ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY
School of Mechanical, Chemical and Materials Engineering

DESIGN AND DEVELOPMENT OF BREATH ALCOHOL DETECTION SYSTEM FOR PREVENTION OF VEHICLE ACCIDENTS

The Project Submitted in Partial Fulfillment of the Requirements for the Award of Degree of Master of Science in Automotive Technology

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CANDIDATE'S DECLARATION

I hereby declare that the study project work which is being presented in the paper entitled "**Design and Development of Breath Alcohol Detection System for Prevention of Vehicle Accidents**" in partial fulfillment of the requirements for the award of the degree of master of science in automotive technology is an authentic record of my own work carried out from February 2016 to June 2016 under the supervision of : Dr. Chul-Ho Kim (Ph.D) and Ato Alemayehu Wakjira (MSc), Department of Mechanical and Vehicle Engineering, Adama Science and Technology University, Ethiopia.

The matter embodied in this paper has not been submitted by us for the award of any other degree or diploma. All relevant resources of information used in this paper have been duly acknowledged.

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ACRONYMS AND ABBREVIATIONS

A	Ampere
AC	Alternative Current
BAC	Blood Alcohol Content
DC	Direct Current
PIC	Peripheral Interface Controller
PS	Power Supply
DWI	Drunk while under the influence of alcohol
R/W	Read/ Write Signal
R_l	Load Resistor
R_s	Sensor Resistor
R_v	Variable Resistor
BAIID	Breath alcohol ignition interlock device
I/O	Input/output
V_{ref}	Reference Voltage
V_{ss}	Negative Power Supply
LED	Light Emitting Diode
LCD	Liquid Crystal Display
PCB	Printed Circuit Board
V	Voltage
VAPS	Vehicle Accident Prevention System

ABSTRACT

Driving the vehicles by drunken drivers is one of the major reasons causing vehicle collisions which is increasing day by day affecting economically the society and the country as a whole. In this connection to minimize the collisions caused by the drunken drivers, it is aimed to design and develop a system which detects the alcohol content in the air exhaled by the driver in the vehicle and automatically turns off the car if alcohol percentage exceeds the limit avoiding to drive the vehicle. The design of this project includes the development of hardware and software as the device modules. Hardware part includes the sensor circuit, the PIC16F877A Microcontroller circuit, LCD circuits and Buzzer as the alarm & relay circuit. The alcohol sensor was used in this project to detect the of alcohol content in the air exhaled by the driver. A program is developed using C program and embedded in to a microcontroller PIC16F877A, for receiving analog data from alcohol sensor, analyzing it and controlling ignition system. PIC microcontroller compares the data which it receives from alcohol sensor, compares it with the threshold values and if the value is beyond the limit it takes appropriate action like turning off the ignition system to avoid the driver from driving the vehicle. An electro mechanical relay is used to control the ignition system. Based on the values that were detected the system also gives waning to the drunken drivers via alarm from buzzer, LCD and finally disables the ignition switch to stop from driving the vehicle. The developed system was tested for its functionality and it is observed that the system is working as per expectations.

Keywords*: Drunk driving, ignition system, Alcohol gas sensor (MQ-3), Microcontroller.*

1. INTRODUCTION

1.1. Background of the study

Transportation is one of the basic requirements for the proper functioning of societies as its demand is highly related to the movement of people from one place to another. It is difficult to conceive of a situation where transport does not play a major role in the life of an individual. It is an accepted fact that of all modes of transportation, road transport is the nearest to people out of all other transportation systems. And its major advantage compared with others, its flexibility, which allows it to operate from door-to door over short distance at the most competitive prices. In Africa over 80% of goods and peoples are transported by roads where as in Ethiopia road transport accounts for over 90%of all the inter-urban freight and passenger movements in the country. Therefore, transportation has accident on the day-to-day activities of the people, especially in large cities where the drunk driving the vehicle. Cities in developing nations are not only showing a rapid population growth, but also a change in their resident's way of life. Vehicle accident occurs due to drunk driving, slow road construction and maintenance, over speed, shortage of parking space in the narrow streets, driving vehicle without safety such as seat belt, using mobile during driving vehicle, technical problem, as well as in effective management and enforcement.

Worldwide, about 1.2 million persons were killed on the roads and an additional 20-50 million were injured. Drunk driving was the leading cause of death. Only 28 countries, representing 449 million people (7% of the world's population), have adequate laws that address five risk factors (speed, drink driving, helmets, seat belts and child restraints). High income countries reduced fatalities from road traffic accidents by more than 25% during 1968-1998 and other drop of 30 % has been recorded by 2020. While in low and middle income countries, where 81 % of the world's population live and own about 20%of the world's vehicles. However, less than 35% of low and middle income countries have policies in place to protect this road users [1] .Today every country is facing serious problem with drunk drivers. The European Union has recognized drunken driving, as a priority area, due to the fact that the loss due to death alone is 10,000 [1] of the GDP of EU. In USA due to the drink and driving every year 1,393 people were dead, which meant nearly four fatalities every day of the year [2].In India every year nearly 130,000 people were being killed in drunk and driving road accidents, overtaking China and now have the worst

road traffic accident rate worldwide [3].According to World Health Organization (WHO) report, 70% of total road fatalities were caused under the influence of alcohol. In India alone the death toll rose to 14 per every hour. The risk of a driver under the influence of alcohol being killed was at least eleven times [4] that of a person with no alcohol.

To prevent this problem, many states have certain motor vehicle codes which specify that a person was illegally intoxicated and presumptively an able of operating an automobile if his blood alcohol level exceeds the normal level. Blood alcohol is measured as a function of the percentage of alcoholic vapor in the air exhaled by drunk driver relatively accurate reading of blood alcohol level through analysis of breath samples [7]. Alcohol detection from a person has been examined by the device through an alcohol sensor, checks alcohol content and displays output in unit of blood alcohol concentration (BAC). The detected amount was shown by means of BAC percentages through LCD display or seven segments decode [8]. Initially, alcohol detection was limited, only being utilized in purpose to detect and display blood alcohol concentration only. However, as the number of drunk driving causes increased in recent years, extensive researches and developments have been done in applying these devices in vehicles in effort to prevent individuals who consumed excess alcohol beverages from driving vehicles. Subsequently, in the United States , which its nation's drunk driving related accident causes has reached concerning level, drunk driving offenders are required to install an alcohol detection system in their vehicles [9].

Ethiopia has experienced high rates of road traffic accidents, as the road was the major means of transportation. From 2001/02-2004/05, the traffic accident death rate was in the range of 129 and 145 per ten thousand motor vehicles [5].

The main purpose behind this project is "Drunk driving detection". Thus Drunk and driving is a major reason of accidents in almost all countries all over the world. Absorption of alcohol into the blood stream affects people by making them intoxicated. Technically it is determined by the driver's blood alcohol level called the 'blood alcohol concentration' *(BAC),* which indicates the degree of intoxication. In most countries 0.08 grams of alcohol per 100 mL of blood (BAC 0.08) is set as the legal limit beyond which the driver is considered to be legally drunk. Any driver with BAC > 0.08 can be considered to be driving under the influence of alcohol (DUI) or driving

while intoxicated (DWI) and should not be allowed to drive, because, it affects the central nervous system of a person which instable the driver's ways of thinking [2& 5].

This project should be fitted / installed in the vehicle as well as the system should be integrated with ignition switch in order to automatically disconnect the circuit when the car driver is intoxicated. As a result the ignition system is deactivated and the car will be stopped.

The system was made from a compact circuitry built around PIC microcontroller, which outputs the blood alcohol content (BAC) from the breath using MQ-3 alcohol sensor. The presence or absence of alcohol is displayed on LCD.

The main intention of this system is to avoid the rate of accidents used ignition interlock device technology which is normally happened due to drunkenness of driver. This system detection of the drunkenness of driver and prevents them from driving. So there is a need for an effective system to check drunk driver. In this project, alcohol detection content in the air exhaled by the drunk driver which controls the ignition switch used microcontroller have been developed. Instead of just indicated and displayed the BAC percentage, the tester has been programmed to control the ignition switch, as well as an alarm and a number LCDs. The fundamental components of this system were the MQ-3 alcohol sensor, PIC16F877A microcontroller unit, is Analog to Digital Converter: We Know That System Understands Only Boolean Data and the Output of the regulator is Analog Value that converts a continuous physical quantity (usually voltage) to a digital number that represents the quantity's amplitude. The result is a sequence of digital values that have converted a continuous-time and continuous-amplitude analog signal to a discrete-time and discrete-amplitude digital signal and 2x16 characters LCD alphanumeric display, buzzer and ignition switch circuit. Compared to the already available detectors in the market, this system offers simplicity with extensive features and at a minimal cost of production.

In Adama City Administration currently we have observed many traffic accidents due to problem of drunk drivers. Most vehicles in the city are not currently using modern technology to check drunk drivers to prevent accidents. Therefore, we are interested to apply/implement this project to avoid traffic vehicle accidents in Adama City Administration. The Statistics of law breakers is depicted in table 1.1 given below.

Table 1.1 Statistics of lawbreakers

Law Breakers	Two wheelers	Four wheelers
Signal jumping	2,20,859	1,46,945
Drunken driving	36,727	17,237

1.2. Problem Statement

Vehicle accident is the major alarming issue in the world. This problem making the citizens afraid of their journey. This is because during any vehicle accident, there was at least one death or injury. In developing countries the death rates per vehicle are in the order of 50 times that of European countries [10]. Currently Ethiopia, one of the developing countries in the world, loses around 400 million Birr in each year due to vehicle accident [11]. One of the major reasons for vehicle accidents is drunk driving. The Road Safety Council estimates that 30 percent of road accidents nationwide were caused by drinking and driving [12].Drivers have 24 hours within which to report a crash caused a likely under reported of drunk driving accident. So that the proportion of alcohol in the breath blood or urine exceeds the prescribed limit set could punished with imprisonment for a term not less than three years and not more than ten years, a fine of not less than eight thousand dollars and not more than twenty thousand dollars [13]. The main reason for driving during drunk are: The alcohol lowers inhibitions, make driver difficult to make rational decisions, drunk driver still driving the vehicles, when the drunk drivers drive alone no one has been give warning to them, the drunk drivers always drive alone especially during late night with situation unconsciousness and they loss their rationalism & drunk driver itself chooses not to follow any safety. A common example of supervised blood alcohol concentration test occur when a police officer administers test a subject of operating motor vehicle under the influence of alcohol [14].So, a systematic and effective approach in effort to prevent alcohol impaired driving is definite necessity [15].

Based on the above statements of problems, we are interested to design and implement alcohol detection system in the vehicle to avoid car accidents from Adama City Administration Roads, moreover implement to all country of Ethiopia.

1.3. Project Objectives

1.3.1. General objective

The general objective of this project is to design and development of breath alcohol detection system with the featuersofwarningdriverandengineignitionlockingforperventingvehicleaccidents.

1.3.2. Specific objectives

The specific objectives for this project are:

- To Prepare a circuit layout of alcohol detection system with required features
- To produce a program coding and embed in PIC microcontroller
- To construct a prototype
- To Test the prototype for its functionality

1.4. Project scope

There are many parameters which may cause vehicle collisions. But this project delimited only to minimize collisions by avoiding the drunken drivers from driving.

The project scope is essential in insuring the project to conduct within its intended boundaries and remains in the right directions to achieve its objectives.

The intended boundaries of this project are:

- Development of hardware
- Development of software,
- Disabling ignition system.
- Construction of small casing for mounting developed alcohol detection system.
- It can be used or placed in any vehicle and easy to use.

1.5. Significance of project

This project has been aimed to solve the drink and drive related traffic causes in today's society. The main purpose of designing the system is to develop an efficient and reliable alternative method in preventing excess alcohol consumers from driving vehicles on road. By allowing them operating their vehicle on the road, they are not only putting their life at jeopardy but other road user's safety as well. Obviously, development of a safety system is vital. This detection system is efficient and offers reliability. If calibrated correctly, it can produce accurate measurement with very little errors. Its production cost is also minimal as the components used are relatively cheaper and mostly always available in the market.

The imbedded significances:

1. To prevent accidents due to drunk and driving.
2. Easy and efficient to test the alcohol content in the body.
3. Quick and accurate results.
4. Helpful for police and provides an automatic safety systems for cars and other vehicles as well.

1.6. Application

1. Alcohol Detector project can be used in the various vehicles for detecting whether the driver has consumed alcohol or not.
2. This project can also be used in various companies or organization to detect alcohol consumption of employee's i.e. Domestic gas leakage detector, Industrial Combustible gas detector and Portable gas detector.

1.7. Agreement

Government regulations are important in ensuring that vehicles meet a minimum standard of safety. However, there are many other ways in which vehicle safety can be advanced outside of the regulatory framework.

1.8. Limitations of the study

Since as it is a new technology to our country, very few studies (almost no) had conducted by Ethiopian scholars concerning the field (drunk driving alcohol detection system using microcontroller), getting information is very hard. Moreover, electronic components required for the project are not easily accessible so that we had to find alternatives; in the course of finding the best alternatives we have faced considerable time and financial constraints.

1.9. Organization of the Study

This project consists of five chapters. The first chapter is an introduction part and discusses about the overview of project, statements of the problem and its magnitude, objective of the research-general and specific objectives, significance of the study, scope of the project, and limitation of the study. Chapter two refers the review of related literature and it contains a detailed description of vehicle accident system. It explains about the concept of semiconductor model system, Blood Alcohol Concentration (BAC) and alcohol detection system the application of this system and the involved components in this project. Chapter three includes the project methods and materials and it explains how the project is organized and the flow of process in completing this project. Also this topic discusses the methods of the system, circuit design, hardware and software design Chapter four is about findings and analysis and it contains detailed description about hardware development. It explains more detail about the electronic component that had been used and the method used to develop hardware. This chapter includes the software method of model and simulation. This project was discussed more about the software that had been used to design programming for the whole project and the software that had been used to design a Printed Circuit Board (PCB). Chapter five consists of more about the result and discussion and shows the result of the project step by step. This chapter also describes about summary, conclusions and recommendations. It summarizes and concludes the whole project and gives future recommendations to make the project perfect and improve its quality. Finally, references of the sources cited in the project and appendices containing any other relevant material used for the study and sample of the programming codes are attached at the end of the paper.

2. LITERATURE REVIEW

2.1. General Overview

In recent years, there a lot of inventions have been created to detect the alcohol in person blood stream. In this chapter will be discussed in detail about the hardware development and explains about the sensing system and the output system of the project. It also touches about the software that will be used for the programmed, which were PIC microcontroller. Beside that there were a couple of past related works presented contain useful information about the development of breathalyzer will be discussed.

This system detects the content of alcohol in the breath and it attempts to clamp down alcoholics. This system uses PIC16F877A, LCD display, MQ-3 gas sensor, relay and buzzer. The output of the sensor is directly proportional to the content of alcohol consumed. Now days alcohol sensor play a significant role in our society and it has vast applications. This type of sensors in cars is a great safety factor which can be embedded in the steering of the cars. When the driver starts the ignition, sensor measures the content of the alcohol in his breath and automatically switches off the car which will stop the drink driving offenders. Thus we can reduce alcohol related road accidents and hence these kinds of detectors have a great relevance. It can also be used in schools, colleges, offices and some public places such as hospitals, libraries etc. [26].

2.2. Review on previous work

The breath alcohol detector in current market, which is require a blowing through a mouthpiece, usually have some limitation because of requirement of mouthpiece and requirement of a long hard blowing from more than five second. Mouthpiece in alcohol detector is to prevent the expiration being diluted with ambient air and to make the expiration certainly reach detector and five second blowing is to get an exhaled air sample deep from the alveolar air and lung, which is needed for accurate estimation of BAC [16]. Figure 2.1 show the schematic design of breath alcohol detector with suction fan that consist of an electric suction fan, an alcohol sensor and oxygen sensor mounted in the cubical metal case that has air in the tunnel. Driver's breath sample is captured by suction fan and alcohol sample will reach the sensors through air tunnel by an electric suction fan [16].

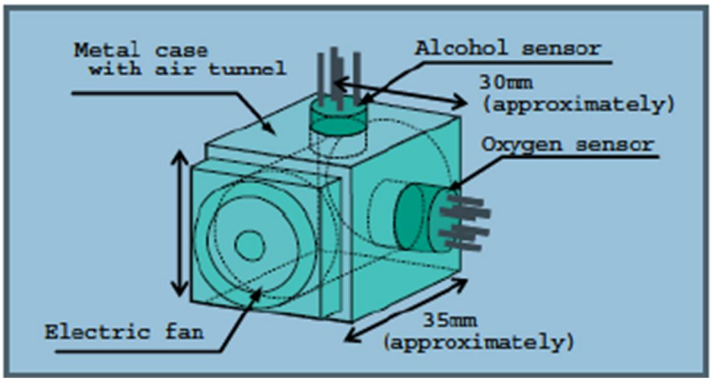

Figure 2:1 Schematic design of breath alcohol detector

2.2.1. Breath alcohol detector model

Basically there are four type of breath alcohol sensor which is semiconductor model, fuel cell model, infrared ray (IR) spectroscopy model and gas chromatography model. These models are used to detect alcohol concentration and produce the output to reader.

2.2.1.1. Semiconductor model

The semiconductor model consist of three major components, which are the breath sampler, glass vials containing chemical mixtures of sulfuric acid, potassium dichromate, silver nitrate and water and photocell to convert the color change due to chemical reaction into electrical pulses. These electrical pulses are fed into a microcontroller and the corresponding BAC value is calculated. The process is based on the chemistry of alcohol. Alcohol functional group consists of one oxygen and hydrogen atom. Basically, this is what makes a compound has alcoholic property [9].

