ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 8, Issue 7, July 2019

Factory Worker Alcohol Detector System with Automatic Machine Shutdown

Pahalson, C. A. D[1], Nuhu Habila[2].

Dept. of Science, Plateau State Polytechnic Barkin Ladi, Jos, Nigeria[1&2]

ABSTRACT: The "Factory Worker Alcohol Detector System with Automatic Machine Shutdown" is a system that is intended to protect the factory worker, the machine and safeguard the huge investment of the owner by preventing accident in the factory. It is a system that checks the workers condition constantly to know his state; if he is drunk or normal. If he is in drunken condition, then also check the range of drunken value; if it is above the permissible range then shut down the machine automatically to prevent any accident that may occur as a result of his operation on the machine.

In the Cement factory for instance, the worker may need to work at heights or depths as much as 1000 meters from ground level, at temperatures above 1200°C, and high system operating pressures above 6 bars. There are so many machines involved which are costly and their operations are complicated. For operating these complicated systems, the worker should be in mentally fit condition. If the Worker is drunk, it directly affects his mental condition and in this condition if he operates the machine, he can easily make mistakes that can lead to a serious accident with consequences such as damage to the machine, environment, injury or even loss of life. For preventing this life or business loss, a system has been designed with the help of the PIC microcontroller, alcohol detector sensor, LCD display, GSM modem, relays, an alarm system and a DC motor. The system shuts down the motor automatically, sends an alert message to an authorized mobile GSM number, and raises an alarmafter detecting that the worker's drunken condition is above permissible range. The code for the system was written and debugged in MikroC environment while the hardware was simulated in Proteus environment. The response of the system agreed with the design

I. INTRODUCTION

An Embedded System is a combination of Computer Hardware and Software, and perhaps additional mechanical or other parts, designed to perform a specific function. The word embedded reflects the fact that these systems are usually an integral part of a larger system, known as the embedding system. Embedded systems are Real Time Systems (RTS) meaning they have to respond to events within a specified deadline. We use embedded system in our homes, offices, transportation, industries, automation, defence and virtually all aspects of human endeavour. Examples of embedded systems includes; cameras, televisions, telephones, handsets, printers, toys, speed controllers, digital temperature sensor and alcohol detector systems. Embedded Systems are used for few applications that are known at design time with clear requirements for inputs and environment while General Purpose Systems are used for broad class applications.

Embedded Systems have fixed runtime and are not programmable by end users while the General Purpose Systems are faster and end user programmable.Embedded systems are smaller in size, less costly, easier to use and require low power as compared to General Purpose Systems. The "Factory Worker Alcohol Detector System with Automatic Machine Shutdown" works on the principle of alcohol detection through the alcohol detector sensor. The resistance of the sensor changes as per the concentration of alcohol. When alcohol concentration is high, the resistance would be low and when alcohol concentration is low, the resistance would be high. When a drunken worker stands in front of the machine, the alcohol sensor senses the breath of the worker and check the concentration level of alcohol, if the concentration level is higher than permissible level then it gives the logic high signal to the microcontroller. After receiving the logic high signal, the microcontroller goes into alerting mode. In the alerting mode, it turns on the buzzer for giving warning intimation and displays this alert on the Liquid Crystal Display (LCD). In this condition, the

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microcontroller also gives a logic low signal to turn off the motor and sends an alert message to an authorized GSM mobile number. The microcontroller used for this work belongs to the PIC18F microcontroller series. This alcohol sensing and alerting system is implemented in a minimumcost and serves as a safety device; this is the main advantage of this work. Another advantage of Alcohol Sensing Alert project is low or minimum maintenance required after the installation.Applications of Alcohol Detection using PicMicrocontroller are

1. The Factory Worker Alcohol detector mini project can be used in various manufacturing industries to detect if the person at work has consumed alcohol or not.
2. PIC microcontroller based alcohol detector systems can be used at hospitals, school as well as college campuses.
3. This project can also be used as alcohol detection system in cars to reduce road accidents.

II. HARDWARE COMPONENTS

The hardware components used for the "Factory Worker Alcohol Detector System with Automatic Machine Shutdown" include; PIC18F2585 microcontroller, Alcohol Detector Sensor (MQ3), Liquid Crystal Display (LM016L), GSM modem, MAX232, Buzzer, Transistors, Relays, DC motor, Crystal Oscillator, Resistors, Capacitors and power supply. The block diagram is shown in Figure 1.

