COAL MINE MONITORING SYSTEM USING ZIGBEE

B.E. Dissertation

Submitted in partial fulfilment of the requirement of

University of Mumbai

For the Degree of

Bachelor of Engineering
(Electronics and Telecommunication Engineering)

By

Khan Asif Ali (11ET21)

Shaikh Mohd Zaid (11ET54)

Shaikh Tajammul (11ET57)

Khan Ibrahim Anwar (13ET74)

Under the guidance of
Prof. SHAHIN ATHAVANI

Department of Electronics and Telecommunication Engineering
Anjuman-I-Islam's Kalsekar Technical Campus,
Sector 16, New Panvel , Navi Mumbai
(Affiliated to University of Mumbai)
2017-2018

CERTIFICATE

This is to certify that, the dissertation titled

COAL MINE MONITORING SYSTEM USING ZIGBEE

Is a bonafide work done by,

Khan Asif Ali	**(11ET21)**
Shaikh Mohd Zaid	**(11ET54)**
Shaikh Tajammul	**(11ET57)**
Khan Ibrahim Anwar	**(13ET74)**

and is submitted in the partial fulfilment of the requirement for the Degree of
Bachelor of Engineering
In
Electronics and Telecommunication Engineering
to the
University of Mumbai.

Project Guide
Prof. Shahin Athavani

Head of Department
Prof Afzal Shaikh

Dr. Abdul Razzak Honnutagi
Director

Department of Electronics and Telecommunication Engineering
Anjuman-I-Islam's Kalsekar Technical Campus,
Sector 16, New Panvel, Navi Mumbai
(Affiliated to University of Mumbai)
2017-2018.

CERTIFICATE OF APPROVAL BY EXAMINERS

This is to certify that the dissertation entitled **"COAL MINE MONITORING SYSTEM USING ZIGBEE"**is a bonafide work done by**, Khan Asif Ali, Shaikh Mohd Zaid, Shaikh Tajammul, Khan Ibrahim Anwar** under the guidance of Prof **Shahin Athavani.** This dissertation has been approved for the award of Bachelor's **Degree in Electronics and Telecommunication Engineering,** University of Mumbai.

_____ _____

(Internal Examiner) **(External Examiner)**

Date of Approval: _____

Place: PANVEL

Department of Electronics and Telecommunication Engineering
Anjuman-I-Islam's Kalsekar Technical Campus,
Sector 16, New Panvel, Navi Mumbai
(Affiliated to University of Mumbai)
2017-2018

DECLARATION

I hereby declare that the project entitled **"COAL MINE MONITORING SYSTEM USING ZIGBEE"** submitted for Degree of **Bachelor of Engineering (Electronics and Telecommunication Engineering)** under **University of Mumbai** is my original work and the project has not formed the basis for the award of any degree, association, fellowship or any other similar titles.

Signature of the Student:
Place:
Date:

Department of Electronics and Telecommunication Engineering
Anjuman-I-Islam's Kalsekar Technical Campus,
Sector 16, New Panvel , Navi Mumbai
(Affiliated to University of Mumbai)
2017-2018

LIST OF FIGURES AND TABLES

ACKNOWLEDGEMENT

This project was spanned over a period of one year and the numbers of people who have helped us until now are outstanding. To begin with we would like to thank our project guide Professor **SHAHIN ATHAVANI** who has helped us throughout the period and has helped us through the times of need. In spite of their busy schedules it was very kind of them to spare some of their precious time and give us valuable suggestions which ultimately formed heart of this report. Professor **AFZAL SHAIKH (HOD ELECTRONICS AND TELECOMMUNICATION DEPT)** was a great source of inspiration and allowed us to work in the lab for extended hours. I would also like to thank **DR. ABDUL RAZAK HONNUTAGI**, Director, AIKTC, Panvel, for his encouragement and for providing an outstanding academic environment, also for providing the adequate facilities

The laboratory assistants need a warm mention specially **Mr. Mudassir Ansari** and **Mr. Salman** who have helped us all along the way. We also extend our thanks to all professors of our departments for their valuable guidance. We would also like to thank our fellow students for their support and good wishes.

Finally we thank entire Electronics and telecommunication engineering Department for excellent facilities and encouragement given during course of the projects. I am thankful to all my family members whose constant support and encouragement in every aspect helped me to complete my project.