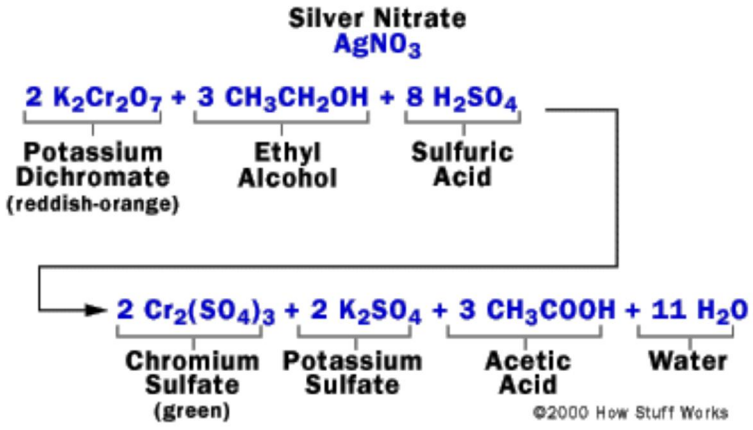

Figure 2:2 Chemical Reaction Process in Semiconductor

These models have the main advantage of being relatively inexpensive compared to other. Many semiconductor models are available and their use has increased rapidly. They have always been the tester of choice in law enforcement because of their reliability and non-invasive tool of forensic alcohol analysis [9].

2.2.1.2. Fuel Cell

The chemical reaction that takes place in an alcohol fuel cell converts alcohol to acetic acid and conversion produces fixed number free electrons per molecule of alcohol. This reaction takes place on the upper surface of the fuel cell. H+ ions are freed in the process, and migrate to the lower surface of the cell, where they combine with atmospheric oxygen to form water, consuming one electron per H+ ion in the process. Thus, the upper surface has an excess of electrons, and the lower surface has a corresponding deficiency of electrons. If two surfaces connected electrically, a current flows through this external circuit to neutralize the charge. This current is a direct indication of the amount of alcohol consumed by the fuel cell. By measuring the amount of current, the amount of alcohol in the sample can be determined [17].

This device is less stable and highly sensitive compared to semiconductor device. It will not function properly under wet conditions. Its response is also affected by temperature and humidity. Hence, margin of error is always present. Regular calibration check against standards is essential.

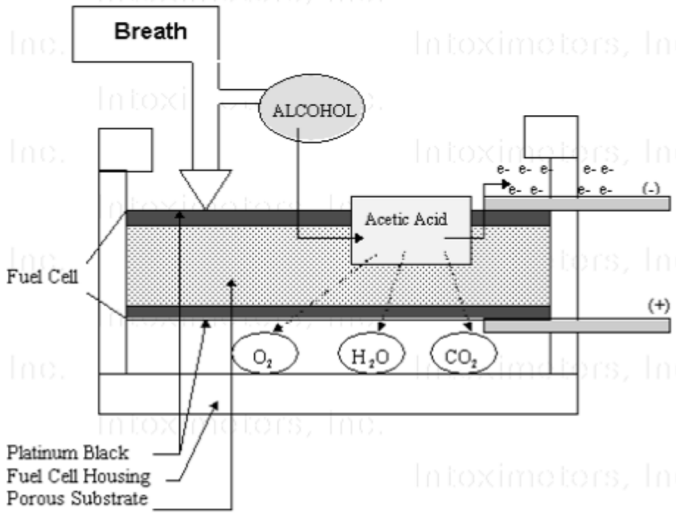

Figure 2:3 Chemical Reaction Process in Fuel cell

2.2.1.3. Infrared Spectroscopy Model

This device uses Infrared ray (IR) spectroscopy. Molecule bonds of alcohol compound are identified by the way they absorbs IR light. Each bond absorbs the IR light at different wavelength, which identifies the type of substance detected and the amount of absorption determines amount of alcohol present. There are four main components inside an Intoxialyzer, which are quartz lamp as the IR source, sample chamber, filter wheel and photocell. The quartz lamp produces IR beam of varying wavelengths. This beam passes the sample chamber to filter wheel. Light passing through the filter wheel gap will be detected by photocell, which then converts it to electrical pulses. These pulses are fed into a microprocessor that calculates the corresponding BAC output. This model is has a major flaw. There is possibility of mistaken identification of all compounds that contains methyl group as ethyl group [9].

One disadvantage of IR technology is the high cost of achieving specificity and accuracy at low breath alcohol concentration levels. The IR detector's output is nonlinear with respect to alcohol concentration and must be corrected by measurement circuits. Because of IR technology's expense, mechanical components, and other limitations, breath alcohol instrumentation manufacturers began a search for an alternative. One technology, electrochemical cells, also known as fuel cells, seemed to offer significant advantages [17].

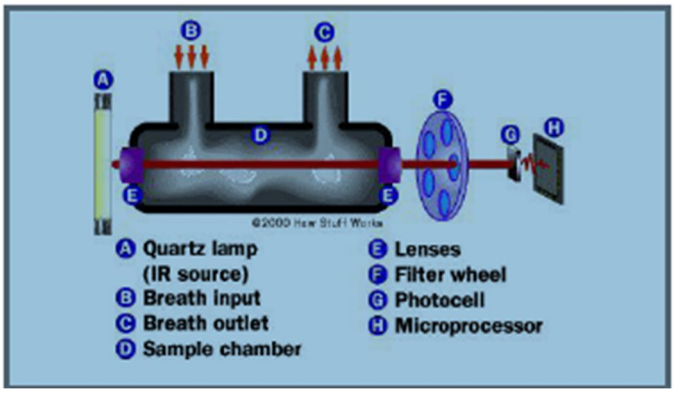

Figure 2:4 Detecting Process in Intoxialyzer

2.2.1.4. Gas Chromatography Model

This model is mainly based on chromatographic separation principle. Alcohol Peak is detected and its intensity is determined.

2.2.2. Alcohol compound

Alcohol is defined as any of a class of organic compounds characterized by one or more hydroxyl (−OH) groups attached to a carbon atom of an alkyl group (hydrocarbon chain). Alcohols may be considered as organic derivatives of water (H2O) in which one of the hydrogen atoms has been replaced by an alkyl group, typically represented by R in organic structures. For example, in ethanol (or ethyl alcohol) the alkyl group is the ethyl group, −CH2CH3 [18].

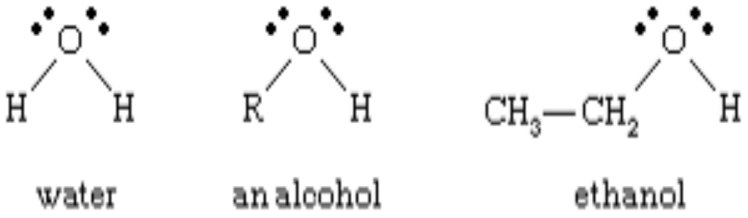

Figure 2:5 Molecular Structure of Alcohol compound

2.2.3. Alcohol in breath

Alcohol is volatile and as a result, an amount of alcohol which is proportion to the concentration in the blood, transfers from the blood into the alveolar air sacs in the lungs. This also happens when carbon dioxide leaves the alveolar blood and enters the lungs for exhalation from the body. So, it is possible to analyze an alveolar breath sample, breath alcohol concentration (BAC) can determine and high degree of accuracy can be predict, the blood alcohol concentration at that same point in time [18].

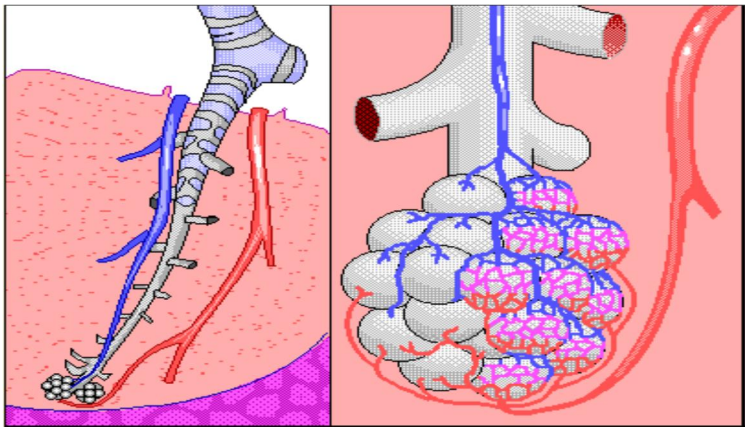

Figure 2:6 Alcohol Concentration in the Lung

2.2.4. Blood alcohol concentration

Blood alcohol concentration (BAC) is defined to be percentage of alcohol in gram per 100mL of blood. It indicates degree of intoxication. Therefore, 0.08% BAC is equivalent to 80mg of alcohol in 100mL of blood. The alcohol sensor has been detected the amount of alcohol in atmosphere, not in blood. Hence, correlation between breath and blood is needed and the scientifically agreed ratio is 2100:1, provided with deep lung breath sample produced. Different BAC level affects human differently. The amount of alcohol BAC considered to be legally impaired varies according to country. In Malaysia, the legal limit of BAC is 0.08% [4]. There are also countries that preferred a legal BAC limit of 0%, which means once alcohol is detected, the person is considered drunk. Each breathalyzer device is individually pre-calibrated. Hence, the calibration method is independent of breathalyzer models used [19].

BAC refers to the amount of alcohol contained in a person's blood. It is measured as weight per unit of volume. Typically this measurement was converted to a percentage such as 0.06%, which indicates that one-six of a percent of a person's blood is alcohol. Because alcohol in the blood travels directly to the brain, cognitive functioning is affected and increased risk of many kinds of injuries. Most significant among these was the risk of a motor vehicle accident when a person drives with too great a concentration of alcohol in his or her system [20].

Impairment from alcohol poisoning was originally defined by blood alcohol levels. It was observed that most people showed measurable mental impairment at around 0.05% blood alcohol concentration. Above this level it has been found that motor functions deteriorate progressively

with increased blood alcohol concentrations. Average person unconsciousness results by 0.4% BAC. Above 0.5% basic body functions such as the breathing or the beating action of the heart can be depressed to the point that death can occur [19].Research on the effects of alcohol has found that many important cognitive functions involved in driving are at least somewhat degraded in many individuals at BACs as low as 0.04%. Although it is not known how much any of these functions used to driving, other evidence obtained from carefully designed, case control studies of drivers involved in crashes indicates that at BACs above 0.08% and the risk of a crash begins to increase sharply [20].

Figure 2.2 below shows how the risk of causing a traffic crash is related to a driver's BAC.

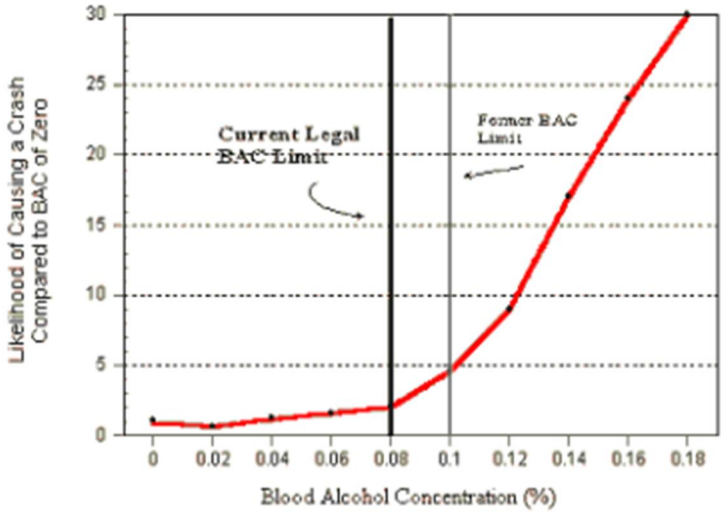

Figure 2:7 Effect of likelihood of causing a accident

2.3. Breathalyzer enabled Ignition Switch System

A breath alcohol ignition interlock device (BAIID) is a mechanism which is installed in a vehicle's dashboard. Before the vehicle can be started, the driver must breathe into the device. If the analyzed result is over a programmed predetermined blood alcohol concentration, the vehicle will not start. These devices keep a record of the activity on the device and the interlocked vehicle's electrical system. Authorities may require periodic review of the log. If violations are detected, then additional sanctions will be implemented. In order maintain its measuring efficiency and accuracy, periodic calibration is needed. This process is performed using either a

pressurized alcohol/gas mixture at a known alcohol concentration, or with an alcohol wet bath arrangement that contains known alcohol solution. In some countries, it is mandatory that one needs to install this device if convicted of drunk driving. In the United States for an instant, the court will impose an ignition interlock device requirement for up to a maximum of three years if the legal alcohol limit allowed for driving is exceeded. Modern ignition interlock devices use an ethanol-specific fuel cell for a sensor. A fuel cell sensor is an electrochemical device in which alcohol undergoes a chemical oxidation reaction at a catalytic electrode surface (platinum) to generate an electrical current. This current is then measured and converted to an alcohol equivalent reading. Basically, a typical block diagram of an IID device operation is shown in the diagram given [27].

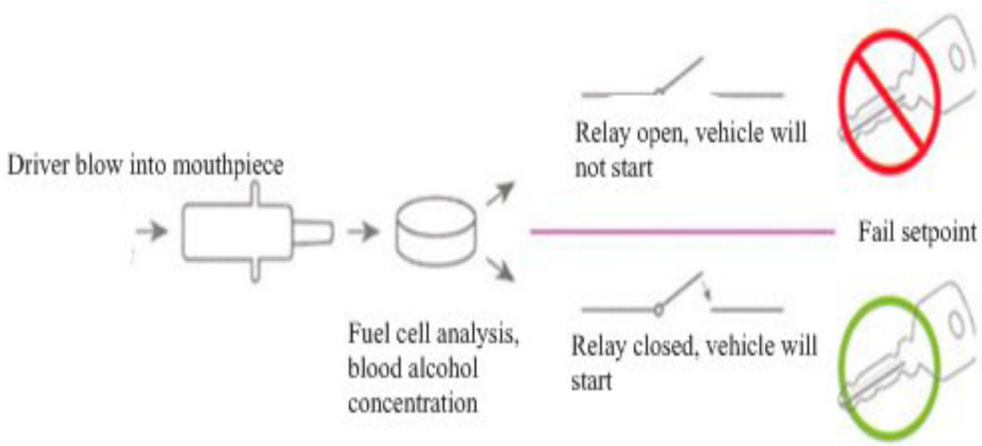

Figure 2:8 Block diagram of IID device operation

2.4. Alcohol Detection System

An alcohol detection system is used to measure the alcohol content present in a body. High alcohol levels lead to a decrease in breathing, which will be made drunk drivers prone to accidents. The amount of alcohol in the blood is called the blood alcohol level. Alcohol level is measured with a MQ-3 gas detecting sensor and the data is transmitted to the controller. The system is designed to shut down the ignition system if the detected value is higher than limit value.

In recent years, there are a lot of inventions have been created to detect the alcohol in person bloodstream. In most countries 0.08 grams of alcohol per 100 ml of blood is set as the legal limit. Blood alcohol levels will be evaluated by using the Breathalyzer [11].

There are lots of cause of accident of car and they are drunkenness of driver, drowsiness of driver, unconsciousness of driver and many time what happen driver was not responsible for accident but their neighboring car behavior have made role to enforce accident. There are some system have been implemented to avoid accident but that do not give proper solution to implement in car to avoid various accidents that they are normally being happen. For example when driver at speed suppose 80 km/h suddenly stop ignition system may lead to chances of dangerous accident. In [21], they had use PIC 16F877A controller, Alcohol sensor, LCD Display and alarm system to notify driver only and ignition system was after some second off when detected alcohol.

Blood Alcohol Content (BAC) is usually expressed as a percentage of alcohol in the blood. High BAC of the drunken driver has been affecting their behaviors likes' unconsciousness, emotional swings and anger or sadness. There is the research about Blood Alcohol Concentration (BAC) with 0.2mg/l and above (measured in mg of alcohol per 100ml of blood, or mg/l) the judgment, coordination and sensory perception are impaired, reaction time slows, performance in intellectual tests falls and eyesight is weakened [22].

If the amount of alcohol consumed is small, the amount could verify. Generally PIC micro controller uses 5V of electricity to process a detected value that is less than the limit value and a signal sent to the relay switch. The relay circuit converts 5V into 230V, which makes the switch turn off. When this happens the DC motor of the vehicle turns on. If the driver consumes a lot of alcohol not happy, the supplied value not enough to turn on the controller and the relay switch. The ignition of the vehicle and DC motor is not activated. An alarm goes off to inform the authorities. This system checks drivers for alcohol consumption and prevents drunk drivers from committing crashes or accidents. Devices for the determination of breath alcohol concentration (BAC) are commercially available for screening and evidential purposes, and alcohol interlocks are being increasingly used [26].

Alcohol detection system includes hardware and software. The major components for alcohol detection system are the following.

2.6.1. Alcohol sensor

The alcohol sensor is used to analyze breath to determine alcohol consumption. Here the transmitted analog signal converted into digital and transmitted to the microcontroller circuit. The alcohol sensor has been detected the alcohol content depending on drunk driver breath in air and the signal has been send data to PIC16F877A as a controller to other circuits. The result of alcohol content in human breath that has been detected from alcohol sensor displayed on the LCD 16 x 2 displays.

Based on the four type of alcohol model of sensor, a semiconductor alcohol sensor was chosen and used due to its sensitivity in detection of small value of BAC, the availability, sensitivity, portability and ease of calibration process. However there are many manufacturers produce the alcohol sensor type semiconductor. The analysis and observation was done to select appropriate alcohol sensor for the system. The alcohol sensors are MQ-3 alcohol sensor, TGS2620 gas sensor and MiCS-5521 sensor. But in this project was used MQ-3 alcohol sensor. The MQ-3 alcohol sensor manufacture by Hanwei Electronic Co. Ltd. It has high sensitivity to alcohol and very small sensitivity on other substances such as benzene and carbon monoxide. It is very fast response, long life span and stable. Besides, it offers very simple drive circuit which will makes connection to microcontroller less complex [23].

