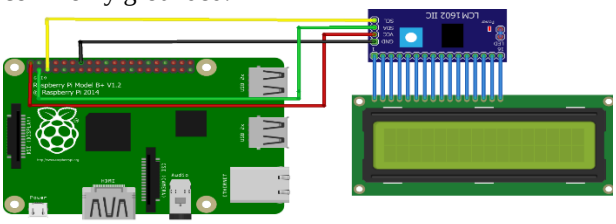


Fig 3.12. LCD interface via I2C with Raspberry Pi

3.2.11. Debugging

The module is connected via USB for debugging purpose and arrives with a pre-flashed NodeMCU firmware allowing to dump the program directly via 2 pins out of 11 are generally reserved for RX and TX in order to communicate with a host PC from which compiled object code is downloaded.

IV. WORKING

This project proposes efficient method for eradicating the upsurge in the number of cases of roads accidents caused by excessive intake of alcohol by drivers on the road and also prevents the theft of vehicles by authentication of the person inside the vehicle. This system can be divided into two parts: Alcohol detection and Face authentication.

4.1. Alcohol detection:

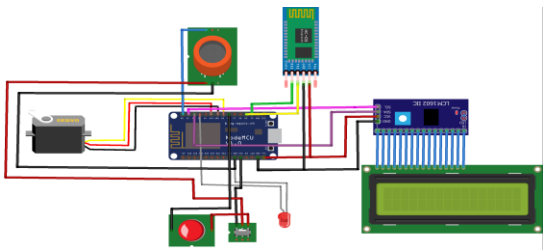


Fig 4.1. Circuit diagram depicting the Alcohol detection

This study develops a prototype alcohol detection by using a NodeMCU microcontroller interfaced with an alcohol sensor along with an LCD screen and a servo motor to demonstrate the concept. Once the ignition key is inserted and turned to the first position the system is turned on. The system uses MQ-3 alcohol sensor to continuously monitor the blood alcohol content (BAC) to detect the existence of liquor in the exhalation of a driver. By placing the sensor on the steering wheel, our system has the capacity to continuously check alcohol level from the driver's breath. The ignition will fail to start, by the activation of kill switch, if the sensor detects content of alcohol in the driver's breath. In case the driver got drunk while driving, the sensor will still detect alcohol in his breath and stop the engine so that the car would not accelerate any further and the driver can park by the roadside. Our prototype system integrates the following hardware components in the design: An LCD, the MQ-3 alcohol sensor, servo motor, buzzer, I2C, Bluetooth module and LED are integrated to Node-MCU microcontroller.

The software code written in Arduino ide is burnt into the NodeMCU board. NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module, it is like a very powerful and compact Arduino that also allows inbuilt WiFi functionality. It has a more powerful processor than the Arduino Uno, a 4Mb flash memory and much more RAM. It basically has almost everything that an Uno has to offer, plus much more. It has fewer GPIO, ADC and PWM options than the Uno, but supports Serial Communication protocols well. So you can always connect a GPIO extender or another Microcontroller if needed. I2C is a serial protocol for two-wire interface to connect low-speed devices like microcontrollers, EEPROMs, A/D and D/A converters, I/O interfaces and other similar peripherals in embedded MQ-3 alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has a range of 0.05mg/L—10mg/L Alcohol. It has a high sensitivity and fast response time. It provides both digital and analog outputs.

The software used in the prototype are: Arduino ide, raspbian stretch, sms api. Once the person's breath is analysed by the sensor, it is programmed and

compared to a threshold value, wherein, if the value exceeds the threshold, the car is locked, and the kill switch is activated. The values given by the alcohol sensor is reflected in the database. Also, a message is sent to the owner/family member of the car with the location and alcohol level. The car will be center locked, and the message is sent through an application, a password is generated by the app to open the car lock. The app is designed to send serial data to the Bluetooth module when the pin is generated on the app. The Arduino Bluetooth module at the other end receives the data and sends it to the Arduino through the TX pin of the Bluetooth module. The code uploaded to the Arduino checks the received data and compares it. If the received data is the same pin generated, then the car is unlocked. The car is locked when the received data is incorrect. This can be observed on the serial monitor.