ABSTRACT

Today safety of miners is a major challenge. Miner's health and life is vulnerable to several critical issues, which includes not only the working environment, but also the after effect of it. Mining activities release harmful and toxic gases in turn exposing the associated workers into the danger of survival. This puts a lot of pressure on the mining industry. To increase the productivity and reduce the cost of mining along with consideration of the safety of workers, an innovative approach is required.

Miner's health is in danger mainly because of the toxic gases which are very often released in underground mines. These gases cannot be detected easily by human senses. This project investigates the presence of toxic gases in critical regions and their effects on miners. A real time monitoring system using wireless sensor network, which includes multiple sensors, is developed. This system monitors surrounding environmental parameters such as temperature, humidity and multiple toxic gases. This system also provides an early warning, which will be helpful to all miners present inside the mine to save their life before any casualty occurs. The system uses ZigBee technology to establish wireless sensor network. It is wireless networking standard IEEE 802.15.4, which is suitable for operation in harsh environment.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

In this chapter we are going to discuss about the Aim, salient features and objective with regards to coal mine monitoring and wireless sensor network and what has motivated us for designing this project.

1.1 AIM OF THE PROJECT

The purpose of our project is to meet the requirement of the present industrial and commercial scenario. The prime objective was to implement the project with the use of latest available technologies and components which can perform well even with a compact hardware and also gives increased accuracy. It provides high accuracy, speed reliability and ruggedness.

In this project, we plan to implement a monitoring and controlling system which will improve the scenario of coal miners working inside the mines. Real time monitoring has become a need of today's world. This system gives you access to monitor the various parameters and act as a alarming system. This system can be implemented in various applications such as, wearable device or helmets or in form of a robot with live feed using camera and can enhanced to save time and improve security in current scenario of India.

1.2 SALIENT FEATURES

- ❖ Fully microcontroller based interface using ARM 7 (LPC2148)
- ❖ For sensing temperature LM35, for humidity DHT11, for gas/smoke MQ6, GSM modem for added feature along with ZigBee for wireless transmission
- ❖ Low power consumption
- ❖ Powered by 12V DC power supply
- ❖ Extremely easy to install
- ❖ It reduces human interference
- ❖ Four to eight sensors can be connected in the system

1.3 OBJECTIVE AND MOTIVATION

Mining environment often has hidden dangers within such as toxic gases, which may present severe health exposures to the people working within mining. These gases need to be detected at times and informed the dangerous situation in right time for the safety of miners. Wired network monitoring systems have assisted the mine safety significantly, but it is not idea for all types of mining environment.

Real-time monitoring systems may assist in monitoring and control over the mining environment. ZigBee technology offers its most of the advantages ideal for the real-time monitoring system. Thus, the primary objective of this project is decided to design an efficient real-time monitoring system so that various leaked mine gases could be identified at times and preventive measures could be devised accordingly. The research investigations to be carried out with the following objectives:

- 1. Detection of different toxic gases within mining environment
- 2. Communication establishment between sensors and Zigbee
- 3. Establishment of Wireless Sensor Network
- 4. Design of a real-time monitoring system

CHAPTER 2

LITERATURE REVIEW

In this chapter we are going to discuss IEEE papers that was referred by our team for implementation and designing this project also the outcome of the same.

1)Design and Implementation of Coal Mine Physiological Parameters Monitoring Protocol, Swarup S. Mathurkar, Shubhada S. Thakare International Journal on Recent and Innovation Trends in Computing and Communication ,Volume: 5 Issue: 1

Outcome: This paper mainly deals with surveillance and safety measures for mine workers, which is most essential in underground mining areas. Here, a concept of wireless sensors network is used to monitor the environment parameters of underground mine area and all sensed parameters are sent to host computer .

2) Intelligent Mining: A Monitoring and Security System for Coal Mine Workers, Nisha Dube1, Prof. K.S. Ingle International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 5, Issue 1, January 2016,

Outcome: This paper introduces an intelligent remote monitoring system based on ZigBee. The system consists of two parts- The ground system and the underground system.