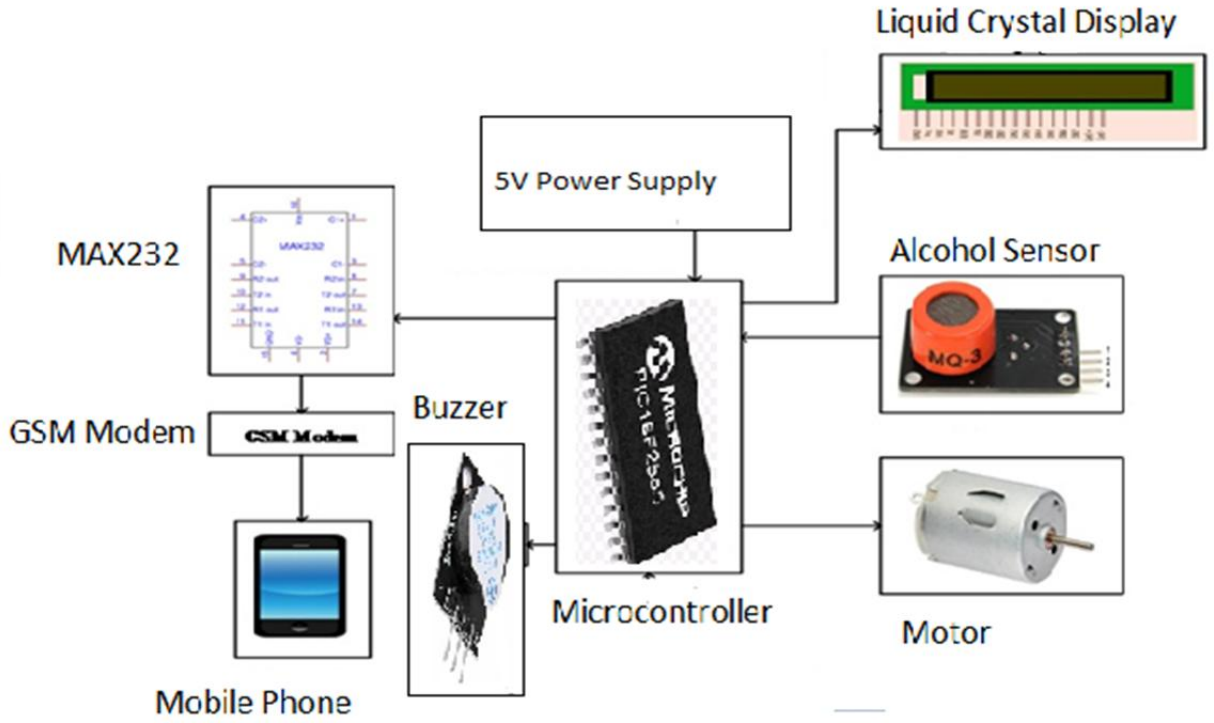

Figure 1: Block diagram of Factory Worker Alcohol Detector System with Automatic Machine Shutdown

PIC18F2585 Microcontroller

The microcontroller used for this design is PIC18F2585; it has 28 Port Pins with 8 ADC channels. This device belongs to a family of microcontrollers that offer high computational performance at an economical price with addition of high-endurance and Enhanced Flash program memory. The resolution of the ADC is 10 bits, thus an analog signal will be converted and represented by a 10-bit binary number. A 10-bit number can hold a maximum decimal number

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equivalent of 1024, so we have measurements ranging from 0 to 1023 digital reading and for conversion Vref and Vcc are externally connected.

Generally, all the port pins of PIC microcontroller act as normal input /output pins until their special functions are declared. ADC registers inside the controller have to be declared in order to make Port A <RA0> to act as an ADC channel. A reset input is provided using the reset switch. It is implemented by using a push button and a 10k resistor connected to VCC and the "MCLR" input of the microcontroller which is an "active LOW" input.A crystal oscillator is connected to the microcontroller through the pins OSC1 and OSC2. The crystal oscillator provides the clock signal for the microcontroller. A 20 MHz crystal oscillator is chosen for this design and the recommended values of C1 and C2 are 33 picoFarad capacitors.Figure 2 show Schematic of PIC18F2585.