This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration. The drive circuit is very simple, all it needs is one resistor. A simple interface could be a 0-3.3V ADC. This is sensitive to ethanol, which is found in liquor. This type of sensor circuit can be used as a breath-analyzer to check a person's blood alcohol content. The more the ethanol content in the blood, the more its present in the air during exhalation. This alcohol content gives a better indication if the person is drunk or not. There are 4 pins to the sensor, they are +5V, AOUT, DOUT, and GND. The +5V and GND leads establishes power for the alcohol sensor. The other 2 leads are AOUT (analog output) and DOUT (digital output). How the sensor works is the terminal AOUT gives an analog voltage output in proportion to the amount of alcohol the sensor detects. The more alcohol it detects, the greater the analog voltage it will output. Conversely, the less alcohol it detects, the less analog voltage it will output. If the analog voltage reaches a certain threshold, it will send the digital pin DOUT high. Once this DOUT pin goes high, the arduino will detect this and will trigger the LED to turn on, signaling that the alcohol threshold has been reached and is now over the limit and alarming the people around the place. The buzzer which is connected to the Kill switch or Ignition switch turns off the Kill switch automatically and the buzzer alarms to indicate the warning.

4.2. Face authentication:

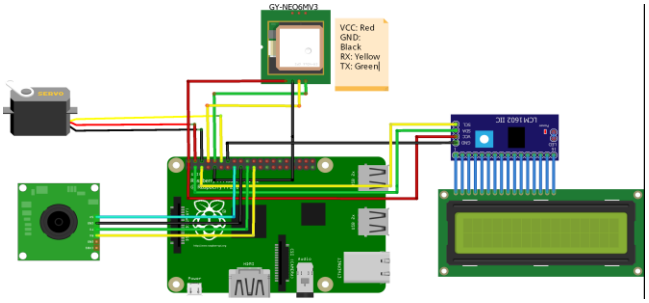


Fig 4.2. Raspberry Pi Interfacing for Face Authentication

Face recognition is one of the key components for future vehicle applications such as determining whether a person is authorized to operate the vehicle. This prototype describes the development and implementation of a face recognition system in the car environment. The challenge is to build a fast and accurate system that is able to detect, recognize and verify a driver`s identity with the constraint introduced in the car environment in daylight lighting conditions. A further constraint is to use a low-cost web camera to capture the frontal images. The system consists of two parts. The first is face detection, which is based on the HAAR cascade algorithm and the second is face recognition. A low-cost web camera mounted on the dashboard on the driver's side is used to capture the face image. During the authentication process, the driver is asked to look straight ahead at the camera. The computer is used as a platform for the face recognition system. Haar cascade is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is well known for being able to detect faces and body parts in an image but can be trained to identify almost any object. Initially the algorithm needs a lot of positive and negative images without faces to train the classifier. The system processes the received data, compares them to the stored data in the template and pops up a message on the display if the user is authorized or not. The hardware components used are: an LCD display, servo motor, raspberry pi

microcontroller, a GPS module, I2C, a webcam. The webcam used in the prototype is a low-cost webcam whose video capture is upto 1280 x 720 pixels. Each stage of the classifier labels the region defined by the current location of the sliding window as either positive or negative. Positive indicates that an object was found and negative indicates no objects were found. If the label is negative, the classification of this region is complete, and the detector slides the window to the next location. If the label is positive, the classifier passes the region to the next stage. The detector reports an object found at the current window location when the final stage classifies the region as positive. Face recognition is done using the OpenCV library. Datasets are collected with 20-30 images of the required users and stored in the database. The database used is a firebase database where the data is stored. The face recognition and GPS location tracking programs are run parallelly. When the face is detected and recognized, it is compared with the users in the database, if the faces do not match then the kill switch is activated and the car is locked. It doesn't allow the person sitting the car to drive the vehicle and also a message is sent to the owner/family member of the car regarding the location of the car through an app.

V. MERITS AND DEMERITS

Advantages:

- Alcohol Detection System in Cars provides an automatic safety system for cars and other vehicles as well.
- It reduces accidents which occur due to drunk driving and theft rates are reduced.
- Work of manual detection of alcohol level by police is reduced which is done to accidents.
- Improvement of the security level and Integration process is flawless.

Disadvantages:

- High initial cost.
- If any person other than the driver has consumed alcohol to a greater level and if the system detects it then the car gets locked and will not allow the car to start.
- Troubles with image size and quality.
- Strongly influenced by the angle of the camera.
- Due to some server problem or the network availability the SMS alert may sometime not be delivered on time.

