FEDERAL UNIVERSITY OYE-EKITI

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ESIGN AND IMPLEMENTATION OF AN ALCOHOL TRIGGERED VEHICLE ENGINE LOCK SYSTEM

BY

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DEGREE IN ELECTRICAL AND ELECTRONICS ENGINEERING

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DEDICATION

This project is dedicated to Almighty God who spared my life throughout my stay in the University, and also to the entire family of Ighalo, for their support, assistance and prayers in my academic pursuit.

DECLARATION OF ORIGINALITY

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CERTIFICATION

This is to certify that this project titled design and implementation of an alcohol triggered vehicle engine lock system, by Ighalo Joshua Oseheromomen meets the minimum requirements governing the award of Bachelor Degree in Electrical and Electronics Engineering of Federal University Oye-Ekiti, Nigeria.

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ABSTRACT

This report presents the design and implementation of an alcohol triggered vehicle engine lock system. The sole aim of this project is to model and design a vehicle engine lock system that is triggered by alcohol. This system would help in drastically reducing the number of road accidents that are due to drunk driving by motorists. The entire system is based on a microcontroller that is used to set an alcohol limit/ threshold which when crossed upon sensing of alcohol by the alcohol sensor would trigger the alarm circuit and warning LED of the circuit to alert the driver that his/her present blood alcohol concentration wouldn't be safe for driving. At this point the system automatically locks the ignition system of the vehicle within which it is embedded while an LCD displays information for the driver's visuals. This project is a model of the system in real time implementation with the vehicle's engine system represented with a DC motor and its ignition system represented with a push button. The overall work was implemented with a constructed work, tested working and perfectly functional.

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CHAPTER ONE

INTRODUCTION

1.1 Background

Drunk driving is a very dangerous behavior caused as a result of excessive consumption of alcohol therefore causing distortion in thought pattern of its victims. The investigation done by the World Health Organization in 2008 shows that about 50%-60% of traffic accidents are related to drunk driving (Killoran et al. 2010). In present times, the cases of traffic accident caused by drunk driving has increased rapidly. More and more people have realized that drunk driving does great harm to public security.

An embedded system based on a microcontroller with the use of an alcohol sensor tries to reduce the possibilities of accidents caused by drunk driving. Embedded system is a computerized or automated system with a dedicated functionality in which large electrical, electronic and mechanical systems are inserted along with their constraints of execution which therefore makes embedded systems as the means of providing solution to the problem of drunk driving. This system is classified into hard and soft real time systems and has applications in communication systems, military and aerospace systems, transportation systems etc. Embedded systems application in the transportation sector takes the form of intelligent transportation systems. Intelligent transportation systems include sensing technologies such as infrastructure sensors (in road reflectors) embedded on road sides, automatic number plate recognition technologies, use of gas sensors in detection of dangerous/harmful gases in vehicles etc. all to reduce the increasing rates of accidents of all forms and causes (Embedded system, 2012.). This project is focused on the eradication of vehicle accidents related to alcohol consumption of motorist by using embedded systems to automatically lock/shut down the engine of the vehicle when the system detects the driver of such vehicle is drunk.

1.2 Problem Statement

Increase in the rate of vehicle accidents due to high alcohol consumption volume by drivers (putting them in a drunk state) of such vehicles, unfortunately the conventional method which is the breathalyzer employed by road traffic authorities to curb this problem to an extent hasn't been 40% efficient as this accidents are still on the high.

1.3 Motivation

Due to the deteriorating state of the road traffic authority system in penalizing drunk driving thereby allowing drivers under the effect of extreme alcohol consumption rates on the roads and ineffectiveness of the conventional method (breathalyzers) used by this authorities to nab drunk drivers, there has been an increase in the rate of vehicle accidents related to drunk driving.

The motivation for this project is to develop a device that is more effective than the conventional method and would impair drunk drivers from taking the road.

1.4 Project Aim & Objectives

The aim of this project is to design, model and implement an alcohol triggered vehicle engine lock system

At the end of this project, the following objectives would be achieved

I. To design a system that will be able to reduce the amount of traffic accidents due to drunk driving to the barest minimum.

II. To design a system that can determine if a driver is drunk or sober after consuming a certain amount of alcohol.

III. To design a system that will not require human intervention to lock a vehicle engine upon sensing of a certain amount of alcohol.

1.5 Scope of the project

The main goal of the alcohol triggered vehicle engine lock system is to reduce drastically the amount of traffic accidents occurring due to drunk driving. The major limitation of the project was the level of complexity of modelling the software design, where by some of the components used were not available in proteus. Another factor that limited the project was the unavailability of components locally.

This project is divided into 3 operational sections which includes; Alcohol testing, Display of BAC results and warning/normal messages on LCD and lock/unlocking of vehicle's engine represented by the DC motor. The design would be able to;

I. The system will be able to detect alcohol molecules present in air.

II. The system will be able to measure blood alcohol content from the driver's breath sample.

III. The system would give the capability of setting a blood alcohol threshold that declares a state of drunkenness when crossed.

IV. The system would be able to automatically lock the vehicle engine when the blood alcohol content threshold is crossed.

1.6 Significance of the project

The rationale of the project is therefore to design a system that test drivers for their blood alcohol content and lock the engine of the vehicle they operate if their blood alcohol content measured exceeds the set threshold in the system. The major significance of this project is that it would help to reduce accidents due to drunk driving drastically without human intervention as in the case of road traffic authorities using breathalyzers. The project is also useful as it saves road traffic authorities the stress of chasing down drunk drivers, issuing tickets for drunk driving and the problem of some road traffic officials taking bribes to allow apprehended motorists go free

1.7 Project Organization

This project is organized into five chapters;

I. Chapter one gives a brief introduction to the project highlighting the problem statement, main objectives, aim, motivation and scope of the project.

II. Chapter two presents an overview of the technological analysis and the concept of related work based on the alcohol triggered vehicle engine lock system. Further discussion on the alcohol triggered vehicle engine lock system and its components is also done here.

III. Chapter three presents the methodology of the project. It illustrates approaches employed to demonstrate steps used to make this project possible. In addition the chapter presents a description of the research process and explanation of the models used to gather data. The functional block diagram and operational flow chart are also part of this division.

IV. Chapter four presents the results and analysis of the design. It gives an insight on the project management, project schedule, risk management and the tests carried out on the project.

V. Chapter five the conclusion and recommendation. This chapter testifies the success of the project, limitations and the suggestion for the future development related to this work.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

The alcohol triggered vehicle engine lock system is a device that would be developed with the primary purpose of reducing drastically the number of fatal road accidents due to drunk driving by motorist. Systems using the alcohol sensor have evolved over the past few years starting with the inception of simple breathalyzers by road safety agencies and driving license agencies that only displayed numeric results of a person's alcohol content to alcohol detecting devices that worked with GSM technology. The automatic engine lock system for drunken driver possesses a major automation feature of locking the vehicle ignition once alcohol concentration by the driver above the set threshold is detected by the system. The alcohol triggered vehicle engine lock system has some major featured which are elaborated in the subsequent pages

2.1.1 Embedded systems

Embedded system is a computerized or automated system with a dedicated functionality in which large electrical, electronic and mechanical systems are inserted along with their constraints of execution. An application in embedded system acquires specific characteristics of the system which are not functional These characteristics are listed as per its importance (Embedded system, 2012).

i. Throughput – Our system may need to handle a lot of data in a short period of time.
ii. Response–Our system may need to react to events quickly.
iii. Testability–Setting up equipment to test embedded software can be difficult.
iv. Debug ability–Without a screen or a keyboard, finding out what the software is doing wrong (other than not working) is a troublesome problem.
v. Reliability – embedded systems must be able to handle any situation without human intervention.
vi. Memory space – Memory is limited on embedded systems, and you must make the software and the data fit into whatever memory exists.

vii. Program installation – you will need special tools to get your software into embedded systems. (RTOS, 2007.).

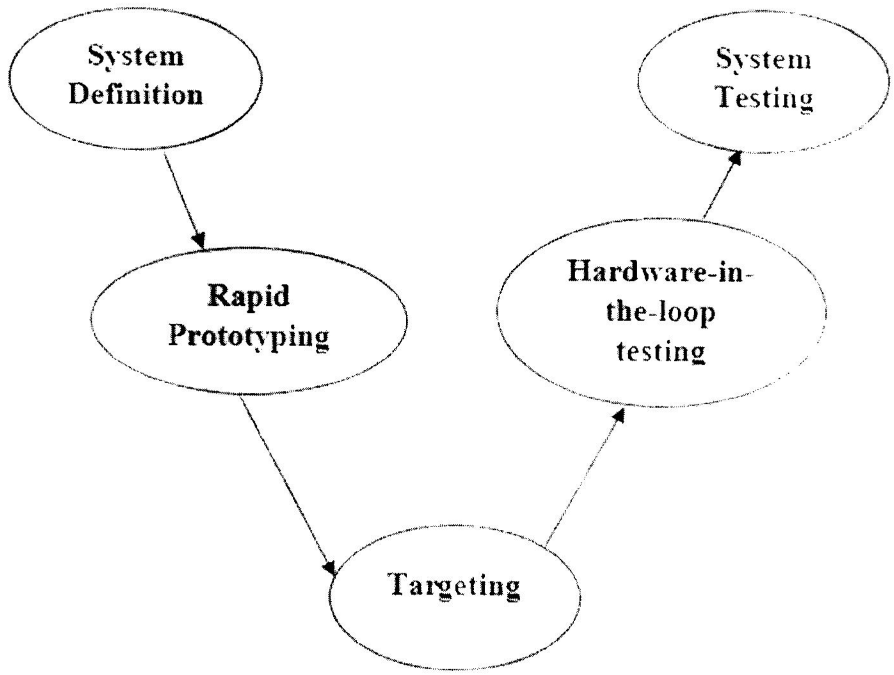


Fig 2.1 'V' Diagram of an embedded system design lifecycle (Phani et al., 2014, p. 2)

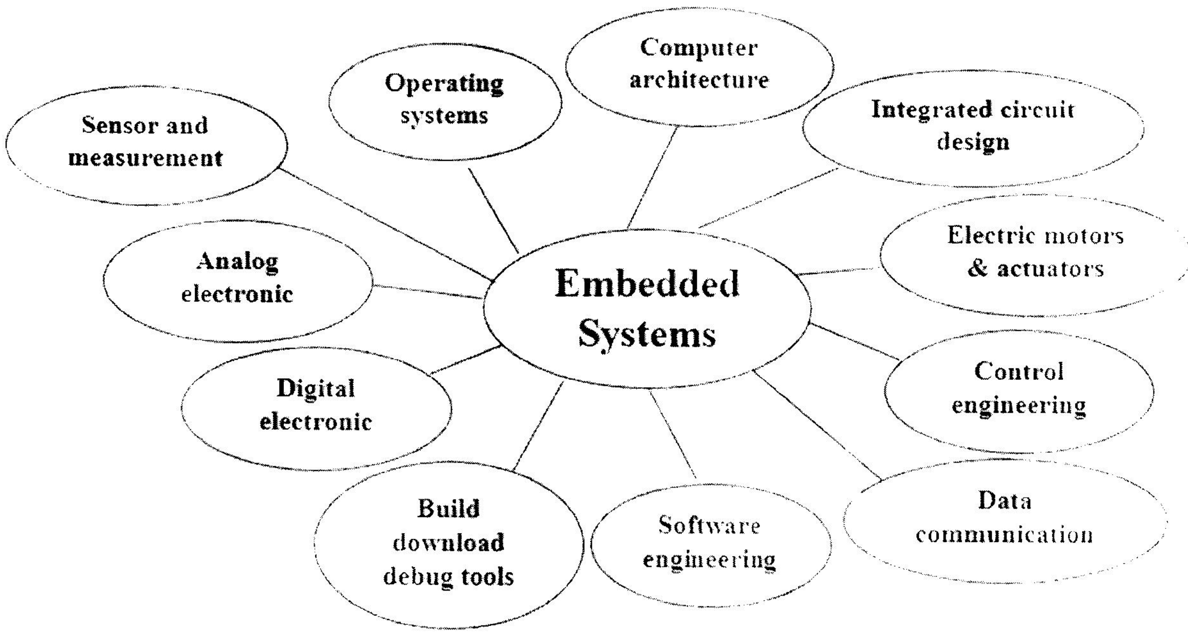


Fig 2.2 Embedded system design calls (Phani et al., 2014, p. 2)

2.1.2. Types of Microcontrollers

There are several families of microcontrollers which can be classified by architecture, internal bus width, memory and instruction set (Kamal, 2011).

I. 8-bit Microcontroller

The internal bus width of this microcontroller is of 8-bit. The ALU performs arithmetic and logic operations on 8-bits (1 byte) at an instruction. The Intel 8051 family and Motorola MC68HC11 family are of this type.

II. 16-bit Microcontroller

The 16-bit microcontroller has an internal bus width of 16-bit as the ALU performs arithmetic and logical operations on 16-bits (word) at an instruction. Examples of this type of microcontroller are the Intel 8096, PIC2x, Extended 8051XA, ATmega 16 and Motorola MC68HC12 families.

III. 32-bit Microcontroller

In 32-bit microcontrollers, the internal bus for the data transfer operations in a microcontroller is 32-bit bus and the ALU performs arithmetic and logic operations on words of 32-bits at the instructions. They give better performance and precision than 16-bit microcontrollers but are more expensive. Some examples are PIC3x, ATmega 32, Intel/Atmel 251 family and Motorola M683xx.

2.1.2.1. AVR Family

AVR microcontrollers are categorized into TinyAVR, MegaAVR and XmegaAVR. The TinyAVR microcontrollers are used for simple applications that require a lower pin count than the MegaAVR and subsequently, XmegaAVR microcontrollers have the highest pin-out count among the three (Atmel 42735B ATmega 328/P Datasheet, 2016.)

