

### AUTOMOBILE DRIVER ALCOHOL LEVEL MONITORING SYSTEM

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#### ABSTRACT

Automobiles were invented to help or ease human stress and make transportation easier but this invention seems to have several negative effects one of which is road accident. Drunk driving has been found to be one of the major causes of road accidents as it does not only affect the life of the driver but also passengers. Hence, the need for automobile driver alcohol level monitoring system that can address the aforementioned dangers. In this paper, a modeled automobile was

presented with hardware and software components. An alcohol sensor to analyze breathes and voice recognition module serve as input to a microcontroller programmed to deactivate the ignition system of an automobile at the detection of alcohol.

**KEYWORDS:** Automobile driver, Alcohol level, ATmega328P microcontroller, ELECHOUSE Voice Recognition Module version 3, MQ3 alcohol sensor, alcohol monitoring system.

#### INTRODUCTION

Road accident is a serious humanity and public health issue in the world especially in countries like Nigeria. Apart from the loss of many lives, the effect of road accident on the country's economy is massive. It is caused by incompetence of driver, damages or faults on the car, improper management of traffic, poor road network, among many others. However, the most common of these is the unworthiness to operate a vehicle by drivers as a result of fatigue (Qian & Nikolas, 1997; Qiang, 2004; Zhang & Zhang, 2009), stress or intoxication

from intake of alcohol (Bhuta, Desai & Babar, 2015), of which the later has claimed too many lives both in developed and developing nations.

Over the decades, steps had been taken to limit the rate at which alcohol has been influencing the occurrence of accidents. The first happened to be the use of an alcohol sensing instrument by law-enforcement agents to analyze the breath of drivers in order to discover the intake of alcohol and where the use of alcohol is found, a detainment or relieving of the user from driving has long been adopted to prevent such person from dying untimely on the wheel, as well as jeopardizing the lives of other passengers or road users (Cahalan & Crossley, 1969). The success of this method is however limited as certain drivers cannot be stopped by law enforcement agents, creating the need of a system that detects alcohol when the driver is in motion at the same time prevent any harm that can ensue as a result.

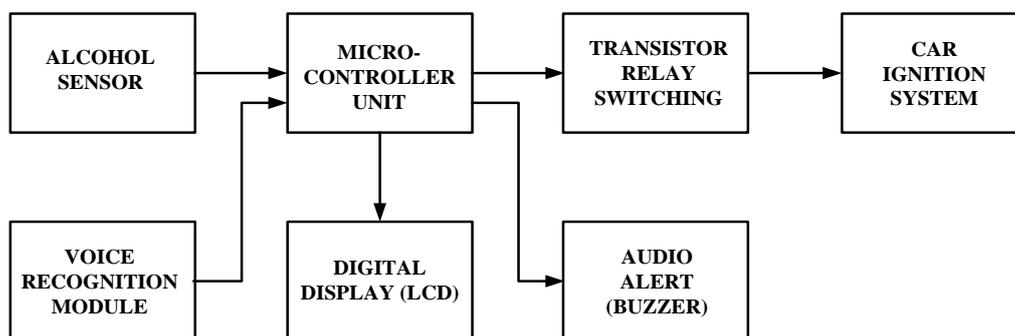
Most automobile do not come with inbuilt alcohol monitoring devices but devices have been made to be attached to automobiles to monitor a driver's alcohol level Der-Ghazarian (2008). However, to enable monitoring of a driver's alcohol level in time and to reduce delay, an inbuilt alcohol level monitoring device should be used for measuring and controlling drunk driving. The system will contain the acceptable legal alcohol limit so as to be able to compare it with the measured alcohol level. Several systems had been built for this purpose ranging from Elfman & Zajac, (1989) whose system sensed the pressure, the temperature and the humidity of the breath sample to generate a breath signature signal and compared to the breath reference. Collier *et al* (1986) system has a breath input unit, a controller which delivers a sample of deep lung breath to an evaluator including an alcohol detector and an output apparatus, an uninterrupted flow must occurred and a threshold before test determined. Benesh, (2006) system measures the alcohol content, the change in the alcohol content signal, flow of the breath of the test person, and indicates the alcohol content when the change in the signal per unit time is below a pre-selected change value. Bigliardi & Jablonski (1991) worked on ignition system, Prachar *et al* (1995) also developed a breath analysing device and more specifically an improved breath analysing device used in an automobile ignition locking system which prevents a car from starting when the driver is intoxicated and which requires periodic rolling retests while the car is being operated. Bellehumeur, (2005) proposed a system of galvanic skin sensor that can provide trans-dermal monitoring of a person's skin for ascertaining the level of alcohol consumption. Der-Ghazarian *et al* (2008) offered a remote hand-held space equipped with an RF transmitter allowing an operator to operate a

