INTELLIGENT HELMET FOR COAL MINERS

MINI PROJECT REPORT

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BACHELOR OF TECHNOLOGY

In

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CERTIFICATE

This is to certify that the project report entitled ***"Intelligent helmet for coal miners"*** *submitted by* ***Anjana P U, Krishnendu M, Sajjad S P, Vishnu Balachandran*** *to the University of Calicut towards partial fulfilment of the requirement for the award of the Degree of Bachelor of Technology in Electronics and Communication Engineering is a bonafide record of the work carried out by them under my supervision and guidance.*

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ABSTRACT

This project tackles the problem of coal mine accidents which results in the death of several people per year. It is found out that the rate of fatality in the coal mine industry is nearly six times the rate for all private industry. And most of these accidents are due to toxic gasses, fires and lack of rescue system.

By implementing a Coal Mine Surveillance robot, which can move around unmanned in the mine and detect the level of different toxic gases and temperature level and report them live to the control room, this level of fatality can be considerable reduced. The objective of this project is to accomplish this task.

From a technical aspect this project is software and hardware oriented project. It requires very specific types of sensors, and innovative methods in transmitting and receiving data. Because a conventional approach will not do much good from an industrial aspect

The project can be considered valid if it can detect different sorts of gases, the temperature and give a warning to the miners inside the mine in case of a danger, at the same time transmitting all the data to the control panel. The data send to the control panel can make a lot of difference, setting up and giving strategies to a rescue team for rescue will make the rescue very efficient.

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List of abbreviations

LCD **Liquid Crystal Display**

MHz **Mega Hertz**

PCB **Printed Circuit Board**

µC **Microcontroller**

CHAPTER 1

INTRODUCTION

In the last few years for almost every country has one aspect that is environmental care. In last decades, without any control, accidents in industries have been increasing. So current situation in industries is more hazardous. Recently, for monitoring and control of environmental parameter in hazardous environment, modern industries require instrumentation. Because human safety and property losses are important to maintain in industrial environment.In coal mines, whenever explosions occur, the rescue work is done by rescue worker without any priorknowledge of the environmental condition inside coal mines because mine monitoring system may be destroyed ordamaged. This makes the life of rescue workers very risky. Coal mine accidents are unpredictable, due to number of factor this accidents are occur. Because of this accidents the human live is in danger. Coal mine monitoring system is wired system then the arrangement of the system become complex. When any type accidents occur we have a chance of breakages in fibres. We do not have continuously getting the information in such cases. We will not have direct contact to the Ground section. Inside mines due to uncomfortable situation the installation cost as well as maintenance cost is high for wired communication networks.

Wireless Sensor Network

Number of sensor connects to controllers and processing stations directly. An increasing number of sensors communicate with each other and share the collected data wirelessly to a processing station which is centralized. This is very much important because many network applications consist of hundreds or more number of sensor nodes, often established in remote area and inaccessible areas. Therefore, a wireless sensor has sensing component, on-board processing, communication, and storage capabilities. With these enhancements, a sensor node is responsible for data collection, network analysis, correlation. When number of sensors collectively monitors physical parameters, they create a wireless sensor network (WSN). Sensor nodes are communicate with each other and sensor nodecommunicate with a base station using their wireless radios, allowing them to send their sensor data to remote processing, visualization, analysis, and storage systems.

CHAPTER 2

LITERATURE REVIEW

2.1 BLOCK DIAGRAM

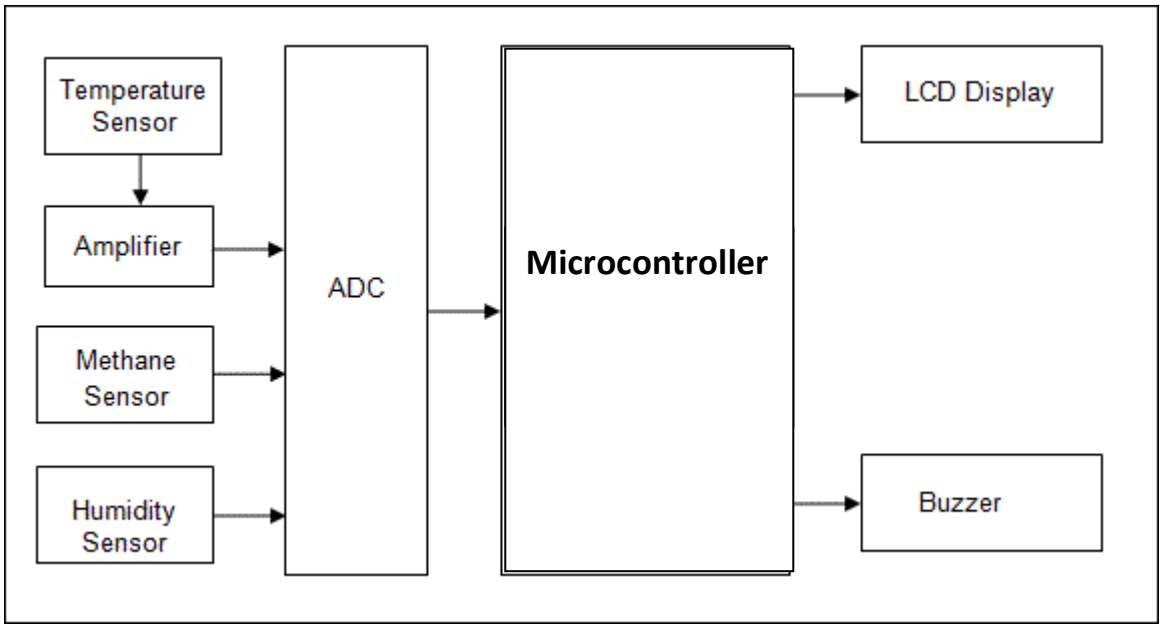

Fig No.2.1 Block diagram of intelligent helmet

2.1.1 BLOCK DIAGRAM EXPLANATION

This project is designed to provide intelligent helmet for Coal miners and safety monitoring of coal miners. Various parameters like Methane gas, Carbon monoxide as, Temperature and Humidity are monitored for the safety of coal miners. These sensors should be fitted in the helmet of coal miners. The block diagram contains Microcontroller, ADC, various sensors like Gas sensors, Temperature sensors, Light sensors, Humidity sensors LCD Screen and Buzzer. These sensors sense the various environmental conditions inside the mine. The sensed analog signals are then converted to digital signals by the ADC (Analog to Digital Converter).The digital signals are then provided to the Microcontroller which processes the output signals. Whenever any parameter crosses a particular threshold value, a buzzer is turned on so as to indicate the miner about the danger .The values of gas, temperature, light and humidity are provided by the LCD screen. The LCD and the buzzer are the outputs of the block diagram.