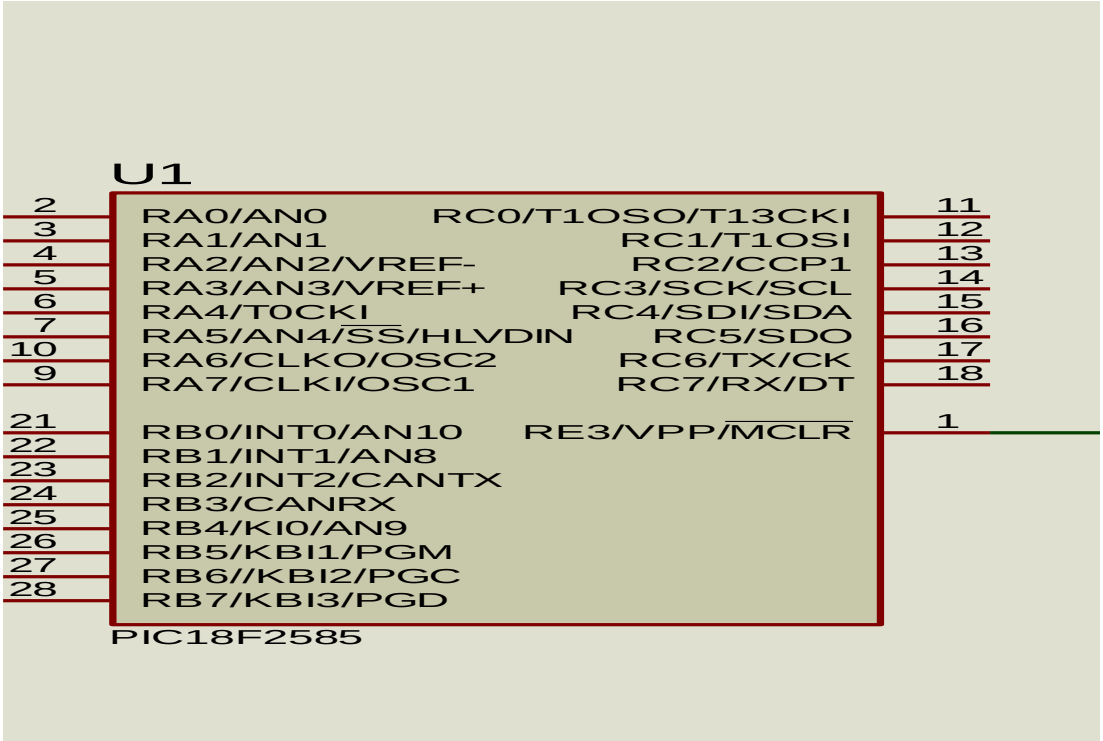

Figure 2: Schematic diagram of PIC18F2585.

Alcohol Detector Sensor (MQ3)

The analog gas sensor - MQ3 is suitable for detecting alcohol and It has high sensitivity to alcohol. The sensitivity can be adjusted by the potentiometer. It is recommended to calibrate the detector for 0.4mg/L (approximately 200ppm) of Alcohol concentration in air and use value of Load resistance (RL) about 200 KΩ (100KΩ to 470 KΩ). The sensitive material of MQ-3 gas sensor is SnO2, which has lower conductivity in clean air. When the target alcohol gas exists, the sensor's
conductivity is higher along with the gas concentration. The use of simple electro circuit converts the change of conductivity to correspond to output signal of gas concentration.

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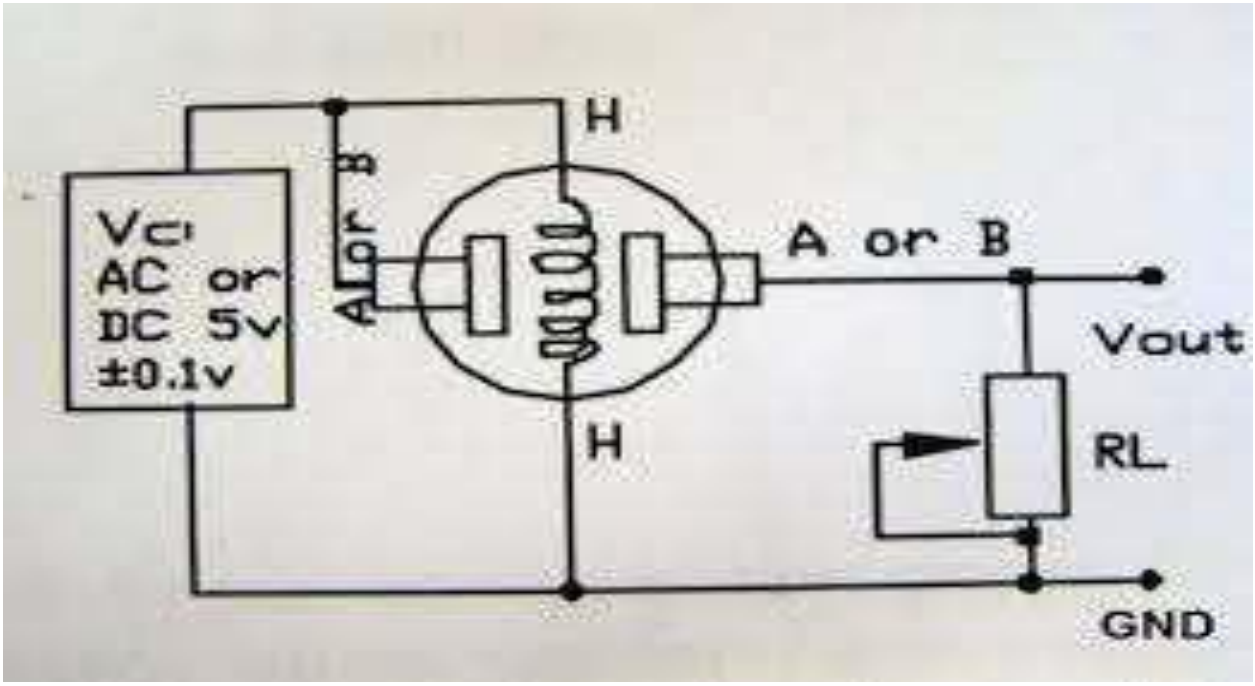