VI. RESULTS

6.1 Alcohol Sensing

Table 1 below provides the test results for alcohol sensing. A cotton dipped in a high-smell perfuse with high alcohol content and parallelly a cotton dipped in a low-smell perfume as detected by the sensor provided the following results when held for 5 seconds.

Table 6.1: Results showing accuracy of detection when the sample alcohol level has crossed the threshold level set.

Trial No	Content Level	Threshold	Sensed Value	Result	Analysis
1	High	Greater than 600 samples	642	Detected High	TRUE
2			635	Detected High	TRUE
3			854	Detected High	TRUE
4			591	Detected High	FALSE
5			584	Detected High	FALSE
6			768	Detected High	TRUE
7			910	Detected High	TRUE
8			690	Detected High	TRUE
9			710	Detected High	TRUE
10			760	Detected High	TRUE

A graph in the fig 6.1 depicts the alcohol sense with respect to the threshold. The accuracy is more than that of 80% with plus/minus 20% error.

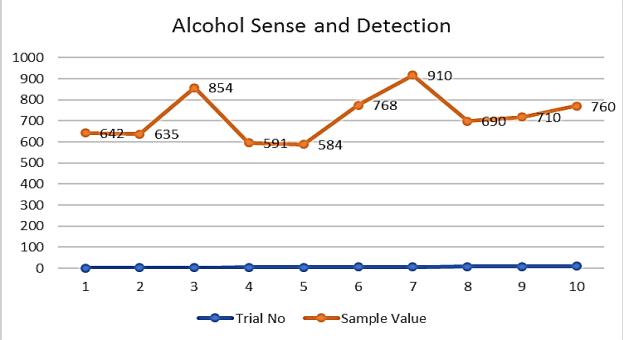


Fig 6.1. Alcohol Sense Accuracy

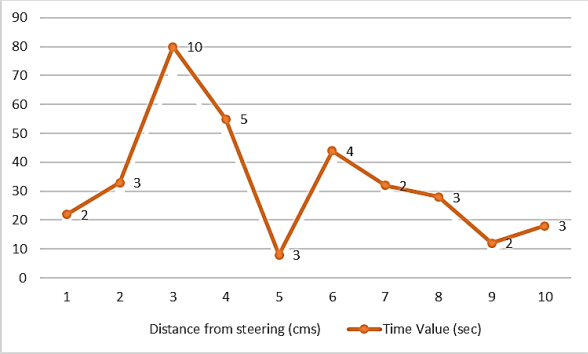
6.2. Image Identification:

Table 1 below provides the test results for image capture and identification. The driver's / owner's images have been added into the firebase database. The person is made to sit ahead in front of camera for about 2-5 seconds and captured results are analysed.

Table 6.2: Results showing accuracy of person identification based on the distance of the driver/ owner seated.

Sl No	Distance from steering (cms)	Number of attempts	Time Value (sec)	Result	Analysis
1	20	2	2	Identified	TRUE
2	30	4	3	Identified	TRUE
3	70	6	10	Not Detected	FALSE
4	50	2	5	Identified	TRUE
5	5	2	3	Identified	TRUE
6	40	1	4	Identified	TRUE
7	30	2	2	Identified	TRUE
8	25	3	3	Identified	TRUE
9	10	2	2	Identified	TRUE
10	15	2	3	Identified	TRUE

A graph in the fig 6.2 depicts the person capturing and identification with respect to the distance seated from the steering. The image accuracy gave an 77% accuracy with 26 attempts based on distance and ambient environment.



.Fig 6.2. Image Identification and Detection

The car door lock/unlock mechanism, key verification, location sharing occurred every-time whenever the following 2 results mentioned above were successful.

VII. CONCLUSION

This system is designed and implemented successfully via the use of Node MCU an ESP8266 based open source IOT platform device and MQ-3 sensor. The experimental evaluation of the system showed that the alcohol sensor was able to deliver fast response when alcohol is detected. Also, the ability of the sensor to operate over a long time is a feature of the proposed system. An automatic face recognition system for intelligent vehicles has been presented in two parts the recognition and the detection. The recognition uses output of the detection module as the input signal. Experimental results have shown that the system produce fast and accurate results in a well-lit environment. This is true even with a low-cost capturing device and at a proper angle.

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