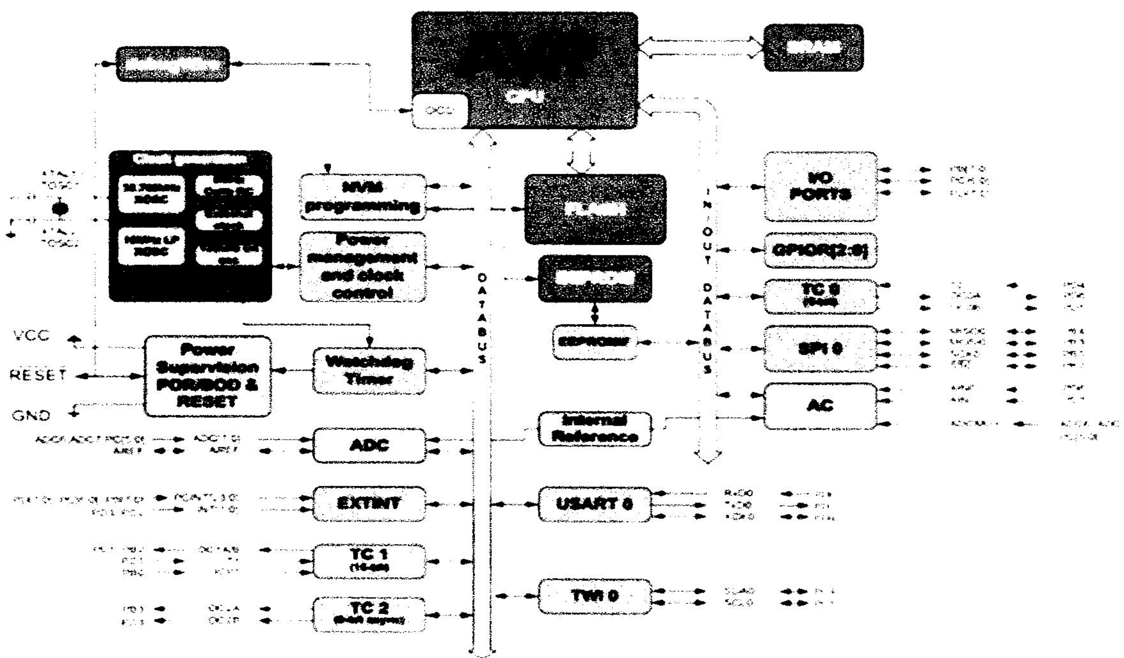


Fig 2.3 Block diagram of AVR Microcontroller (Atmel 42735B ATmega 328/P Datasheet, 2016)

2.1.2.2 Pin Configuration of ATMEGA 328-pu

The ATmega 328-PU microcontroller is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture with 28 pins in total. By executing powerful instructions in a single clock cycle, the ATmega328-PU achieves throughputs close to 1MIPS per MHz this empowers system designer to optimize the device for power consumption versus processing speed. The microcontroller is packaged in a rectangular housing with two parallel rows of electrical connecting pins known as a Plastic Dual In-line Package (DPIP) or a thin Quad Flat Package (TQFP) (Quad Flat Package, 2009.).

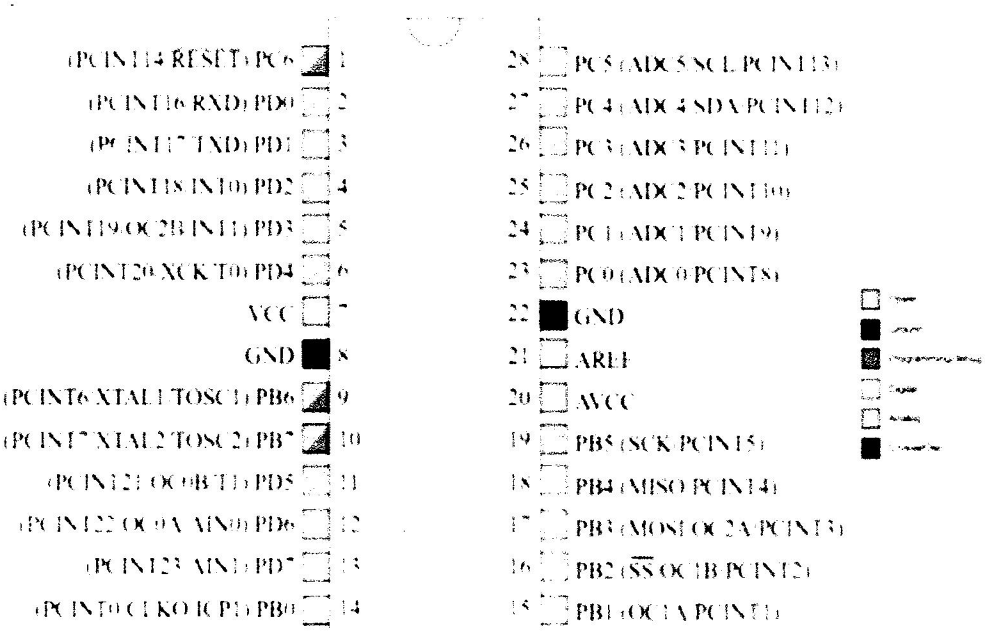


Fig 2.4 ATmega 328-PU PDIP (Atmel 42735B ATmega 328/P Datasheet, 2016)

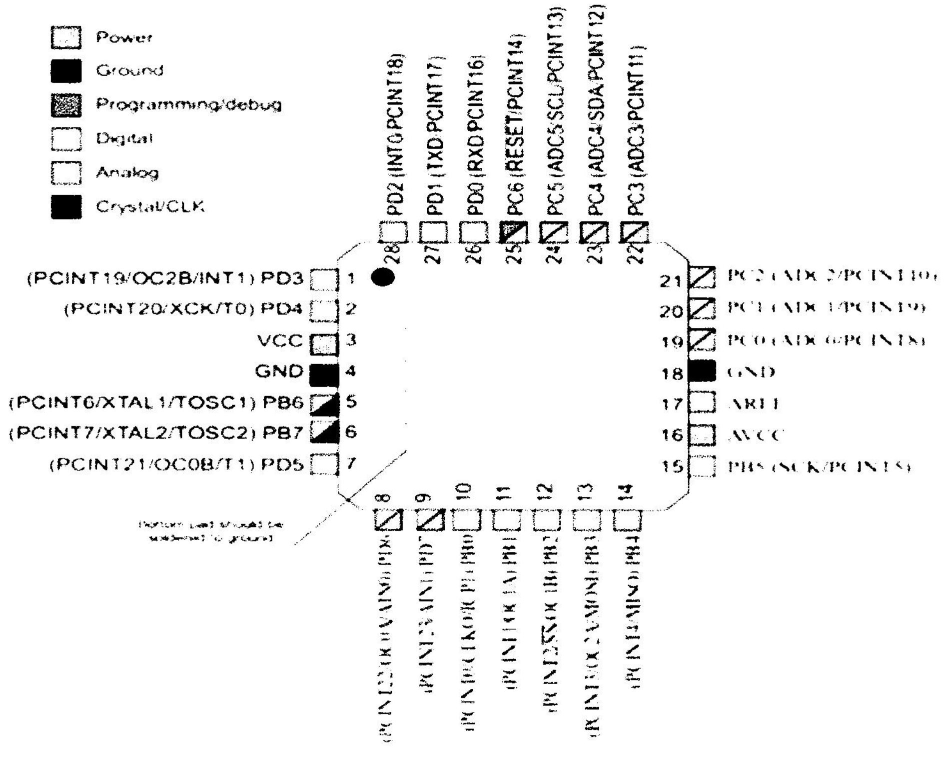


Fig 2.5 ATmega 328-PU TQFP (Atmel 42735B ATmega 328/P Datasheet, 2016)

2.1.2.3. Features of ATMEGA 328-PU

High Performance, Low Power Atmel AVR 8-Bit Microcontroller Family

i. Advanced RISC Architecture

– 131 Powerful Instructions

– Most Single Clock Cycle Execution

– 32 x 8 General Purpose Working Registers

– Fully Static Operation

– Up to 20 MIPS Throughput at 20MHz

– On-chip 2-cycle Multiplier

ii. High Endurance Non-volatile Memory Segments

– 32KBytes of In-System Self-Programmable Flash program ThiMemory

– 1KBytes EEPROM

– 2KBytes Internal SRAM

– Write/Erase Cycles: 10,000 Flash/100,000 EEPROM

– Data Retention: 20 years at 85°C/100 years at 25°C(1)

– Optional Boot Code Section with Independent Lock Bits

- In-System Programming by On-chip Boot Program

- True Read-While-Write Operation

– Programming Lock for Software Security

iii. Operating Voltage:

– 1.8 - 5.5V

2.1.2.4. Working Principle of ATMega 328 PU

The ATmega 328-PU microcontroller has a pin count of 28 pins and executes a set of instructions in the form of a program. C programming language or C++ programming language can be used. These pins are grouped in 'ports' and may be programmed to act as inputs that receive information or outputs that send out voltage. Communication to peripheral devices by sending commands, receiving commands, writing data and retrieving data is achieved through programming to perform the required tasks. Analogue to digital conversion (ADC) is also made possible by the ADC pin

2.1.3. MQ3 Sensor (Alcohol Sensor)

The analog gas sensor - MQ3 is suitable for detecting alcohol, this sensor can be used in a breathalyzer. It has a high sensitivity to alcohol and small sensitivity to Benzene. The sensitivity can be adjusted by the potentiometer. Tin oxide (SnO_2) is Sensitive material of MQ-3 gas sensor is, which has a lower conductivity in clean air. When the target alcohol gas exist, the sensor's conductivity is higher along with the gas concentration rising, using a simple resistive circuit converts change of conductivity to the corresponding output signal of gas concentration. (MQ3 Sensor Datasheet, 2012.).

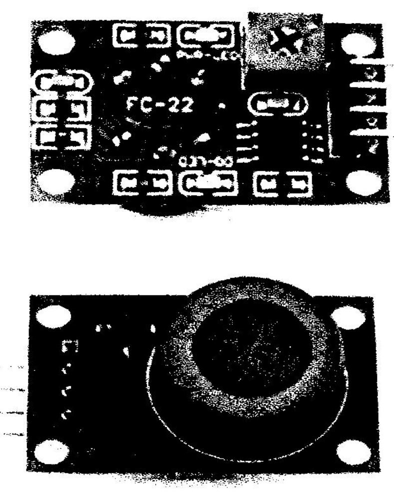


Fig 2.6 MQ3 Sensor (MQ3 Sensor Datasheet, 2012)

2.1.3.1. Working Principle of MQ3 sensor

Basically the MQ3 Sensor has 6 pins, the cover and the body. Even though it has 6 pins, only four of them can be used. Two of them are for heating system and other two are for connecting power and ground. A little tube is placed inside the sensor. This tube is a heating system that is made of aluminum oxide and tin dioxide and inside of it there are heater coils, which practically produce the heat. Two pins are connected to the heater coils and others are connected to the tube. The core system is the cube. Basically, it is an Alumina tube cover by SnO2, which is tin dioxide. And between them there is an Aurum electrode. Basically, the alumina tube and the coils are the heating system. If the coil is heated up, SnO2 ceramics will become the semi - conductor, so there are more movable electrons, which means that it is ready to make more current flow. Then, when the alcohol molecules in the air meet the electrode that is between alumina and tin dioxide, ethanol burns into acetic acid then more current is produced. So the more alcohol molecules there are the more current flows. Due to current change, the sensor gives different values (Sensor Report - MQ3 Gas sensor, 2008)

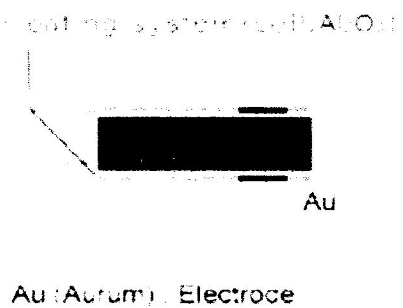


Fig 2.7 Internal view of MQ3 Sensor (MQ3 Sensor Datasheet, 2012)

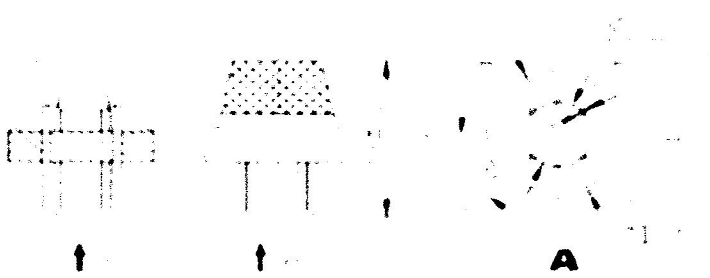


Fig 2.8 Overview of MQ3 Sensor (MQ3 Sensor Datasheet, 2012)

2.1.4. Liquid Crystal Display (LCD)

LCD (Liquid Crystal Display) screen is an electronic display module and has a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. 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 (LCD Datasheet, 2008). The data is the ASCII value of the character to be displayed on the LCD. A typical LCD is shown in figure 2.9.

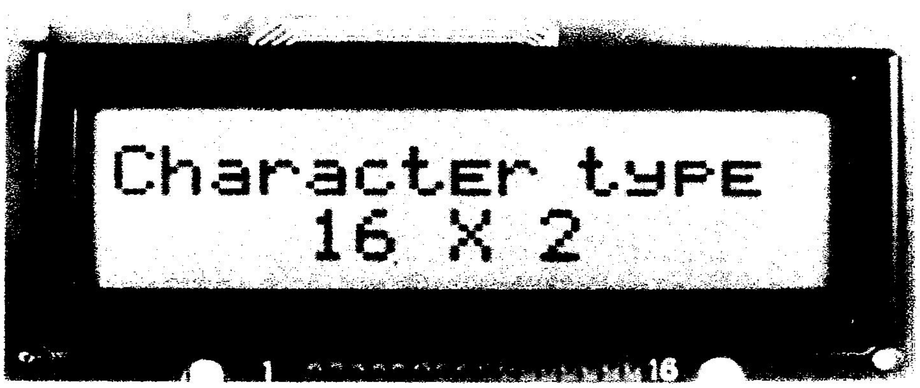


Fig 2.9 16 × 2 Display (LCD Display, 2008)

2.1.5. DC Motor

This DC or direct current motor works based on the principle that, when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. This is known as motoring action. If the direction of current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field interact they produce a mechanical force, and based on that the working principle of dc motor established. The direction of rotation of a this motor is given by Fleming's left hand rule, which states that if the index finger, middle finger and thumb of your left hand are extended mutually perpendicular to each other and if the index finger represents the direction of magnetic field, middle finger indicates the direction of current, then the thumb represents the direction in which force is experienced by the shaft of the dc motor.

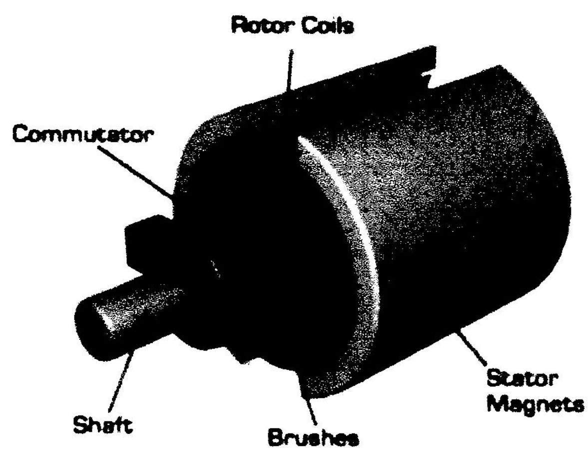


Fig 2.10 DC Motor principle and construction (DC Motor, 2006)

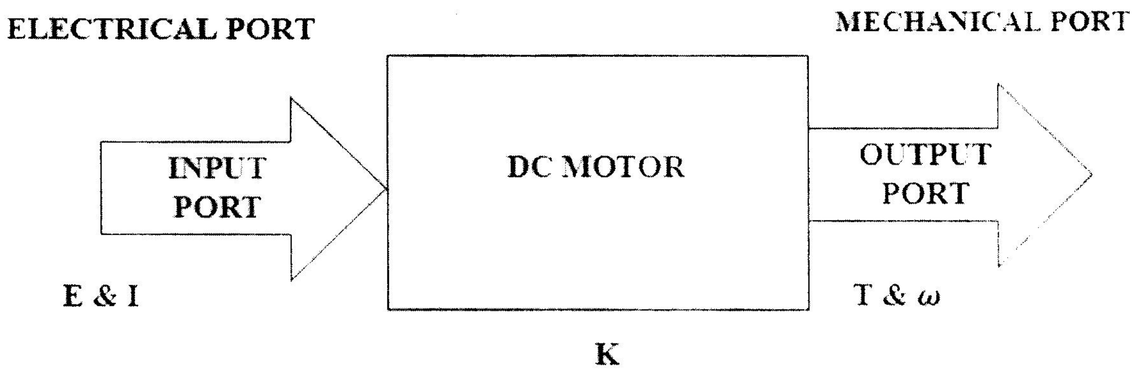


Fig 2.11 Block diagram layout of DC Motor (DC Motor, 2006)

Structurally and construction wise a direct current motor is exactly similar to a DC generator, but electrically it is just the opposite. Here we unlike a generator we supply electrical energy to the input port and derive mechanical energy from the output port. We can represent it by the block diagram shown above in fig 2.11. Here in a DC motor, the supply voltage E and current I is given to the electrical port or the input port and we derive the mechanical output i.e. torque T and speed ω from the mechanical port or output port. The input and output port variables of the direct current motor are related by the parameter K.

$$T = KI \text{ and } E = K\omega$$

So from the picture above we can well understand that motor is just the opposite phenomena of a DC generator, and we can derive both motoring and generating operation from the same machine by simply reversing the ports (DC Motor, 2006.)