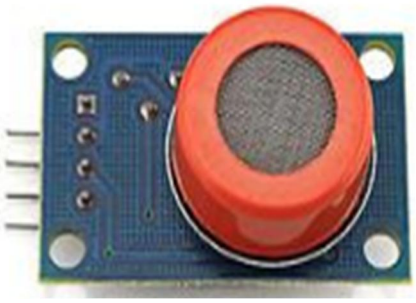

Figure 2:9 Photo of a MQ-3 Alcohol Sensor

2.6.2. Microcontroller

PIC stands for Peripheral Interface Controller given by Microchip technology to identify its single chip microcontrollers. These devices have been very successful in 8-bit microcontrollers. The main reason is that Microchip Technology has continuously upgraded the device architecture and added needed peripherals to the microcontroller to suit. A microcontroller is a small computer on a single integrated circuit containing a processor core, memory and

programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM are included on chip. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

Microcontrollers are used in automatically controlled products and devices such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Microcontroller programmed to measure the processed value against predefined limit values that is divided into: low, medium and high. If the detected value is higher than the limit value a signal sent to set the alarm inside the vehicle.

Selection of Microcontroller

As we know that there are so many types of micro controller families that are available in the market.

These are:

- 8051 Family
- AVR microcontroller Family
- PIC microcontroller Family
- ARM Family

Basic PIC family is the best controller and easily available in the market with low cost as well as easily interfaced with programmed. Due to these basic reasons, PIC16F877A controller has been selected inbuilt ISP (in system programmer) option.

There are minimum six requirements for proper operation of microcontroller.

Those are:

1. Power supply section
2. pull-ups for ports (it is must for PORT0)
3. Reset circuit
4. Crystal circuit

5. ISP circuit (for program dumping)
6. EA/VPP pin is connected to V_{CC}.

PORT0 is open collector that's why we are using pull-up resistor which makes PORT0 as an I/O port. Reset circuit is used to reset the microcontroller. Crystal circuit is used for the microcontroller for timing pluses.

Figure 2: 10 Photo of a PIC16F877A Microcontroller

The PIC16F877A`s internal block diagram is shown in Figure 2.11. PIC contains an ALU which is to do logic operations and the RAM which is called the register file, the program EEPROM (Flash Memory), the data EEPROM and the W register. The W register is not a part of the register file but a standalone that working as register and sometimes called as accumulator. The ALU, the RAM, the W register and the data EEPROM each manipulate and hold 8-bit-wide data which ranges in value from zero to 255 (hex =0x00 to 0xFF). The program EEPROM (Flash Memory) works with 14-bit-wide words and contains each of the user's instructions.

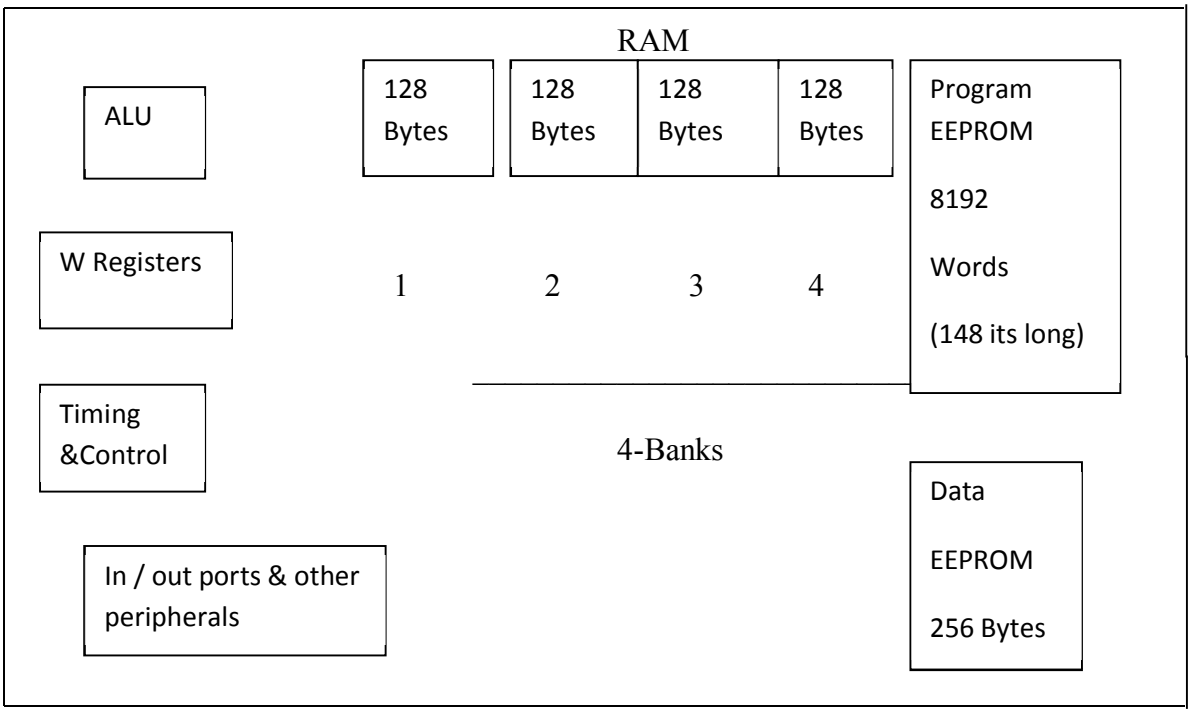

Figure 2:11 Internal Block Diagram of PIC16F877A Microcontroller

Microcontrollers usually have different sizes of memory data and program memory (in the PIC: 8-bits for data and 14-bits for program words). Besides that, the key is that the data and program memories occupy separate spaces allows access to each at the same time. The PICRAM addresses range from zero to 511 but the user can only access a RAM byte in a set of four banks of 128 bytes each and only one bank at a time. Not all RAM is available to the user as read write memory. However, many addresses are assigned to special functions within the processor but they look like RAM and are accessed the same way.

Table 2.1 show below the PIC16F877A feature

Table 2:1 PIC16f877 A feature

Parameter name	Value
Program memory type	Flash program
Program Memory size(Kbytes)	14
RAM (bytes)	368
Data EEPROM(bytes)	256
I/O	33

PIC16F877A pin Layout

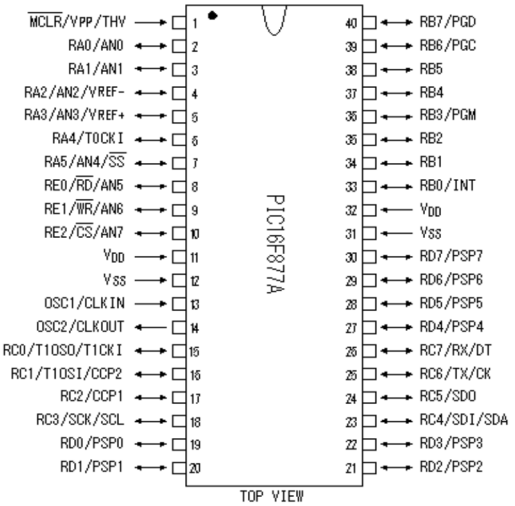

Figure 2:12 Labeled Pin Out Array of PIC16F877A

I/O Pins

There are 40 pins on PIC 16F877A. Most of them can be used as an I/O pin. Others are for specific functions.

VSS and VDD

These are power supply pins .VDD is the positive supply and VSS is the negative supply or 0V.The maximum supply voltage that you can use is 6V and the minimum is 2V.

2.6.3. Liquid Crystal Display

Liquid crystal display (LCD) is a display unit that has the ability to display numbers, letters, words and all manners of symbols. Its features make it a good deal more versatile than a familiar 7-segment light emitting diode (LED) displays. Although it is more expensive than an ordinary seven segment decoders, but it has significant advantages compared other cheaper display units when applied in sophisticated electronic display projects. LCD comes in a variety of sizes and shapes. Line lengths of 8, 16,20,24,32 and 40 characters are all standard in one, two and four line versions. Two types of connections can be done to a microcontroller unit either in series or in parallel. Connections in series require additional components to interface a microcontroller to the display unit. Most of the LCDs need a supply voltage of about 5V to operate. Some of them also have backlights so that they can be viewed in dimly-light conditions. Major features of LCD are its light weight construction, its portability, and its ability to be produced in much larger screen sizes than are practical for the construction of cathode ray tube (CRT) display technology. Its lower electrical power consumption enables it to be used in battery powered electronic equipment.

Table 2:2 The Pin Function of the LCD Pannel

Pin No.	Name	Function
1	VSS	Ground
2	VDD	Positive supply
3	VEE	Contrast
4	RS	Register select
5	R/W	Read/Wright
6	E	Enable
7	D0	Data bit 0
8	D1	Data bit 1
9	D2	Data bit 2
10	D3	Data bit 3
11	D4	Data bit 4
12	D5	Data bit 5
13	D6	Data bit 6
14	D7	Data bit 7

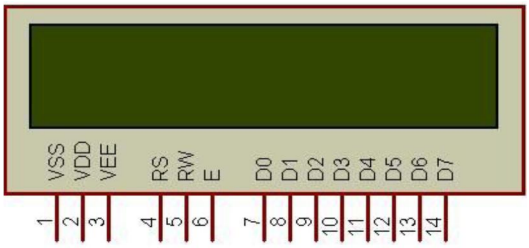

Figure 2:13 The Pin Out Array of the Model LCD Pannel

Note: Pin no.15 and 16 is for back light power supply Pin out view

In this project, the output of blood alcohol concentration (BAC) has been displayed at LCD panel. This is better choice of displaying the output rather using the LED as the output. LCD output will provide the fast and correct reading and avoid human error while read the output. The input of this LCD has been connected to the microcontroller that has been produced the reading and displaying to LCD after do some logical operation.

Table 2:3 Parameters of the JHD162A LCD Pannel

Parameter	Symbol	Testing Criteria	Standard Values			Unit
			Min	Typ.	Max	
Supply voltage	VDD-VSS	-	4.5	5.0	5.5	V
Input high voltage	VIH	-	2.2	-	VDD	V
Input low voltage	VIL	-	-0.3		0.6	V
Output high voltage	VOH	IOH=0.2mA	2.4	-	-	V
Output low voltage	VOL	IOL=1.2Ma	-	-	0.4	V
Operating voltage	IDD	VDD=5.0V	-	1.5	3.0	Ma

Figure 2:14 Photo of the JHD162A LCD Pannel

2. 6. 4. Ignition system

The main purpose of the ignition system circuit is to produce a spark at spark plugs. So it will be enabling or disable vehicles engine. Basically ignition system requires a supply, ignition switch and ignition coil. The minimum supply voltage is 12V alternating current (AC). The AC power supply helps the ignition coil to produce high voltages to the pulse of spark plugs. In vehicle accident prevention system, the ignition system is connected with the high voltage inverter to enable or disable the engines ignition starter. The relay on this circuit is normally closed and will set to normally open when the alcohol sensor detected the drunkenness level. As a result of this condition the spark plug could not produce the spark or in the real condition hence the car's engine could not start.

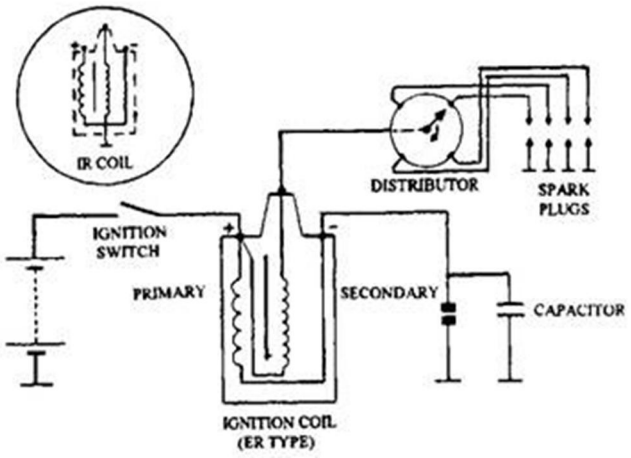

Figure 2:15 Electric Circuit Diagram of the Ignition system

2.6.5. Power supply and voltage regulator

Output power supply unit dc is given to the controller, input and output system. The primary purpose of the regulator is to rectifier and filter circuit in providing a constant dc voltage to the device. Power supplies without regulators have an inherent problem of changing dc voltage values due to variations in the load or fluctuations in the input voltage [24].

2.6.6. Buzzer

A buzzer is an audio signaling device which may be mechanical, electromechanical or piezoelectric. Typical uses of buzzer include alarm devices; timers and confirmation of user input such as a mouse click [25].

Figure 2:16 Photo of the buzzer

2.6.7. DC MOTOR

It is used as a dummy for indicating the engine locking facility whenever alcohol is detected. Geared motors are complete motive force systems consisting of an electric motor and reduction

gear train integrated into one easy to mount and configure package. This greatly reduces the complexity, cost of designing and constructing power tools, machines and appliances calling for high torque at relatively low shaft speed or RPM. Gear motors allow the use of economical low horsepower motors to provide great motive force at low speed such as in lifts, winches, medical tables, jacks and robotics. They can be large enough to lift a building or small enough to drive a tiny clock.

Figure 2:17 Photo of the Geared Electric Motor

2.6.8. Capacitor

A capacitor is a passive electronic component consisting of a pair of conductors separated by a dielectric. When there is a potential difference across the conductors a static electric field develops in the dielectric that stores energy and produces a mechanical force between the conductors.

Capacitor is characterized by a single constant value capacitance and measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. In our project we are using 470F capacitor. Capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass in filter networks, for smoothing the output of power supply, in the resonant circuits that tune radios to particular frequencies and for many other purposes.

The effect is greatest when there is a narrow separation between large areas of conductor. Hence capacitor conductors are often called plates referring to an early means of construction. In practice the dielectric between the plates passes a small amount of leakage current and an electric field strength limit, resulting in a breakdown voltage, the conductors and leads introduce an undesired inductance and resistance2.6.9. Relays

Relay is a common simple, application of electromagnetism. It uses an electromagnet meet from an iron rod bound with hundreds of fine copper wires. When electricity is applied to the wire, the rod becomes magnetic. A movable contact arm above the rod is then pulled towards the rod until it closes a switch contact. When the electricity is removed, a small spring pulls the contact arm away from the rod until it closes the second switch contact. By means of relay, a current circuit can be broken or closed in one circuit as a result of a current in another circuit. Relays have several poles and contact. The types of contacts could be normally open and normally closed. One closure of the relay can turn on the same normally open contacts; can turn off the other normally closed contacts. Relay requires a current through their coils, for which a voltage is applied. This voltage for a relay can be dc low voltages upto 24volt or could 240-volt ac.

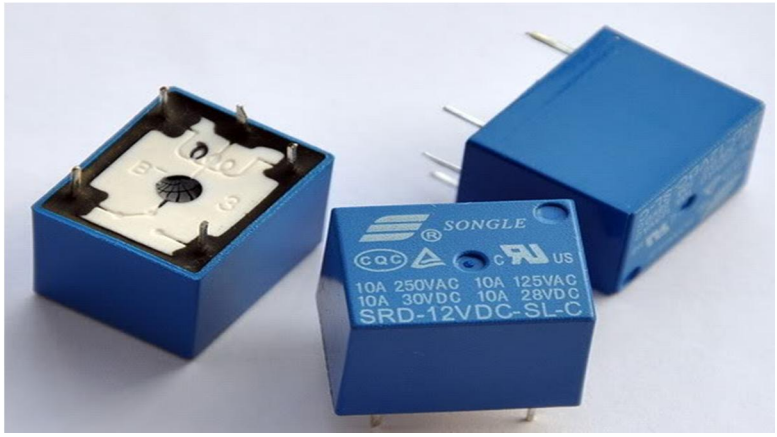

Figure 2:18 Photo of the Relays

Interfacing Relays: Fig. 14 shows how to interface the Relay to microcontroller. There are 2 input channels. Each input is connected to the triggering coil of the respective relay. There are 2 output channels that each correspond to an input. When the input is energized, the relay turns on and the '+' output is connected to +12v. When the relay is off, the '+' output is connected to Ground. The '-' output is permanently wired to Ground.

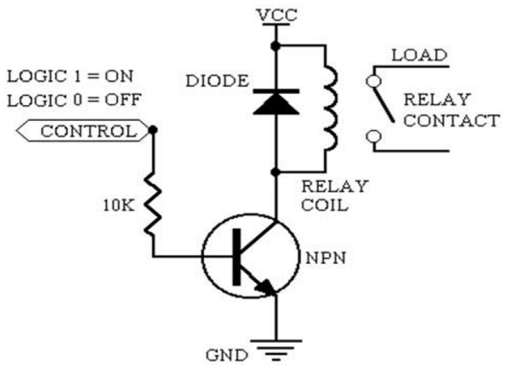

Figure 2: 19 Circuit Diagram of Interfacing buzzer to Microcontroller

2.6.10. Transistor

Transistor applications: As a switch and amplifier.