device according to breath sample analyzed thereof. Sofer, (2010) designed a car alcohol monitoring system which monitors the driver's alcohol level continuously during the operation of the car. This however, uses a special sensor inside the steering wheel that detects the alcohol coming from the driver's perspiration. Bhumkar *et al.*, (2012) proposed an intelligent car system for accident prevention using ARM-7. However, the requirement that a person maintain a continuous, uninterrupted flow of breath at or above a certain pressure for a predetermined period of time in order to pass the test may be difficult as evident in previous work.

## MATERIALS AND METHODS

### Design Approach

A remote-controlled car is modeled as an automobile; the input into this monitoring system is obtained from both a voice module and an alcohol sensing unit. The driver reads-out the start instructions for the car from a digital display in the right order, this method is introduced as a measure against the drawback in previous work; while reading the alcohol sensor analyses the breath for alcohol. ATmega328P microcontroller processes this action, alerts when alcohol is detected as well as disables the car ignition system. The ignition system remains disabled until alcohol is no longer detected on the driver. Figure 1 shows the block diagram of the system.



**Figure 1: System Block Diagram.**

### Alcohol Sensor

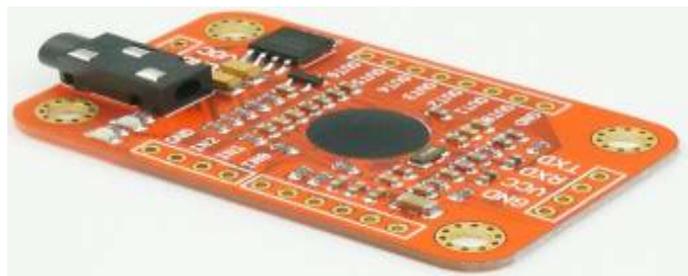
The MQ3 alcohol sensor as shown in figure 2 was used for alcohol sensing because it has good sensitivity and fast response to alcohol. This sensor outputs a voltage inversely proportional to the alcohol concentration in air. It is suitable for Breath analyzer and requires a 5Vdc for operation compatible with TTL logic and allows for direct interface with a microcontroller.



**Figure 2: MQ3 - Alcohol Sensor.**

### **The Voice Module**

The voice module utilized the ELECHOUSE Voice Recognition Module version 3 (VR3) as shown in figure 3. The VR3 is a compact and easy-control speaking recognition board, preferred for its low power consumption and ease of connection with the microcontroller. It is a speaker-dependent voice recognition module and supports up to 80 voice commands in all. Maximum of 7 voice commands could work simultaneously and any sound could be trained as command. This board has 2 controlling ways: Serial Port (full function) and General Input Pins (part of function). General Output Pins on the board could generate several kinds of waves while corresponding voice command was recognized.