Figure 4: Schematic diagram of MQ3 Alcohol sensor

Table 1: Technical Parameter of MQ3 Alcohol Sensor

Model	MQ-3
Sensor type	semiconductor
Standard encapsulation	plastic cap
Detection range	25 – 500 ppm alcohol
Standard circuit condition loop voltage V_C	≤ 24VDC
Heater voltage V_H	5.0V±0.1V AC or DC
Load resistance R_L	adjustable
Heater resistance R_H	29Ω±3Ω
Heater consumption	≤900mW
Sensitivity S	Ro(in air) / Rs(125ppm C_2H_5OH) ≥ 5
Output voltage Vs	2.5V – 4.0V (in 125ppm C_2H_5OH)
Concentration slope	≤ 0.6 (R300ppm / R50ppm C_2H_5OH)

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Standard test condition temperature	20°C±2°C
Standard test condition humidity	55%±5 RH
Standard test circuit	V_C=5.0V±0.1V , V_H = 5.0V±0.1V
Preheat time	Over 48 hours

Liquid Crystal Display (LCD)

LCD modules are commonly used in most embedded projects to show alpha numeric characters because they are cheap, available and are programmer friendly. An Interface IC like HD44780 is mounted on the backside of the LCD Module. The function of this IC is to get the Commands and Data from the MCU and process them to display meaningful information onto our LCD Screen. LM016L is used for this project and it has a total of 16 pins and it can display 16 characters in two lines. A 10K ohm potentiometer is connected with pin three to set the contrast of the LCD. It also contains backlight LED.

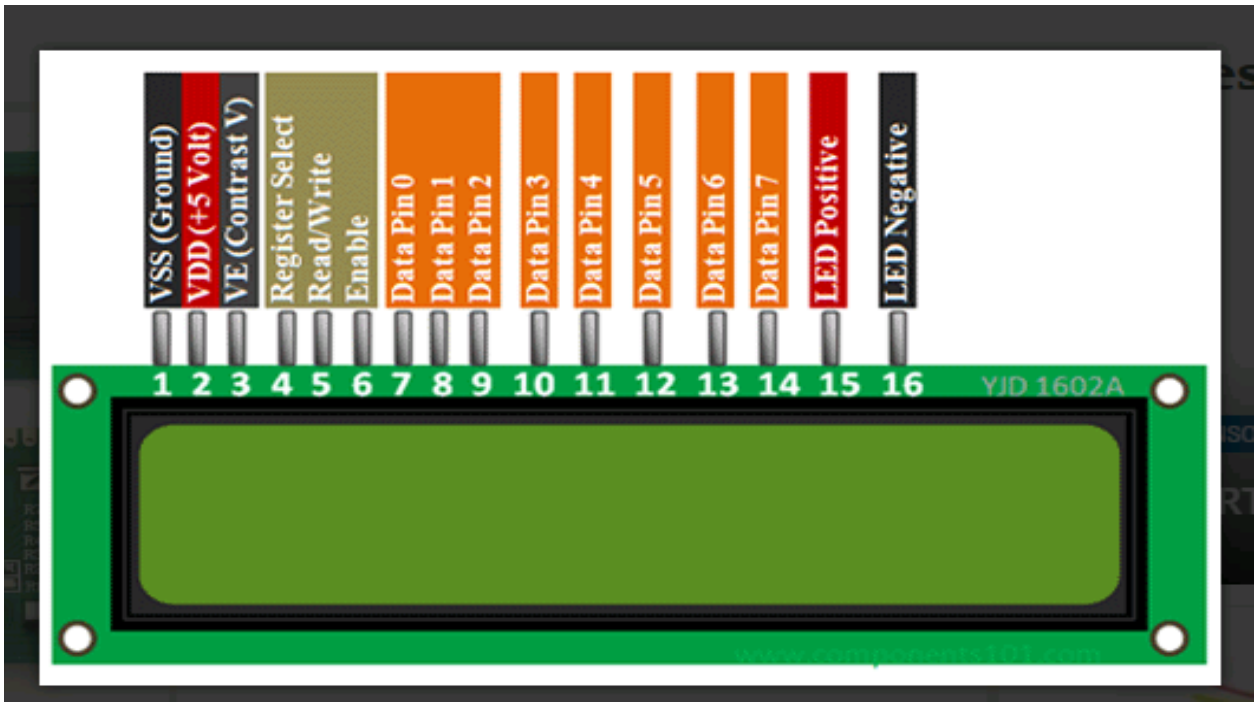

Figure 5: LCD MODULE (LM016L)

Buzzer

Buzzers are electronic transducers. They are widely used in timers, alarms, electronic toys, computers, telephones and other products where generation of sound is required. Some buzzers require more current than the microcontroller digital pin gives; we will have to connect a MOSFET to amplify the current. An active buzzer is used for this project and generates sound at an audible frequency of 2 kHz when powered.