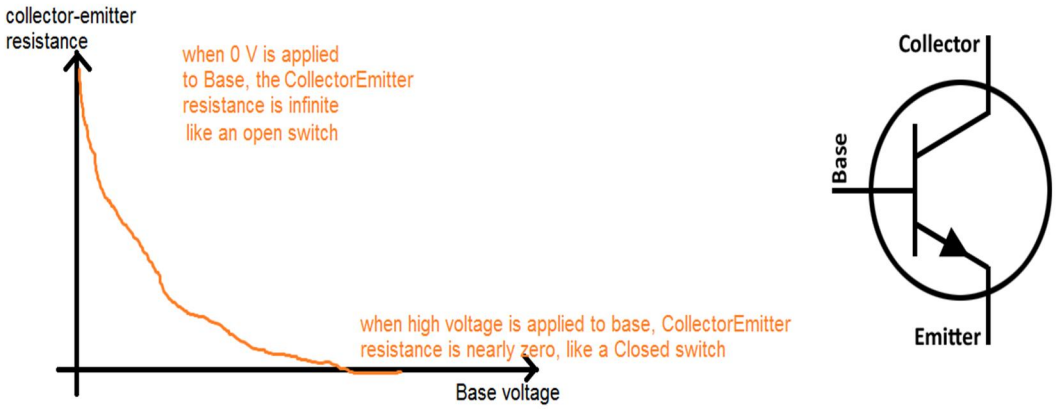

Figure 2:20 The Model Transistor and Its Performance Curve

2.6.11.11 Development of Control Software

Software development as a general to develop embedded software required to be integrated and controlled with the hardware development. Software development is an activity on the computer programming required to construct a circuit as a simulation before doing a fabrication to construct a real physical hardware development.

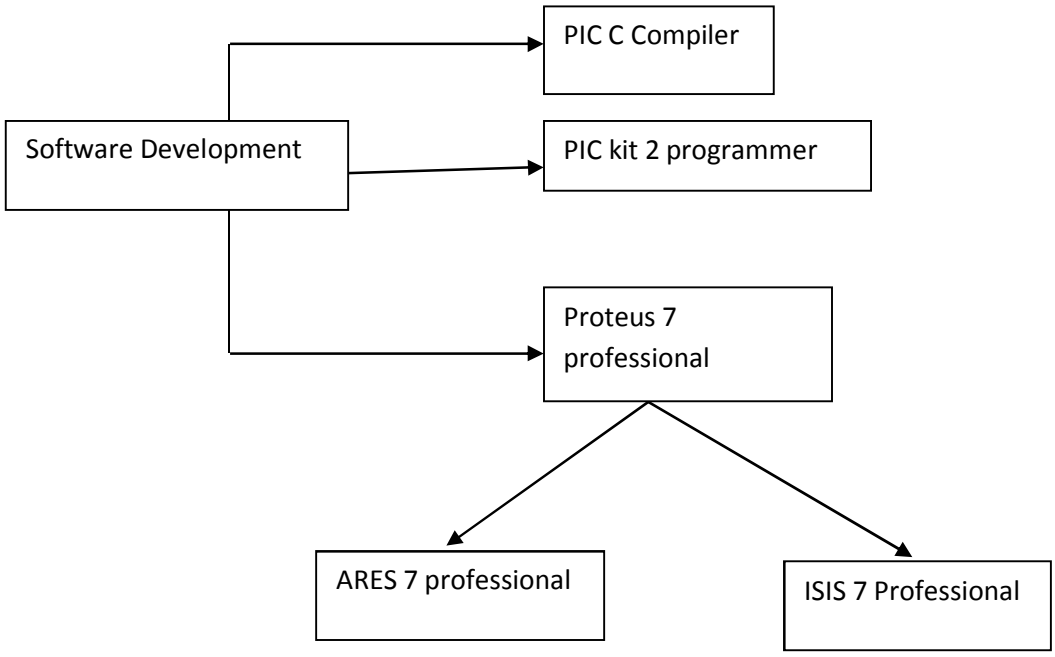

Figure 2:21 Software Development

PIC C Compiler allowed user to create the desired instruction using C language. This software was produce hexadecimal data to be embedded in PIC 16F877A. The value of the output voltage is change based on the concentration of the alcohol detected. PIC 16F877A control the output system based on the changing voltage from the alcohol sensor. The C Compiler

The source code written in source file is the human readable source for our program. It needs to be "compiled", to turn into machine language so that our CPU can actually execute the program as per instructions given. This C programming language compiler will be used to compile our source code into final executable program.

Micro C: -MICRO C IDE has seven different parts through which we can make the projects. These are Code Editor, Code Explorer, Debugger, Error window, Statistics, Integrated tools, keyboard shortcuts.

Code Editor:-The Code Editor is an advanced text editor fashioned to satisfy the needs of professionals. General code editing is same as working with any standard text-editor, including familiar Copy, Paste, and Undo actions, common for Windows environment. Advanced editor

Features include: Adjustable Syntax Highlighting, Code Assistant, Parameter Assistant, Code Templates (Auto Complete), Auto Correct for common types, Bookmarks and Go to Line. Customize these options from the Editor Settings dialog. To access the settings, choose Tools > Options from the drop-down menu, or click the Tools icon.

Code Explorer:-The Code Explorer is placed to the left of the main window by default, and gives a clear view of every declared item in the source code. It is possible to jump to a declaration of any item by clicking it, or by clicking the Find Declaration icon. To expand or collapse tree view in Code Explorer, use the Collapse/Expand all icon. Also, two more tabs are available in Code Explorer. Q Help Tab lists all the available built-in and library functions, for a quick reference. Double-clicking a routine in Q Help Tab opens the relevant Help topic. Keyboard Tab lists all the available Collapse/Expand keyboard shortcuts in MICRO C.

Proteus 8.0 (ISIS) Professional

It is very famous software in electrical, electronics, computer and telecom engineering students for simulation of electrical, electronics and microcontrollers based circuits. Proteus is simulation software for electric circuits provided by Lab center electronics. Proteus provides three types of plat forms for simulation and designing of electric circuits. Main platform of Proteus is intelligent schematic input system (ISIS). ISIS is used for simulation of electrical, electronics, embedded system and microcontrollers based circuits. Proteus VSM is complete software to learn microcontrollers. Proteus 8.0 is a Virtual System Modeling (VSM) that combines circuit simulation, animated components and microprocessor models to co-simulate the complete microcontroller based designs. This is the perfect tool for engineers to test their microcontroller designs before constructing a physical prototype in real time. This program allows users to interact with the design using onscreen indicators and/or LED and LCD displays and, if attached to the PC, switches and buttons.

Procedures to work on Proteus 8.0 (ISIS) Professional windows

The Home Page is a new application module in Proteus 8 which makes it easy to get started with a project and also performs some system tasks The Start Panel on the screen control project opening and creation while the News Panel includes general information, integrated update manager and crash dump reporting.

Opening, Creating & Importing Projects

In Proteus 8, the relationship between Schematic Design and PCB Layout involves a shared database and is far more integrated. We therefore have a single project file rather than separate design and layout files. You can create a new project or import a legacy schematic/layout via the options on the home page.

Opening Projects

Existing projects can be opened via the button on the home page or, in the case of recent projects, directly from the recent projects list. Finally, you can browse and open our extensive sample design libraries via the Open Sample button at the right of the Start Panel.

Creating New Projects

This wizard guides you through the setup of your next Proteus 8 project. There is a start page in which you specify the project name and destination directory and then potentially three main screens for schematic, PCB and firmware.

Schematic

When we create a schematic we have to check the box at the top of the screen and then select the template on which we want to base the schematic. Those provided by Lab center basically contain different sizes of work area, although we can customize and save our own templates from within the schematic capture module.

PCB Layout

If we are creating a PCB we check the box at the top of the screen and select from the available templates. PCB templates contain pre-defined board edges; mounting holes and a full set of technology data (design rules, layers in use, default units, etc.) As with schematic, we can customize and save our own templates from within the PCB layout module.

Introduction to Micro C

MICRO C is a powerful, feature rich development tool for PIC micros. It is designed to provide the customer with the easiest possible solution for developing applications for embedded systems, without compromising performance or control. MICRO C provides a successful match featuring highly advanced IDE, ANSI compliant compiler, broad set of hardware libraries,

comprehensive documentation, and plenty of ready-to-run examples. PIC and C fit together well: PIC is the most popular 8-bit chip in the world, used in a wide variety of applications, and C, prized for its efficiency, is the natural choice for developing embedded systems. It develops applications quickly and easily with the world's most intuitive C compiler for PIC Microcontrollers (families PIC12, PIC16, and PIC18). Highly sophisticated IDE provides the power which is needed with the simplicity of a windows based point-and-click environment. With useful implemented tools, many practical code examples, broad set of built-in routines, and a comprehensive Help, MICRO C makes a fast and reliable tool.

Micro C allows developing and deploying complex applications:

- Write C source code using the highly advanced Code Editor.
- Use the included MICRO C libraries to dramatically speed up the development: data acquisition, memory, displays, conversions, and communications.
- Monitor program structure, variables, and functions in the Code Explorer.
- Generate commented, human-readable assembly, and standard HEX compatible with all programmers.
- Inspect program flow and debug executable logic with the integrated Debugger. Get detailed reports and graphs on code statistics, assembly listing, calling tree…

The C programming language

The C programming language is a general-purpose, at was originally developed by Dennis M. Ritchie to develop the UNIX operating system at Bell Labs. C was originally first implemented on the DEC PDP-11 computer in 1972. In 1978, Brian Kernighan and Dennis Ritchie produced the first publicly available description of C, now known as the K&R standard. The UNIX operating system, the C compiler, and essentially all UNIX applications programs have been written in C. The C has now become a widely used professional language for various reasons.

- Easy to learn
- Structured language
- It produces efficient programs.
- It can handle low-level activities.

- It can be compiled on a variety of computer platforms.

C was initially used for system development work, in particular the programs that make up the operating system. C was adopted as a system development language because it produces code that runs nearly as fast as code written in assembly language.

Some examples of the use of C might be:

- Operating Systems
- Language Compilers
- Assemblers
- Text Editors
- Print Spoolers
- Network Drivers
- Modern Programs
- Databases
- Language Interpreters

3. METHODS AND MATERIALS

3.1. Methods

The main sources of data for this project were primary and secondary data. More of project data collection methods were based on secondary data collection. However, as primary data we used as a chance observation and oral question at some where accidents occurred during our study. But this is not has so much acceptance, instead it is base for our motivation for study this problem and collecting secondary data. Secondary data was obtained from the Adama Traffic Police Department, and Ethiopian Federal Transport Agency. Moreover, different books, journals of World Health Organization (WHO) and World Bank, articles and reports publication were also conducted. Furthermore, so as to get a general picture of road safety problems specifically drunk driving detection, a good closure was made with internet web sites.

The overall method is on Figure 3.1 shows the basic flow of methods and approach for this project. The project began with research and planning. This is done in order to identify the suitable component needed for hardware implementation and circuits.

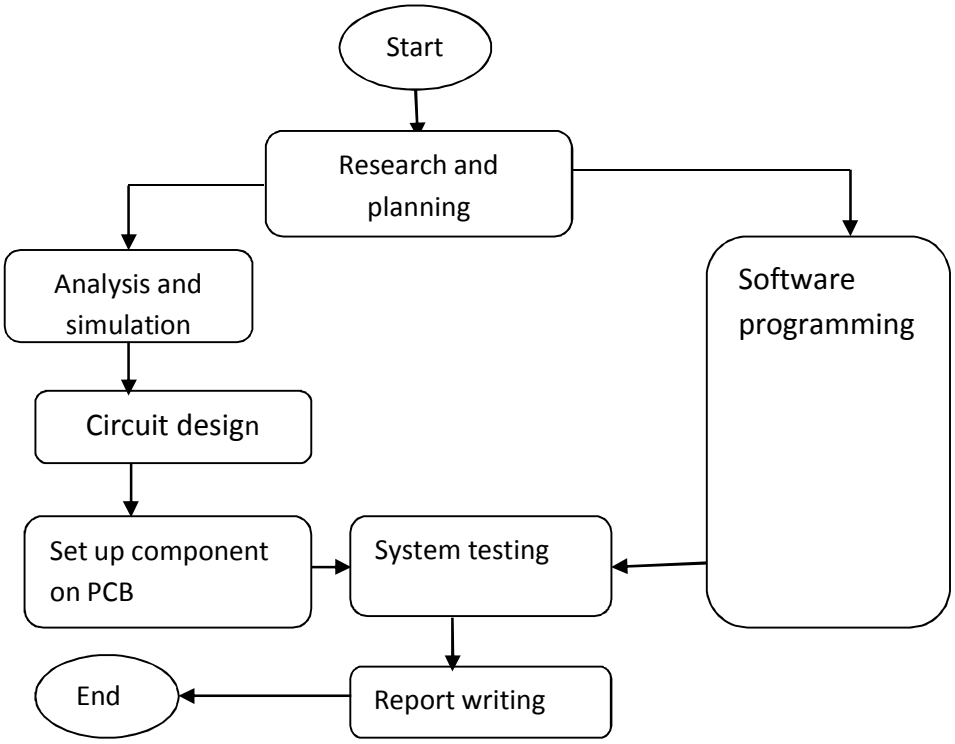

Figure 3:1 Process and Methodology of the project

3.2. Data Analysis

In order to systematically solve the problems, the quantitative research method was used in this study. This type of research method was used to generate the road accident statistics from the traffic police and part from the respondents.

The development was divided into three phase:

Phase1: Review, Data collection and Analysis

- Data was collected from different sources including general literature, website, international journals, different books, You Tubes and online information.

Phase2: Project design, model development and simulation.

- Based on the collected data and information the drunk driving detection and automatic engine locking system circuit was developed and simulation is carried out by using Proteus software and Micro C PRO compiler.

Phase3: Hardware development and test.

- Appropriate materials and components used for system were supplied.
- The model was designed on bridge board and tested for realization.
- The prototype of the project was carried out on PCB board.
- The constructed prototype was tested by using LCD, Buzzer, and relay switch.

3.3. Required Materials

3.3.1. Hardware Components

In hardware designing, different types of components have been selected according to their specifications and connected together to build the complete system. For this reason to development of the hardware design in this project, we have used the following basic components:-

1. Power supply(12v DC)
2. Alcohol sensor-MQ3
3. Microcontroller (PIC16F877A)
4. Buzzer 12VDC
5. Regulator-7805
6. Relay 12VDC ,5pins
7. Diode 1N4004
8. LED (Green & Red)
9. Transistors (NPN)
10. LCD 16x2
11. Ignition switch
12. Resistors(Metal film & potentiometer)
13. Capacitor22pF & 0.1µF(ceramic type),
14. Crystal 8MHz

3.3.2. Software Components

1. Proteus
2. Micro C PRO compiler

A detailed review of the components for the development of this system has been done in the theoretical study in the previous chapter. From the review, type of components needed for the hardware development has been identified. The table below shows the components needed.

The construction of this system consists of two parts which was hardware development and software development. Hardware development involved the designing the circuit of the project and setup on printed circuit board (PCB). While the software developments were focused on simulating the circuit before test to the real components and also designed code to be embedded in the hardware. After both parts have been completed, the testing and calibration have been taken place. The result for each experiment has been discussed and recorded. Each part of the project has been discussed in detailed in the following system block diagram section.

3.4. System Block Diagram

The block diagram below shows the interconnection of the hardware of this system.

Block diagram description

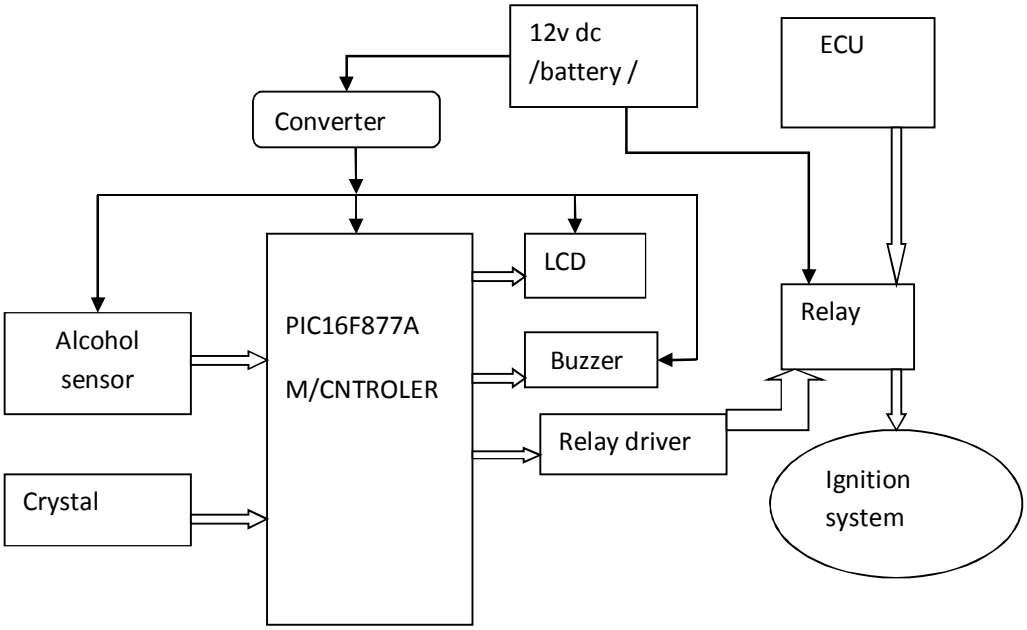

Figure 3:2 Block Diagram of the System Electric Circuitry

Based on the block diagram above the entire components are driven by DC power supply of 5V. If the supply is not 5V DC the voltage regulator needs to be installed to convert the supply of 5V DC and supply to the sensor circuit, PIC microcontroller, buzzer, LCD, but for relay circuit 12V. The heart of the system is the microcontroller. All the input and output has been connected to the microcontroller.