2.2 Review of related work

There have been ideas on the alcohol sensor in recent years but have been very few as the MQ3 Sensor is a recently developed sensor among the gas sensor series. Some of these ideas include: simple sensing and detecting circuits by hobbyists to projects channeled towards reducing drastically the number of fatal road accidents due to drunk driving by motorist. One of the works that was initiated towards achieving this goal was by (Lee, 2010). He proposed a device which was made up of the alcohol sensor, AC power supply, LM 358 op amp and LCD circuitry. When in operation, this system would display the results of the alcohol sensor as it senses the alcohol molecules and when it crosses the fixed threshold set by the LM358 op amp. The major merit of Lee's proposed work was that it was the first major headway in the use of the alcohol sensor to drastically reduce the number of fatal road accidents due to drunk driving by motorist. Also, among the gas sensor series the alcohol sensor was presumed to be one of the most difficult sensors to use as it was very difficult to get libraries to simulate circuits with the sensor in simulation applications. Subsequently, the alcohol sensor libraries filled the web space in recent years to allow for simulation for its use in various applications. The major demerit of this system was its inability of being portable which was clearly specified by (Lee, 2010). It required whosoever to be tested to be close to the AC power outlet due to the system running on AC power unlike the portability that would have been enjoyed if it were powered on DC. Another demerit was the presence of a preset threshold due to the presence of the LM358 op amp in the circuit with any action to respond to the crossing of such threshold. The LM358 op amp which was acting as a comparator in the circuit and came with a preset value for the threshold upon crossed, had no response such as an alarm to warn that the threshold has been crossed. This system was required two participants i.e. one person to carry out the testing and note when the threshold is crossed and the other as the person being tested. This system was nowhere close to proving a means of inhibiting a driver if he/she were drunk not to mention real time implementation. Due to the large current consumption of both the LCD and the alcohol sensor and the need for portability for use by traffic agencies in later years, improvements were done on (Lee, 2010) ideas in the industry to allow for switching to DC power but with a less power hungry circuitry. As said earlier, this design paved way for more libraries on the alcohol sensor to be available.

Even with the availability of more libraries on the alcohol sensor, it would be presumed that any major work or publication related to the sole aim reducing drastically the number of fatal road accidents due to drunk driving by motorist would involve the use of microcontrollers but that was not to be as the next closely related work was another breathalyzer that possessed an alarm that would be triggered upon the values of the alcohol molecules detected being greater than the set threshold. This system proposed by James et al (2011) had embedded in it the generic alcohol sensor, an alarm circuit, LCD circuitry and AC power supply. This system and the other previously reviewed were both based of idea of a preset threshold as both authors stuck to the idea of employing a preset threshold by using the LM358 op amp not taking note of the human body as a biological system that changes as BAC values change overtime and as such limiting both designs to the inability of changing the threshold in an event where the BAC of the person to be tested changes. The system was proposed by the authors for a real time implementation in a vehicle but this wouldn't be possible due to it being powered by an AC power supply, the alcohol sensor wouldn't have the opportunity to have at least 3hrs full run in time it would get if on DC supply(vehicle battery) to give the sensor the degree of accuracy it requires for its operation Though still surprisingly dependent on the LM358 Op amp like in the previously reviewed work, this work distinguished itself from the former by the presence of an alarm circuit in its circuitry. This allowed for a response upon crossing of the set threshold by the op amp when the system is in test unlike (Lee, 2010) proposal that only displayed just numerical results. With the presence of the alarm circuit this system took a huge leap in bridging the gap between alcohol sensor related projects and the aim of reducing drastically the number of fatal road accidents due to drunk driving by motorists but still did not provide a means of inhibiting the driver in the case were he/she were drunk.

Kong et al (2013) proposed an alcohol detection system that alerts the driver through his/her cellphone. This system was an advancement to the two previously reviewed works as it was based on GSM technology using the GSM module and dumped the use of an alarm circuit. But still employed the LM358 op amp like the previously reviewed works. The system alerted via text messages using a GSM module and had a unique ringtone for such text messages set on the cellphone .This system was also proposed for use in a vehicle for real time implementation which again distinguished positively further from the two previously reviewed works. The system lacked a display unit i.e. LCD due to the presence/use of the cellphone. With all this features highlighted, this system was a huge breakthrough in bridging the gap further in reducing drastically the number of fatal road accidents due to drunk driving by motorist but it had some drawbacks still like another project. Its major demerit was the lack of an LCD unit and an alarm circuit. As generic as the alarm circuit seemed in this work, it is required as since the system was proposed for real time implementation, there would be cases of where the driver would not be with his or her cellphone in the vehicle at the period of drunkenness and as such no means of alerting the driver of his/her state of drunkenness keeping in mind this system doesn't provide any other means of impairing the driver's ability to drive. Another demerit is in the case of the visual and hearing impairment of such driver. If both were to occur at the same time to a particular driver, then there is absolutely no means of alerting the driver. The presence of the LM358 op amp as a comparator was another drawback as it can be assumed that with the advancement in the technology in use in this system, the use of op amp would be ditched and a microcontroller employed to allow for flexibility in changing the blood alcohol concentration (BAC) threshold due to probability in changes of body chemistry of the driver. The issue of cellphone batteries running down also comes up implying that the system would be inactive in the state that a cellphone battery is dead .Also, with most drivers in the habit of keeping their cellphones in the vibration or silent mode while driving, this inhibited the alerting property of the work. Still, this work didn't provide a means of inhibiting the driver's ability to drive just liked the previously reviewed works above provided he/she were in a drunken state.

Phani et al (2014) proposed a work similar to that of Kong et al. The major difference between both works was the introduction of a microcontroller in the former's work. Also this system was to operate on AC power unlike the former which was on the cellphone's battery. The microcontroller used was the PIC 16F877A microcontroller which is a type of microcontroller whose architecture is old. The microcontroller has a high power consumption rate and required a lot of code therefore making it difficult to be recompiled when necessary but this created room for flexibility in the setting of the threshold value and no issue of changing body chemistry of the driver therefore affecting his/her blood alcohol concentration value was supposed to occur. With the presence of the microcontroller, there was room for addition of other better features in the future. The only major drawback was that he system was proposed by the authors for a real time implementation in a vehicle but this wouldn't be possible due to it being powered by an AC power supply, as the alcohol sensor wouldn't have the opportunity to have at least 3hrs full run in time it would get if on DC supply (vehicle battery) to give the sensor the degree of accuracy it requires for its operation. With all this features, this work still didn't provide a means of inhibiting the driver's ability to drive just liked the previously reviewed works above provided he/she were in a drunken state.

The alcohol triggered vehicle engine lock system project is based on the ideas of the previously reviewed works above but with a lot of modification in terms of circuitry but with one goal it would achieve which none of the works above achieved that is inhibit the driver's ability to start up the vehicle provided the alerting features of the system fails to stop the driver. This project is majorly a huge modification to Phani et al (2014) work due to the use of the ATmega 328PU microcontroller which is an AVR microcontroller that is less expensive, faster, less power consumption and possesses a 64bit architecture compared to the PIC microcontroller. The microcontroller here is used to set the threshold and allows for easy recompilation of code compared to the PIC. In this project, the alcohol sensor (MQ3 sensor) is used to detect the alcohol content, a piezoelectric buzzer is triggered when the alcohol content has been exceeded the set limit in the microcontroller, an LCD is present to display 'normal' mode for driving and display warning 'alert' when the alcohol content of the driver exceeds the set threshold/limit and a DC motor serves a model/prototype for the vehicle's engine. But above all this features, the system would provide a means of inhibiting the driver's ability to drive just liked the previously reviewed works above provided he/she were in a drunken state.

CHAPTER THREE

METHODOLOGY

3.1. Introduction

This chapter presents the design of the software and hardware part of the project. Proteus and Arduino were the main software used during this project. Simulation in proteus was done to study the behavior of the system before the hardware design.

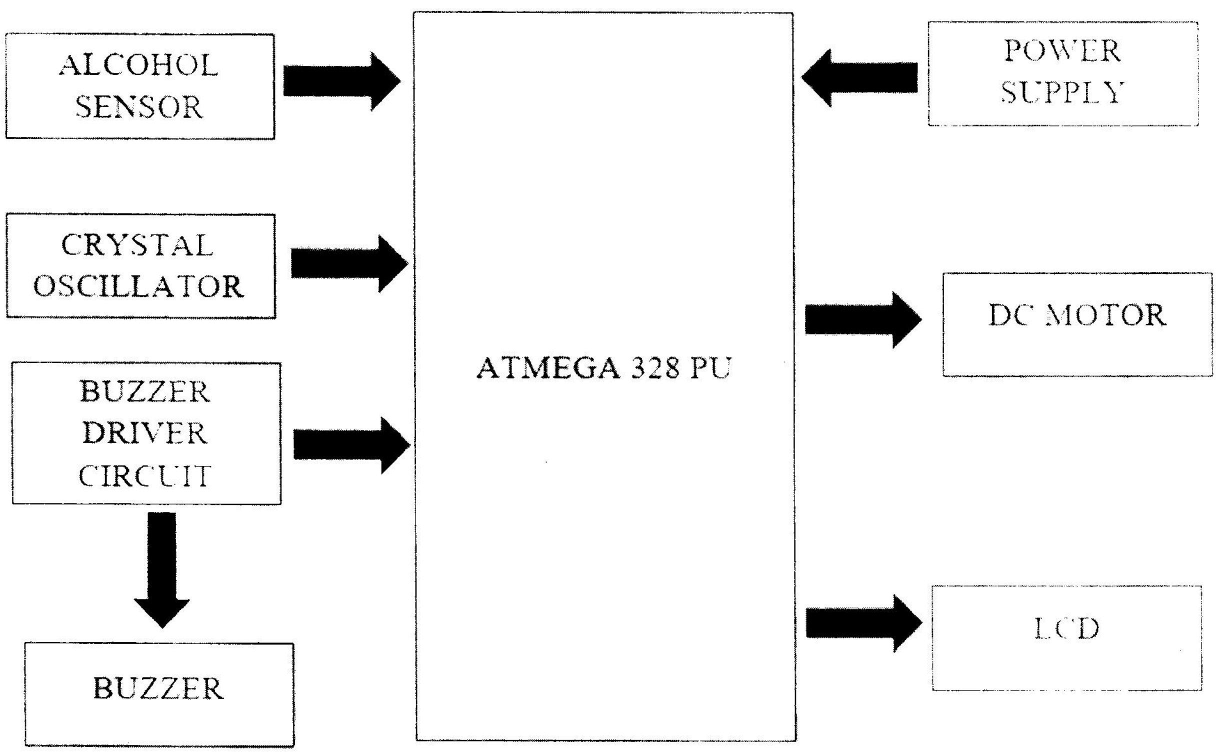


Fig. 3.1 Block Diagram of the project

With the aid of Fig 3.1 the mode of operation of this project is described .Whenever the ignition of the engine is started, the sensor measures the content of the alcohol in the breath of the driver and automatically switches off the engine if the driver is found to be drunk. In this system the sensor delivers a current with a linear relationship to the alcohol molecules from zero to very high concentration. The output of the sensor is fed to the AT Mega 328pu for comparison. If the measured value reaches the threshold, the motor stops automatically and the buzzer produces sound. The project's operational flowchart in fig 3.1.1 describes the mode of operation of the system with the events in the big rectangular boxes occurring in milliseconds after one another.

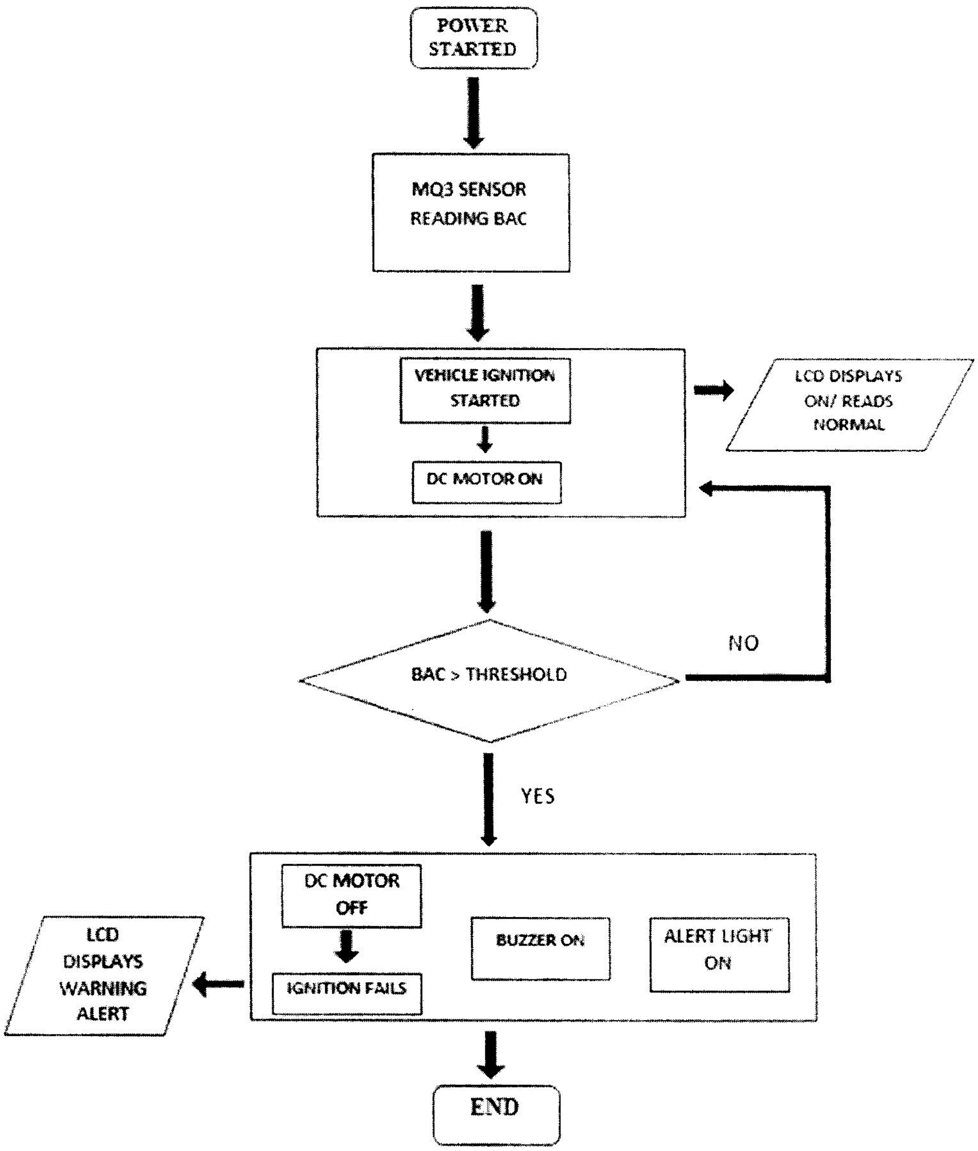


Fig 3.1.1 Operational flow chart of the project

3.2 System Hardware Design

3.2.1 Power Supply Stage

The circuit diagram of the power supply unit is shown below. It mainly consists of a voltage regulator (7805), 12V battery, filter capacitors and a resistor. The voltage regulator plays an important role in a power supply unit. Output of the power supply unit is always dc which is given to the controller. The primary purpose of the regulator is to aid the rectifier and filter circuit in providing a constant dc voltage to the device. Power supplies without regulators have an inherent problem of changing of dc voltage values due to variations in the load or due to fluctuations in the input voltage. With regulator connected to the dc output, the voltage can be maintained within a close tolerant region of the desired output.