2.2 CIRCIUT DIAGRAM

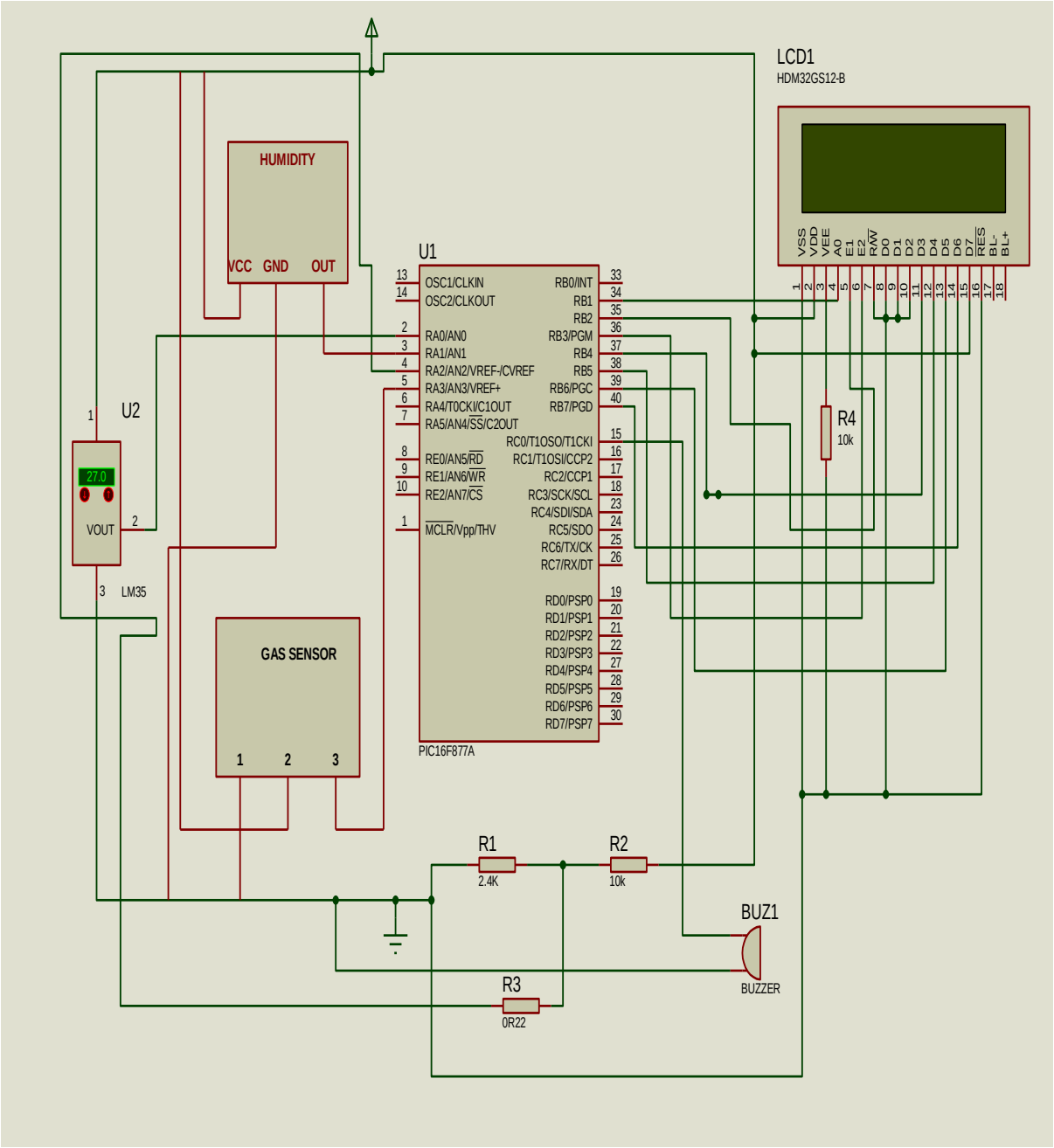

Fig.2.2 Circuit diagram

2.2.2 CIRCUIT EXPLANATION

The circuit mainly consists of a microcontroller, LCD display, gas sensor, temperature sensor, light sensor, humidity sensor. The three sensors are given as input to the microcontroller and the output is obtained in the LCD display. The commonly used temperature sensor is LM35. The advantage of this device over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient centigrade scaling. MQ6 is the gas sensor used depending on the type of gas to be sensed, physical dimensions and numerous other factors.

The circuit has an input and output sections. These are connected to the microcontroller. The LM35 sensor is connected topin2, the humidity sensor to pin3, light sensor to pin4 and the gas sensor to pin5 of the microcontroller. A crystal oscillator of 20MHz frequency is connected between pin13 and pin14. VCC is given at pin11 and ground to pin12. A buzzer is given at pin15 of the controller which warns when any of the input exceeds its threshold limit.

The LCD display is a 16*2 bit which is two layered. Pin 4(RS) is connected to RB1 (pin34) pin of microcontroller, pin5 to the RD/WR(RB2), enable pin6 to the RB3(pin36), pin11 to the RB4, pin12(D5) to the RB5(pin35), pin13 to RB6(pin39), pin14 to RB7(pin40) of the microcontroller. Pins7,8,9,10 are shorted to the ground pin1. VCC of +5v is given to the pin2 and to pin15. The two layers of the LCD is 16 bit each and the first 16 bit ranges from 80 to 8F and the next row from C0 to CF.