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Figure 6: An Active Buzzer

GSM Modem/Module

The GSM modem is used for communication between the user mobile phone and the microcontroller. It is a wireless base modem, accepts SIM card and works on the principle of used mobile phone subscription. SIM900D GSM module uses "AT" commands for SMS, CALLS and GPRS. Before interfacing GSM module with microcontroller, it is necessary to check that the transmit (TXD) and receive (RXD) pins of GSM module and microcontroller are compatible with each other. Maximum input voltage to receive (RXD) pins of GSM module is 3V and maximum output voltage of transmit (TXD) pins of GSM module is about 2V. The voltage at transmit (TXD) and receive (RXD) pins of PIC microcontrollers is about 4V to 5V.

MAX232 Transceiver

MAX 232 IC is a voltage converter used for serial communication between the microcontroller and GSM modem. It is a dual channel integrated circuit IC and is powered up with 5V DC supply. Baud rate is the number of bits transferred per second from one device to another and it is an important factor to consider when using serial communication. SIM900D GSM module support 9600 baud rate with Universal Asynchronous Receiver and Transmitter (UART) type serial communication while the PIC microcontroller have in- built hardware to implement UART serial communication.

DC Motor

The working of this system is checked by connecting the DC motor to one ofthe digital output of the microcontroller through a relay switch as an interlock to the system. The "normally closed" contact of the relay switch opens and stops the motor when excess alcohol is detected while the "normally open" contact closes to light up an LED indicating a TRIPPAGE.

Power Supply

The Power supply is designed using a transformer for step down of AC voltage from 220V to 12V. The transformer is connected to the Bridge Rectifier to convert the AC voltage into DC.The voltage Regulator (LM7805) isused to regulate the 12V DC to 5V DC voltage required to power the system. Alternatively, a 9V battery can be used in conjunction with a 7805 regulator to provide the required 5V.

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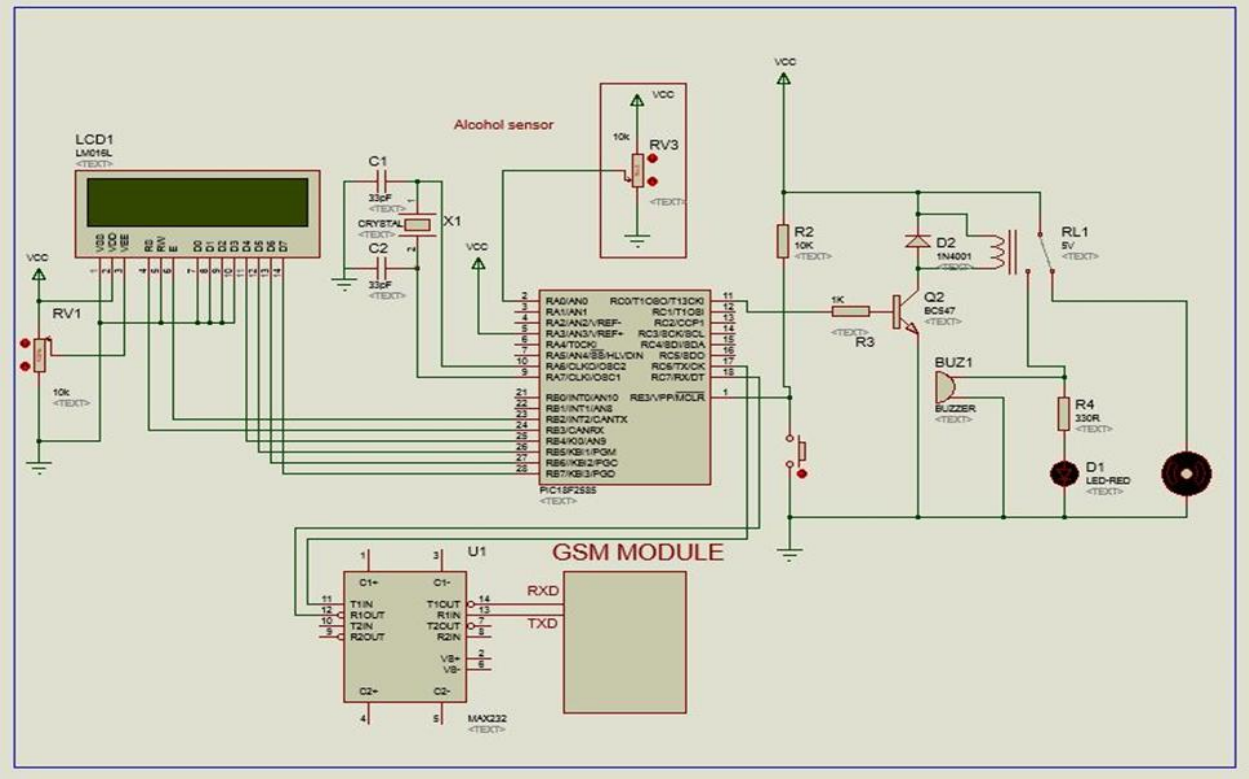

Figure 7: Circuit diagram of the "Factory Worker Alcohol Detector System with Automatic Machine Shutdown"

III. METHODOLOGY

There are several C compilers used to develop C-based high-level programs for PIC18 microcontrollers. For this seminar presentation, the program is written in C- language, using "micro C PRO for PIC" integrated development environment (IDE).