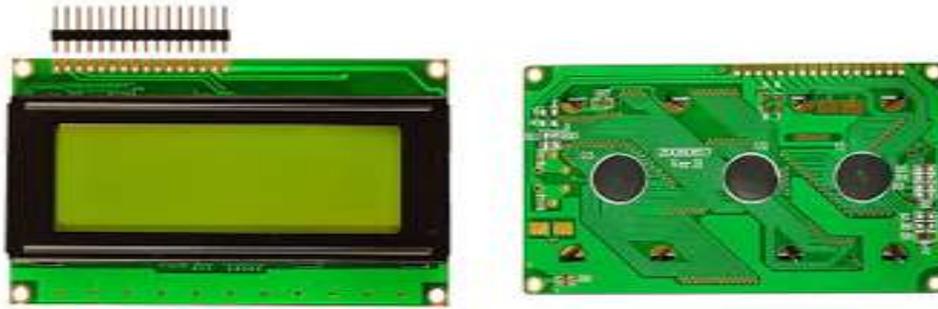


**Figure 3: The ELECHOUSE Voice Recognition Module Version 3.**

### **Digital Display**

The operating status display stage for this design, was implemented using the HD44780 based 20 columns by 4 rows alphanumeric liquid crystal display (LCD) which is cost effective, small in size, consumes least power and has enough room to display the necessary instructions on the remote-controlled car model used. The LCD shows the status of system as well as displays the message the driver must speak at start up. The messages displayed at startup are tongue twisting words with some required keywords in them. The LCD communicates with the microcontroller using microcontroller to microcontroller communication. All HD44780 based character LCD displays are connected through 14 pins:

8 data pins (D0-D7), 3 control pins (RS, E, R/W), and three power lines (Vdd, Vss, Vee). Some LCDs have LED backlight feature that helps to read the data on the display during low illumination conditions. So, they have two additional connections (LED+ and LED-), making altogether 16 pins. Figure 4 shows the LCD.



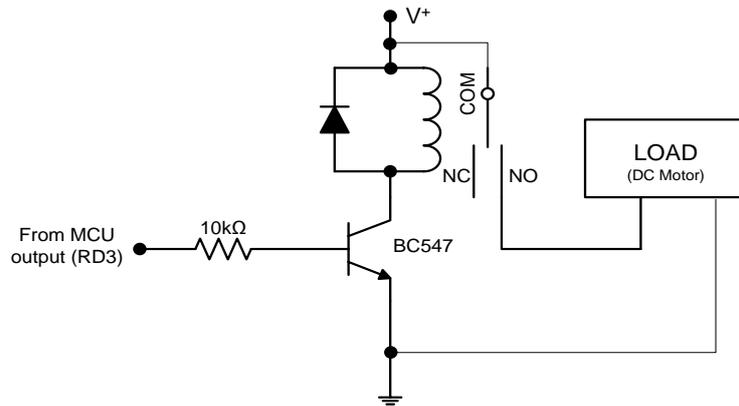
**Figure 4: The LCD.**

### **Microcontroller Stage**

ATMega328P microcontroller was used in this work. The choice was arrived at as a result of its large program memory (32KB flash) and data memory (2272 bytes SRAM) size, analogue to digital converter (ADC), as the input needed for the microcontroller is analogue. The magnitude of clock frequency, as the microcontroller determines the execution rate of tasks. The number of interrupts and timer circuits, as it provides accurate timing. The number of digital inputs, analogue inputs the system concerned requires; a factor which helps to determine the minimum number of inputs and outputs (I/O) of the choice microcontroller. Including EEPROM Memory: 1kBytes EEPROM, Working Register: Byte wide used in most instructions.

### **Transistor Relay Switching**

The output of the microcontroller controls the switching of the relay via the transistor switching stage, which turns the automobile power on. This stage is necessary to build up for the car ignition system requirement of 5V at 1000mA compared to the 5V at 40mA output from the microcontroller. A relay is an electromechanical switch; normally closed and turned on when the microcontroller has a HIGH output which makes current flow to the car ignition system. The power of the load to be activated hence depends on the relay contact rating. A base resistor is required to ensure perfect switching of the transistor in saturation and is calculated to be 10K $\Omega$ . This is shown in Figure 5.



**Figure 5: Transistor Relay Switching Stage.**

### Audio Alert System

The audio alert system used is a buzzer, it works on a piezoelectric or electromechanical circuit. The buzzer acts as the alarm of the circuit to notify when alcohol is sensed on the driver above the acceptable limit and when the car is to be stopped due to the presence of alcohol. The audio alert system stage is shown in Figure 6.