2.22 Flow chart

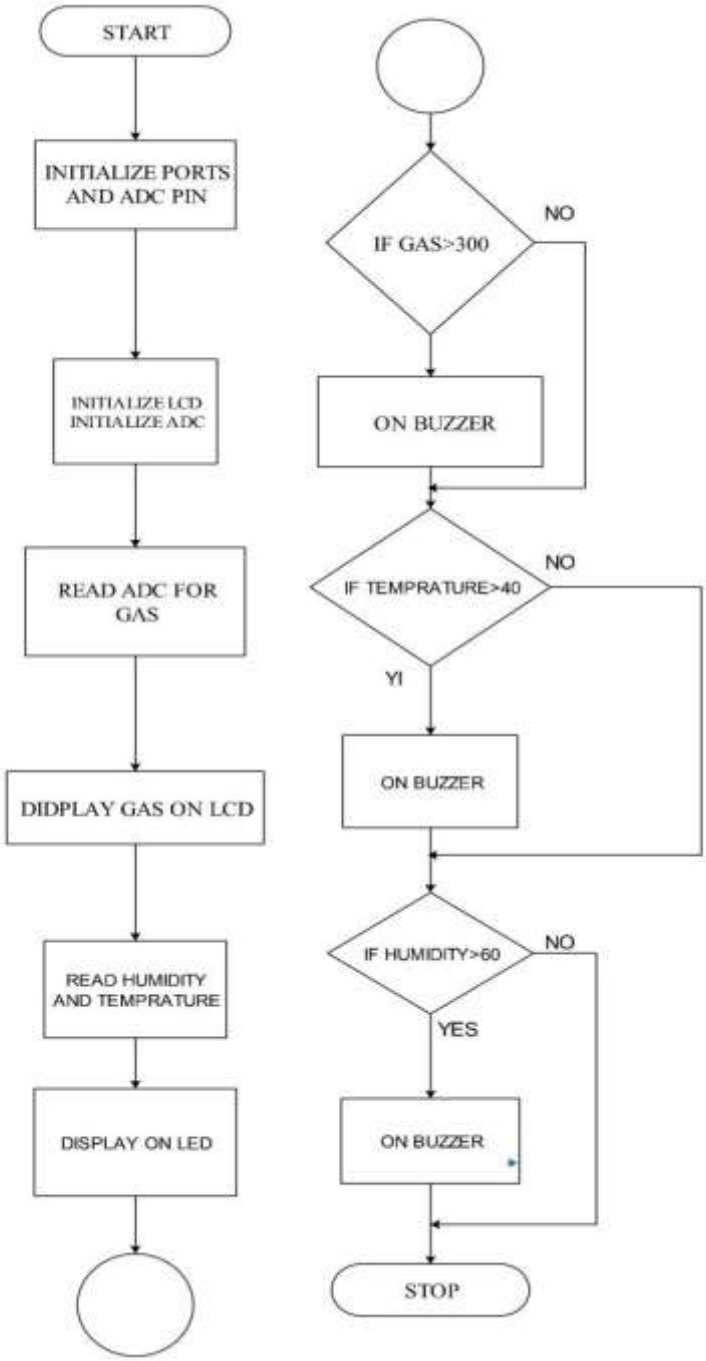

Fig No.2.3 Folw chart of program

2.3 HARDWARE SECTION

2.3.1 MICROCONTROLLER PIC16F877A

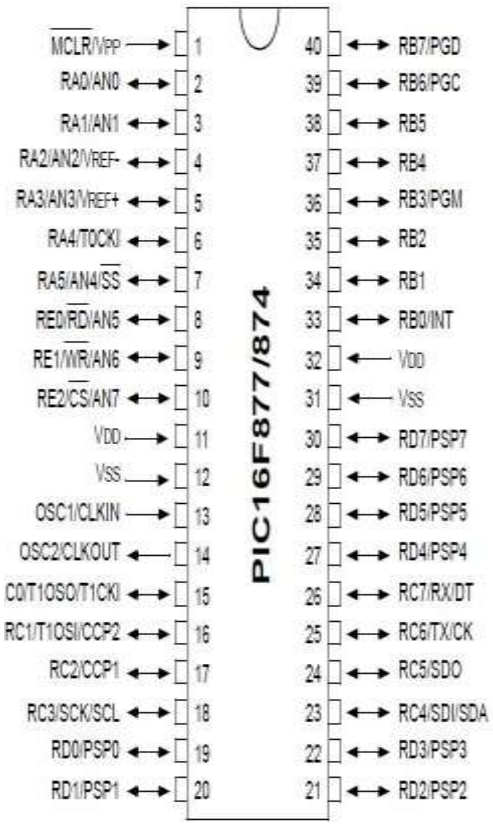

fig 2.4: Pin diagram of 16F877A

The PIC 16F877A is a low-power, high-performance CMOS 8-bit microcomputer with 8K word of Flash Programmable and Erasable Read Only Memory (PEROM). The device is manufactured using Microchip's high density nonvolatile memory technology and is compatible with its RISC instruction. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the PIC 16F877A is a powerful microcomputer which provides a highly flexible and cost effective solution for many embedded control applications.

This is a software controlled system, and it makes use of an 8 bit microcontroller PIC16F877A, is a 40 pin IC having 5 I/O ports (33 I/O pins). It has 14 interrupts, 8 A/D input channel, USART with 9 bit address detection, 8K x14 words Flash Program Memory, 368 x 8 bytes of Data Memory (RAM), and 256 x 8 bytes of EEPROM Data Memory.

Whether the temperature reaches at extreme conditions the system takes appropriate decisions to on /off cooler ,fan & heater within 1 minute. If the time exceeds 5 minutes, System failed & control will turn to GPS and GSM, and the buzzer turned on. GPS locates the soldier's current co-ordinates and Send messages to desired numbers using GSM modem.