3) Coal Mine Monitoring System for Rescue and Protection using ZigBee, Shilpa Lande, Prof.Matte P.N, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 4 Issue 9, September 2015,

Outcome: This paper discusses continuous monitoring of underground coal mine parameter like gases, temperature, humidity & vibration.

4) Safety Scheme for Mining Industry using ZigBee, N. Krithika* and R. Seethalakshmi,Indian Journal of Science and Technology, Vol 7(8), 1222–1227, August 2014, ISSN (Print) : 0974-6846 ISSN (Online) : 0974-5645

Outcome: This work proposes a safety scheme for coal mining industry using sensors and ZigBee. The ZigBee built safety scheme with precise remote monitoring and tracking is the most suitable life saving system for underground mining environment.

5) A Coal Mine Safety System using Wireless Sensor Network, Vijaya Kumari Doddi 1, N.Anuradha , International Journal of Professional Engineering Studies, Volume II/Issue 1/JAN2014 page 1-6,

Outcome: This paper designs a monitoring system for coal mine safety based on ZIGBEE wireless sensor network.

6) A Measurement of Medium Range of Underground Coal Mine Using Wireless Sensor Network, K.Sujitha, R.Jeevanatham, International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 3 Issue XI, November 2015ISSN: 2321-9653

Outcome: In this paper can extend and intend to monitor subversive coal mine by using the transceiver Zig Bee wireless network It can detect three ways of sensor that is humidity sensor, temperature sensor, gas sensor.

7) Rescue And Protection System For Coal Mine Workers By Using WSN, Prof.Swapnil D.Patil ,Ms. Bagane R. S. ,Ms. Khandekar M.V.,Ms. Misal T. A. ,Ms. Sayyad M. S, IJARIIE-ISSN(O)-2395-4396, Vol-3 Issue-2 2017.

Outcome: The proposed coal mine safety system using wireless sensor network replaces traditional coal mine safety which is wired system. This information is send to the Arduino.

8) Robot Based Wireless Monitoring and Safety System for Underground Coal Mines using Zigbee Protocol: A Review
Sachin M. Ledange, Swarup S. Mathurkar,International Journal of Science, Engineering and Technology Research (IJSETR), Volume 5, Issue 1, January 2016

Outcome: In this paper a robot based wireless monitoring and safety system for underground mines using wireless communication protocol zigbee is proposed, which will take the data of environmental parameters of underground mine using different sensors and send the data to control room using zigbee. This whole system will be placed on a robot which is operated by remote.

9) Safety Helmets For Coal Miners Using Zigbee TechnologyMonika Prasad1, Deovrat Singh2, Rishabh Sachdeva3,
Priyanka Singh4, Mr.Manoj Vishnoi5IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 3, Issue 2, April-May, 2015ISSN: 2320 – 8791 (Impact Factor: 1.479)

Outcome: This paper presents a study on how ZigBee is used for the transmission between the hardware circuit fitted with the coal mine workers and the ground control system through some routers.

10) Intelligent safety system for coal miners
Beena M Varghese, Binisha Balan, Neethu Varghese, Reshma Gangadharan, Shaima PK M A College of Engineering, Kothamangalam, Kerala. International Journal of Engineering and Innovative Technology (IJEIT) Volume 4, Issue 9, March 2015

Outcome: The system adopted a ZigBee wireless technology to build wireless sensor networks, realized real-time surveillance with early-warning intelligence on methane, temperature, humidity in mining area to reduce potential safety problems in coal production.

CHAPTER 3

DEVELOPMENT STAGES AND PROCESS

In this chapter we will be discussing about development stages and how the project was designed developed and testing was done.

The complete development of this system can be divided into following stages:

- ❖ Problem definition stage
- ❖ Designing a Block Diagram
- ❖ Implementing circuits and components
- ❖ Developing algorithm for software
- ❖ Writing actual code for Microcontroller
- ❖ Compiling the code
- ❖ Burning the hex into microcontroller with Programmer
- ❖ Testing and running

3.1 PROBLEM DEFINITION STAGE

This is the very first stage to develop any project. It actually defines the aim and concept of the project. The aim of "**COAL MINE MONITORING SYSTEM USING ZIGBEE**" is to implement a temperature controlling system which will improve the scenario of home automation with least complexity and cost.