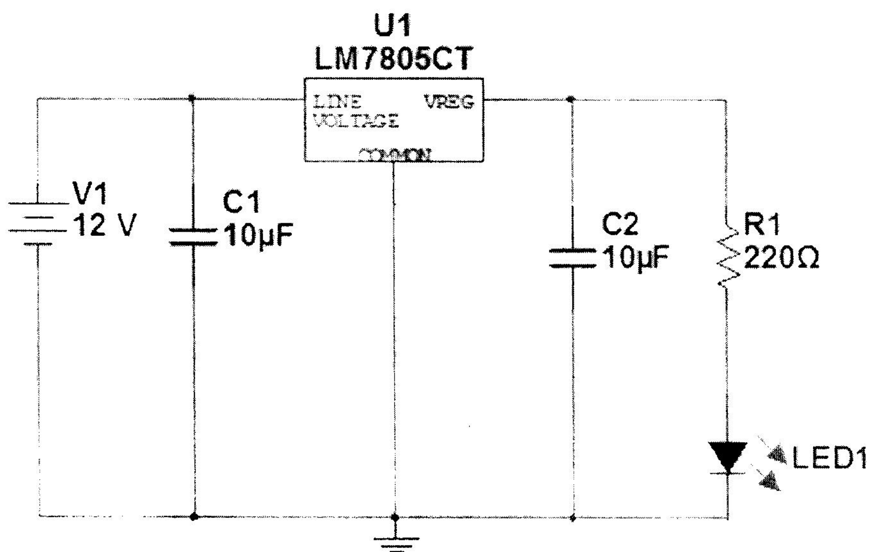


Fig.3.2 Power supply circuit

3.2.1.1 Design Analysis

The voltage source for this system is a 12V DC battery. This was chosen based on the range of values that the voltage regulator used for the project requires which is from 7V-20V.

The two capacitors used in this stage of the project are two 10μF electrolytic capacitors as they would give the power supply section low leakage resistance feature (at input and output of the voltage regulator respectively) and are selected instead of the conventional 0.33μF and 0.1μF (input and output of the voltage regulator respectively) stated in the LM7805 datasheet because the whole the system will pull power from power source for some time.

The voltage regulator used in this project is the LM7805 voltage regulator. This type of voltage regulator was selected because its output of 5V is required for operation by the microcontroller, MQ3 sensor, LCD and DC motor.

As seen in the circuit above, the first capacitor, the 10μF electrolytic capacitor, is hooked up after the voltage source, in this case the 12V battery and before the input of the LM7805 regulator. This capacitor filters out any noise coming from the battery. The capacitor, in essence, acts as a bypass capacitor. It shorts the AC signal of the voltage signal (which is noise on the voltage signal) to ground and only the DC portion of the signal goes into the regulator.

The second capacitor, the 10μF electrolytic capacitor, is hooked up after the voltage regulator This capacitor is there again to filter out any noise or high-frequency (ac) signals that may be on the DC voltage line therefore outputting a precise voltage i.e. 5V required to power the microcontroller

3.2.2 Sensing Stage

3.2.2.1 MQ3 Sensor

The MQ3 sensor in combination with the LM393 was used in this project for detecting alcohol and processing the detected alcohol into signals that is interpreted by the microcontroller. Fig 3.3 shows a full circuit diagram of the sensor.

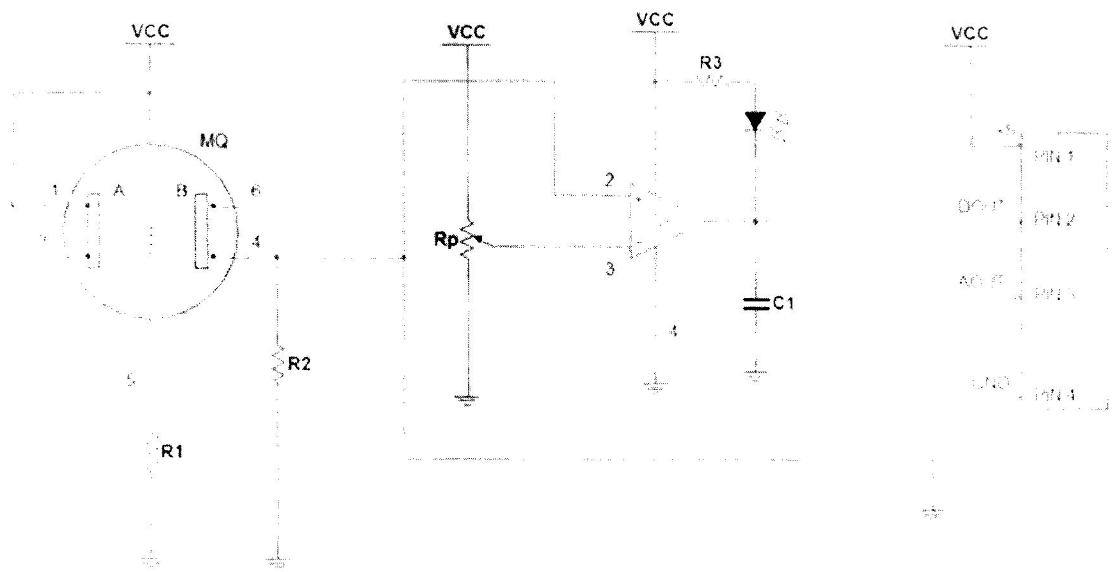


Fig 3.3 Circuit diagram of MQ3 Sensor (MQ3 Sensor datasheet, 2012)

The MQ3 module itself has four pins. It has an analog output pin, and a digital output that is supplied from a comparator output. The digital output is normally high. When alcohol molecules become present in the surroundings of the sensor, the sensor output swings from 5v (1) to 0v (0). This output is further calibrated in the project with the aid of a 10K variable resistor as can be seen in fig 3.8

Fig 3.4 is a schematic diagram of the MQ3 element alone

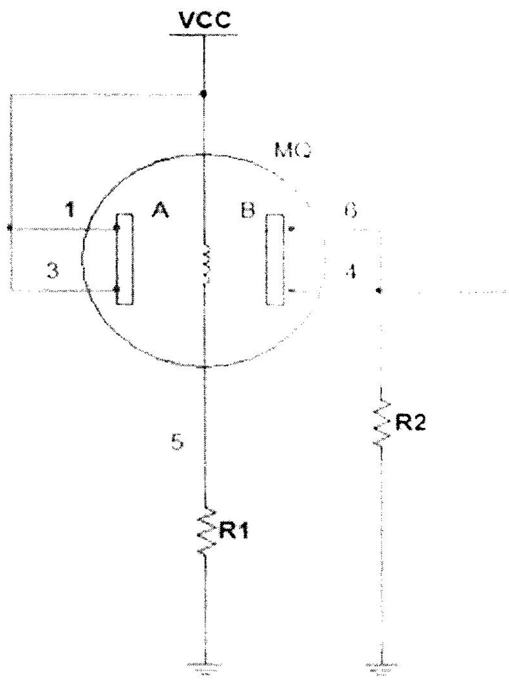


Fig 3.4 Schematic of the MQ3 Sensor (MQ3 Sensor datasheet, 2012)

The resistance across the A pin and B pin varies depending on how much alcohol is in the air around the sensor. Alcohol in the breath is represented in resistance. The more alcohol, the lower the resistance. Instead of measuring the resistance directly, we measure the voltage level at the point between the sensor and a load resistor R_2 The sensor and load resistor R_2 form a voltage divider, and the lower the sensor resistance, the higher the voltage reading which is then fed directly into the input of the LM393 comparator.

R_S = Sensor resistance = 1MΩ

V= Circuit voltage = 5V

R_L = Load resistance = 200KΩ

V_{R2} = Voltage across R_2

V_S= Voltage across sensor

Voltage across the sensor when alcohol molecules are present in its surrounding air;

$$V_S = \frac{R_S}{R_S + R_2} \times V$$

$$V_S = \frac{1 \times 10^6}{1 \times 10^6 + 200 \times 10^3} \times 5$$

$$V_S = 4.2V$$

Voltage across the load resistorR_2 when alcohol molecules are present in the surrounding air of the MQ3 module;

$$V_{R2} = \frac{R_2}{R_2 + R_S} \times V$$

$$V_{R2} = \frac{200 \times 10^3}{200 \times 10^3 + 1 \times 10^6} \times 5$$

$$V_{R2} = 0.83V$$

From the calculation above, the two voltage levels are clearly affected by the presence of alcohol molecules in the surrounding air of the MQ3 sensor module. Therefore to provide two distinct voltage levels, the LM393 Voltage comparator is used.

3.2.2.2 Comparator Unit

The LM393 is the comparator circuit used and it compares two voltage signals and determines which one is greater. The result of comparison is indicated by the output voltage. The comparator functions in the following manner. It gives a high output when the voltage in the non-inverting input (+) is greater than the voltage at the inverting input (-) and it gives a low output when the voltage at the inverting input (-) is greater than or equal to the voltage in the noninverting input (+). Fig 3.5 is a circuit diagram of the LM393 comparator.

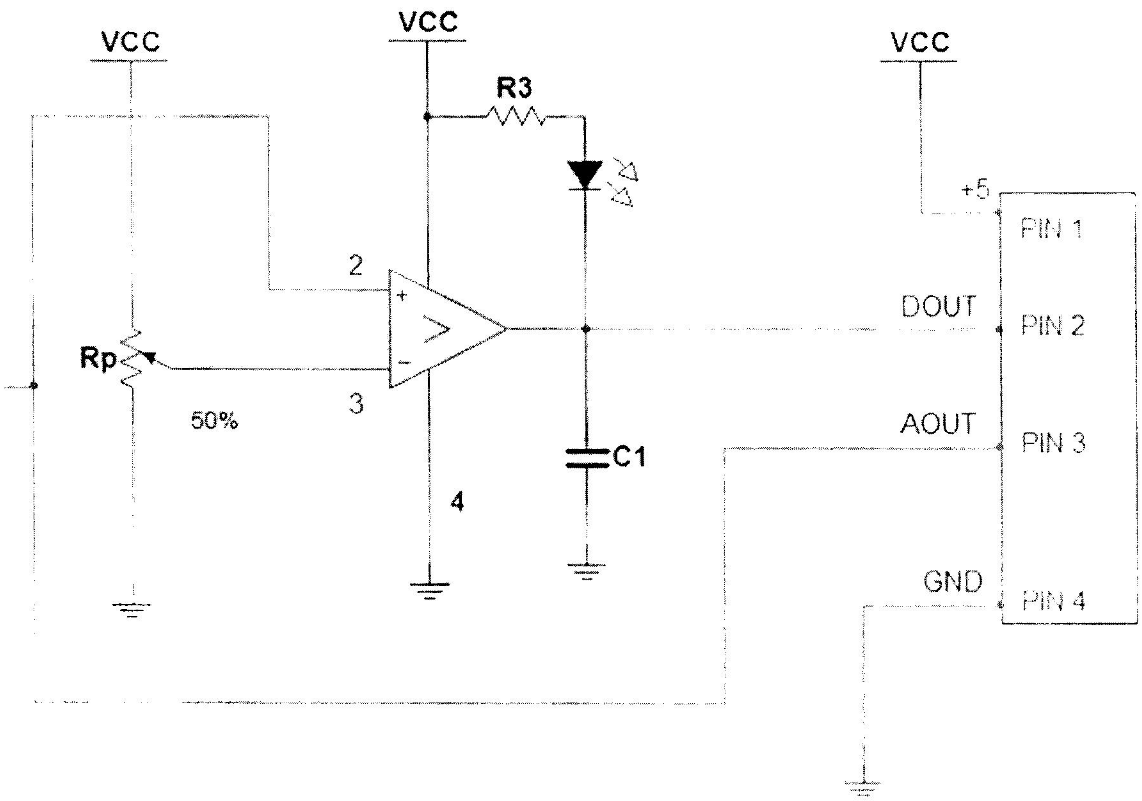


Fig 3.5 Circuit diagram of LM393 voltage comparator (MQ Gas Sensors, 2014)

In the comparator stage a precise point is set where the output voltage will change. This is achieved by adjusting voltage of R_P (V_{R_P}) in fig 3.5 above.

Setting V_{R_P} to 2.0V implies that any voltage below 2.0V in the inverting input (when alcohol molecules are present in the surrounding air of the sensor module) will make the comparator output HIGH. Any voltage above 2.0V in the inverting input will make the comparator output LOW.

The comparator therefore gives a HIGH when there are alcohol molecules present in the air surrounding the sensor module and a LOW when there are no alcohol molecules present in the air surrounding the sensor module. This therefore implies the sensor would be very sensitive (i.e. the sensor would immediately sense the presence of alcohol molecules no matter the quantity present) and therefore a 10K potentiometer is added to enable calibration of the sensor via the microcontroller. The output of the comparator is sent to the microcontroller for interpretation and actions to be taken via the AOUT and DOUT pin.

3.2.2.3 Calibration of the MQ3 Sensor Module

The alcohol content in a volume of breath or blood is expressed as milligram per litre (mg/L). A 1% blood alcohol content (BAC) is equivalent to 10g/L or 10000mg/L. Alternatively, 0.1% BAC is equivalent to 1000mg/L. In every milligram of alcohol in the breath, there are 2100mg of alcohol in the blood. Different countries have different BAC (%) values (e.g. china= 0.02%, USA = 0.08% etc.) but for this project, the value used in Nigeria (i.e. 0.05%, 0.5g/L) is employed in the calibration of the sensor. The Arduino ATMEGA 328PU microcontroller reads the analog voltage value from 0 till 1024 via the AOUT pin.