MICROCONTROLLER CORE FEATURES

- High performance RISC CPU
- Only 35 single word instructions to learn
- All single cycle instructions except for program branches which are two cycle
- Operating speed: DC - 20 MHz clock input DC - 200 ns instruction cycle
- Up to 8K x 14 words of FLASH Program Memory, Up to 368 x 8 bytes of Data Memory (RAM) Up to 256 x 8 bytes of EEPROM Data Memory
- Pin out compatible to the PIC16C73B/74B/76/77
- Interrupt capability (up to 14 sources)
- Eight level deep hardware stack
- Direct, indirect and relative addressing modes

- Power-on Reset (POR)
- Power-up Timer (PWRT) and Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving SLEEP mode
- Selectable oscillator options
- Low power, high speed CMOS FLASH/EEPROM technology
  - In-Circuit Debugging via two pins
  - Processor read/write access to program memory
  - Wide operating voltage range: 2.0V to 5.5V
  - High Sink/Source Current: 25 mA
  - Commercial, Industrial and Extended temperature ranges
  - Low-power consumption:
  - < 0.6 mA typical @ 3V, 4 MHz
  - 20 μA typical @ 3V, 32 kHz
  - < 1 μA typical standby current

Peripheral Features:

- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler, can be incremented during SLEEP via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare, PWM modules
- Capture is 16-bit, max. resolution is 12.5 ns
- Compare is 16-bit, max. resolution is 200 ns
- PWM max. resolution is 10-bit
- 10-bit multi-channel Analog-to-Digital converter Synchronous Serial Port (SSP) with SPI (Master mode) and I2C (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) 8-bits wide, with external RD, WR and CS controls (40/44-pin only) Brown-out detection circuitry for Brown-out Reset (BOR)

2.3.2 GAS SENSOR MQ6

MQ 6 Gas sensor is used as LPG, Butane and Propane Sensor to generate alarm when there is leakage of these gases from the source. MQ6 is a highly sensitive gas sensor to petroleum based gases but less sensitive to Alcohol and Carbon di oxide. This simple sensor can be installed in the kitchen to give warning alarm if there is leakage of LPG.MQ6 gas sensor is a 6 pin device and it requires 5 volt DC maximum which is derived from a Zener based power supply. There is a heating element inside the sensor which becomes hot at 5 volt and remains stand by.

When the sensor detects gas molecules between 100 ppm to 1000 ppm, in the atmosphere, its output turns high and triggers to activate the buzzer. Red LED indicates the high output from the sensor.

Fig No.2.5 Gas sensor

Gas detection sensors measure the concentration of different gases in the atmosphere. There are different technologies by which these sensors operate. These sensors are used in households, industries, mines, laboratories, and places with chance of toxic gas exposures in order to prevent toxic exposure and fire. These detectors are often battery operated devices used for safety resolutions. They are made as portable or stationary units and work by indicating high levels of gases through audible or visible indicators, such as alarms, lights or even some time connected to operate actuators attached to a vent or exhaust system.

While many of the older, standard gas detector units were originally fabricated to detect one gas, modern multifunctional or multi-gas devices are capable of detecting several gases at once. As the sensor measure a specified gas concentration, usually in PPM (parts per million), the sensor response serves as the reference point or scale. When the sensor detects a higher ppm of gas in comparison to its reference, an alarm will actuate to warn the user.

Gas Detector Technologies

Gas detection sensors are categorized by the category of gas they detect: combustible or toxic. Within this broad categorization, they are further defined by the technology they use: catalytic and infrared sensors detect combustible gases and electrochemical and metal oxide semiconductor technologies generally detect toxic gases (Anon,).

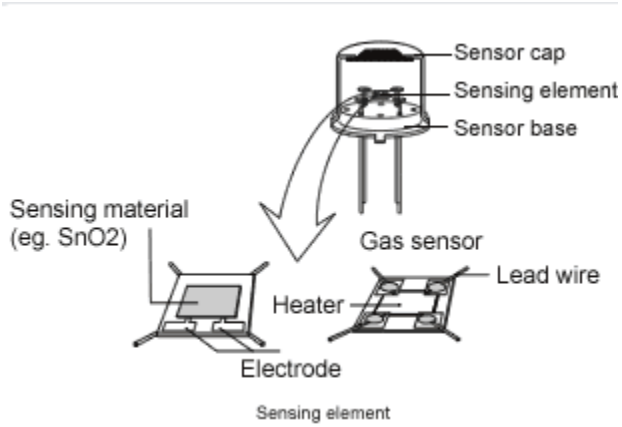

Fig No.2.6 Gas detector technology

2.3.3 TEMPERATURE SENSOR LM35

Another essential component of this project is a temperature sensor. Just like all other technologies or components, the basic temperature sensor has also undergone many changes as part of the growth in technology. In outwards it has become much more compact, durable and most importantly precise.

Today most temperature sensors use a solid-state mechanism to determine temperature. Previously there were temperature sensors which used elements like mercury to determine temperature. Then there were sensors using bimetallic strips like the once used in the stoves and furnace. There was also temperature sensors based on heat sensitive resistors.

But modern temperature sensors use a very different approach; they determine the temperature by analysing the increase in voltage across a diode. This increase in voltage across the diode shows the increase in temperature. Theoretically this is the voltage drop between the base and emitter, the VBE of a transistor. Amplifying the voltage change between this base and emitter an analogue signal can be obtained which is proportional to the temperature. The exact sensor used for this project, the reason for using it and its specifications are discussed.

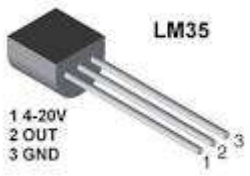

Fig No.2.7 Temprature sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level.

The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than 0.1°C in still air.

The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

2.3.4 HUMIDITY AND LIGHT SENSOR

The HIH-5030 Low Voltage Humidity Sensors operate down to 2.7 V. It is designed specifically for high volume OEM (Original Equipment Manufacturer) users. With a typical current draw of only 200 ìA, the HIH-5030 is ideally suited for many low drain, battery operated systems. The HIH-5030 delivers instrumentation-quality RH (Relative Humidity) sensing performance in a competitively priced, solderable SMD. We chose Light Dependent Sensor (LDR) which features like wide spectral response, wide ambient temperature range and low cost.

Fig 2.8. Humidity sensor

2.3.5 LCD DISPLAY 16x2

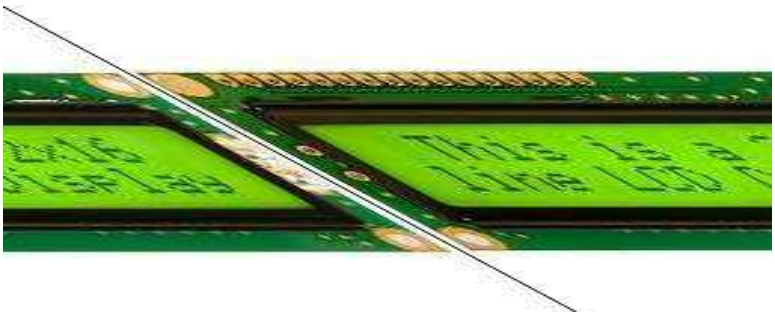

Fig.2.9 :LCD display

Frequently, a microcontroller program must interact with the outside world using output devices that communicate directly with a human being. Oneof such common devices

attached to a microcontroller is an LCD display. LCD display unit displays all essential details such as temperature, number of persons inside the room, and etc. Some of the most common LCDs connected to the 8051 are 16*2 and 20*2 displays. This means 16 character per 2 lines and 20 characters per line by 2 lines, respectively.