3.2 DESIGNING A BLOCK DIAGRAM

At this stage we have categorized the whole system into different individual modules. These modules (block diagrams) will be helpful in understanding the concept and working of the integrated system. It also simplifies the entire debugging and testing process.

3.3 IMPLEMENTING CIRCUITS AND COMPONENTS

This is actual implementation of circuit of each block. At this stage we have actually designed each block separately and finally integrate them into complete working system.

3.4 DEVELOPING ALGORITHM FOR SOFTWARE

To get the logical flow of the software. The development of algorithm is having a prominent role. So we have analysed the complete system and organized the algorithm in such a manner that one can understand the complete working of the software.

3.5 WRITING ACTUAL CODE FOR MICROCONTROLLER

After the development of the algorithm and flowchart we have actually translated them into C language for **Atmega32** Microcontroller so that it can understand the instructions and run as per our requirement. The instructions are in ASCIIC language.

3.6 COMPILING THE CODE

The code is implemented on the computer for which we have used AVR studio preinstalled on the PC. AVR studio is a computer aided program to stimulate the working of Microcontroller in real time without burning the software into actual IC. We stimulated and compiled our program for error checking. After removing of several compiling errors the program was converted into machine language i.e. Intel Hex Format.

3.7 BURNING THE HEX FILE INTO MICROCONTROLLER WITH PROGRAMMER

In this stage the compiled hex format was downloaded into ATMEGA32A flash microcontroller. It was done using BASCOM.

3.8 TESTING AND RUNNING

This time we tested our project for actual working, after loading the software into the microcontroller. Any errors found were removed successfully. This is the last and final stage of development of our project.

CHAPTER 4
DESIGNING A SYSTEM DIAGRAM

Here we will see our system designing block diagram and circuit diagram also software designing flow