Set threshold = 244

AOUT value range = 0 – 1024

% alcohol in breath = $\frac{244}{1024} \times 100 = 23.83\% \approx 0.2383$

BAC (mg/L) = (alcohol in breath) $\times \left(\frac{2100}{10000}\right)$

BAC (mg/L) = (0.2383) $\times \left(\frac{2100}{10000}\right) = 0.05\text{g}/100\text{mL} = 0.5\text{g/L}$

The calculation above verifies that the set threshold of 244 gives a BAC value of 0.5g/L as required for the project. The MQ3 detects alcohol molecules which are measured as analog reading (sensor value). A 10K potentiometer is connected to the analog pin (A1) of the microcontroller that aids in the calibration by holding the threshold analog value which when crossed makes the system declare the driver drunk. The following terms below are included into the program for the project so as enable successful calibration of the sensor.

```
const int analogPin = A1;

const int threshold = 244;

void loop() {

  int analogValue = analogRead(AOUTpin);

  if (analogValue > threshold) { }

  else {}
```

3.2.3 Display Unit

The display used in this project is the liquid crystal display (LCD). It displays information of the project based on what information it has being programmed using the microcontroller to display. The 16 X 2 LCD is employed in the display unit as it is economical; easily programmable; has no limitation of displaying special & even custom characters (unlike in seven segments).The LCD is connected according to the guidelines as directed in the datasheet but a 10K potentiometer and a 220Ω resistor is connected to the LCD so as tune the LCD for better clarity of characters and reduce the brightness of the display respectively. Fig 3.6 shows the diagram below

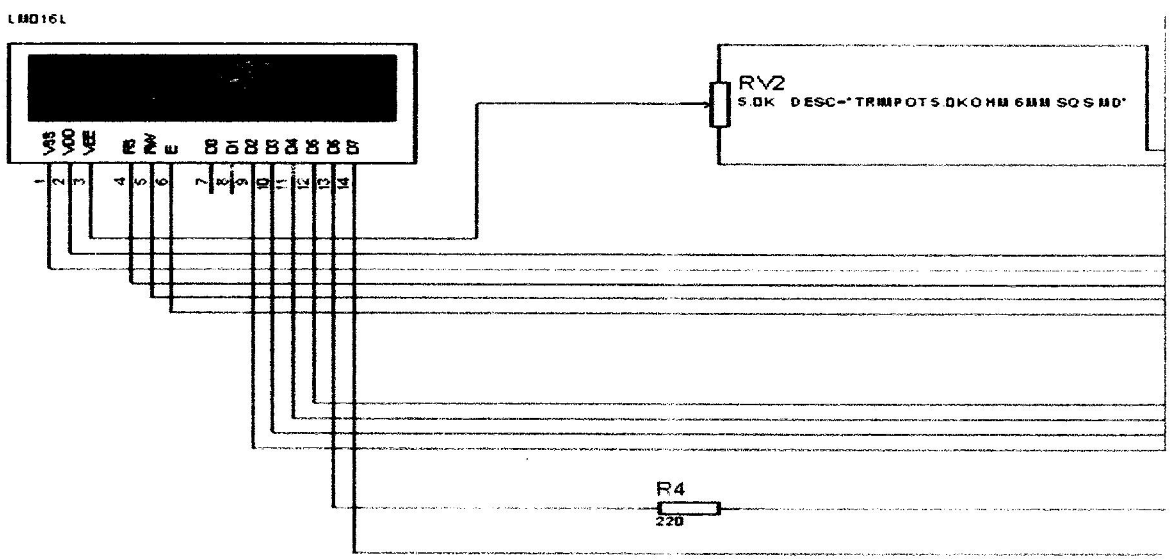


Fig 3.6 Circuit diagram of display unit

3.3 Software Design

This section deals with both the simulation and the coding of the microcontroller. The simulation of the project was the very first step taken before procurement of the hardware. Successful simulation of the project allows for implementation of the project on a breadboard for testing before final implementation on the PCB or Vero board. The proteus software was employed in the design simulation.

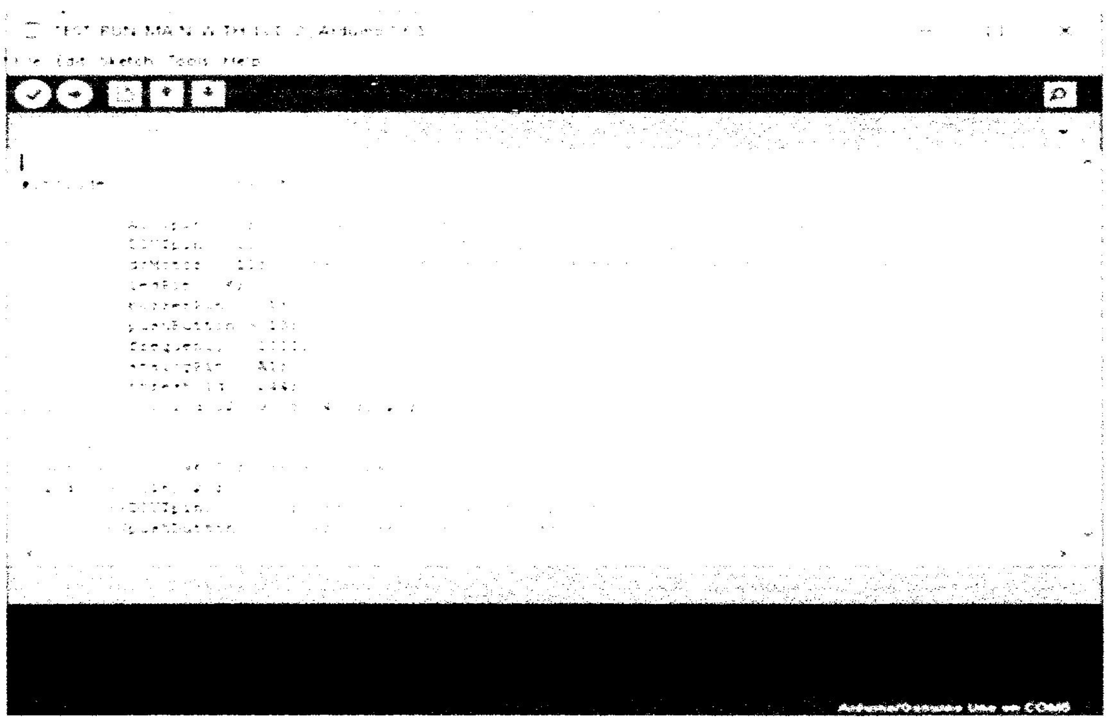


Fig 3.7 Snapshot of Arduino v1.77 IDE homepage

The Arduino v1.77 IDE was used to write the microcontroller code, compile and upload the codes for the project. The code is then linked to the simulated circuit in the proteus software where it is observed and results are taken.

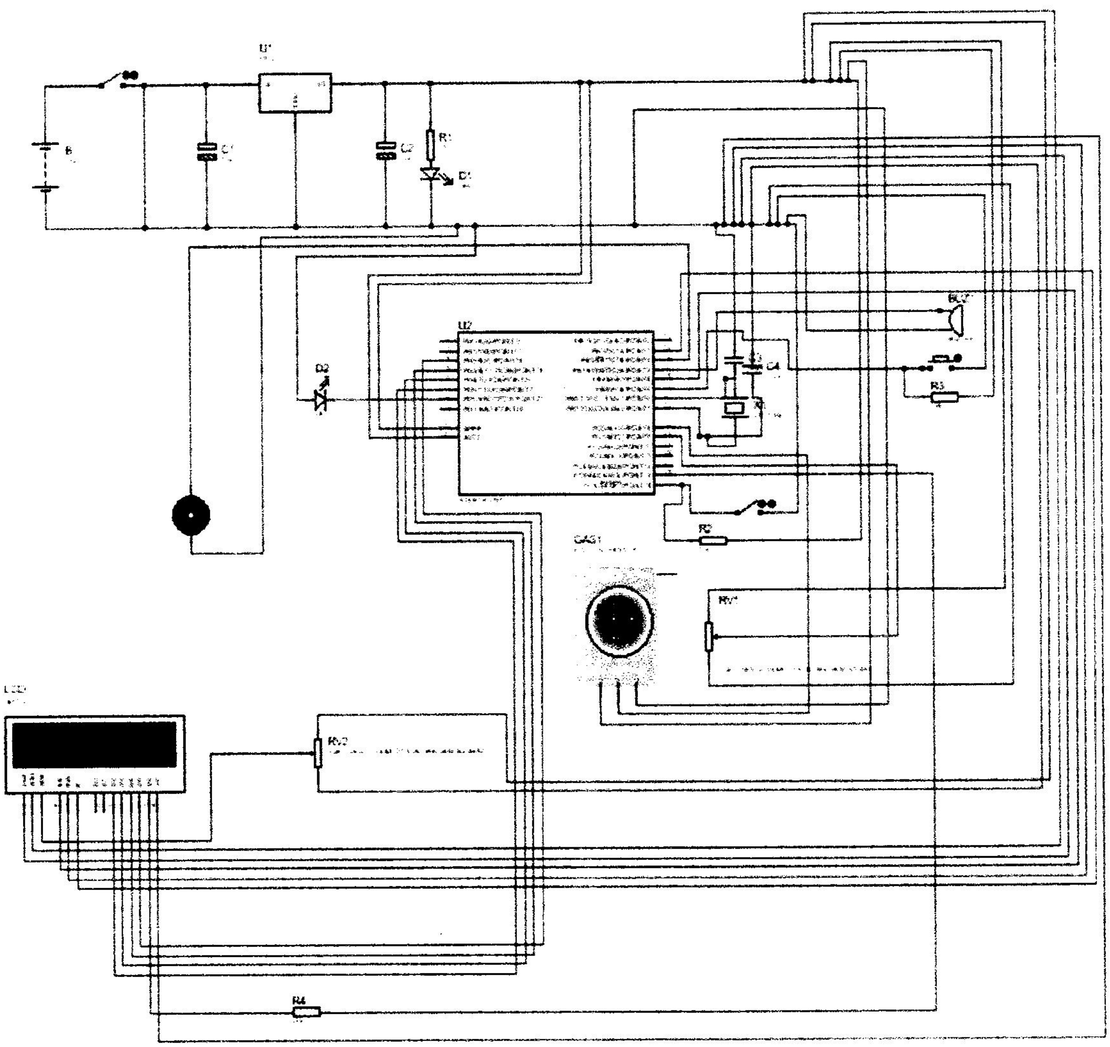


Fig 3.8 Complete circuit diagram of an alcohol triggered vehicle engine lock system

CHAPTER FOUR

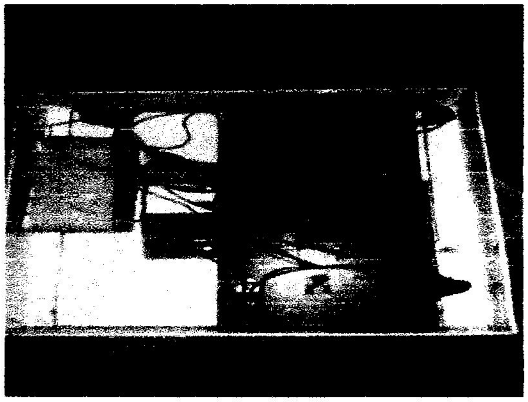
RESULTS, ANALYSIS & DISCUSSIONS

This project is a prototype based project. It is a prototype work that can be further evaluated by those in the industry in order to develop the real work and implement in the industry. An iterative approach was employed during the development of this project as repetitive testing was carried out to identify pitfalls and correct them during the implementation of the project on the breadboard.

4.0.1 Construction

The construction of this project was in two stages namely, the soldering of the components and the casing of the entire system. The circuit was soldered in a number of patterns on the Vero board that is, stage by stage from the power supply stage to the microcontroller stage and all the other stages (LCD, DC motor and Ignition button) were soldered. Each stage was tested using the multi-meter to make sure it was working properly before proceeding to the next stage. This helps to detect mistakes and faults easily. The soldering of the circuit was done on a 10cm by 24cm Vero-board. Fig 4.1 shows images of the project during the soldering stage from beginning to completion

(a)



(b)

Fig 4.1 (a) Soldering on Vero board (b) after completion of soldering

The second stage of the system construction is the casing of the soldered circuit. The casing for the system is a wooden casing, this makes the system look attractive, and it helps in marketing the project because the circuit has to be attractive before someone would want to know what it does. The casing has special perforation to ensure the system is not overheating, and this will aid the life span of the circuit. Fig 4.2 shows the system in its housing

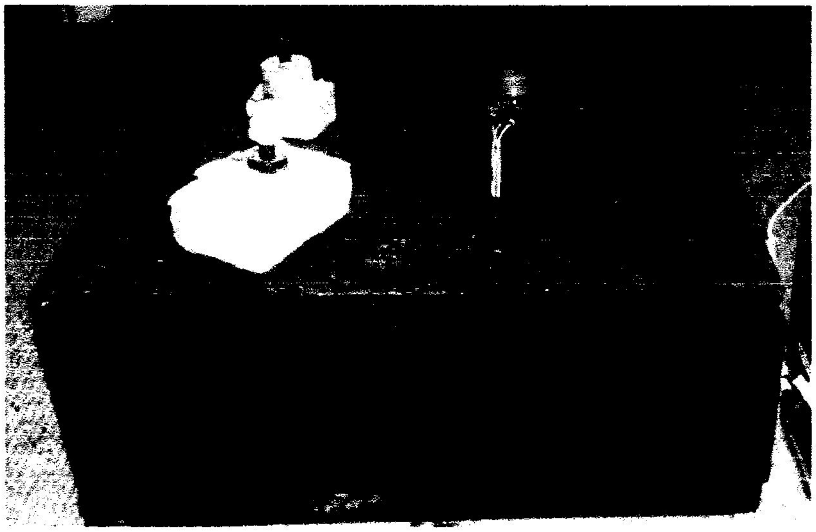


Fig 4.2 Housing of the project

4.0.2 Implementation

The implementation of this project was carried out on the Vero board. The power supply was first derived from 6 × 9V batteries by connecting them in parallel to increase their current supply. From one Stage to another, testing was done according to the block representation on the breadboard, before soldering of circuit commenced on the Vero board. This system was given a wooden housing with perforation and vents to ensure the system is not overheating.

The electronic circuit on the Vero board was firmly pinned to the inside base of the case using a wooden clamp designed at the base of the casing. Finally, the DC motor, MQ3 sensor, 12V battery and ignition switch were left on the outside of the system. This is what the finished work looks like (Fig 4.3):-

Top view

Side view

Fig 4.3 Real time implementation of the system

4.1 Testing

The process of testing involved the use of digital multi-meter. The digital multi-meter basically measure voltages, resistance, current, frequency, temperature, and transistor hFE. This process of implementation of the design on the board required the measurement of parameters like, voltages and resistance values of the components. The digital multi-meter was used to check the various voltage drops at all stages in the system. Also the digital multi-meter was used for troubleshooting the soldering and coupling.