Fortunately, a very popular standard exists which allows us to communicate with the vast majority of LCDs regardless of their manufacturer. The standard is referred to as HD44780U, which refers to the controller chip which receives data from an external source (in the case, the PIC16F877A) and communicates directly with the LCD.

FEATURES

- Easy interface with a 4/8-bit MPU.
- Built-in dot matrix LCD controller with font 5x7 or 5x10 dots. Display data RAM for 80 characters (80x8 bits).
- Character generator ROM which provide 160 characters.
- Both DD ram and CG ram can be read from MPU.
- Internal automatic reset circuit at power on.
- Built-in oscillator circuit.
- Wide range of instruction functions: clear display, cursor home, display on/off, sources shift, etc.

When connecting the LCD module to a parallel I/O device, the burden of ensuring proper operation falls on the software. Incorrect combination of data bus direction and R/W pin logic can irreversibly damage the module. At the interface of LCD module, there are three power supply terminals- Vdd, GND, Vo. The LCD is driven by the voltage which is determined by Vdd-Vo.

Since the optimum voltage for LCD shifts according to temperature changes, voltage at Vo terminal needs to be adjusted.

The data bus lines DB7-DB0 has the capacity of driving one TTL of capacitance 130pF. The data bus terminals have tri-state construction. When the enable signal is at the low level, these data bus terminals will remain in a high impedance state. The data bus terminals has pull-up MOS: so, when the data bus is open, it produces a high output voltage. When the busy flag is at a high level, it indicates that the controller is in the internal operation mode and the next instruction will not be accepted. The next instruction must be written after the busy flag goes low.

ADDRESS COUNTER (AC)

The address counter generates address for DD RAM, CG RAM and for the cursor display. When an instruction code for DD RAM or CG RAM address is written to the controller after deciding whether it is DD RAM or CG RAM, the address information is transferred to the AC. After writing into or reading from DD RAM or CG RAM, AC is automatically incremented or decremented. The data of the AC is output to the DB0-DB6, when RS is 0 and R/W is 1.

CHARACTER GENERATOR MEMORY

The CG ROM generates 5x7 dot or 5x10 dot character patterns from the 8-bit character codes. It can generate 160 types of 5x7 dot character patterns. When the 8-bit character code of a CG ROM is written to the DD RAM, the character pattern of the CG ROM corresponding to the code is displayed on the LCD display position corresponding to the DD RAM.

The CG RAM is the RAM with which the user can generate character patterns by programs. The CG RAM has the capacity to store 8 kinds of 5x7 dots.

DISPLAY DATA RAM

The DD RAM stores the display data represented by 8-bit character codes. Its capacity is 80 characters. Depending on the 8-bit character code that is written to the DD RAM LCD will select the character pattern either from the CG ROM or CG RAM.

The cursor is under the control of the microcontroller program. The display of the cursor on the LCD is made at a position corresponding to the DD RAM address given to the AC. The timing generation circuit is used to generate timing signals to operate on the internal operations upon reception of the microcontroller instructions and also for such internal circuits as the CG RAM, DD RAM and CG ROM.

It is so designed that the external operation by the accessing MP3 will not interfere with the internal operation of the LCD display. Therefore, when writing data to the DD RAM, for example, there will be no undesirable influence, such as flickering on the display area. In addition, this circuit also generates the transfer signal to the externally connected driver chips display character expansion.

INSTRUCTION CODE

The instruction code is a command set through which the LCD module is controlled by the MPU. Prior to the internal execution of the instruction code, control information is temporarily stored in the internal registers of the module, to allow interface of various types of MPU, which operate at different speeds. The LCD module begins its operation upon the reception of instruction codes from the MPU.

Different instruction codes and various abbreviations are as below:

S=1: Accompanies display shift when data is written, for normal operation set to 0.

I/D=1/0: Increment/decrement

DL=1/0: 8-bits/4-bits

S/C=1/0: Display shift/cursor move

N=1/0: 2 line/1 line

R/L=1/0: Shift to the right/ shift to the left

F=1/0: 5x10 dots/ 5x7 dots

BF=1/0: Internally operating/ can accept instruction

*: Don't care

B=1/0: Blinking on/ off

C=1/0: Cursor on/off

D=1/0: Display on/off

CG RAM: Character generator RAM

DD RAM: Display data RAM

CG0-CG5: CG RAM address

DD0-DD6: DD RAM address corresponds to cursor address

BA0-BA6: address counter used for both DD RAM and CG RAM address

2.3.6 PIEZO BUZZER

Piezoelectricity is the ability of some materials (notably crystals and certain ceramics, including bone) to generate an electric field or electric potential[1] in response to applied mechanical stress. The effect is closely related to a change of polarization density within the material's volume. If the material is not short-circuited, the applied stress induces a voltage across the material. The word is derived from the Greek piezo or piezein, which means to squeeze or press.

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as microwave ovens, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a pareset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the

form of a continuous or intermittent buzzing or beeping sound or like electric bell without the metal gong (which makes the ringing noise).

Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to an 8-ohm speaker.

Fig.2.10 Piezo buzzer

Initially this device was based on an electromechanical system which was identical to an popular to use a ceramic-based piezoelectric sounder which makes a high-

pitched tone. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

In game shows it is also known as a "lockout system" because when one person signals ("buzzes in"), all others are locked out from signaling. Several game shows have large buzzer buttons which are identified as "plungers". The buzzer is also used to signal wrong answers and when time expires on many game shows, such as Wheel of Fortune, Family Feud and The Price is Right.

The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.

Fig.2.11 Buzzer

2.3.7 POWER SUPPLY

The power supply is the most indispensable part of any project. IC regulators are versatile and relatively inexpensive and are available with features such as current/voltage boosting, internal short circuit current limiting, thermal shutdown and floating operation for high voltage applications. The regulated circuit is used to maintain constant output level. The integrated circuit regulator, sometimes called the three terminal regulators contains the circuitry for reference source error amplitude control device and overload protection all in a single IC chip. The regulator IC here used isL7805. It provides regulated 5V to the controller. Its maximum input voltage is 35V and minimum voltage is 8V. Output is constant 5V.