The flow of circuit began when the sensor detect blood alcohol concentration. Then the sensor drive circuit has been produced the output voltage due to the change in resistance of semiconductor. The higher alcohol substance detected, the lower resistance will be produced. Hence, the output voltage will be higher. This output voltage will be measured by the microcontroller. The calibration of the sensor need to be done before the value of BAC should be set with the corresponding output voltage of the sensor. The microcontroller will be performed some logical operation, calculate the output and determine the result.

The result has been displayed on the LCD panel in term of Blood Alcohol Concentration. At the same time, the microcontroller will be derived the buzzer and relay based on the result produced. If the results show the higher concentration (over 0.08 BAC) the LCD have been displays the message, the buzzer on and relay disable ignition circuit. Hence the LCD panel sows the subject was drunk driver.

3.5. System Flow Chart

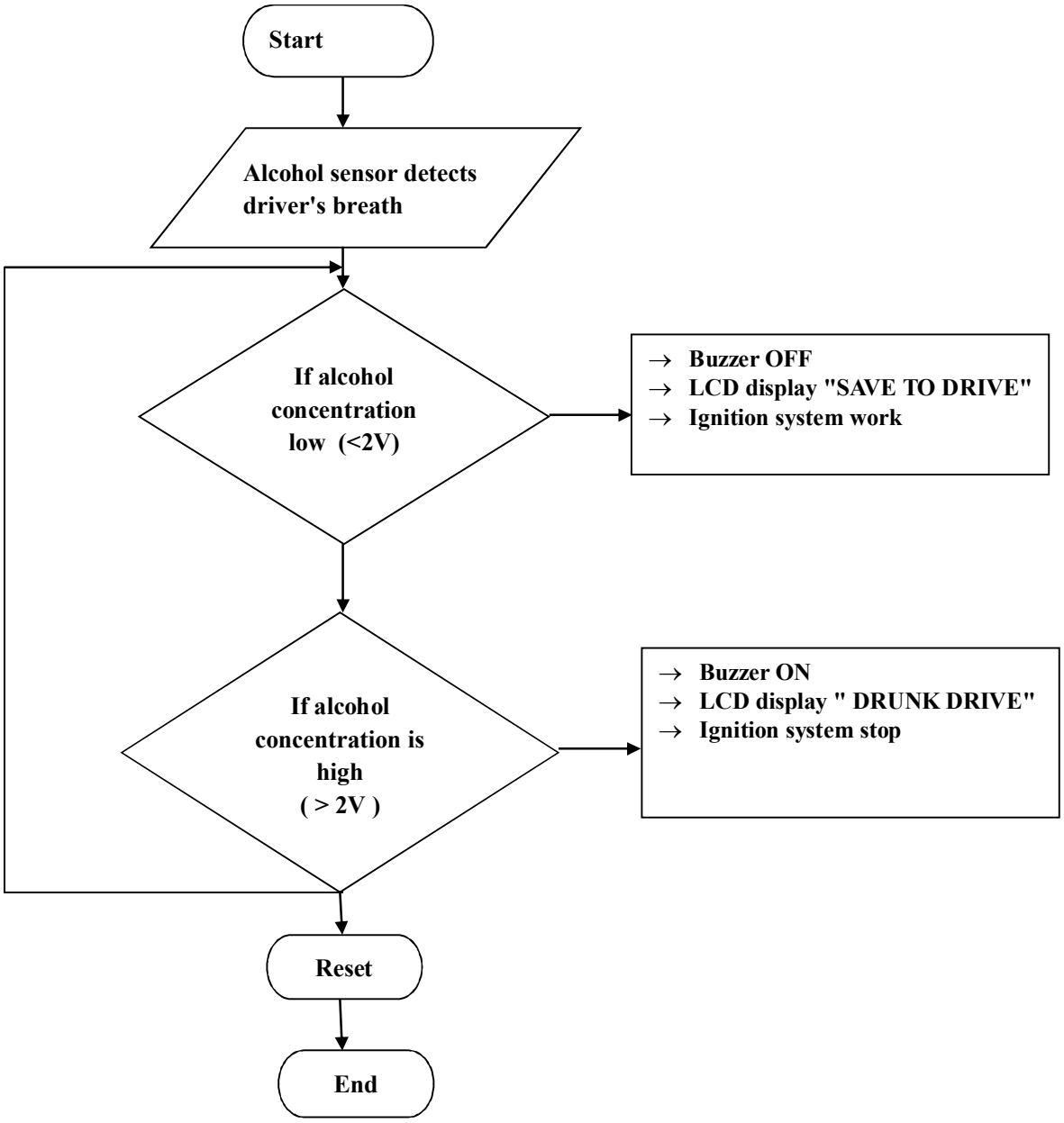

Figure 3:3 System flow chart

3.6. System description

3.6.1. LM7805 voltage regulator

The entire components in this system required supply of 5V to operate. Hence, a voltage regulator needs to be built to convert the supply to 5V. Figure 3.5 shows the schematic diagram of the voltage regulator. Voltage regulator usually having three legs converts varying input voltage and produces a constant regulated output voltage. They are available in a variety of outputs.

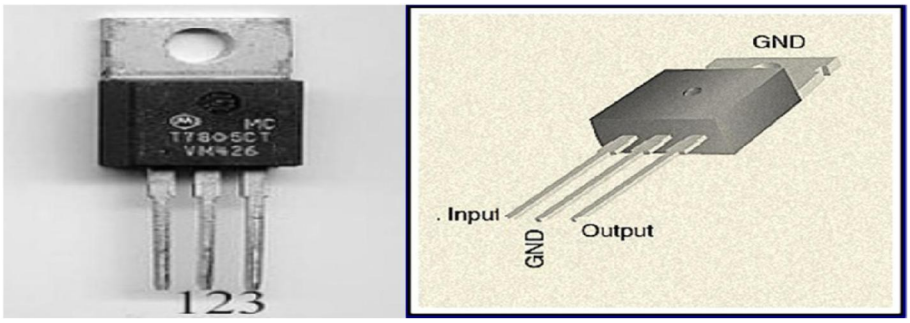

Figure 3:4 Photo of a Sample of the Voltage Regulator

Schematic circuit diagram of Voltage regulator

The schematic circuit below shows the design details of power supply from 9V DC power supply to the loads. The PIC16F877A requires a regulated 5 volt supply voltage to be initialized. For this case an LM 7805 voltage regulator is used. The circuit is shown in Figure3.5.

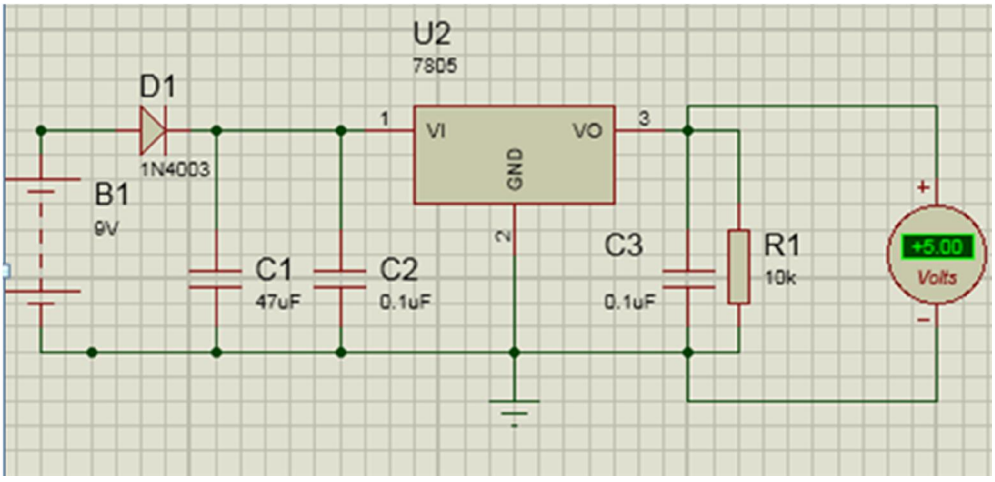

Figure 3:5 Electric Circuit Diagram of the Voltage Regulator

As mentioned above, the component has three legs: Input leg which should be hold up to 36VDC common leg (GND) and an output leg with the regulator's voltage. For maximum voltage regulation, added a capacitor in parallel between the common leg and the output was usually recommended. Typically 0.1μF capacitor is used. This eliminates any high frequency AC voltage that could otherwise combine with the output voltage. If the input voltage is unnecessarily high, the regulator will overheat. Unless sufficient heat dissipation is provided through heat sinking, the regulator will shut down [24]. The diode D2 is used to protect the circuit from wrong polarity of supply. The LED D1 is the indicator of the power status of the circuit. The resistor R1 connected to this LED protects it from over current.

3.6.2. Alcohol Detecting Sensor

In this project, MQ-3 type of alcohol sensor used which is making from Hanwei manufacturer. It is suitable in develops alcohol detection system because it has high sensitivity of alcohol, stable and long life span compared to the other models. As mention before, the semiconductor sensor act like potentiometer and produce the output based on change of resistance. However, the sensor cannot operate if it doesn't have driven circuit. The driver circuit needs in order to make the sensor operated and produced the output voltage. The driver circuit was shown in figure below.

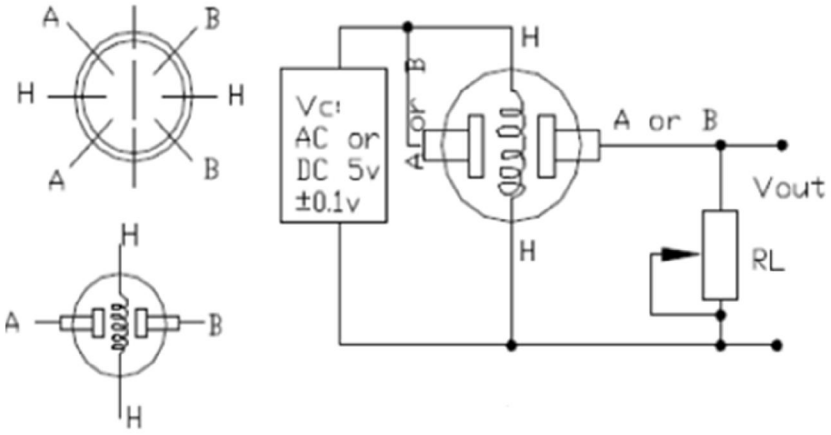

Figure 3:6 Electric Circuit Diagram of the MQ-3 Sensor

This sensor has different resistance values based on the various kinds and concentration of gases. In order to get accurate result, it is recommended to calibrate the alcohol sensor and sensitivity adjustments are necessary. The calibration is set to the 0.4mg/L of alcohol

concentration in the air and use value of load resistance of RL about 10kΩ.It is better if the calibration taken at same humidity and temperature because semiconductor type sensor are affected by humidity and temperature. The MQ-3 sensor is time dependent. So when it exposure to the ethanol gases, the sensor will be taken some time (about a minute) to produce the output value. For this project, the procedure of tested were fixed like the distance from mouth to sensor and the time taken for hard blowing.

Table 3.1 Concentration of alcohol in breath and their corresponding BAC

Concentration of alcohol in breath(mg/l)	BAC
0.00	0.00 %
0.0095	0.02 %
0.019	0.04 %
0.028	0.06 %
0.038	0.08 %
0.047	0.10 %
0.057	0.12 %
0.095	0.20 %

3.6.3. Main circuit

The main circuit is the main part of this project. The main circuit is as given in the figure below.

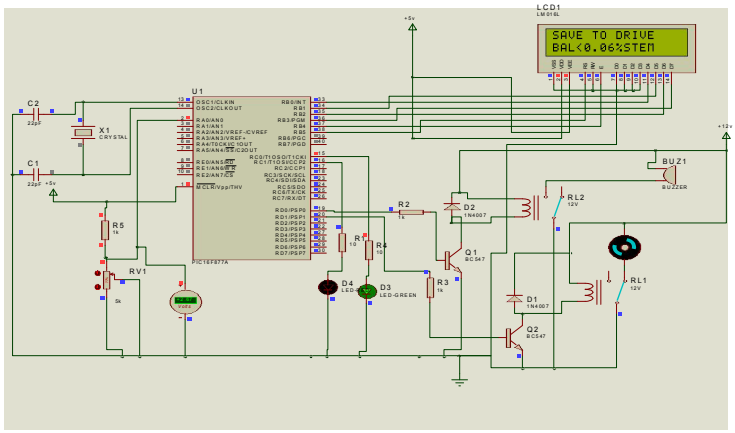

Figure 3:7 Main circuit schematic diagram

Based on the figure above, the main circuit was connected need 5V supply. The input of the circuit was from the sensor circuit and the output of the main circuit was connected to the LCD panel and alarm system which was consists of buzzer. The alarm system has been activated if the microcontroller detect the amount of BAC from subject were equal or higher the limit of BAC. At the same time the microcontroller has been send the data to the LCD panel to display output of the tested where the subjects were consider drunk or safe drive

3.6.4. Interface LCD (2 x 16 Characters) with PIC16F877

LCD is used to display BAC percentages. LCD used in this project is JHD162A.To use the LCD display, 16 pin header pin have to solder to the LCD display. The LCD connection circuit is shown as figure below. The transistor is used to provide more current for the LCD backlight.

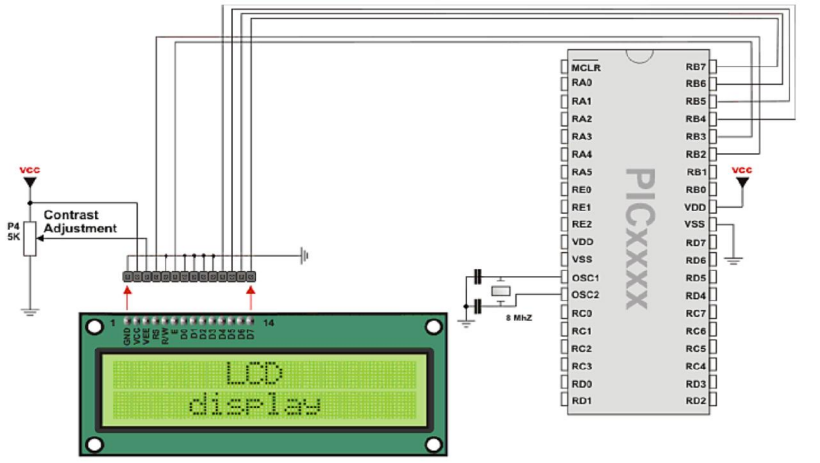

Figure 3:8 Main circuit schematic diagram

Table 3.2 LCD connection circuit

Pin Name	Pin No.	Description	Application
VDD	11,32	positive Supply (+5V)	Positive supply to chip
VSS	12,31	Ground Reference	Ground Reference
OSC	13,14	For Oscillator or resonator	Connected to Resonator 8MHz with 22Pf

3.6.5. PIC 16F877A Circuit Components

- Crystal oscillator
- Capacitors
- Resistor

Crystal oscillator:

Crystal oscillator of 8MHz is connected to the (13-14) pin of PIC.22Pf capacitor with one leg grounded is connected to leg of oscillator.

Transistors

A Transistor is a semiconductor device used to amplify and switch electronic signals and electrical power.

The NPN transistor can be used in two different modes: forward biased mode and the reverse biased mode. In forward biased mode, the electric current can easily flow through it. So it acts like a CLOSED SWITCH. However, in reverse biased mode, the current through it is practically zero and thus, it acts like an OPEN SWITCH.

So in this project the transistors are used in relay driver circuit and acts as switch to deactivate the relay as a result of base current triggered by alcohol sensor when alcohol is detected and consequently buzzer and LCD are activated.

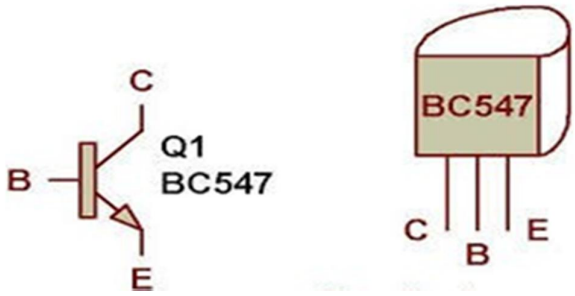

Figure 3:9 NPN Transistor symbols

3.5.6. Buzzer

Buzzers are frequently employed to give a user or operator an audio indication of the stage of a mechanical device. This high reliability electromagnetic buzzer is applicable to

automobile equipment. Compact, pin terminal type electromagnetic buzzer with 2048Hz. Pin type terminal construction enables direct mounting onto printed circuit boards. it produces sound so that the polices and peoples in the car understand that the driver consumed alcohol.

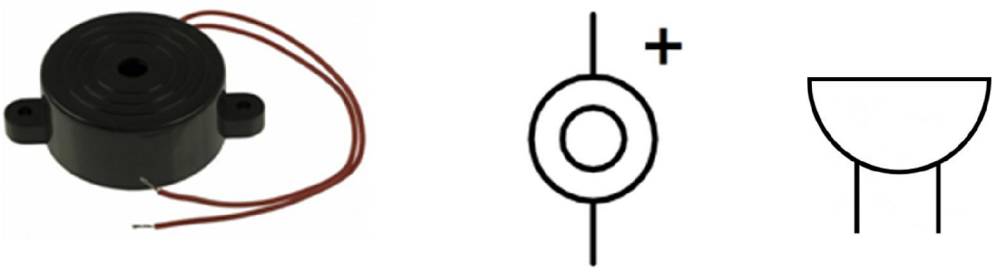

Figure 3:10 Buzzer's photo and symbols

Relay

A relay is an electrical switch that opens and closes under control of another electrical circuit. When electricity is applied to the wire, the rod becomes magnetic. A movable contact arm above the rod is then pulled toward the rod until it closes a switch contact. When the electricity is removed, a small spring pulls the contact arm away from the rod until it closes a second switch contact.