This stage also discusses how the whole system (project) reacted under two conditions. These conditions include;

I. Breath with no alcohol

II. Breath with alcohol

4.1.1 Breath with no alcohol

4.1.1.1 Analysis

The system was switched ON, and the DC motor was started by hitting its ignition button .The MQ3 sensor was tested with a breath that does not contain alcohol by breathing my nonalcoholic breathe onto the sensor. The sensor detected no alcohol presence and produced a digital value of 85 (BAC = 0.02g/L) which is less than the set threshold of 244 therefore leading to the LCD displaying 'normal', LED warning light not glowing indicating no presence of alcohol above threshold in the breathe, buzzer not ringing indicating the alcohol molecules present in the atmosphere is below threshold and DC motor still running. Fig 4.4 is a picture of the message gotten at the LCD in this stage

4.1.1.2 Result of test

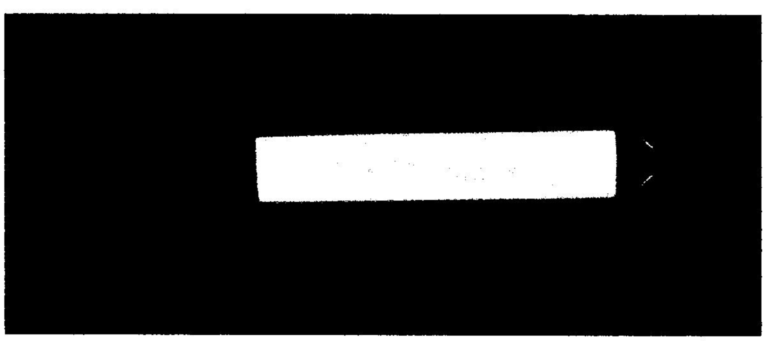


Fig 4.4 LCD displaying alcohol normal level

4.1.2 Breath with alcohol

4.1.2.1 Analysis

The system was switched ON, and the DC motor was started by hitting its ignition button .The MQ3 sensor was tested with a bottle containing alcohol by placing the sensor surface into a free space in the bottle not containing liquid alcohol. The sensor detected alcohol presence and produced a digital value of 325 (BAC = 0.7g/L) which is greater than the set threshold of 244 therefore leading to the LCD displaying 'ALERT', LED warning light glowing to notify presence of alcohol above threshold, buzzer ringing to indicate presence of alcohol molecules above threshold while DC motor stopped running and could not be switched back on so as the alcohol level detected by the sensor was above the set threshold. Fig 4.5 is a picture of the reaction of the message displayed on the LCD

4.1.2.2 Result of test

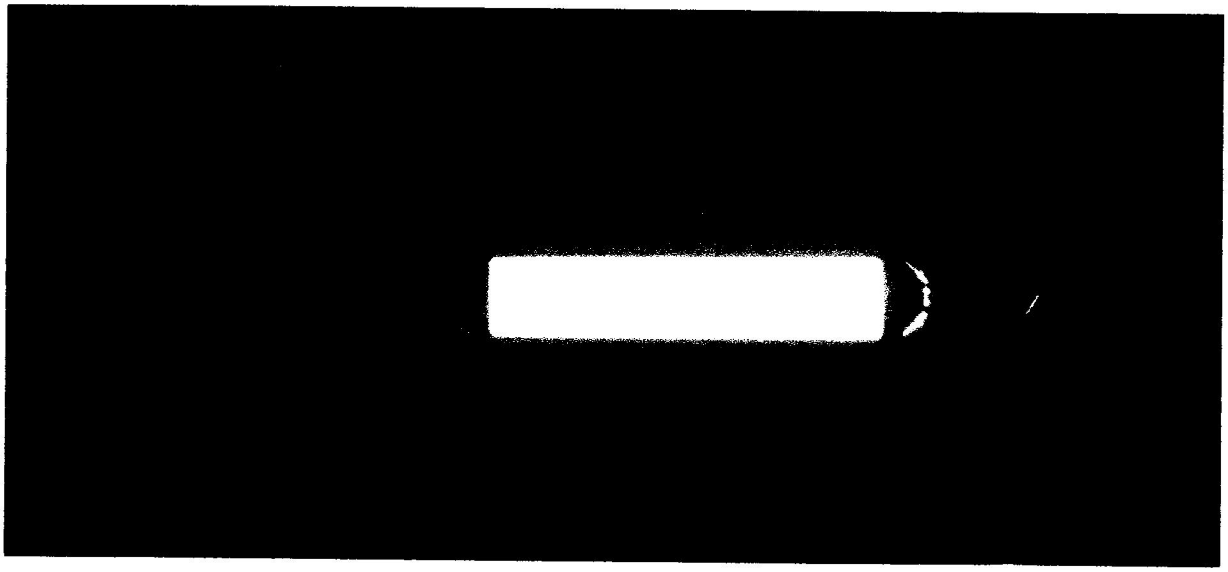


Fig 4.5 LCD displaying alcohol warning level

4.1.3 MQ3 Sensor range test

I carried out a test that would help illustrate the response of the sensor with respect to the distance between the sensor from the alcohol. The set threshold for the project was 244 (analog value) i.e. 0.5g/l (BAC value). Below is a table showing the results of this test carried out with Fig 4.6 showing the behavior of the sensor graphically with fig 4.7 (a-f) showing pictorially the test carried out

4.1.3.1 Results

Table 4.1: BAC (g/l) vs Distance (cm)

Distance (cm)	Analog value	BAC (g/l)
0	320	0.66
10	260	0.53
20	155	0.32
30	126	0.26
40	94	0.19
50	87	0.18

4.1.3.2 Analysis of MQ3 sensor range test

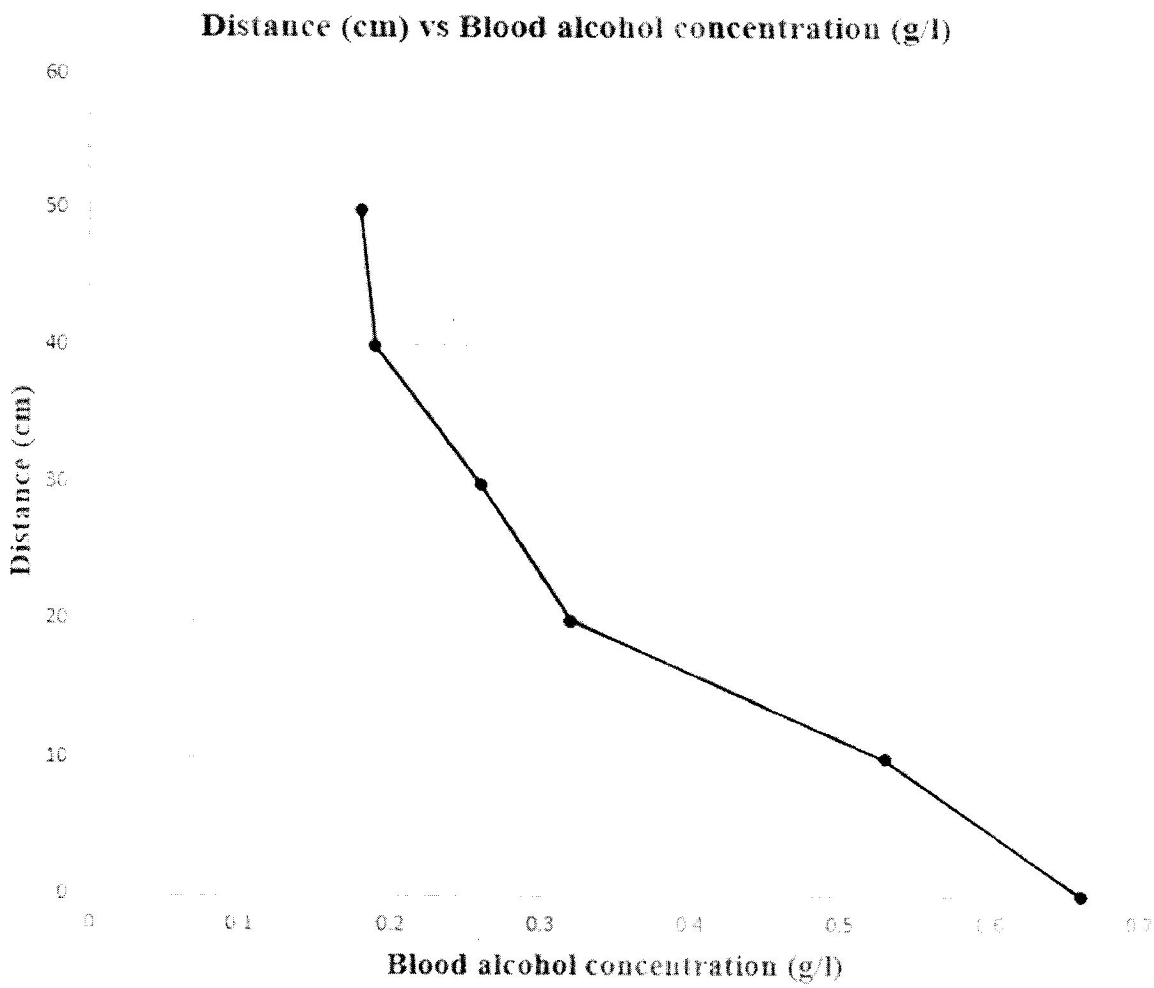


Fig 4.6 Graph of distance between sensor and alcohol content (cm) vs Blood alcohol concentration (g/l)

From Table 4.1, it can be seen that as the distance between the sensor and the alcohol content increases, the analog and BAC values decreases.

From the graph above it is inferred that the distance between the sensor and alcohol molecules (cm) is inversely proportional to the blood alcohol concentration (BAC) and that the threshold was reached at a range of 14-16cm from the alcohol.

From the graph, it is seen that the sensor begins to sense alcohol molecules at stables values at a distance of 40cm from the sensor. At 50cm upwards, the values are not stable which there implies the sensing range on a straight line is 0-40cm

With the values above the normal sensing area and triggering area for the sensor is deduced below;

Sensing area;