The L7800 series of three-terminal positive regulators is available in TO-220, TO-220FP, TO-3 and D2PAK packages and several fixed output voltages, making it useful in a

wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

Different packages of L7805

Features

- output current up to 1.5 A
- Thermal overload protection •Short circuit protection
- Output transition SOA protection
- output voltages of 5; 5.2; 6; 8; 8.5; 9; 12; 15; 18; 24V
- Maximum input voltage =35V (for Vo=5 to 18V),
- =40V (for Vo=20 to 24V)

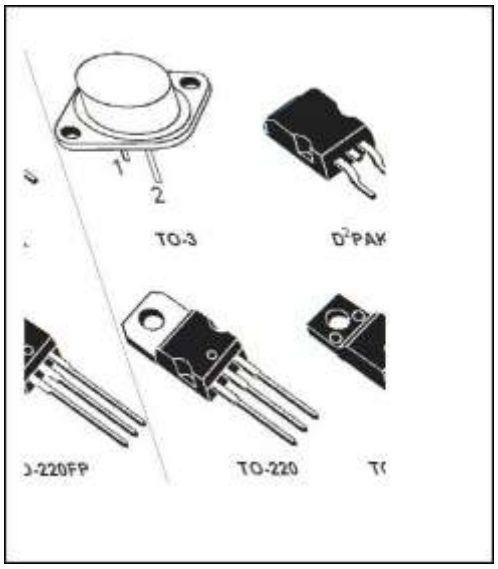

Fig.2.12 Power supply components

2.4 SOFTWARE DESIGN

2.4.1 PROGRAM

```
#include<pic.h>
#include"delay.h"
#include"lcd4bit.h"

#define HEAT    0
#define HUMID   1
#define LIGHT   2
#define GAS   3

#define BUZZ RC0

chardisp_buf[10];
int heat = 0;
int light = 0;
int sound = 0;
int humid = 0;
int  gas = 0;

unsignedintread_adc(char chn){
unsignedintval;
char chm;
        ADCON0 = 0x81 | (chn<< 3);
        for(chm=0;chm<100;chm++);
        ADGO = 1;
        while(ADGO==1);
        val= ADRESH;
        val = val<< 8;
        val = val | ADRESL;
        returnval;
```

```
        }

voiddtoa(char *ptr,unsignedintval,char digits){
ptr[digits] = 0;
        while(digits-- > 0){
                ptr[digits] = val%10 + '0';
                val /= 10;
                }
        }

int main(void){

ADCON1 = 0x80;
RBPU = 1;
TRISA0 = 1;
TRISA1 = 1;
TRISA2 = 1;
TRISA3 = 1;
TRISB = 0x01;
TRISD = 0x00;

lcd_init();

printlcd("     HELMET    ");
lcd_command(0XC0);
printlcd("               ");
DelayS(2);

lcd_command(0X80);
printlcd("HEAT:   C HUM:  ");
lcd_command(0XC0);
printlcd("LIGHT:  %  G:  %");
```

```
while(1){
        lcd_command(0X80);
        heat = read_adc(HEAT)*0.48;
        dtoa(disp_buf,heat,2);
        printlcd("HEAT:");
        printlcd(disp_buf);
        lcd_data(0xD8);
        printlcd("C HUM:");
        humid = read_adc(HUMID)/11;
        dtoa(disp_buf,humid,2);
        printlcd(disp_buf);

        lcd_command(0XC0);
        light = read_adc(LIGHT)/11;
        dtoa(disp_buf,light,2);
        printlcd("LIGHT:");
        printlcd(disp_buf);
        printlcd("%  G:");

        gas = read_adc(GAS);
        dtoa(disp_buf,gas,2);
        printlcd(disp_buf);
        printlcd("%");

if(gas > 200 || heat > 40 || humid > 60){
        BUZZ = 1;
        }
else{
        BUZZ = 0;
        }
        }
}
```

2.5 THE PCB DESIGN

Design of printed circuit board (PCB) can be considered as the last step in electronic circuit design as well as the first step in production. It plays important role in the performance and reliability of electronic circuits, the productivity of the PCB's its assembling, and its service ability depends on design. All these factors get reflected in a piece of electronic equipment. It is clear that task of PCB design is not very simple or always straight forward. The schematic is follower by layout generation. Layout design is the stage where engineering capacity combined with creativity is the governing inputs.

2.5.1 ELECTRONIC DESIGN AUTOMATION TOOLS

Most product testing is being done is done with the help of computer programs.The term Electronic Design Automation (EDA) is being used to describe the use of these tools. With the help of advanced powerful computing systems and interactive software tools and development of electronic circuits has undergone automation. Thus the software and hardware tools, which enables this automation includes PCB designing, IC design, circuit simulation etc. These tools help us in such a way that we can draw the circuit; test the functioning of the circuit in response to test inputs in simulation software.

After successfully simulation we can get the PCB art work done by replacing the routing software. The design automation tool used here is EAGLE (Easily Applicable graphics Layout Editor.)

2.5.2 PCB DESIGN PROCEDURES

The PCB designing procedure consists of following steps:

- **Drawing the circuit schematic**

Drawing of circuit is done through EAGLE schematic. It includes many libraries with thousands of component symbols. We can select the required symbol from the library and place it in the schematic page. After placing the component symbols, we can complete the interconnection using wire or bus control.

The next step is to assign part reference. Each component has to be assigned footprint or PCB pattern name. The footprint gives the actual size physical representation of Components on the PCB artwork. The component symbol and foot symbol should correspond in all respects.

- **Design Rule Check and net list creation**

After the circuit schematic is completed with all required information such as part reference and footprints, the design rule check can be used for checking errors in the design. It will check for duplicate symbols, overlapped lines and dangling lines.

After the schematic design file passes the DRC check, it is processed by a program called an electric rule checker (ERC) that checks for writing errors. The final operation to be done before starting PCB artwork is the net list creation.

A net list creation of the components and interconnection along with other information such as foot prints, track width etc. A net list software or tool can take the circuit schematic as input and generate net list. The net list can be used as an information source for the remaining stages.