There are four parts in every relay:

- Electromagnet
- Armature that can be attracted by the electromagnet
- Spring
- Set of electrical contacts

1. AZ Relay Performs high reliability in dry circuit.
2. High density design is available on P.C. Board with size of 10.4x15.4x11.2 in mm and the weight of 3.5 grams.
3. The Employment of 2.54mm terminal pitch is equal to I.C.'s terminal pitch.
4. The low power consumption of AZ-L type and general power consumption type of AZ-D are prepared for user's wide selection.
5. Complete protective construction is designed from dust and soldering flux. In addition, the plastic sealed type is prepared for washing procedure.

Application: Telecommunication, Domestic Appliances, Office Machine, Audio Equipment, etc.

In general, relay is used to move an armature that is able to switch a much larger amount of power by using a small amount of electromagnet power which came from a small dashboard switch or a low-power electronic circuit. When the coil is energized with direct current, a diode is often placed across the coil to dissipate the energy from the collapsing magnetic field at deactivation, which would otherwise generate a voltage spike dangerous to semiconductor circuit components.

In this project relay is used to control the ignition switch in the car by controlling the electric ignition system.

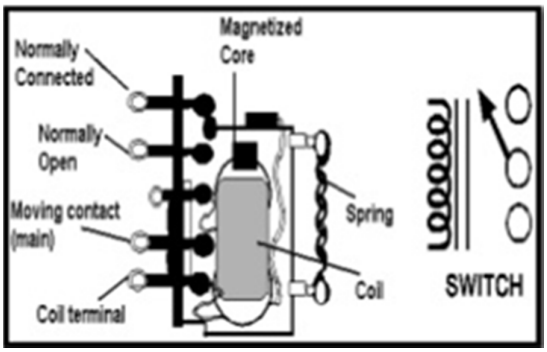

Figure 3:11 Relay internal connection

3.7. Software Implementation

For software implementation, Proteus 8.0 Professional (ISIS) for circuit making and to build the PCB of the system, and Micro C PRO compiler have been used to compile the source code written in C program language.

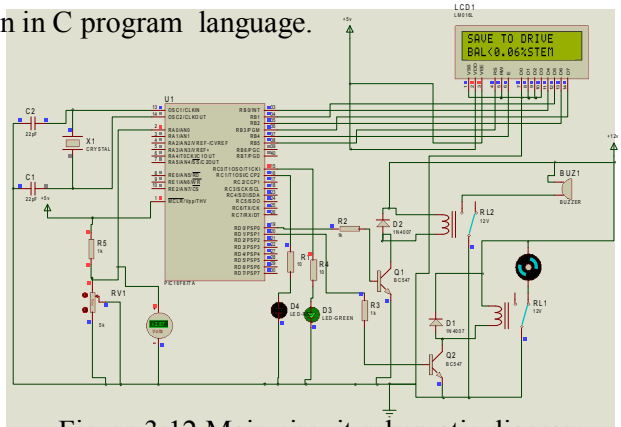

Figure 3:12 Main circuit schematic diagram

3.7.1. Program flow chart

The flowchart of the program for the system was given as in the figure below:

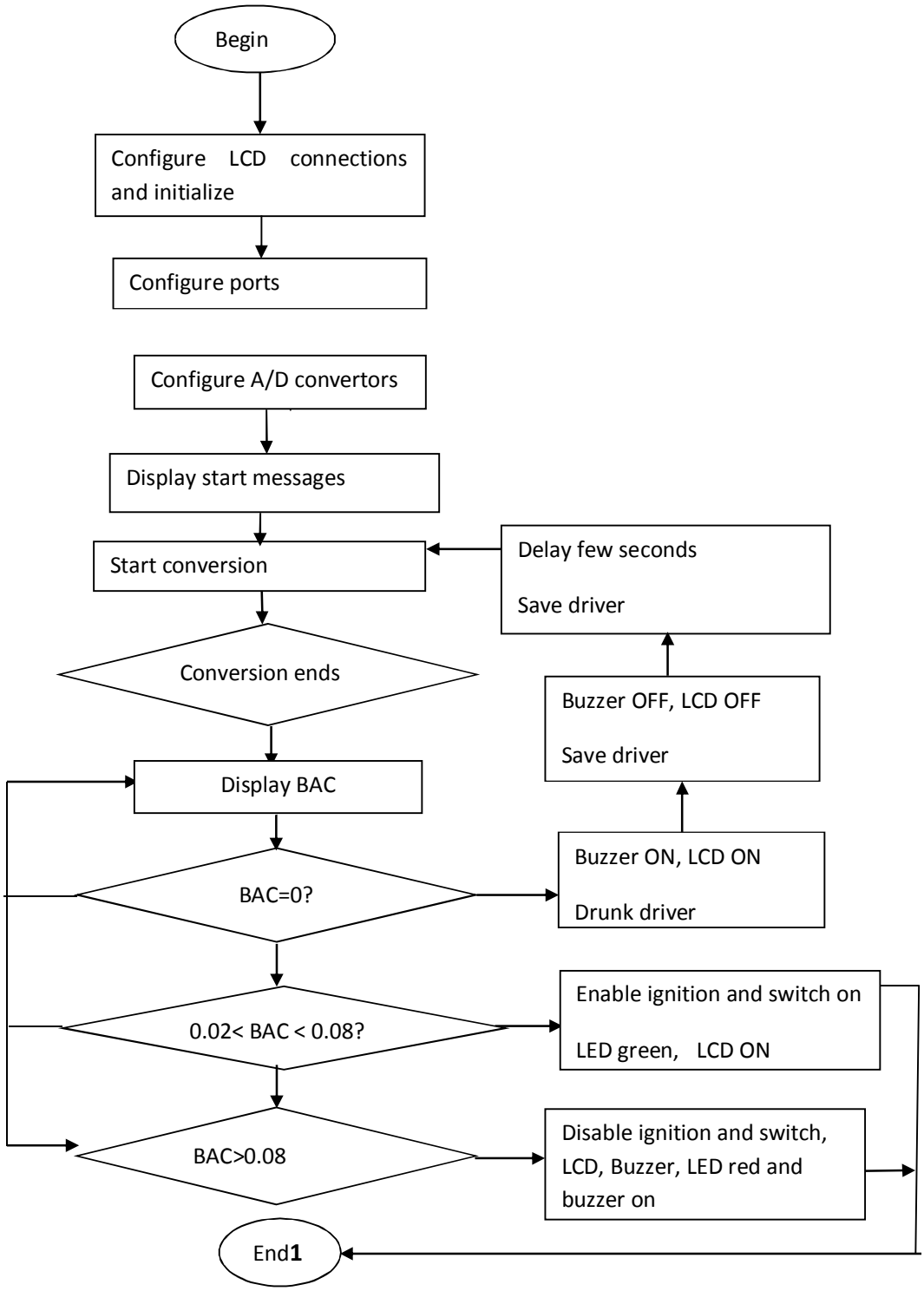

Figure 3:13 Flow chart of the program

This part shows the design steps to achieve the main aim which is a system design to detect an accident. This part of the paper describes which software should be used and the important steps to be followed to achieve the final design. The steps followed to implement the design are as described below:

3.7.2. Proteus software

Proteus software is used for microcontroller simulation, schematic capture, and printed circuit board (PCB). Steps' following shows the designing of the circuit using Proteus software

1. Install the MICRO Basic PRO for PIC then press on MICRO Basic software.

2. After that click on the project and choose from the list, new project

3.8. Analog to Digital Converter

Analog to digital converter will convert analog voltage to binary number. The binary number can be different length 2, 4, 8, 10 bit. If there are more bits the binary number, the higher the resolution of the analog to digital converter. If the voltage supplied to A/D converter varies from 0 –5 volt, so the A/D will convert the input voltage to a binary number of two bits. This project; we need to know the binary value/representation of the analog input voltage. For example 5V analog input equal to 1024. Using triangle method we can calculate other binary value for different input voltage.

$$\left\{\begin{matrix} 5V & \rightarrow 1024 \\ 3.65V & \rightarrow X \end{matrix}\right\} \rightarrow X = \frac{1024 * 3.65}{5} = 747.52 \approx 748$$

The analog input voltage of 3.65V will represent by decimal number 748 or binary number 1011101100. This method has been used as the condition to select the BAC value. For example if the input voltage is 3.65 (768 decimal). So microcontroller will decide if the value exceed the limit of BAC or not.

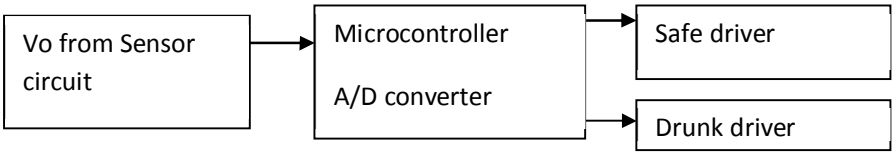

Figure 3:14 A/D block diagram

3.9. Integration of the System

In this stage, the hardware of the system with that of the software of the system have been integrated or interfaced for the successful implementation of the project. The following figure shows the integration of the System.

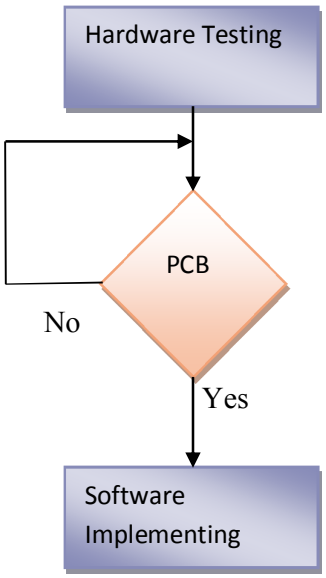

Figure 3:15 Flowchart of the Integration of the System

3.10. System Testing and Calibration

The whole system will malfunction if the power supply fails. Hence, proper testing of the voltage regulator is essential. The completed circuit of the voltage regulator is tested using LED as load and the corresponding output voltage across the LED is measured using multimeter. The most important task in this section is the calibration of the alcohol sensor. The input voltage is fed into the microcontroller not entirely linear over all concentrations of ethanol. Hence, careful attention had to be placed so that calibration was over the linear or near linear region. Attention was also paid to the possibility of saturated or even damaged the sensor if too high a concentration was placed on the sensor. Each prepared ethanol concentration was placed against the sensor and the voltage level was viewed on the multimeter and recorded. An average value for each respective concentration is taken. First, the completed circuit without the alcohol sensor was put through functional testing. The sensor voltage was replaced by a DC voltage source that was varied from 0V to 5V at increments of 0.5V. Once this calibration was done the

sensor was connected to the rest of the circuit. The whole device was tested using the solutions that were prepared for the calibration of the sensor.

After fixed sensor to the driver and connecting it to the motherboard, output voltage from the sensor at normal room temperature is taken. This output voltage was set as the reference voltage for the calibration process. Then, human breath sample was blown at the sensor and the subsequent output voltage was taken. Finally, the sensor is then tested using alcohol substance and its output voltage is taken as well. The voltages set in the programmed were readjusted according to the voltage measured during calibration and the hardware is then again tested to verify the BAC percentage produced.

4. RESULT AND DISCUSSIONS

Some tests on prototype were conducted in order to determine the project was a success and working properly. This chapter discusses about the results of task conducted on hardware and software, System operation, the necessary adjustments that were made during the testing and calibration process for the system to work perfectly were explained and commented. The data collection was done several times, condition of the system and the data obtained were analyzed.

4.1. Simulation

Proteus software was used to test the circuit to check whether the system is working properly or not.

Regulator Circuit

As its code number indicates the 7805 voltage regulator produced 5Vdc from 12Vdc as multimeter reading shows as the following circuit simulation.

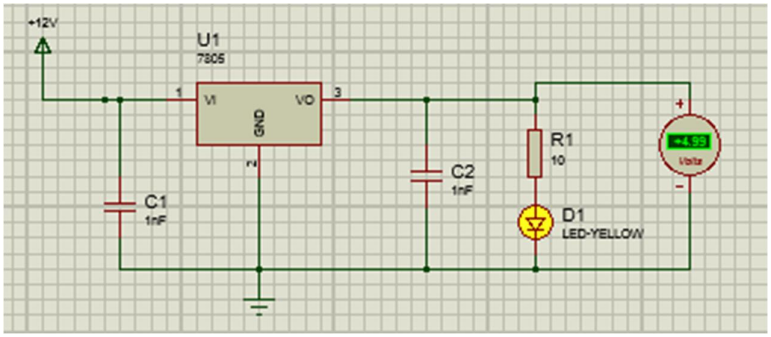

Figure 4:1 Regulator circuit simulation result

Complete Circuit Simulation Results

Here we used variable resistor to produce different input voltages for microcontroller as input through R_1 and RV_1. We used 5Vdc from Regulator output and varied it through variable resistor by applying voltage divider rule with resistor R1 as following equation:

$$Vin = Vdd\,\frac{dRvar1}{dRvar1 + R1}$$

Where Vdd is supply voltage, d is coefficient by which variable resistor is changed. when d is equal to 1, then the value of $Vinis = 5 * \frac{20}{20+10} = 3.33V > 2$, which is found in the range at which the relay can be disabled.

Based on the program developed and burned on microcontroller the model circuit is simulated as shown in the following diagram.

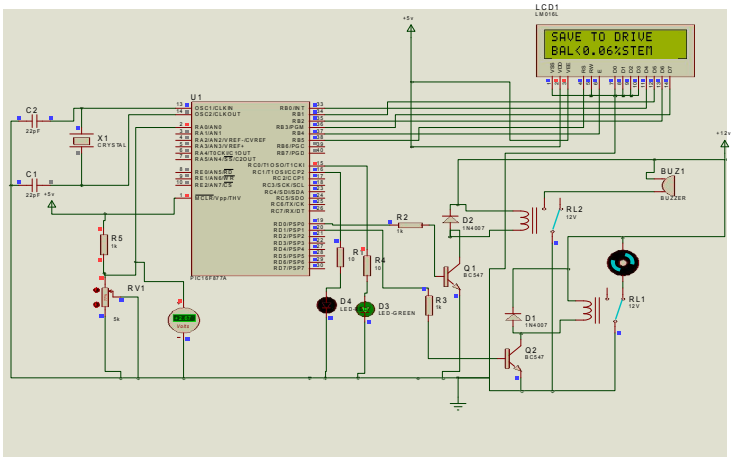

Figure 4:2 System simulations under normal condition

From the above simulation we see that the potentiometer resistor center tapped pointer is on the top position which shows that the Rv1 is very low and Vin is <<2. This indicates that there was no alcohol disturbance in the vehicle. So the system is operating under the normal condition. Hence motor is on running, LCD shows that the driver is "SAVE TO DRIVE" and buzzer is OFF.

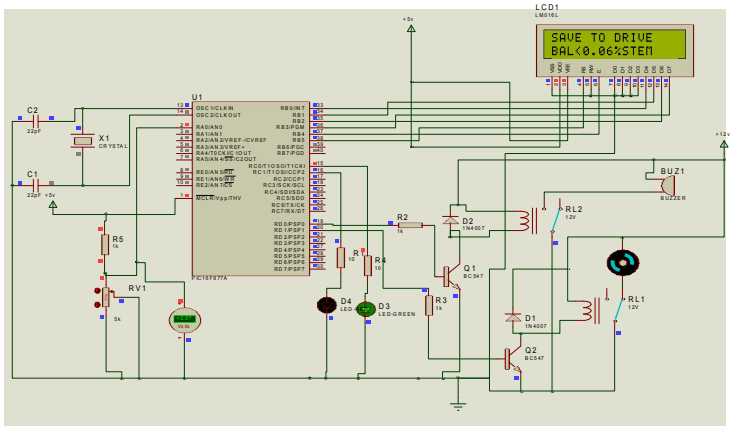

Figure 4:3 System simulation result under influence of alcohol

Now the pointer is below half of the resistor. This indicates that the resistor is increased, V_{in} increased and micro controller activates the output pins, thus the relay disconnects the power from motor, and buzzer is alerted, also LCD displayed the warning words "DRUNK DRIVER".

The push button seen on the diagram is used as RESET. When it pressed all functions of microcontroller are stopped and when it reset the operation is continued. This is needed for keeping the vehicles from further accidents. In the case when vehicle is at

inappropriate place to stop and at the same time the disturbance of alcohol going to stop the car, the only solution is stopping the microcontroller functions and after he passed the obstacle he should reset the microcontroller to continue its operation. This time ignition system activate, however LCD remain with displaying warning. This is the best and most consideration when designing this project.

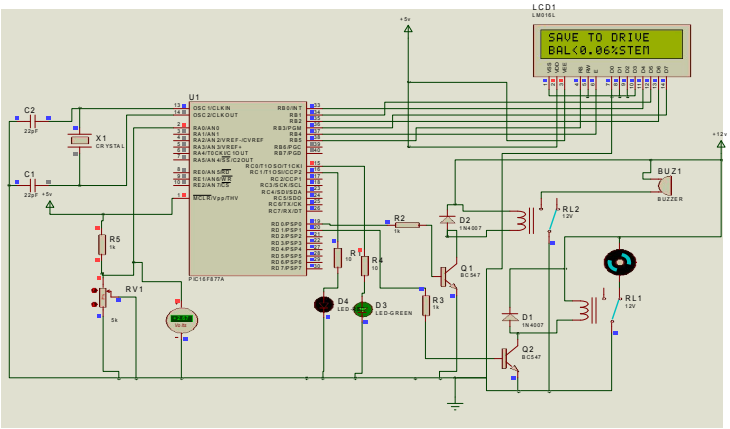

Figure 4:4 Reset effects on the microcontroller

4.2. Hardware

In this section, the detailed about the hardware components and their testing were discussed. As it was discussed in the previous chapter, the circuitry is divided into 3 sub-circuits which are the voltage regulator circuit, the motherboard which houses the microcontroller and the sensor driver.