Flow Diagram

The flow diagram for the "Factory Worker Alcohol Detector with Automatic Machine Shutdown" is given in Figure 8. The flow diagram clearly shows the sequence and steps followed in the program.

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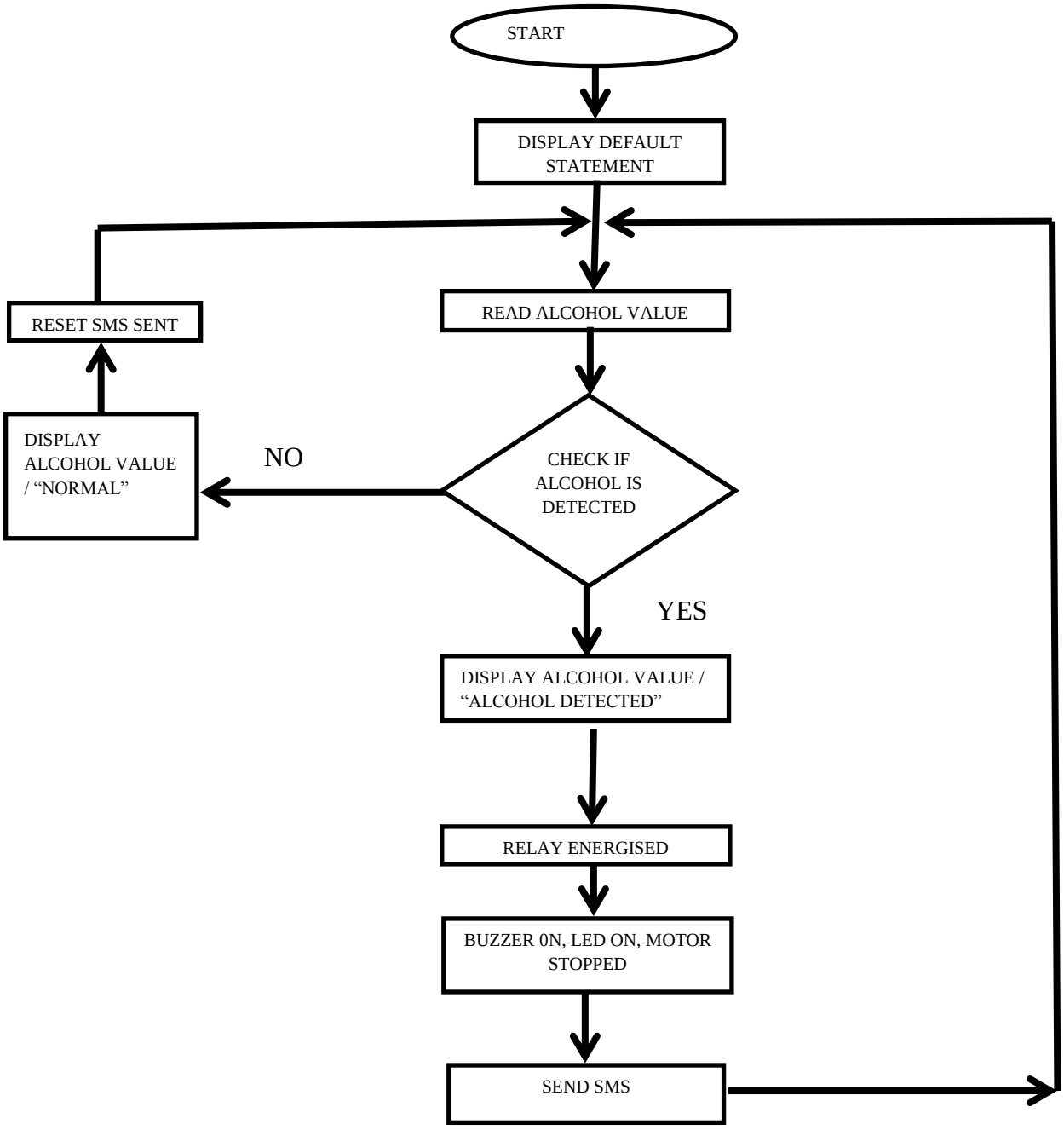

Figure 8: The flow diagram for the "Factory Worker Alcohol Detector with Automatic Machine Shutdown"

IV. PROGRAMMING AND TESTING

The program was tested using both software and hardware debugging. The simulation of the program was carried out in the "micro C PRO for PIC" integrated development environment (IDE) to verify the accuracy of the syntax as well as the logical flow of the program. The main objective of the debug process was to ensure that all file registers and memory locations held their correct values after the execution of each program instruction.

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The PROTEUS Development Environment enables us to test hardware in software environment before the hardware can actually be constructed. In order to do this, the schematic of the entire hardware was reproduced in PROTEUS environment. The target microcontroller (PIC18F2585) was loaded with the program and the performances of all the hardware components were observed as the program was sequenced through its steps. The program was thoroughly tested and observed, performing as required.