CO ORDINATOR SECTION

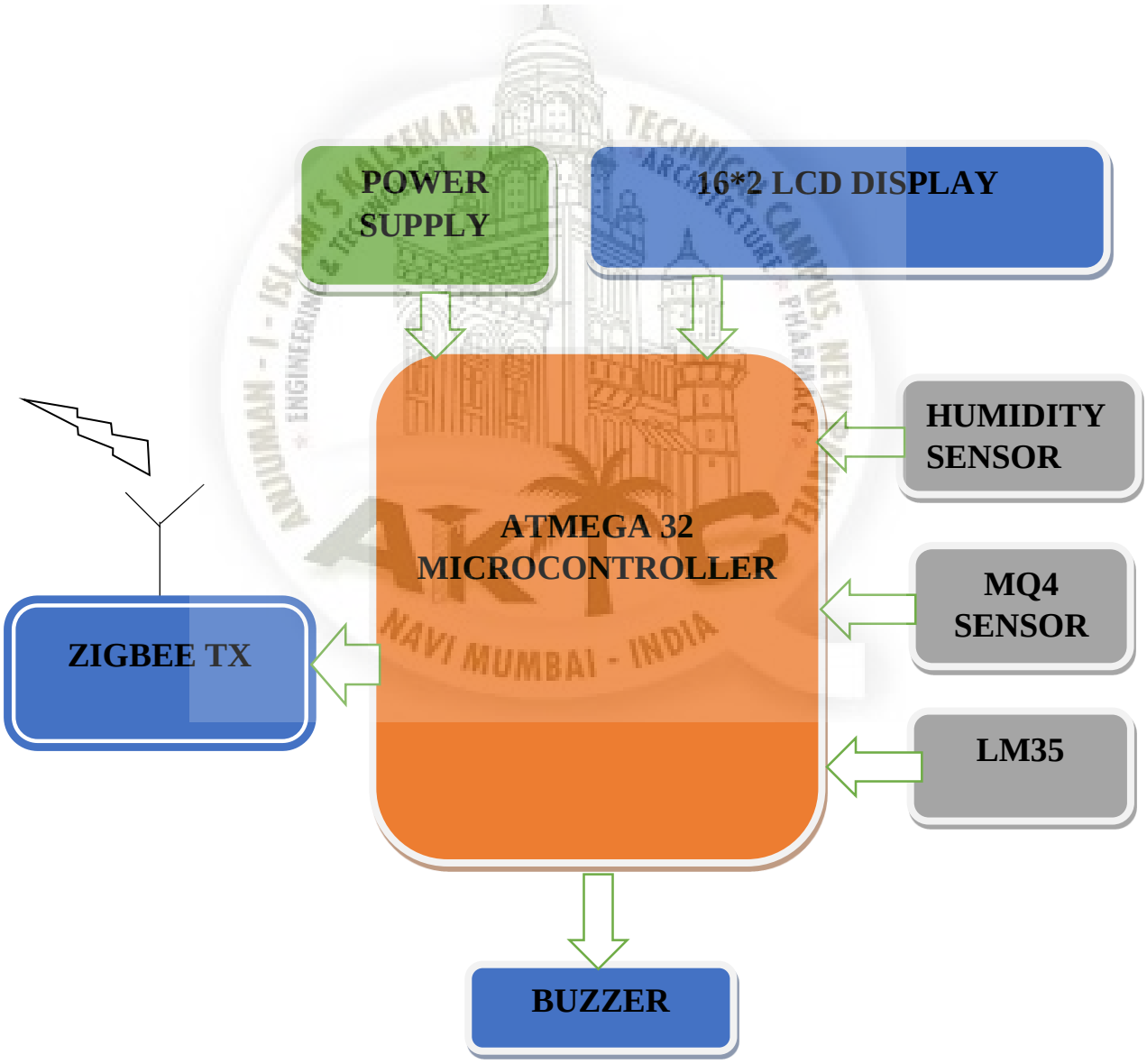


Fig no 01 Transmitter section

END DEVICE SECTION