4.2.1. Voltage regulator

The voltage regulator which acts like power supply of the system was connected to all circuits that used 5V as supply. The input of the voltage regulator was directly from dc-dc adapter and has been regulated the circuit at fixed voltage output of 5V.

The voltage regulator which acts as the power supply of the system and the sensor driver is connected to the motherboard which controls the whole system. Proper testing of the voltage regulator is essential. The completed circuit of the voltage regulator was constructed and tested using LED putting with 10ohm resister in series and the corresponding output voltage across the LED and resister was read 4.99V using digital multicentre.

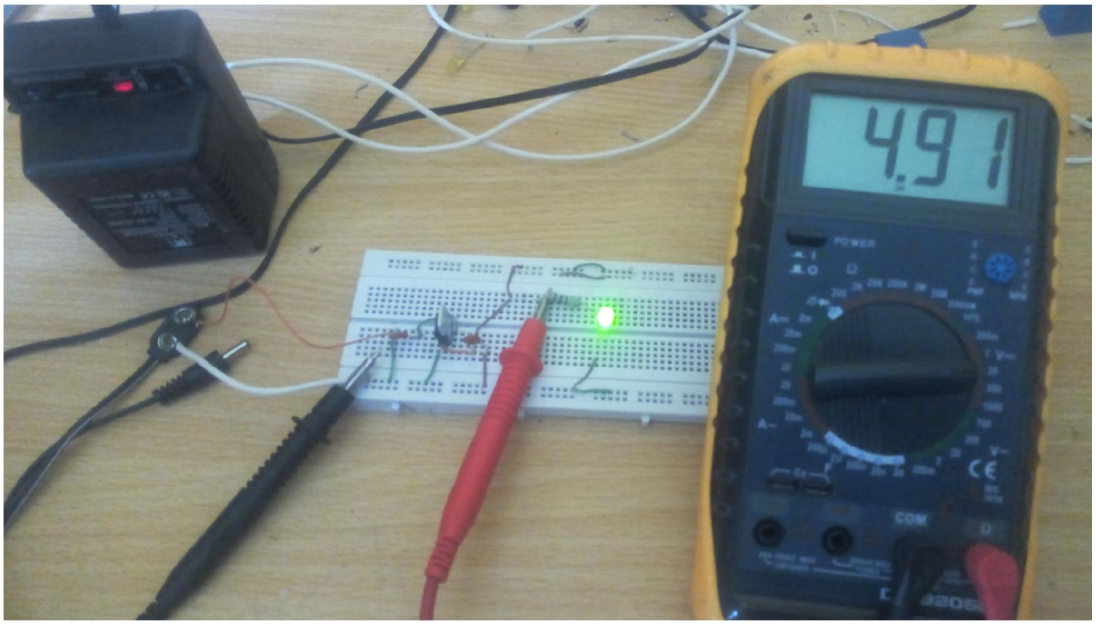

Figure 4:5 Regulator Circuit Testing

The input and output of the voltage and current values are shown in the table 4.1 below. The input voltage is 12V and the input current is 100mA. Meanwhile the output voltage and current are 4.96V and 50mA respectively.

Table 4:1 Input and output values of voltage regulator

Parameter	Voltage(V)	Current (mA)
Input	12	100.00
Output	4.01	50.00

Table 4:2 Input and output of voltage regulator

Symbol	Parameter	Technical condition
VC	Circuit voltage	5V
VH	Heating voltage	5V
RS	Sensing resistance	1M-8Mohom
RL	Load resistance	10Kohm

4.2.2. Sensor driver

The image of the sensor driver built was shown in the figure 4.3 below.

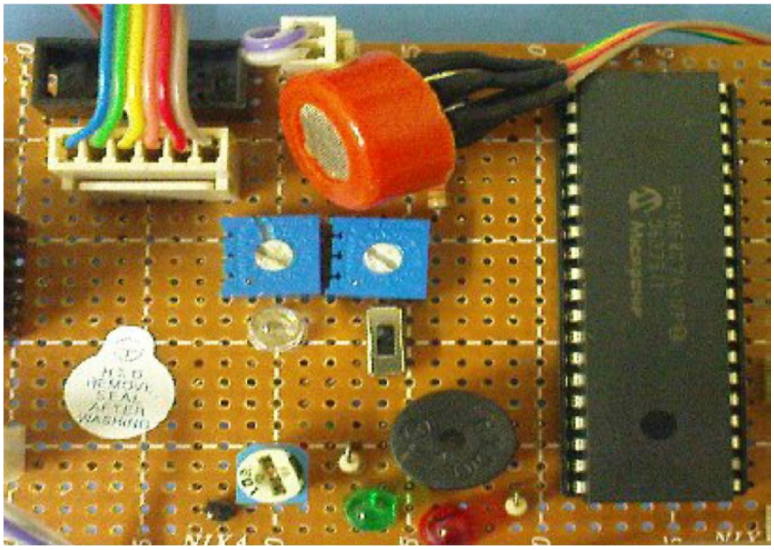

Figure 4:6 MQ-3 Alcohol sensor driver

The sensor circuit which consists of MQ-3 alcohol sensor and load resistance. The sensor resistance changes due to the detected alcohol substance. If the sensor detects more alcohol the resistance of the sensor drops, hence the voltage output increases. The input of this sensor circuit is 5V and the output varies from 0 V to 4.75 V. The specifications of the sensor circuit are shown in Table 4.2. The voltage and current values of the sensor are given in the table below. The input voltage and current for the sensor driver are 5V and 25mA respectively while the output voltage varies from 0V to 4.75V and the output current for the sensor driver is same as input current which is 25mA. There is only small current value in order to protect the sensor from damage.

Table 4:3 Input and output value of sensor

Parameter	Voltage(V)	Current(Ma)
Input	5	25
Output	0 to 4.75	25

The input voltage that was fed into the microcontroller was not entirely linear over all concentrations of ethanol. Hence, careful attention had to be placed so that calibration was over the linear, or near-linear, region. Attention was also paid to the possibility of

saturating or even damaging the sensor if too high concentration was placed on the sensor. First, the completed circuit without the alcohol sensor was put through functional testing. The sensor voltage was replaced by a variable resistor. When we moved potentiometer clockwise and anti-clockwise direction the value of input voltage V in to microcontroller was been increased and decreased respectively with the principle of voltage divider rule. When the input voltage is below (2V), the microcontroller output pins were deactivated, buzzer OFF, LCD displayed "SAFE TO DRIVE" according to set program. When the input voltage is above (2V), the microcontroller output pins were activated, buzzer ON, LCD displayed "DRUNK DRIVER" and the system checks the process every 500ms.

Table 4:4 Input and output value of sensor

Input Voltage	**Buzzer**	**LCD**	**Ignition system**
1.5V	OFF	SAFE TO DRIVE	Work
1.8V	OFF	SAFE TO DRIVE	Work
>2V	ON	DRUN DRIVER	Stop

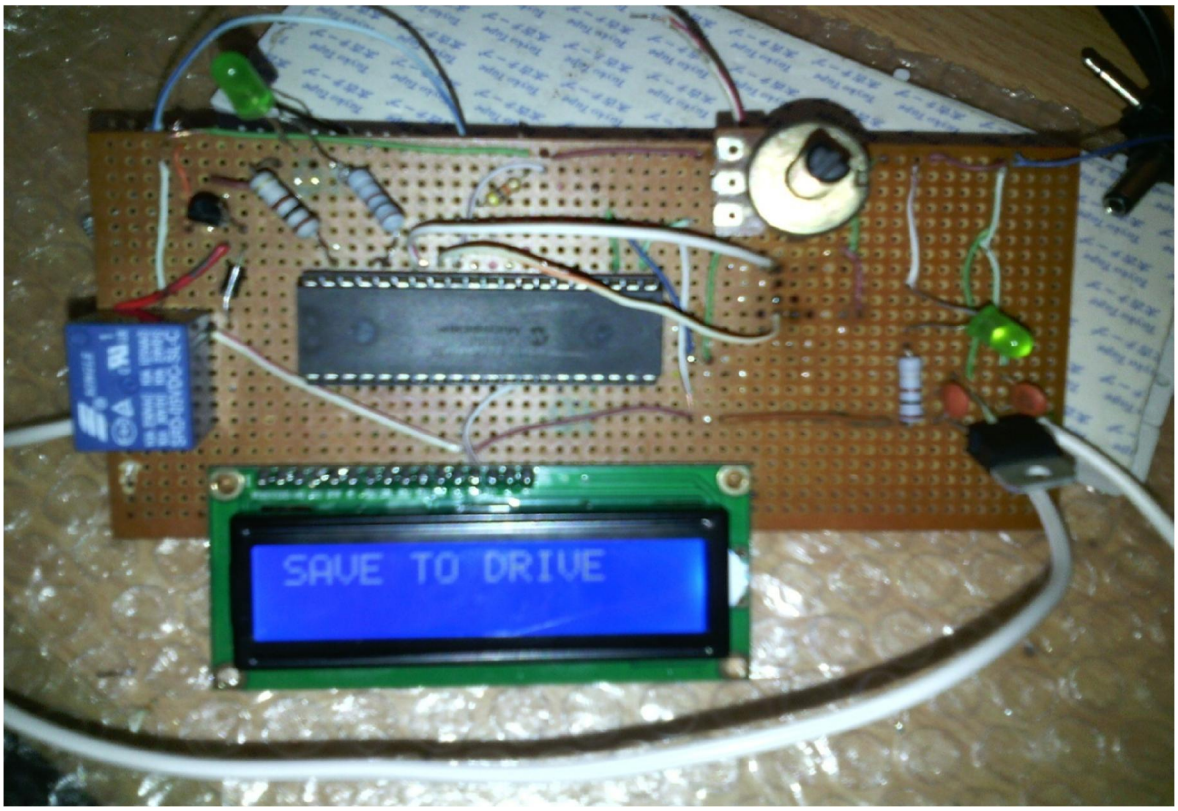

Figure 4:7 Testing prototype with potentiometer (Vin<2V)

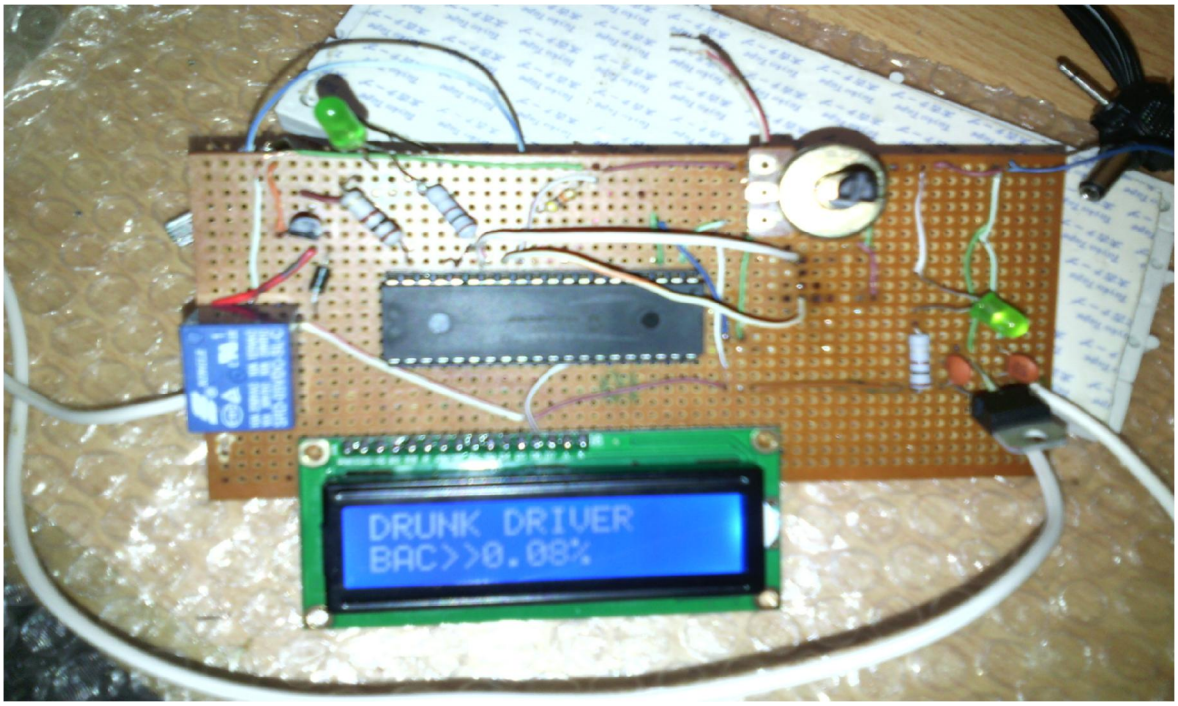

Figure 4:8 Testing Prototype with potentiometer (Vin>2V)

Once this calibration was done the sensor was connected to the rest of the circuit. After fixing the sensor to the driver and connecting it to the motherboard, the output voltage from the sensor at normal room temperature was taken. This output voltage was set as the reference voltage for the calibration process. Then, human breath sample was blown at the sensor and the subsequent output voltage was taken. Finally, the sensor was then tested using alcohol substance and its output voltage was taken as well. The voltages set in the programming were adjusted according to the voltage measured during calibration and the hardware was again tested to verify the BAC percentage produced.

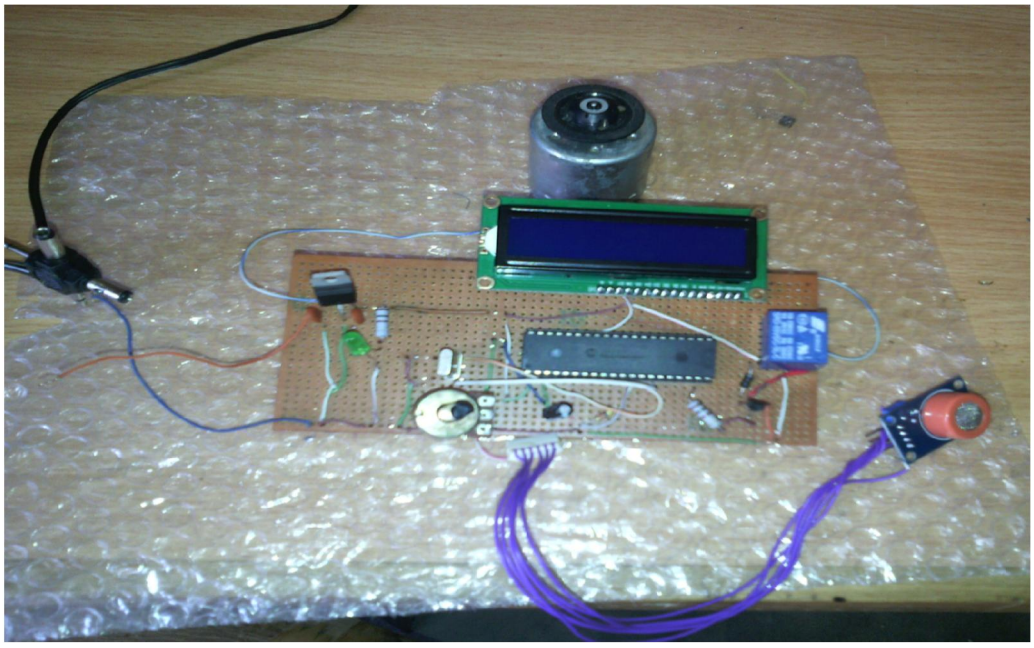

Figure 4:9 Testing prototype with potentiometer (Vin<2V)

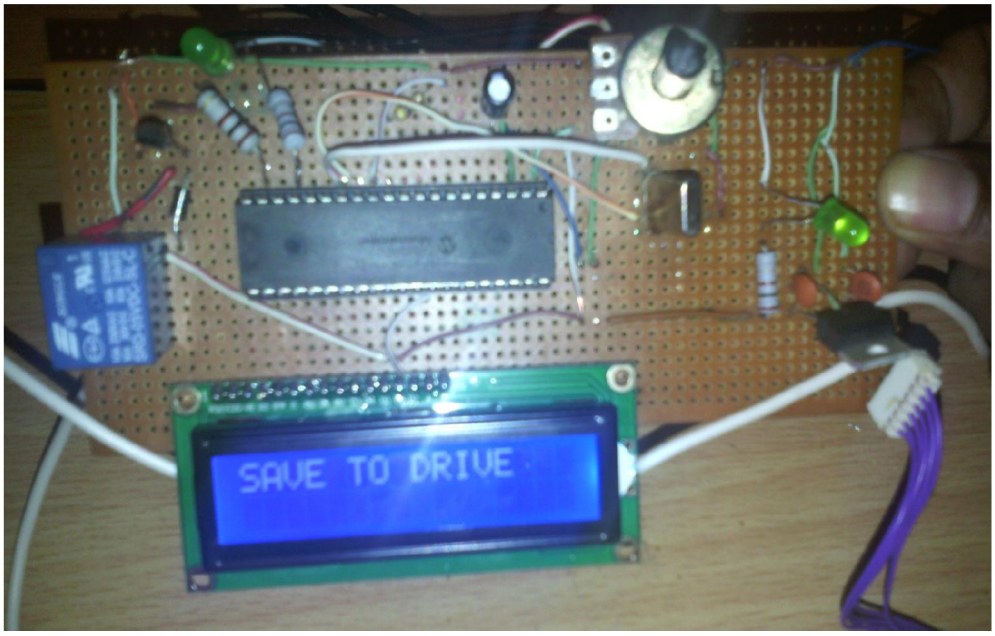

Figure 4:10 Condition when Alcohol does not detected by sensor

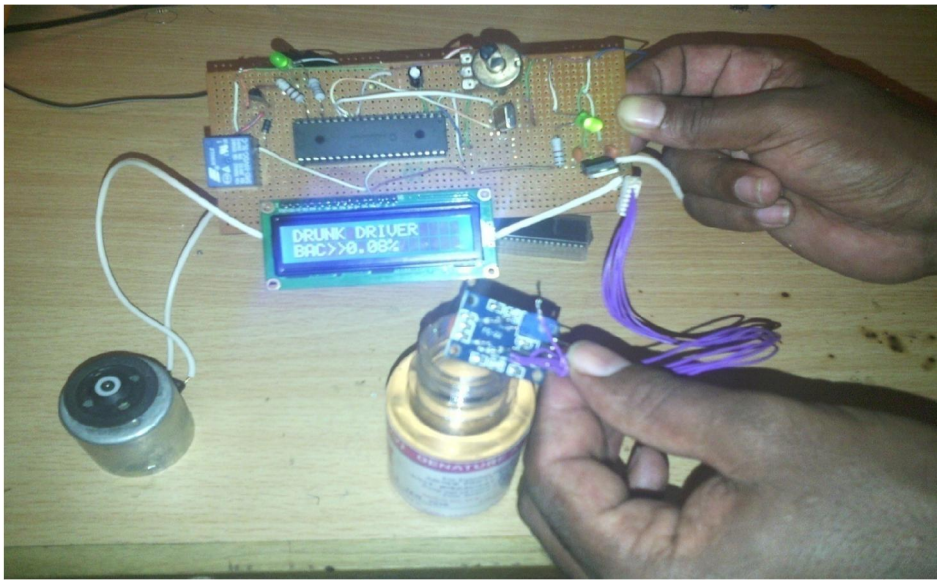

Figure 4:11Condition when Alcohol does not detected by sensor

When the program was start up, LCD has been display “DRUNK DRIVER DETECT SYSTEM” and then the system was in standby mode while displaying “DRUNK DRIVER (BAC>0.08...”.