- **Creating the PCB artwork**

In automatic design, the net list obtained from the previous stage is used for getting the required foot print and interconnections. The software used for the PCB artwork design in the EAGLE layout.

- **PCB fabrication**

The PCB consists of an insulating base material on which conductors are attached by photographic method or screen-printing method or manual method. The PCB with conductors only one side of the base material is called single sided PCB and with conductors on both sides called double sided PCB. The insulating material gives mechanical rigidity and electrical isolation for the printed conductor. The following steps are involved in the fabrication of PCB.

- Preparation of layout
- Transfer the layout in to copper.
- Etching to remove the copper from the copper clad wherever it is not required

First step is the drawing of the layout on the copper clad. The layout is coated with a material such as paints, to retain the copper lines on the PCB. After painting the clad sheet is dipped in the solution of ferric chloride. After sometime it can be seen that uncoated copper is etched out. The reaction taking place can be expressed by following equation.

$FeCl3 + Cu \longrightarrow CuCl + Fe$

There are some conditions for layout making. They are the following:

- The negative track must be larger than the positive track
- Positive side should be the upper side of the PCB and negative track is at the lower side of the PCB.
- Positive and negative track should not cross.
- Tinning angle of conductors should not be less than 90.
- Layout should be developed in the direction of the signal flow as far as possible.
- Larger component should be placed first and then decreasing order of the size
- Components required, input and output connection should near the end connections.
- While preparing layout draw the conductors only on grid lines.
- Spacing between conductors should be confirmed.

In the case of transformer, connects it on the outside of the PCB and connect the leads on the PCB. After the etching process drill the holes for mounting the components. Varnish the copper side of to protect it from oxidation. This PCB is ready for mounting the components.

➢ ETCHING

Ferric chloride etchant is a messy stuff, but easily available and cheaper than most alternatives. It attacks any metal including stainless steel. So when setting up a PCB etching area, use a plastic or ceramic sink, with plastic fitting and screws wherever possible, and seal any metal screws with silicon. Copper water pipes may be splashed or dripped-on, so sleeve or cover them in plastic; heat-shrink sleeve is great if you are installing new pipes. Fume extraction is not normally required, although a cover over the tank or tray when not in use is a good idea. You should always use the hex hydrate type of ferric chloride, which should be dissolved in warm water until saturation. Adding a teaspoon of table salt helps to make the etchant clearer for easier inspection. Avoid anhydrous ferric chloride. It creates a lot of heat when dissolved. So always add the powder very slowly to water; do not add water to the

powder, and use gloves and safety glasses. The solution made from anhydrous ferric chloride doesn't etch at all, so you need to add a small amount of hydrochloric acid and leave it for a day or two. Always take extreme care to avoid splashing when dissolving either type of ferric chloride, acid tends to clump together and you often get big chunks coming out of the container and splashing into the solution. It can damage eyes and permanently stain clothing.

If you are making PCBs in a professional environment where time is money you should get a heated bubble-etch tank. With fresh hot ferric chloride, the PCB will etch in well under 5 minutes. Fast etching produces better edge-quality and consistent line widths. If you aren't using a bubble tank, you need to agitate frequently to ensure even etching. Warm the etchant by putting the etching tray inside a larger tray filled with boiling water.

➢ DRILLING

If you have fiber glass (FR4) board, you must use tungsten carbide drill bits. Fiberglass eats normal high-speed steel (HSS) bits very rapidly, although HSS drills are alright for older larger sizes (> 2mm). Carbide drill bits are available as straight-shank or thick-shank. In straight shank, the hole bit is the diameter of the hole, and in thick shank, a standard size (typically about 3.5 mm) shank tapers down to the size of hole.

The straight-shank drills are usually preferred because they break less easily and are usually cheaper. The longer thin section provides more flexibility. Small drills for PCB use usually come with either a set of collets of various sizes or a three-jaw chuck. Sometimes the 3-jaw chuck is an optional extra and is worth getting for the time it saves on changing collets. For accuracy, however, 3-jaw chucks are not brilliant, and small drill sizes below 1 mm quickly formed grooves in the jaws, preventing good grip. Below 1 mm, you should use collets, and buy a few extra of the smallest ones; keeping one collect per drill size as using a larger drill in a collet will open it out and it no longer grips smaller drills well. You need a good strong light on the board when drilling, to ensure accuracy. A dichroic halogen lamp, under run at 9V to reduce brightness, can be mounted on a microphone gooseneck for easy positioning. It can be useful to raise the working surface above 15 cm above the normal desk height for more comfortable viewing. Dust extraction is nice, but not essential and occasional blow does the trick! A foot-pedal control to switch the drill 'off' and 'on' is very convenient, especially when frequently changing bits. Avoid hole sizes less than 0.8 mm unless you really need them. When making two identical boards, drill them both together to save time. To do this, carefully drill a 0.8 mm whole in the pad near each corner of each of the two

boards, getting the center as accurately as possible. For larger boards, drill a hole near the centre of each side as well. Lay the boards on the top of each other and insert a 0.8 mm track pin in two opposite corners, using the pins as pegs to line the PCBs up. Squeeze or hammer the pins into boards, and then into the remaining holes. The two PCBs are now 'nailed' together accurately and can be drilled together.

➢ SOLDERING

Soldering is one of the methods of joining two pieces of metal with an alloy that melts at a lower temperature than the metals to be joined .For Soldering purpose a 60/40 fixed core solder is used. This consists of 60% lead and 40% tin, with flux cores added to the length of solder. It comes either in the form of wire or bar with flux cores added to the length of solder.

Flux is used to remove oxides from the metal and to make the solder flow smoothly. Soldering requires a source of heat .A common method of transmitting heat to the metal surfaces is by using a soldering iron. The working end of this tool is made of copper, which is a good conductor of heat.

There are certain safety measures which you should keep in mind when soldering. The tin material used in soldering contains dangerous substances like lead (40-60% of typical soldering tins are lead and lead is poisonous). Also the various fumes from the soldering flux can be dangerous. While it is true that lead does not vaporize at the temperature at which soldering is typically done.

When soldering, keep the room well ventilated and use a small fan or fume trap. A proper fume trap of a fan will keep the most pollution away from your face. Professional electronic workshops use expensive fume extraction systems to protect their workers. Those fume extraction devices have a special filter which filters out the dangerous fumes. If you can connect a duct to the output from the trap to the outside, that would be great.