Fig no 2 Receiver Section

CIRCUIT DIAGRAM

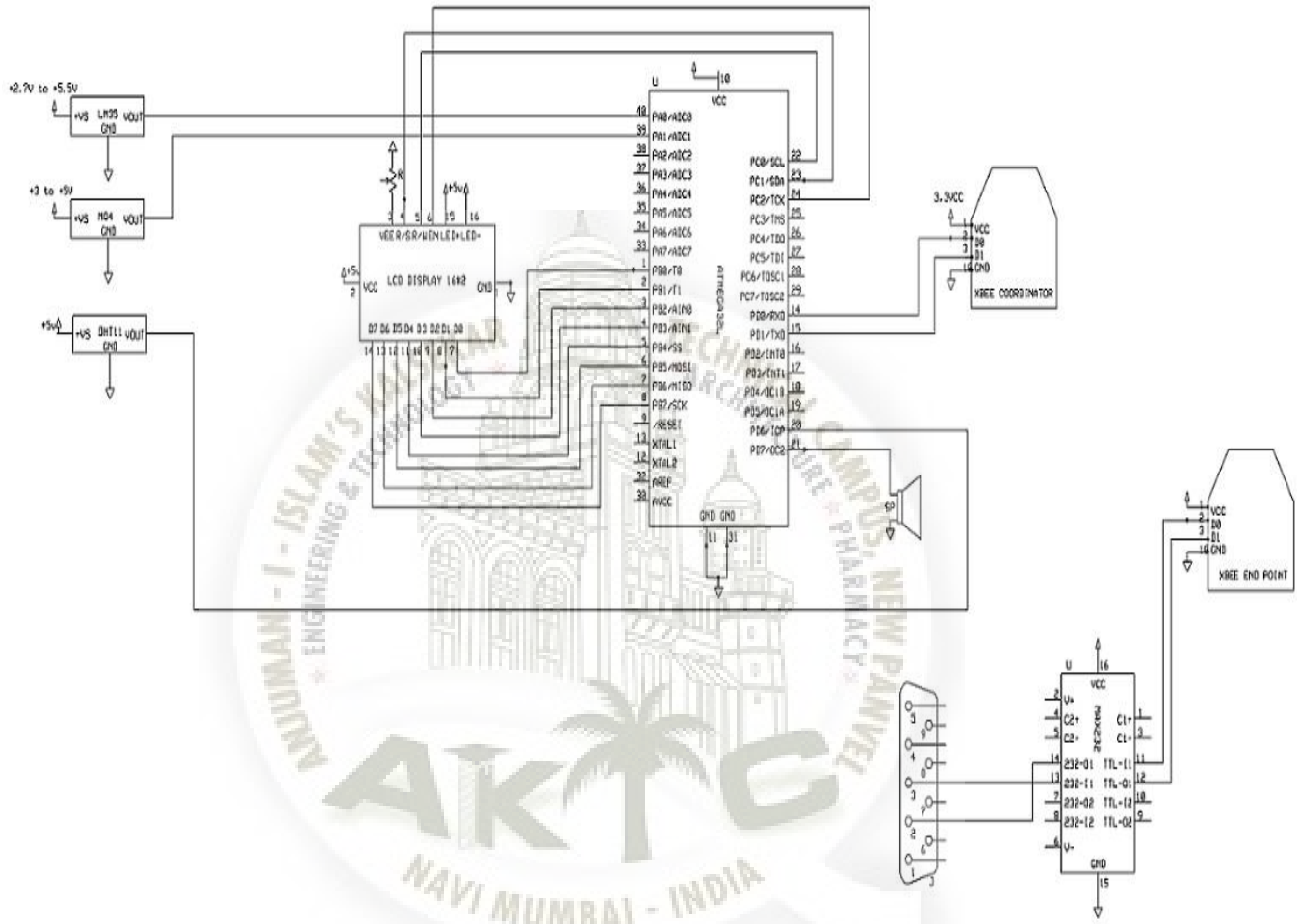


Fig no. system circuit diagram

SOFTWARE DESIGN:

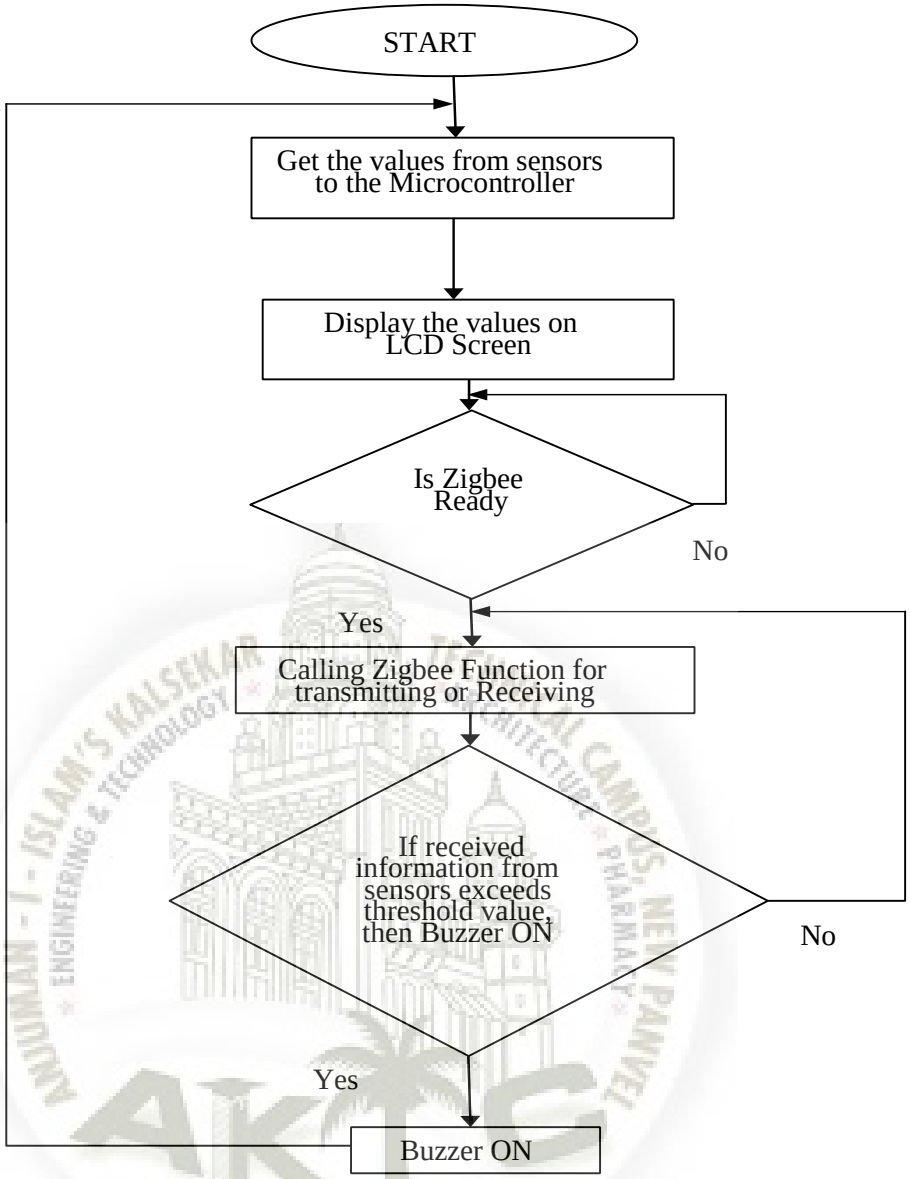


Fig no 03 -Flow Chart for the Under Ground Section

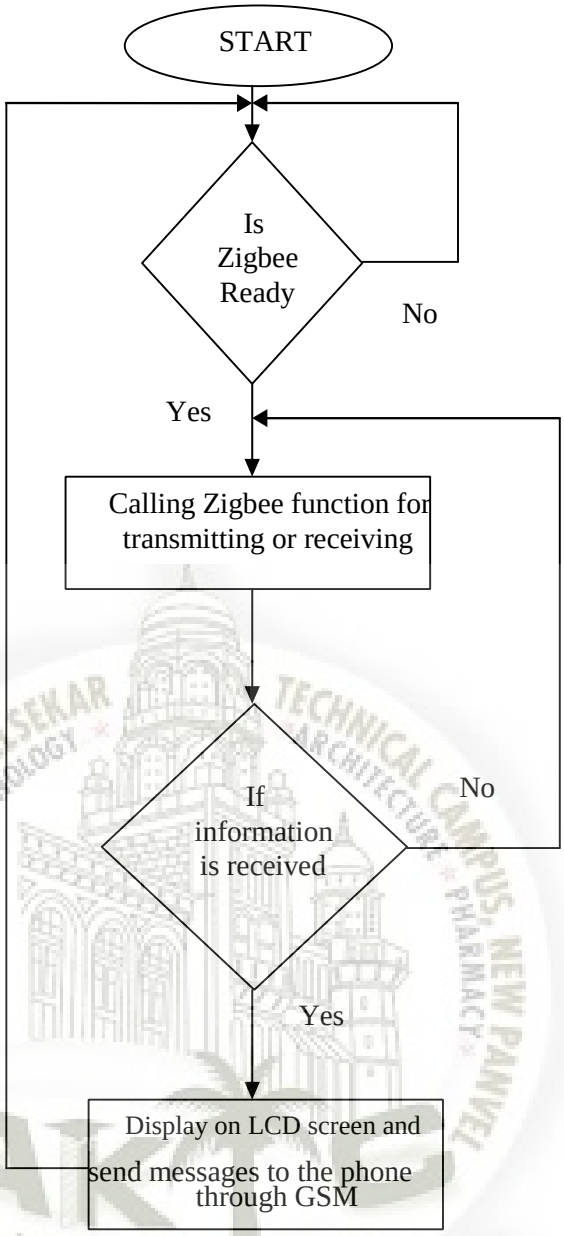


Fig no 04. Flow chart for the Ground Section.

CHAPTER 5
PARAMETERS MONITORING

5.1 MINE GASES

In mine, gases are released during mining operations. It will be observed that return air is depleted in oxygen content and contaminated by mine gases. Impurities come from exhalation by men, blasting, and underground fires, burning of lights, bacterial action and gases given off from strata. It also contains moisture and dust of coal and rock.

When referring to noxious and poisonous gases met with in a mine the commonly used names are as follows:

- **Black damp:** It is a mechanical mixture of the extinctive gases, carbon monoxide and excess nitrogen; sometimes it is referred to as chokedamp or stythe.
- **Firedamp:** It is used either as synonymous with methane or referring to the mechanical mixture of the gases, chiefly inflammable, given off naturally from co
- **White damp:** It is synonymous with carbon monoxide.
- **Stink damp:** It is synonymous with sulphureted hydrogen (H2S).
- **After damp:** This is a mechanical mixture of gases existing in a mine after an explosion of firedamp or coal dust. Its composition is extremely variable, but usually includes carbon monoxide, carbon dioxide, nitrogen and sometimes H2S and SO2 with a very small percentage of oxygen.