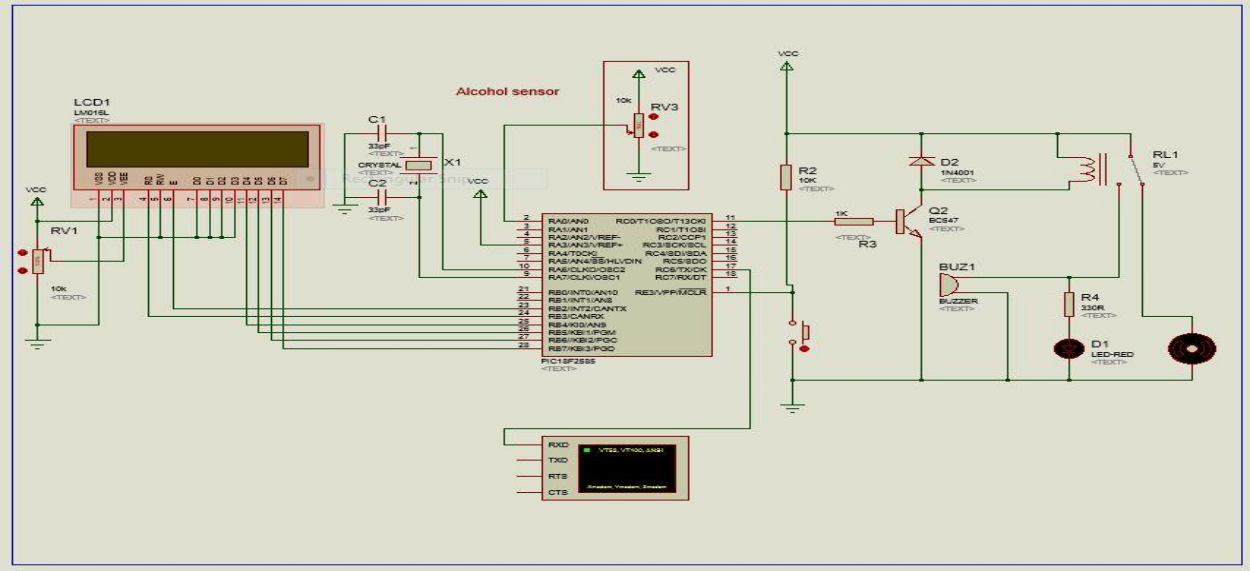

Figure 9: Schematic Diagram on Proteus

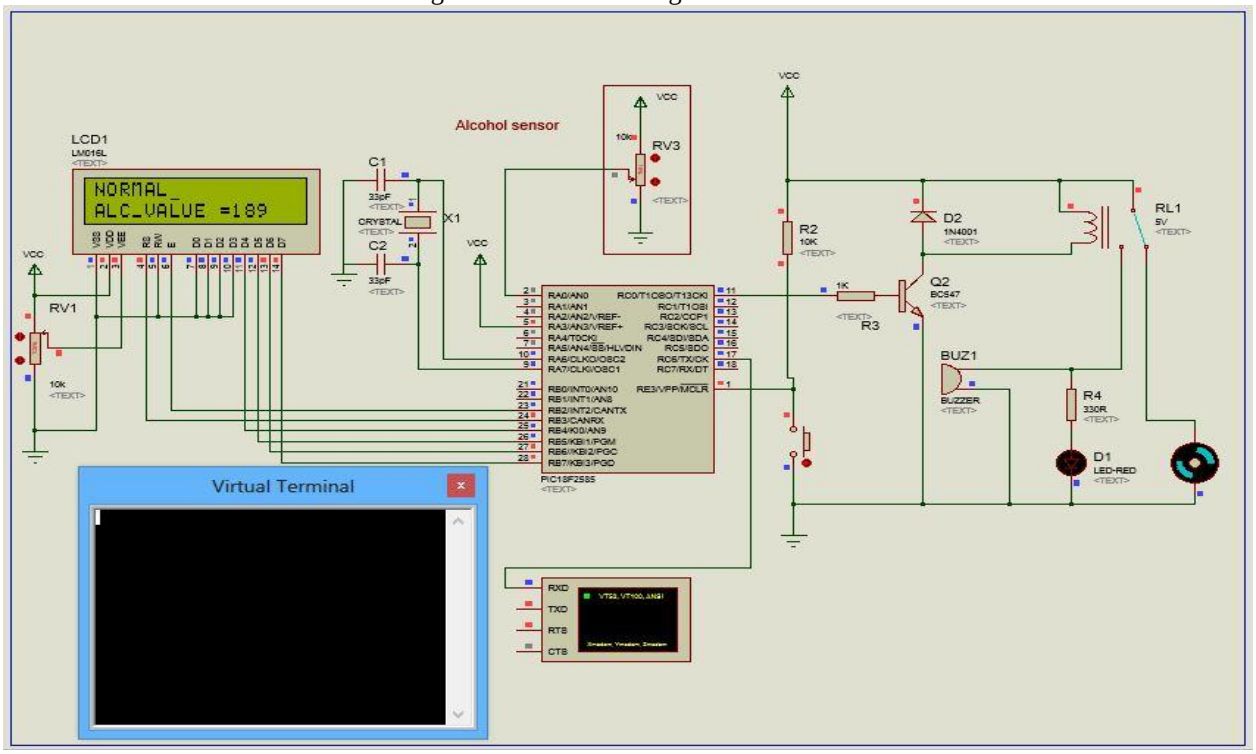

Figure 10: Proteus diagram for Normal Alcohol value

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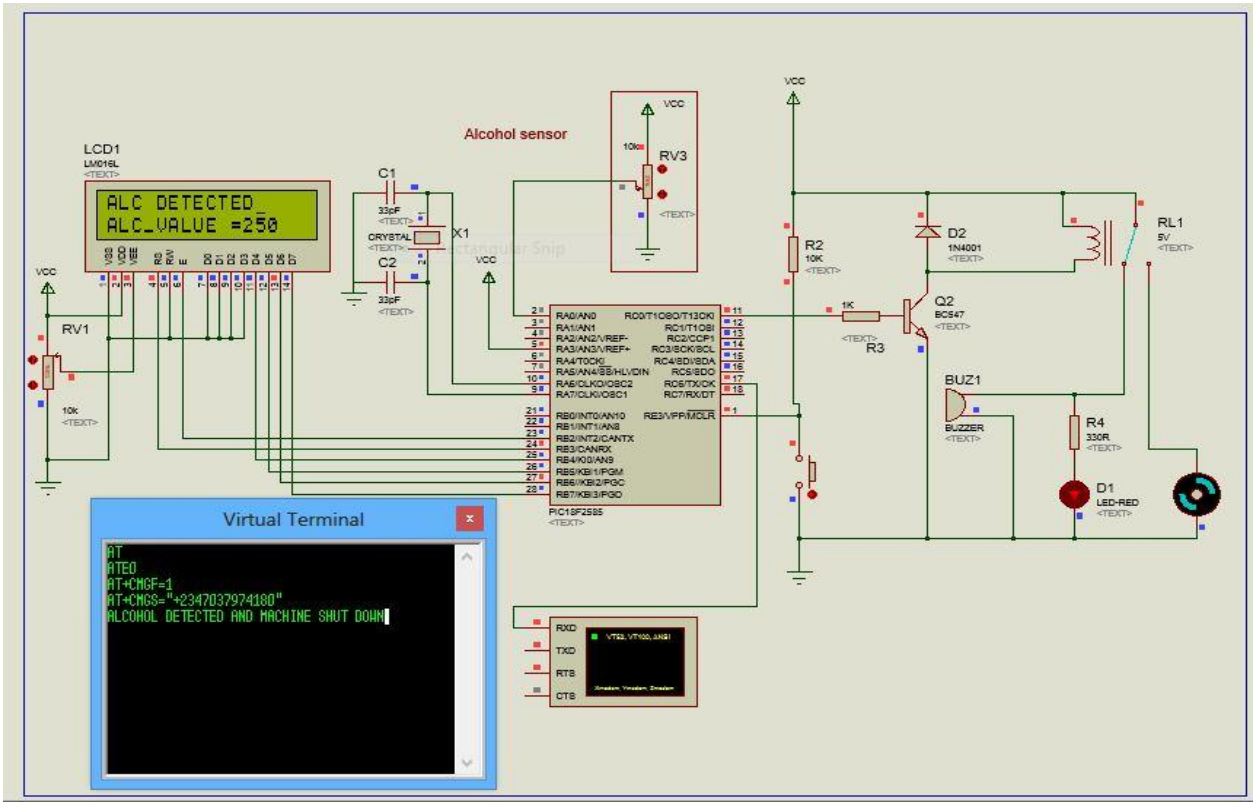

Figure 11: Proteus diagram of Alcohol value above threshold

V. CONCLUSION

The circuit was simulated after the installation of the programmed microcontroller (PIC18F2585) in the target application circuit with all the hardware components interconnected as required in Proteus. The "Factory Worker Alcohol Detector System with Automatic Machine Shutdown" circuit was observed to have performed as required:

- It measured the alcohol value when the variable resistor was varied to simulate change in the alcohol concentration in the worker's breath.
- The measured alcohol value was compared with the set threshold value of 200ppm and the circuit gave the required outputs.
- When the alcohol level was below the threshold value, The LCD displayed "Alcohol Normal," the motor ran without alarm and LED trip indication.

When the alcohol level went above the threshold value, the LCD displayed "Alcohol detected" and the machine was shutdown automatically. The relay was also energised, the buzzer and LED came on and an SMS was sent to the authorised GSM number as displayed on the Virtual Terminal.From all measurements and indications, the circuit was observed to have performed as required.

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