Radius of normal sensing area (r) = 20cm

Sensing area = $\pi r^2 = 3.14 \times (20 \times 10^{-2})^2 = 1256cm^2$

Radius of sensor triggering area (r) = 7.5cm

Triggering area = $\pi r^2 = 3.14 \times (7.5 \times 10^{-2})^2 = 176.625cm^2$

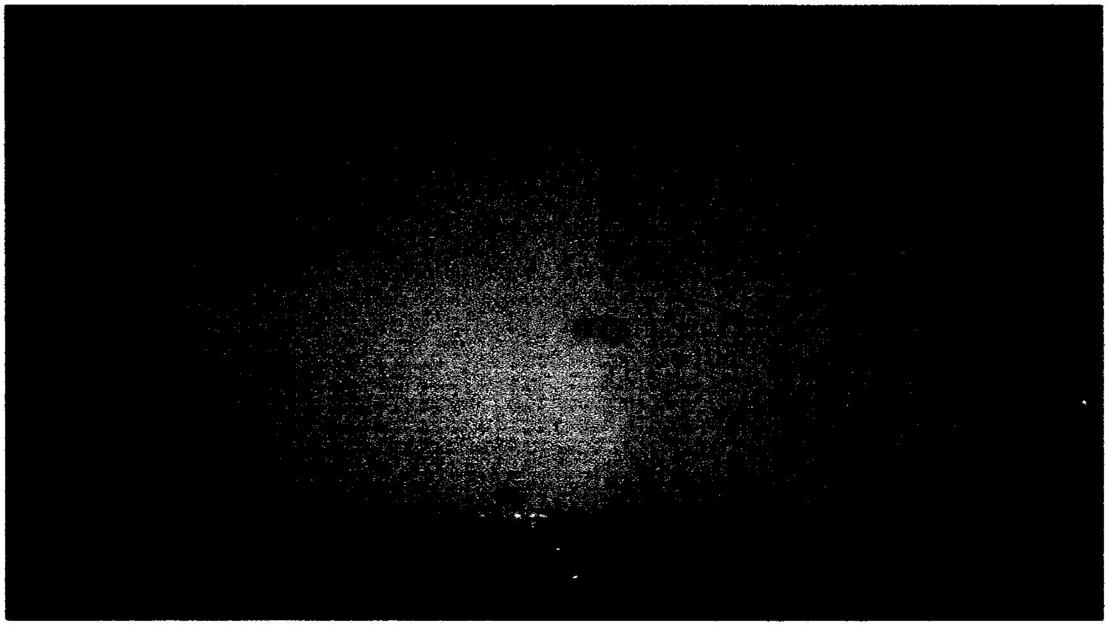


Fig 4.7 (a) at 50cm

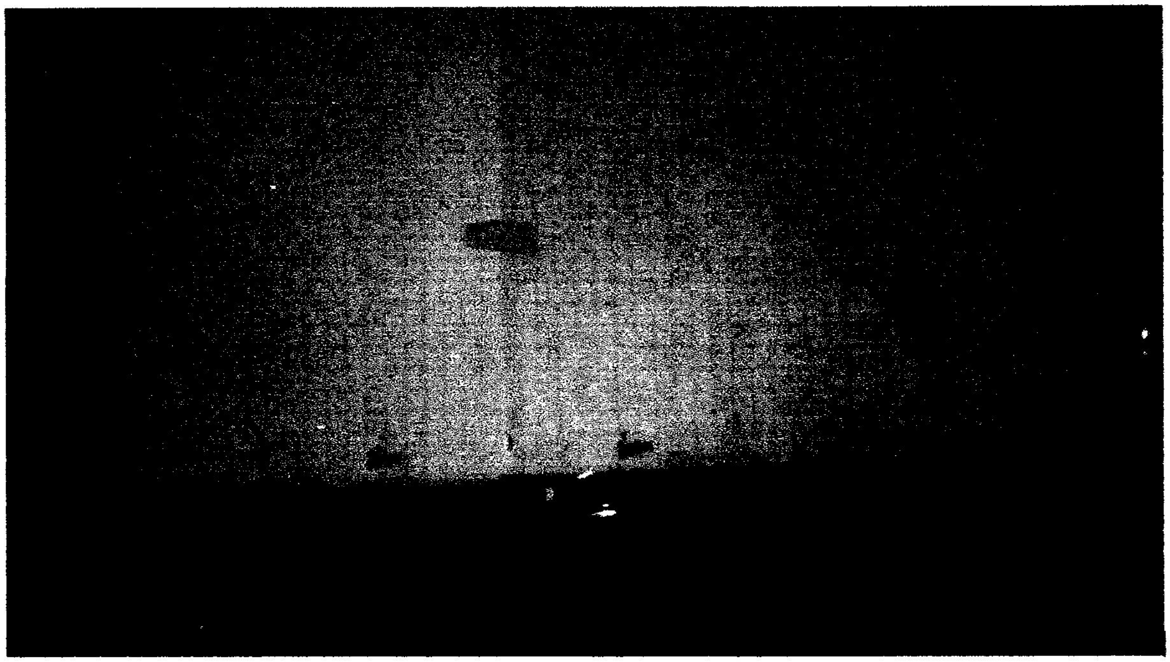


Fig 4.7 (b) at 40cm

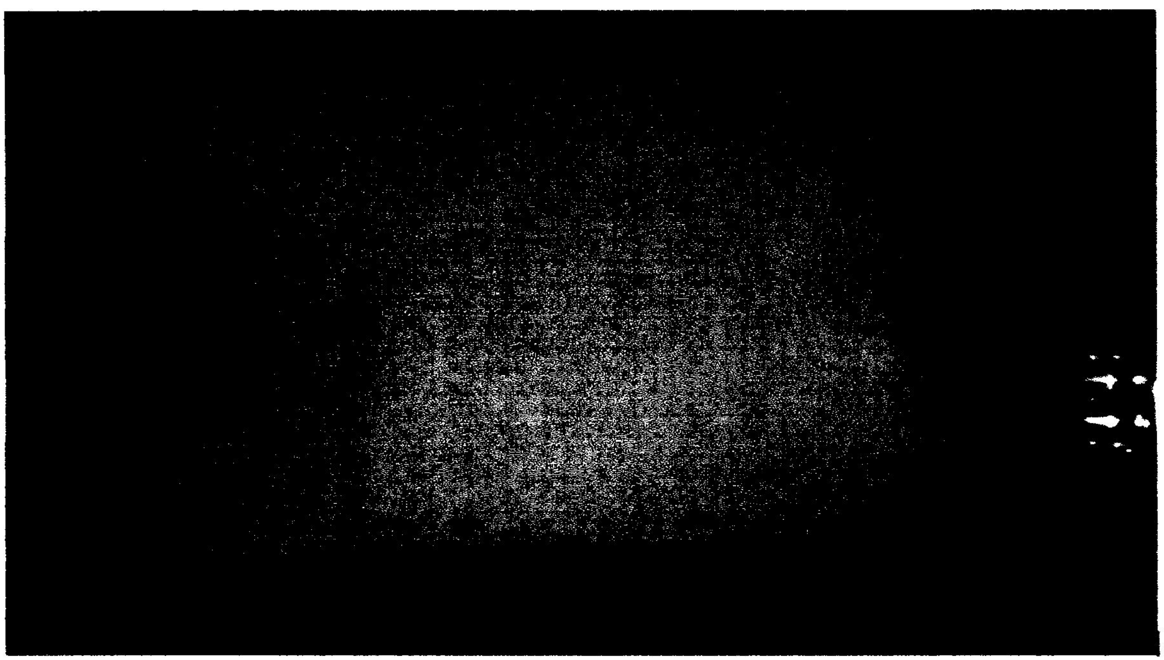


Fig 4.7 (c) at 30cm

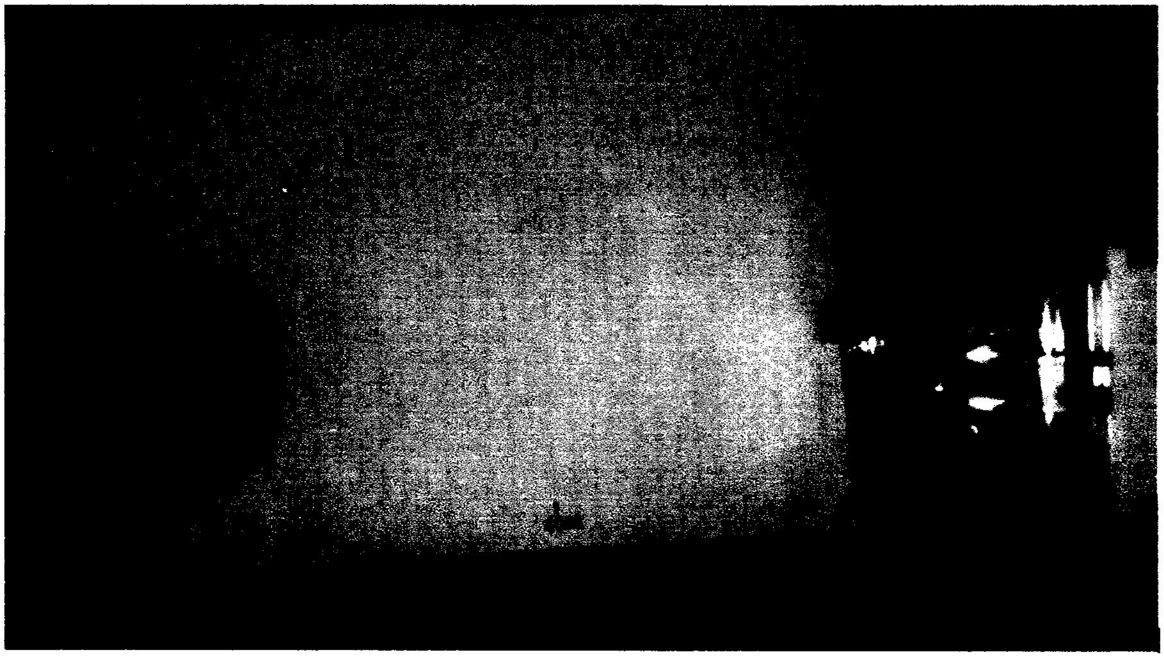


Fig 4.7 (d) at 20cm

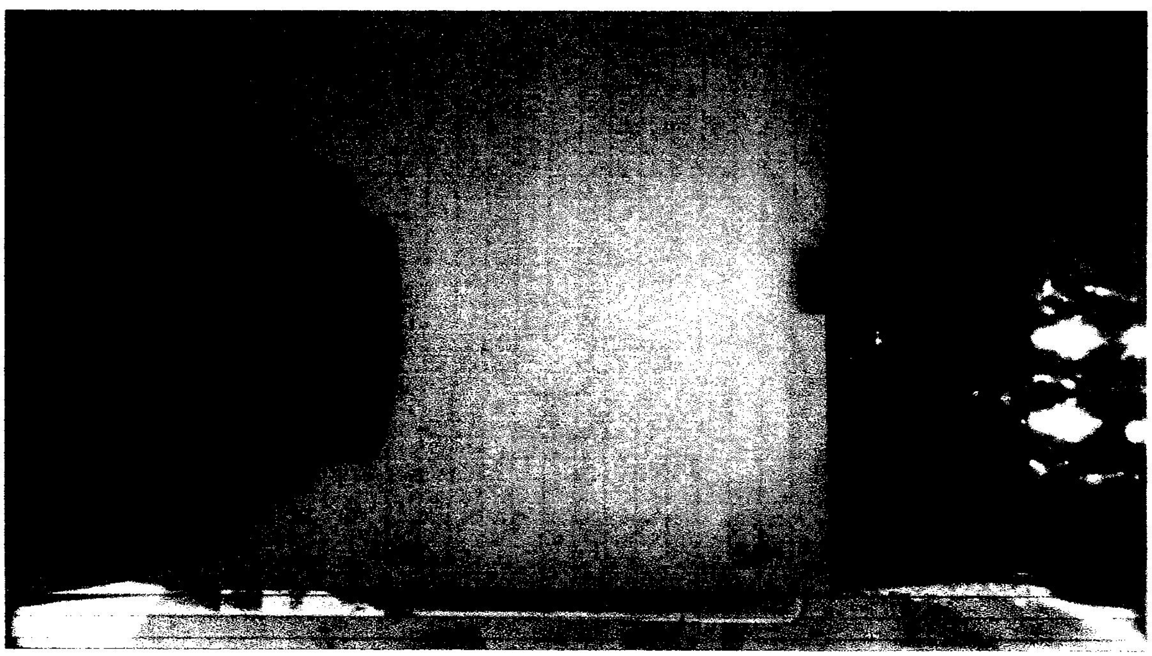


Fig 4.7 (e) at 10cm

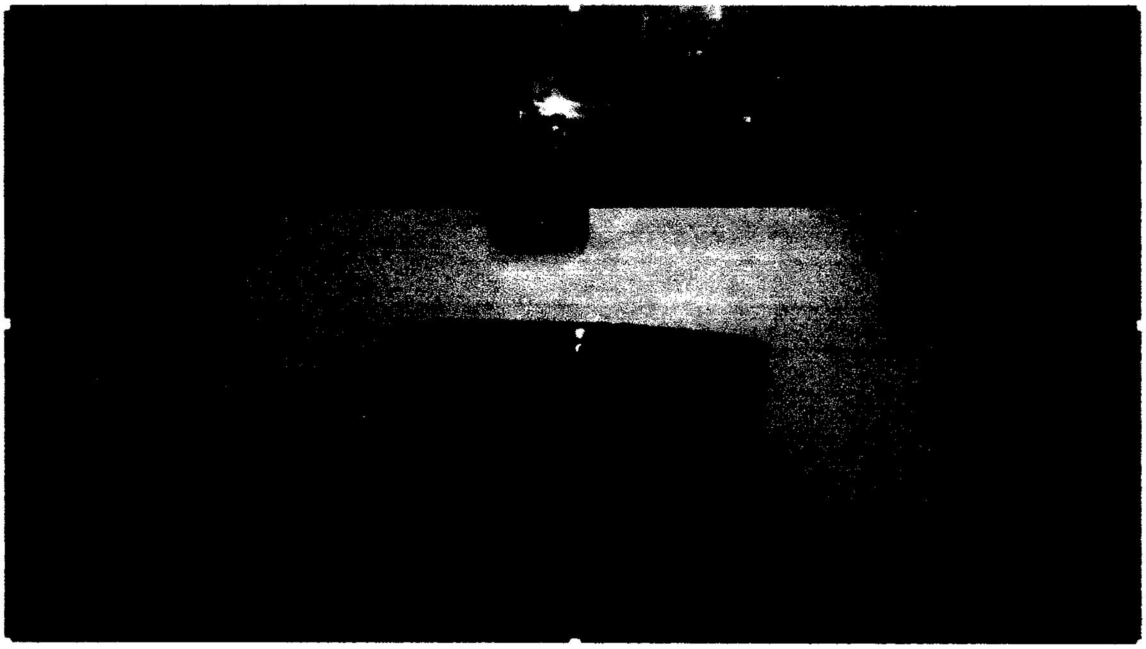


Fig 4.7 (f) at 0cm

4.2 Project Management

4.2.1 Work Breakdown Structure

The design and implementation of a microcontroller based automatic engine lock system for drunken driver was quite a difficult task for a student to undertake in one session (Final session), give the busy live of a final year student. In order for it to run smoothly, I divided the main tasks up successively and gave time frame for the completion of each task. This way each task would be completed within a specific period of time with the previous task completed aiding/assisting in the completion of the next task. The main tasks includes the following;

I. Software

II. Electronics section

III. Housing

The software stage is period within which the codes required for the project was developed. The Arduino Uno R3 was the microcontroller used for the project with the codes written in c on the Arduino IDE which allowed for easy compilation and uploading of the completed codes into the microcontroller.

The Simulation Section involved the simulation of a proposed circuit for the project. Here, a circuit for the project was developed and simulated to allow for easy correction of errors and addition of any necessary components. Simulation provided a means of a real time experience of the project without the cost of any components.

Electronics section involved the implementation of the simulated project circuit on a bread board and then on the Vero board. The simulated circuit, was laid out on a breadboard and once its workability was approved, the circuit was implemented on the Vero board.

Housing section was the stage where the casing for the project was developed. A design was initially done with necessary measurements such as the length and breadth of the whole project, the length of vents required, length and breadth of the LCD opening, thickness of the housing etc were taken. The measured parameters were employed by the craftsman to develop the wooden housing

4.2.2 Project Schedule

4.2.2.1 Gantt chart

This is a chart used to illustrate the breakdown structure of the project by showing the start and finish dates as well as various relationships between project activities, and this way helps to keep track of the tasks against their scheduled time or predefined milestones

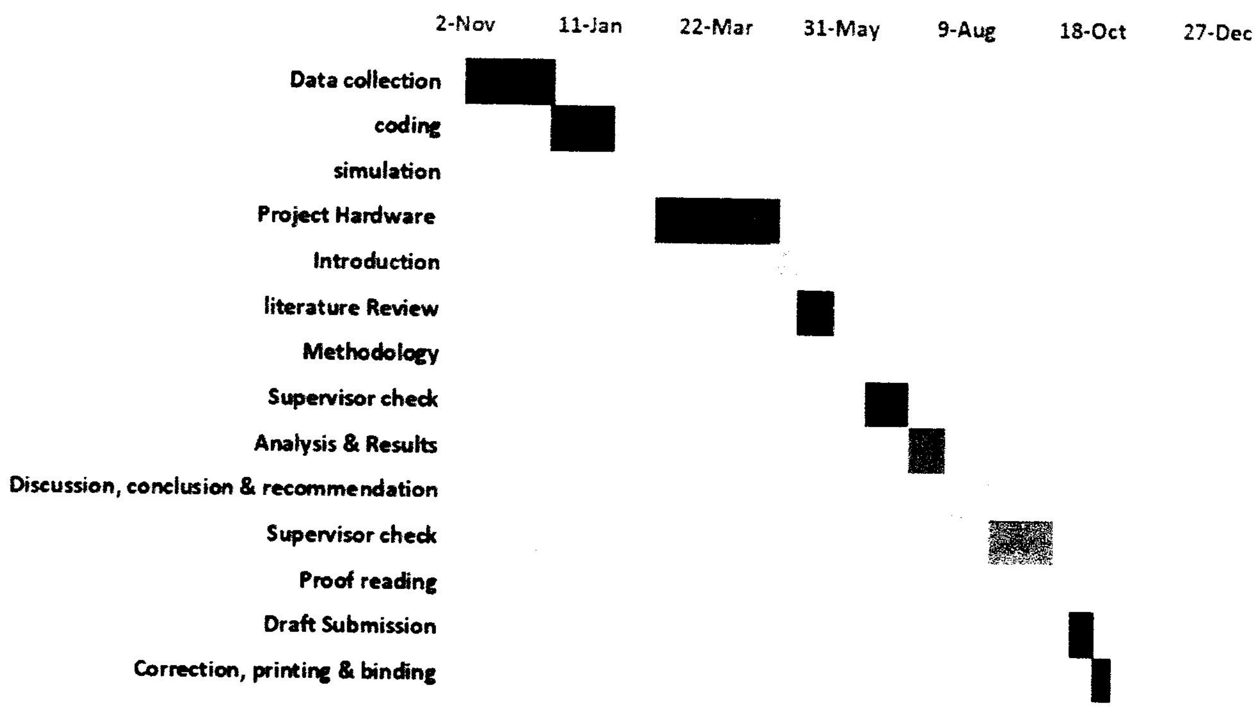


Fig 4.8 Gantt chart of the project

4.2.3 Risk Management

The major risk during the course of this project was the issue of design copyright. There are few prototype designs of the MQ3 sensor with engine lock effect on the internet but the designs given by this authors were not workable designs. To avoid this issue of design copyright, I made sure my design was a huge modification to others. To begin with, 99% of other designs made use of AC power due to their inability to use the MQ3 sensor on DC power, therefore giving my design a huge edge as it has the characteristic of immediate implementation into a real time vehicle with only very few changes to the system required. Then to the system architecture, use of warning LEDs, and warning/normal messages which display on the LCD, the design of this project effectively served as a mitigation plan to the risk of copyright design.