When drunk driver exhale alcohol in air from breath sample was detected (without alcohol consumption), LCD has been displayed “safe driver” BAC = 0.00%,. At the same time has been ON and buzzer has been OFF.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

An efficient system of vehicle accident prevention system embedded by alcohol detector has been proposed. It consists of PIC 16F876A as the main controller, alcohol sensor as the input and three output such as ignition system, LCD display and alarm system. The sensor was able to measure the detected blood alcohol concentration in the exhale of drunk driver in atmosphere and PIC microcontroller has been controlled the output based on analog input from the sensor circuit. The result was displayed at LCD panel (in BAC %) and the alarm system was activated based on the result obtained.

The sensitivity of the sensor toward alcohol is much higher than other substance such as benzene and very reliable as alcohol detecting device compared to other model. The time response of the sensor was fast, however the sensor need preheat time before the test has been conducted. This is to ensure the sensor in stability and produce accurate result. This system capable to alert the driver about the level of drunkenness by indicating the condition on LCD display. The concentration is displayed in terms of Blood Alcohol Concentration or BAC (%) and the legal limits were different between countries to countries. For most countries the legal limit is 0.08% BAC and person who was caught over 0.08 % BAC is driving are against the law and can be fined. So it is important to check the alcohol concentration before to decide whether the driver can drive or not.

It also produced an alarm from buzzer to make the driver aware their own condition and to observant other people in surrounding area. The most safety element provided by this system the driver in high level of drunkenness is not allowed to drive a car as the ignition system will be deactivated. Ultimately, this system help to prevent the driver to drive in risky situation and will avoid accident occur on the road.

5.2 Recommendation and future suggestions

Below were the suggestions of further research and work to improve the design of the system:

a. Replacing the sensor with the sensor that only can detect alcohol substance to increase the sensitivity and accuracy of the reading.

b. Develop the system smaller so that it can be carry anywhere.

c. Compare the sensor with the actual alcohol sensor in the market in term of result obtain and accuracy of the reading to make the calibrating the sensor is easy.

d. Interfacing the system to the vehicle. For example vehicle only can be start if the alcohol test on person breath is below the limit.

5.3. Cost of construction analysis

No	Item	specification	Unit	Qty	Unit price (birr)		Total (birr)		Remark
					birr	cent	birr	cent	
1.	Regulator	LM7805	Pcs	1	30	00	30	00	
2.	Capacitor	22PF	pcs	4	20	00	80	00	
3.	Diode	4001N	Pcs	2	10	00	20	00	
4.	Resister	10K	Pcs	6	5	00	30	00	
5.	DC motor	standard	Pcs	1	70	00	70	00	
6.	Heat sink		Pcs	1	20	00	20	00	
7.	LED, red	standard	Pcs	2	10		20	00	
9.	Variable resistor	100K	Pcs	2	30	00	60	00	
11.	Microcontroller	PIC16F877A	Pcs	1	200	00	200	00	
12.	Oscillator	8MHz	Pcs	1	25	00	25	00	
14.	LCD display	2X16 display	pcs	1	300	00	300	00	
15.	Resistor	1k	pcs	5	5	00	5	00	
16.	Buzzer	12V	pcs	1	60	00	60	00	
17	Transistor	BC547	pcs	2	25	00	50	00	

18	PCB	16X2cm	pcs	1	200	00	200	00	
19	Bread boarded	2x18cm	pcs	1	200	00	200	00	
20	lead	m	pcs	3	30	00	90	00	
21	Soldering iron	standard	pcs	1	90	00	90	00	
22	adapter	7-12V	Pcs	1	250	00	250	00	
23	wire	1.5m	pcs	20	3	00	60	00	Any cooler
24	multimeter	12V	pcs	1	500	00	500	00	
					2,083	00	2,360	00	
Contingency cost (10%)							444.3	00	
Total cost							2804.3	00	

5.4. Educational implication

The objective of the national TVET strategy is to create a competent, innovative adaptable work force in Ethiopia, contributing to poverty reduction social and economical development through be facilitating demandable driven, high quality technical and vocational education and training ,relevant to all sectors of the economy at all levels and to all people a need of skills development and transferring a new technology (national TVET strategy NOE 2006

Since the industries are the stakeholder of TVET institutions the program and drop of industry has an impact on the outcome based training. Intensification of the industry and TVET linkage is very important to provide quality and outcome based training. If the industries have equipped with enough machinery and equipment, the training program will be easy and efficient. Through industrial training the enterprise can also develop ownership of the TVET system.

Technical and vocational skill is vital to economic development because it is needed for industries productivity and profitability, as well as, national productivity. Without the necessary technical skills, industry and national growth can be hampered.

TVET educational system is mostly practical based imparting the necessary skills to the students.

The functional model of VAPS developed helps very much the TVET educational system.

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APPENDIX A

IC microcontroller source code

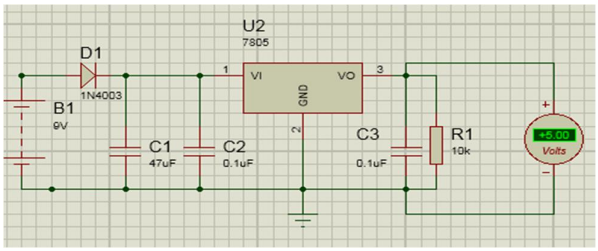
```
sbit LCD_EN at RB4_bit;

sbit LCD_RS at RB5_bit;

sbit LCD_D4 at RB0_bit;

sbit LCD_D5 at RB1_bit;

sbit LCD_D6 at RB2_bit;

sbit LCD_D7 at RB3_bit;

sbit LCD_EN_Direction at TRISB4_bit;

sbit LCD_RS_Direction at TRISB5_bit;

sbit LCD_D4_Direction at TRISB0_bit;

sbit LCD_D5_Direction at TRISB1_bit;

sbit LCD_D6_Direction at TRISB2_bit;

sbit LCD_D7_Direction at TRISB3_bit;

char temper[7];

char *text;

Void main()

{

 LCD_Init();

Lcd_Cmd(_LCD_CURSOR_OFF);

Lcd_Cmd(_LCD_CLEAR);

text="DRUNK DRIVER";

Lcd_ Out (1,1,text);
```

```
text="DETECT SYSTEM";
Lcd_Out(2,1,text);
Delay_ms(200);
TRISC=0xff;
TRISB=0;
 TRISD=0;
 PORTD=0;
do
 {
Lcd_Cmd(_LCD_CURSOR_OFF);
Lcd_Cmd(_LCD_CLEAR);
 {
If(PORTC==1)
 {
 PORTD.F0=1;
 Delay_ms(200);
 LCD_Out(1,1,"DRUNK DRIVER");
 LCD_out(2, 1,"BAC>0.08%");
 Delay_ms(1000);
 PORTD.F1=1;
 }
Else
 {
```

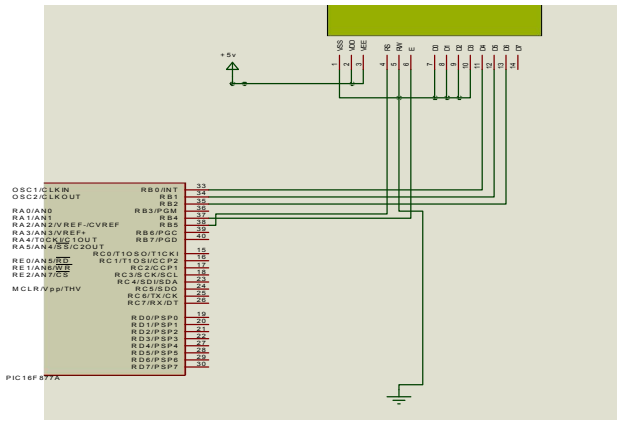
```
 LCD _Out(1,1,"SAVE TO DRIVE");
 PORTD.F0=0;
 PORTD.F1=0;
 }
  Delay_ms(10);
}
}while(1);
```

APPENDEX B

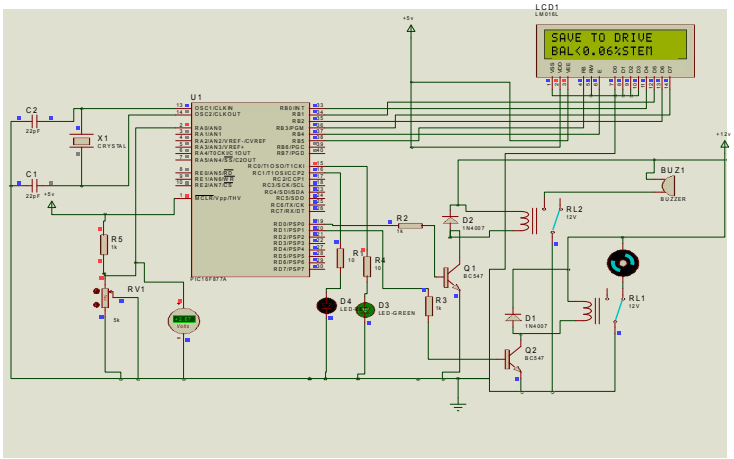
The sub system circuit diagram of (PIC16F877A) Micro Controller based Alcohol Detection System

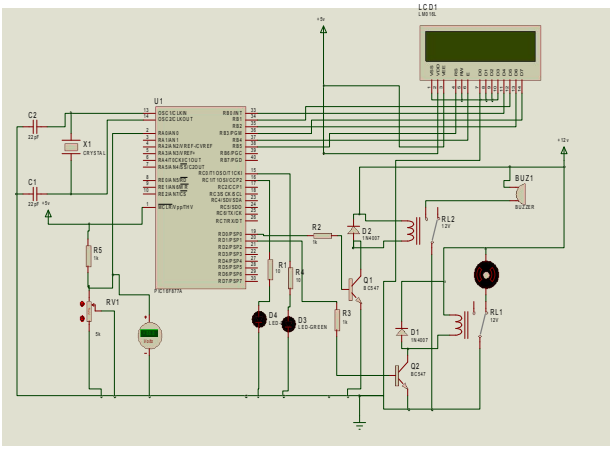


Circuit diagram of the power supply of microcontroller based alcohol detection system



Interfacing circuit diagram of LCD with microcontroller: interfacing circuit diagram of buzzer, LCD& motor with microcontroller

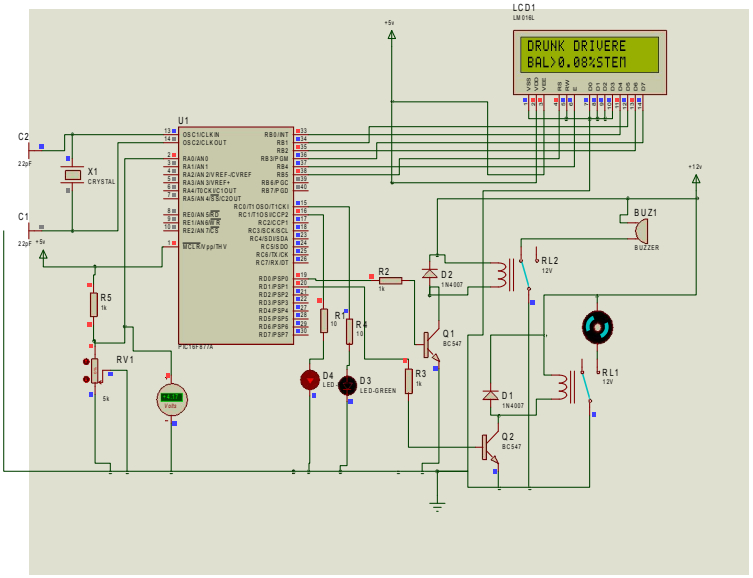




complete circuit diagram of PIC16F877A micro controller based alcohol detection system

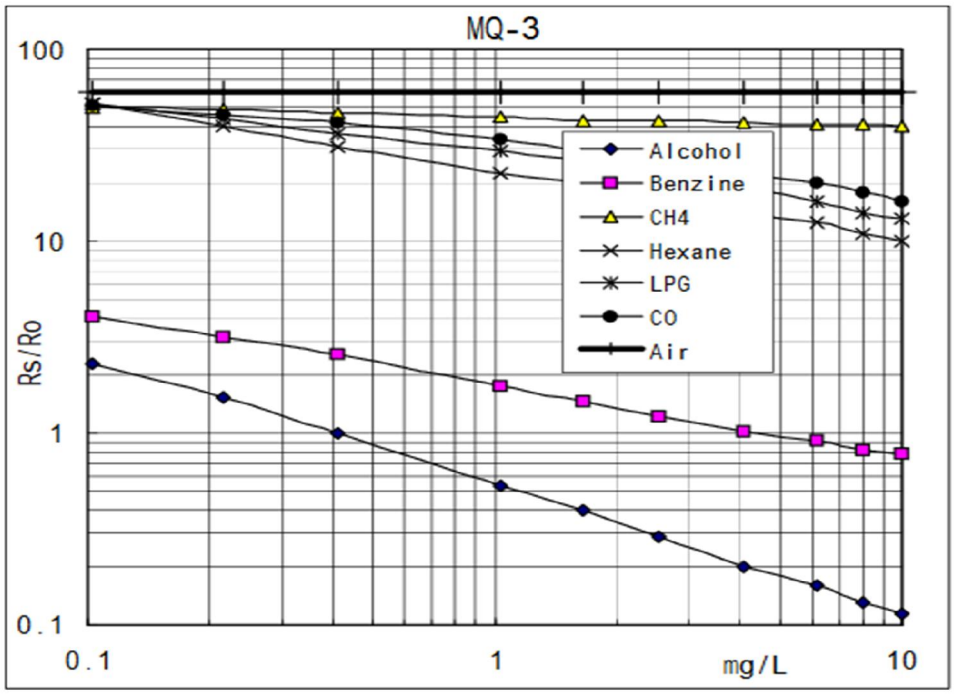
APPENDEX C

Simulation Circuit Layout in Proteus 8.0 ISIS Professional for Design and Implementation of Microcontroller based Alcohol Detection System

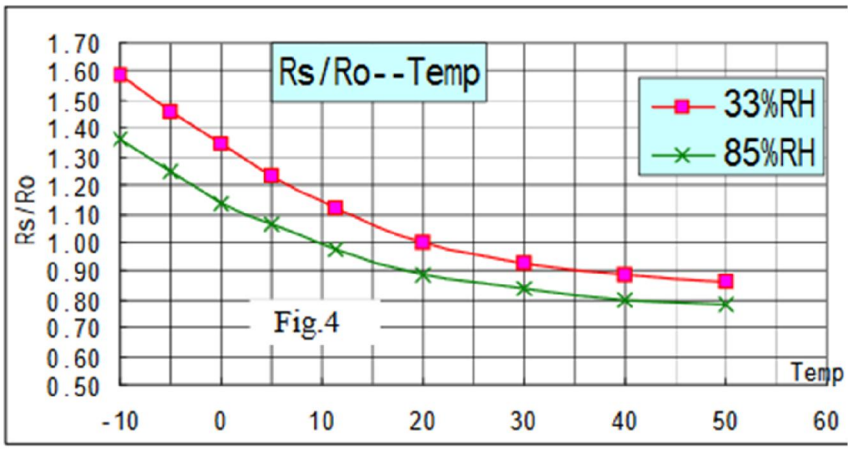


APPENDEX D

Sensitivity characteristic curve



Sensitivity Characteristics of the MQ-3



The above figure is shows the typical dependence of the MQ-3 on temperature and humidity.

Ro: sensor resistance at 0.4mg/L of Alcohol in air at 33%RH and 20 °C

Rs: sensor resistance at 0.4mg/L of Alcohol at different temperatures and humidifies.