**Figure 6: Piezoelectric Buzzer.**

### RESULTS AND DISCUSSION

The implementation was realized by using a Remote Controlled model car as the automobile system, an alcohol sensor to measure the level of alcohol in the drivers breathe, a voice recognition module with a microphone serving as a primary transducer to receive sound to ensure words are spoken by the driver so that the alcohol sensor can sense the drivers breathe and a LCD to show the status of the system at different stages. The alcohol monitoring system as shown in Figures 7 and 8 was powered by a 12volts battery while the RC toy car was powered by a 5volts battery depicting an automobile engine system. Two scenarios describe the operation of the system; alcohol detected at startup and alcohol detected while driving.



**Figure 7: The modeled RC Car.**



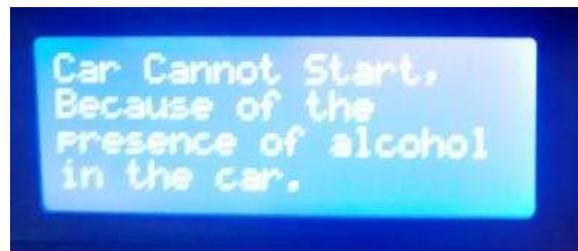
**Figure 8: Top View.**

### **Operation of the system at startup**

When the system and the RC car is powered, the LCD displays a list of words as shown in Figure 9, required for the driver to pronounce in order for the voice to be recognized by the voice recognition module and the driver's breathe be sensed by the alcohol sensor. After the right keywords have been pronounced, if the alcohol sensor senses an alcohol level above the programmed threshold level, the microcontroller's output becomes low and locks the car ignition system. The LCD displays the instruction that the car cannot start due to the presence of alcohol as shown in Figure 10. The LCD maintains this status for 15 seconds after which the whole system is automatically turned off with a blank LCD status as shown in Figure 11 and all the process has to be repeated all over.



**Figure 9: LCD At Startup.**



**Figure 10: Alcohol Detected.**



**Figure 11: Status after 15 Seconds of Alcohol Detection.**

### Alcohol not detected at startup

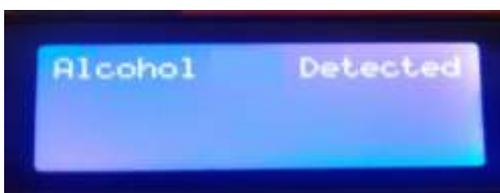
The above process is followed in the second scenario, however if the alcohol sensor senses an alcohol level below the programmed threshold level, the microcontroller's output becomes high and current flows to the car ignition system to unlock it. The LCD displays the instruction that no alcohol was detected and the car can be driven as shown in Figure 12. The automobile can then be driven, this is however implemented through the use of its remote control; Figure 13 shows the automobile in motion. The alcohol sensor keeps monitoring for changes in alcohol level of the drivers breathe while on motion, as the level increases above the threshold the buzzer sounds to alert and the display of alcohol detection and advice to park is prompted. 30 seconds is given to park the car after which it is forced to stop automatically. The status on the display is maintained for 5 seconds after which the entire system including the LCD is turned off. Figures 14 to 18 show the status of the LCD at each point.



**Figure 12: Alcohol Not Detected.**



**Figure 13: Automobile in Motion.**



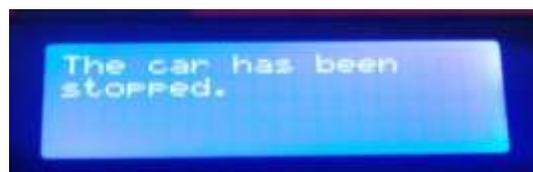
**Figure 14: Alcohol detected while driving.**



**Figure 15: Continuous Detection while driving.**



**Figure 16: Next display status.**



**Figure 17: Car Is Stopped.**

## CONCLUSION

In this paper, automobile driver alcohol level monitoring system was developed; voice recognition module was used as one of the two inputs which serves as an improvement over previous work. The microcontroller was programmed to deactivate the ignition system of a modeled remote controlled car at a threshold with different display status at each state. The design was implemented and operated satisfactorily. However, the general operation and performance is dependent on the user who is prone to human error in the pronunciation of the programmed key words. The product of this study can be enforced by law enforcement agencies as a requirement in cars to bring about a safer environment.

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