4.2.4 Social, Legal, Ethical and Professional Considerations

The alcohol triggered vehicle engine lock system is a prototype based project which was done as an improvement to projects of breathalyzers and alcohol detection system. This project's major modification which makes it stand out and not a copyright of previous alcohol sensor based projects, is its ability to shut down the vehicle's engine and prevent the driver from starting the vehicle's engine on detection of the driver being in a drunk state by the system.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.0 Conclusion

The project which is the design and implementation of an alcohol triggered vehicle engine lock system has met its objectives. The project is a real time implementation of the prototype of the model and was done considering some factors such as economy, availability of components and research materials efficiency, compatibility, portability and also durability. The general operation and performance of the project is dependent on the presence of alcohol within 10cm range of the system which consist of the alcohol sensor. If the quantity of alcohol detected by the system is greater than the threshold set in the system, the system's buzzer alarm is triggered while its warning LEDs come up and a warning message is displayed by the LCD. But if the quantity of alcohol detected by the system is less than the set threshold in the system, the system's buzzer stays low while its warning LEDs does not come on with a normal message instead of a warning message displayed by the LCD.

The operation of the system is also dependent on how well the soldering was done, and the positioning of the components on the Vero board in which proper soldering was done and the components were well spaced on the Vero board with the IC's were soldered away from the power supply stage to prevent heat radiation which, might occur and affect the performance of the entire system. Construction of the system was done in such a way that it makes maintenance and repairs an easy task and affordable for the user should there be any system breakdown with troubleshooting made easier due to soldering of the whole project on just one Vero board.

The design of the microcontroller based automatic vehicle engine lock system for drunken drivers involved research in both analog & digital electronics with intensive work done on microcontrollers and programming in C. In general, the system was designed, and the real time implementation was done with a proto-type of the model.

5.1 Contributions to knowledge

This project is a huge improvement to previous simulation based works and alcohol breathalyzers.

The whole project was successfully powered by a single 12v battery making it very applicable into a real time vehicle allowing for the system to have a full run in time so as to power up the sensor fully as the sensor needs at least a 3hr run time to ensure accuracy in its readings.

With the successful use of DC power in this project, the problems anticipated by other researchers of using DC power with the alcohol sensor and LCD together in one project was solved.

A warning LED was added to alert the driver of his/her inability to start up the vehicle just in case the driver has his/her hearing impaired due to his/her state of drunkenness or hearing disorder making it difficult to hear the warning buzzer alarm.

In summary, the project was successfully completed having a unique ability of being put immediately into a real time vehicle with just few changes required as would be highlighted in subsequent sections of this write-up.

5.2 Challenges Encountered

Several problems were encountered during the project. The problems range from design problems to implementation problems and also construction problems. The major problems are as follows;

1. The MQ3 sensor cannot differentiate between alcohol molecules and perfumes due to the presence of ethanol in both as the sensor reacts to any form of matter with high concentration of ethanol and as such a driver who isn't drunk and has used a lot of perfume could trigger the system.
2. Initially, 9 volts battery was not supplying enough current to power the circuit and the sensor at the same time. This problem was solved by using a 12Volts battery instead of a 9Volts battery.

3. The buzzer was not loud enough when connected to the microcontroller alone. This problem was solved by connecting the buzzer to a transistor so as to amplify it as the microcontroller port doesn't have enough current to power the buzzer to operate at its normal capacity.
4. The voltage regulator got was getting very hot due to the high amount of power dissipating as heat and as such leading to the voltage regulator switching off automatically. This problem was solved by attaching a copper heat sink to the voltage regulator.
5. When the whole system was switched on, the LCD was not displaying any characters. This problem was solved by connecting a 10K potentiometer to the LCD as it was used to tune the contrast of the LCD.

Other problems include soldering and measurement errors but these problems were solved by proper troubleshooting with serious care in the construction of the project.

5.3 Limitations

There are limits to the tasks that can be performed by devices. Some limitations of the alcohol triggered vehicle engine lock system include;

1. The MQ3 sensor cannot differentiate between alcohol molecules and perfumes due to the presence of ethanol in both as the sensor reacts to any form of matter with high concentration of ethanol and as such a driver who isn't drunk and has used a lot of perfume could trigger the system.
2. The system could easily shut down the vehicle at any point in time e.g. in a desert or along a busy road.
3. Due to the range of sensing of the sensor, if not placed in the right position, the system can mistake a drunk passenger as driver and lock the engine

5.5 Future Works

There are no projects that cannot be improved. Enhancements have to be carried out so as to improve the efficiency of this system.

The system should be made smaller. This is one of the improvements that can be done on this system in the future. The smaller the system, the more convenient the alcohol system is, the more likely drivers will accept it.

There should be proper positioning of the alcohol sensor so as to allow convenient reading of the driver's alcohol consumption quantity with or without the aid of the driver. Some options for where the sensor can be placed include;

1. An element that can help differentiate the ethanol quantity in alcohol and perfumes should be introduced into the sensor so as to prevent the issue of the system being triggered due to use of large amount of perfume by the driver.
2. A cable can be put near the driver's seat and then connected with the ignition of the car. This means the alcohol detection system can be another key to the car. The driver should blow to the system before he/she start the car. If the value of the alcohol concentration is above the system's threshold value, the system will stop the car starting. So a drunk driver would not be able to start the car which will prevent the behavior of drunk driving. It is not only safe to the driver, but can ensure the passengers would not be hit because of the driver's drunk driving.

Fig 5.0 Driver blow into sensor (Kong et al., 2013, p.29)

3. Fixing the alcohol sensor on the driver's seat while the other part of the system can be kept on the steering section of the vehicle. The sensor near the seat can detect the driver's breathe alcohol concentration easily and the driver won't take pains to blow to any system intentionally.

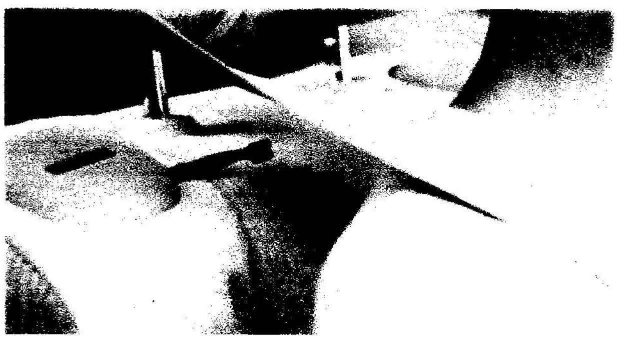


Fig 5.1 Fix on the back (Kong et al., 2013, p. 30)

4. Installation of GPS and GSM systems to the device for transmission of location of vehicle in cases of the system shutting the vehicle in the middle of nowhere.

5.6 Critical Appraisal

The design and construction of a microcontroller based automatic vehicle engine lock system for drunken drivers is a prototype based project which can be adopted by car manufacturers for use in their cars to also ensure safety of lives. This project was done in such a way that it would be the exact replica of what would be on ground if to be implemented in real time. In the process of the design and implementation of this project, it could have been done simply and lightly having in mind that its just a prototype, but due to the desire of wanting something unique and declarable as the next best technology in the automotive area of embedded engineering and smart cars, the project was designed and implemented as a device that could be put in straight into a vehicle leaving vehicle manufacturers with little add-ons and corrections to make based on their type of vehicle and taste of software and design. These project was not an easy one as a lot challenges were encountered as enumerated in unit 5.2 but with the conquering of those problems, a lot of knowledge was gained and as such increased my desire to further in the area of embedded engineering. One of the shortcomings I believe this project has is its inability to utilize internet of things but that can be understood as the country where I undertook the project (i.e. Nigeria) is still shortcoming in the area of internet of things. In all its an interesting project which has led me into other areas of embedded engineering.

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Appendix A

Program for the project

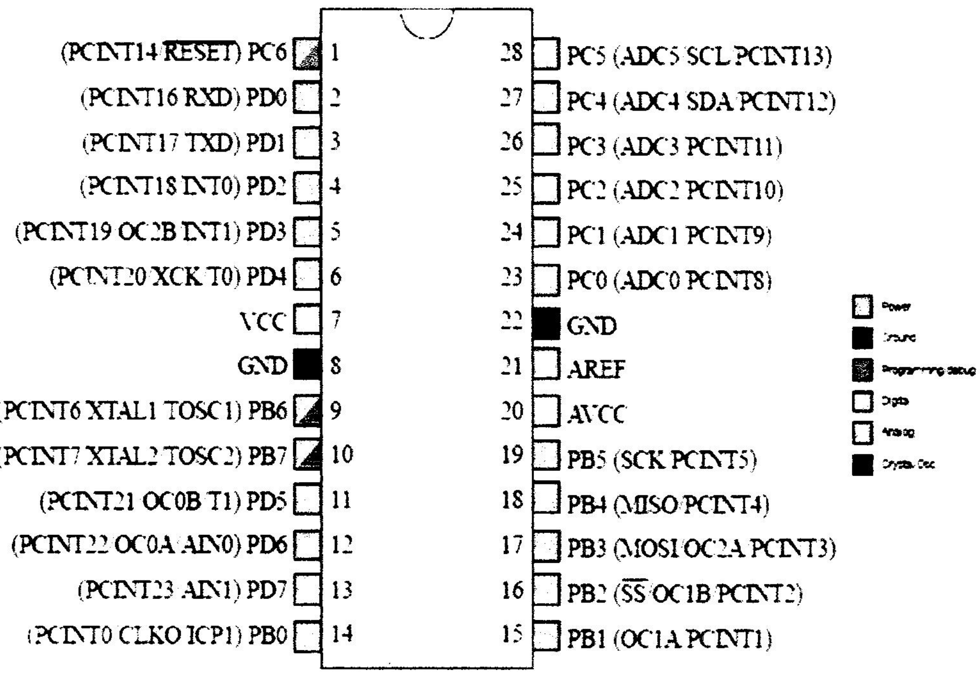
```
/* design and construction of a microcontroller based automatic vehicle engine lock system for drunken
drivers*/

#include <LiquidCrystal.h>

const int AOUTpin = 0;
const int DOUTpin = 8;
const int dcMotor = 10;
const int ledPin = 6;
const int buzzerPin = 11;
const int pushButton = 13;
const int frequency = 1000;
const int analogPin = A1;
const int threshold = 244;
LiquidCrystal lcd(12, 9, 5, 4, 3, 2);

void setup() {
 Serial.begin(9600);
 lcd.begin(16, 2);
 pinMode(DOUTpin, INPUT);
 pinMode(pushButton, INPUT);
 pinMode(ledPin, OUTPUT);
 pinMode(dcMotor, OUTPUT);
```

```
 pinMode(buzzerPin, OUTPUT);
 while (digitalRead(pushButton) == 1);
}

void loop() {
 int analogValue = analogRead(AOUTpin);
 lcd.print("alcohollevel:");
 lcd.println(analogValue);
 Serial.println(analogValue, DEC);
 lcd.print("ALERT!!");
 lcd.println(analogValue);
 lcd.print(" normal");
 lcd.println(analogValue);

 if (analogValue > threshold) {
  lcd.print("ALERT!!");
  digitalWrite(dcMotor, LOW);
  digitalWrite(ledPin, HIGH);
  digitalWrite(buzzerPin, HIGH);
 }
 else {
  lcd.print(" normal");
  digitalWrite(dcMotor, HIGH);
  digitalWrite(ledPin, LOW);
  digitalWrite(buzzerPin, LOW)
 }
```

```
 delay(1000);
 lcd.clear();
}
```

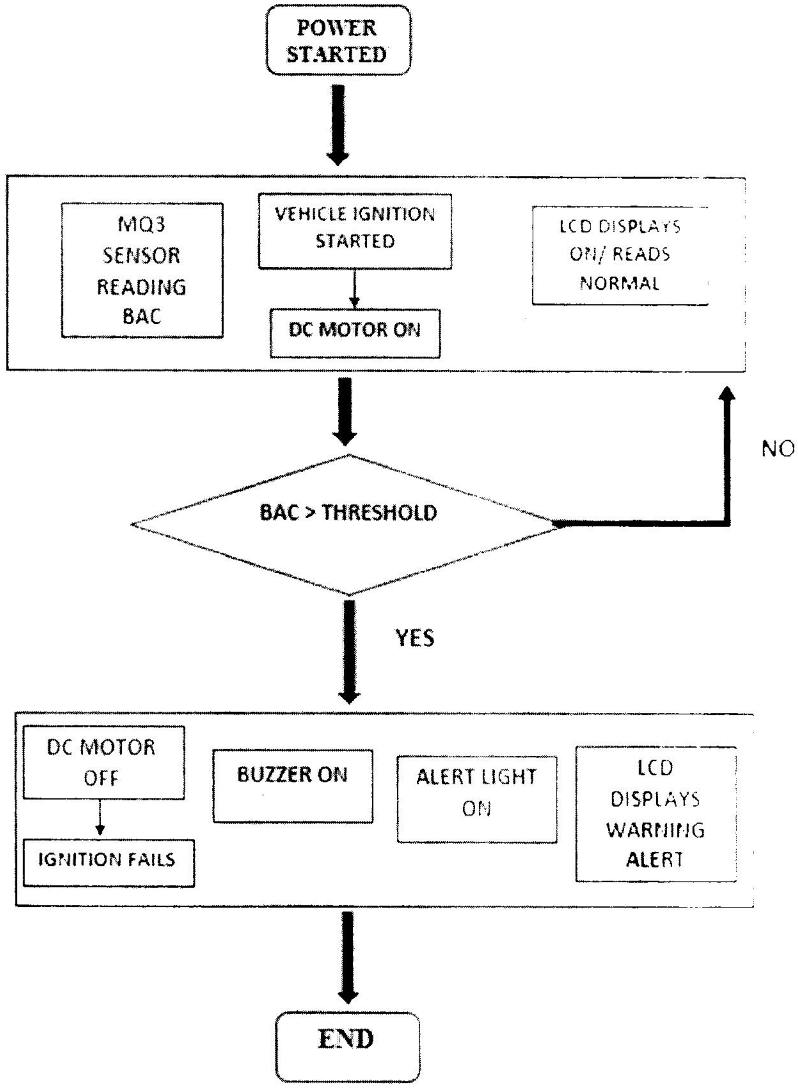
Appendix B

ATMEGA 328PU Configuration



Appendix C

Operational flow chart of the alcohol triggered vehicle engine lock system



Appendix D

Cost Analysis

Component	Cost	Quantity	Total
Arduino Uno R3 kit	8,000	1	8,000
Vero board	300	1	300
Breadboard	300	2	600
MQ3 sensor	1,500	1	1.500
LCD	3,000	1	3.000
Boot loaded AT mega 328PU microcontroller	2,000	1	2,000
12V battery	5,000	1	5,000
Jumper wires	30	40	1,200
Capacitors	50	4	200
LM7805	200	2	400
Resistors	10	20	200
Crystal	150	2	300
Microcontroller socket	50	2	100
Male jumper socket	50	6	300
LCD pins	100	2	200
LEDS	20	10	200
Buzzer	50	2	100
Transistors	50	4	200
Casing	3,000	1	3,000
Transportation			4,000
Soldering lead	700	1	700
Soldering iron	1,500	1	1,500
Miscellaneous			2,000
DC motor	300	1	300
Push button	50	2	100
		TOTAL	35,400