Do not eat, drink or smoke while working with soldering iron. Do not place cups, glasses or a plate of food near your working area. When you handle soldering tin, your hands will pick up lead, which needs to be washed out from it before it gets to your body.

o METHODS OF SOLDERING

The following are the stages involved in soldering work:

- Clean the surface to be soldered.
- Keep the surfaces to be joined, close together.
- Apply a thin layer of flux with a brush.
- Heat the soldering copper to proper temperature.
- Tack the seam by applying solder at several points.
- Begin at one end and move the copper bit slowly, adding solder as needed

CHAPTER 3

RESULT

Aim of our project is to provide safety of the coal miners by introducing a new 'INTELLIGENT HELMET' for the miners. By using this helmet the miner will be aware of the changing climatic conditions in the mine. The changing environmental conditions is displayed through the LCD display and a buzzer is provided as an alarm when the threshold environmental exceeds its limit.

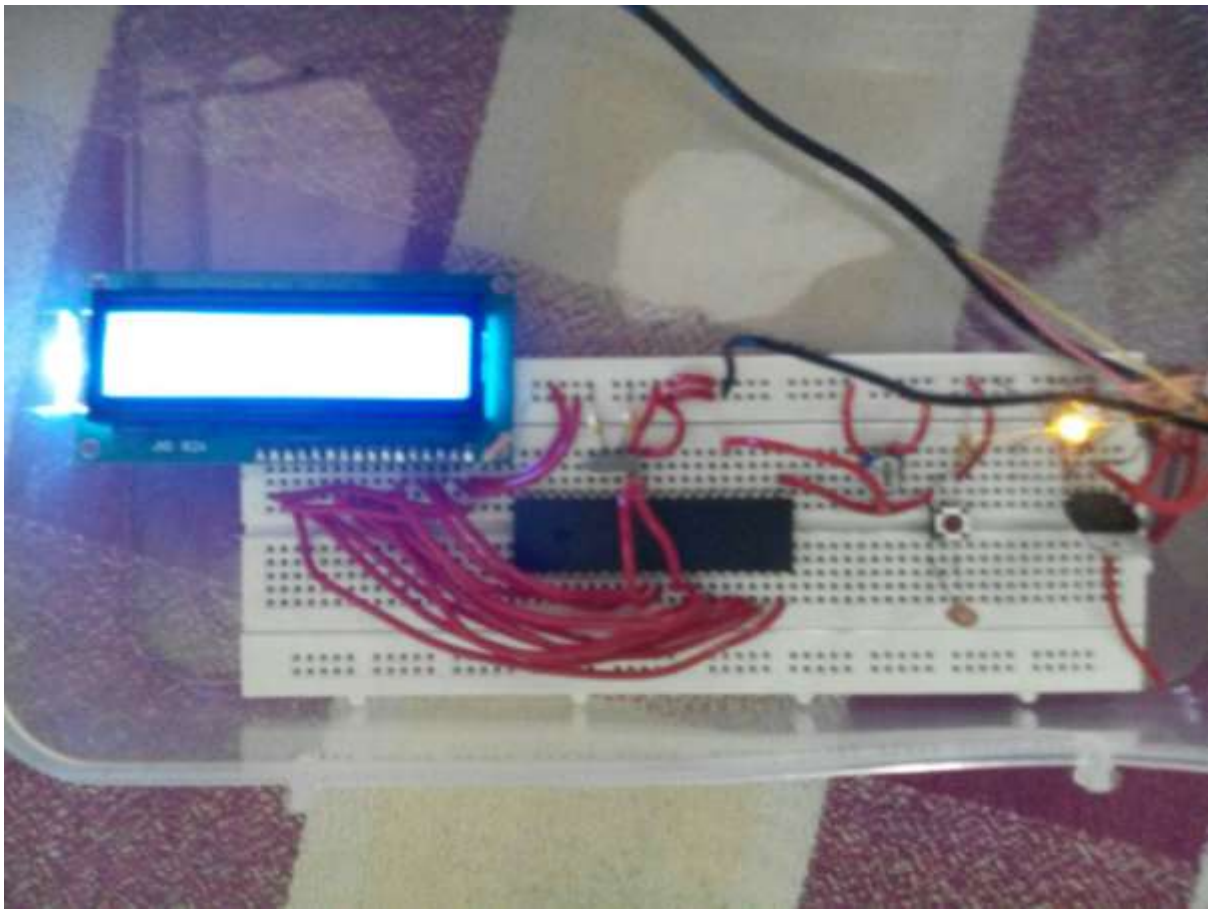

Fig.2.13 breadboard output

CHAPTER 4

ADVANTAGES AND APPLICATIONS

4.1 ADVANTAGES

- Safety monitoring of the environment.
- Improved services in coal mining.
- Providing wireless connection security.
- Faster checked out/in.
- Prevent from the high temperature, humidity and harmful gases.
- Quick searching and can able to give the warning.
- Cost avoidance**.**

4.2 APPLICATIONS

- Can be applied to the persons who are working in the underground.
- Can be applied at any weather conditions.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

The life of everyone need to be protected. In coal mines, whenever explosions occur, the rescue work is done by rescue worker without any prior knowledge of the environmental condition inside coal mines because mine monitoring system may be destroyed or damaged. This makes the life of rescue workers very risky. Here we try to introduce new technology to provide safety to the miners. This system can detect the concentration of gas, temperature, humidity and light in underground coal mine tunnels. This system can not only monitor all kinds of parameters under coal mine, but also indicate alarm automatically when environment parameters are abnormal to exceed the limitation, which help to improve the level of monitoring safety system production and reduce accident in coal mine.

5.2 FUTURE SCOPE

- Instead of the MQ series of gas detectors and industrial solution like the M40.M sensors .They are easy to calibrate. Can display O2, H2S, CO and CH4 all with extreme precision.
- A compartment to store food or rescue gear. This is an easy improvement but an extremely useful one. Because most of the time when an accident happens it will be hard for a human to move around without proper precautions.
- Introducing camera and GPS integration can map the coal mine. And further used for storing weak points inside the mine, in terms of gas Break outs or surface tension. This could also be used by the rescue team to locate and communicate in two ways with the miners.

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