The necessities for gas distinguishing proof can move massively, on the other hand, there are five fundamental sources of hazardous gas in mining applications.

1. Gasses from Blasting:

Blasting generates toxic and harmful gases. These harmful gasses include carbon monoxide and nitrogen dioxide. As a result of the utilization of oxygen in any such impact, oxygen deficiency might likewise be an outcome.

2. Methane from Coal Beds:

Profoundly flammable methane (CH4) or firedamp, as it is brought in numerous coal-fields, is framed in the last phases of coal arrangement, and due to the profundities and weights, it gets to be imbedded in the coal. As unearthing are made, methane gas is freed into the air. Gas is transmitted from the purpose of unearthing, as well as from the coal being transported to the surface.

3. Vehicle Exhaust:

Vehicles are also generated various toxic and poisonous gases. These poisonous gases are an after effect of the operation of burning motors.

4. Underground Explosions and Fires: Due to any underground fire or explosion various gases are emitted within the mine

5. Penetrating into Stagnant Water:

Pockets of stagnant water can contain a lot of hydrogen sulphide coming about essentially from the breakdown of pyrites.

These are some harmful gases and their effects:

5.1.1 NITROGEN DIOXIDE (NO2)

NO2 is a reddish brown gas with a sharp and chafing scent. It changes noticeable all around to shape vaporous nitric corrosive and harmful natural nitrates. NO2 additionally assumes a noteworthy part in climatic responses that create ground-level ozone, a noteworthy segment of brown haze. It is additionally an antecedent to nitrates, which add to expanded respirable molecule levels in the climate.

Sources of NO2

All burning in air produces oxides of nitrogen (NOx) such as NO, NO2, N2O3 and have choking smell. These oxides are easily dissolved by moisture in the mine air. NO2 are formed during the blasting of explosives containing nitroglycerine as one of the constituents if the explosives are not detonated completely.

Impacts of NO2

NO2 can chafe the lungs and lower impervious to respiratory contamination. Affectability increments for individuals with asthma and bronchitis. NO2 artificially changes into nitric corrosive and, when stored, adds to Lake Acidification. NO2, when artificially changed to nitric corrosive, can consume metals, blur fabrics and corrupt elastic. It can harm trees and products, bringing about considerable misfortunes.

Table 3-1 Health effects and Pollutant concentration breakpoints caused by NO_2

Category	Pollutant Concentration Breakpoints (ppb)	Health Effects
Very Good	0 -50	No health impacts
Good	51 -110	Slight smell.
Moderate	111 - 200	Smell.
Poor	201 - 524	Air smells and looks brown. Some increment in bronchial hyperactivity in asthmatics people.
Very Poor	525 or over	Expanding affectability for asthmatics and individuals with bronchitis.

5.1.2 SULPHUR DIOXIDE (SO2)

SO2 is a colourless gas with a strong sulphurous smell, neither combustible nor a supporter of combustion. It is 2.21 times heavier than air. It can be oxidized to sulphur trioxide, which in the region of water vapour is instantly changed to sulphuric corrosive fog. SO2 can be oxidized to shape corrosive vaporizers. SO2 is a forerunner to sulphates, which are one of the principal segments of respirable particles in the air.

Sources of SO2

It may be produced in small quantities during blasting in mines, and after a fire or coal dust explosion.

Impacts of SO2

This gas is very poisonous and extremely irritating to the eyes and respiratory passages. Health impacts brought about by the presentation to abnormal amounts of SO2 incorporate breathing issues, respiratory sickness, changes in the lung's safeguards, and intensifying respiratory and cardiovascular ailment. Individuals with asthma or perpetual lung or coronary illness are the most delicate to SO2. It also harms trees and harvests. SO2, alongside nitrogen oxides, is the principle antecedents of corrosive downpour. This adds to the fermentation of lakes and streams, quickened consumption of structures and diminished deceivability. SO2 additionally causes development of minute corrosive mist concentrates, which have genuine wellbeing ramifications and adding to environmental change.

Table 3-2 Health effects and Pollutant concentration breakpoints caused by SO_2

Category	Pollutant Concentration Breakpoints (ppb)	Health Effects
Very Good	0 - 79	No health impacts
Good	80 - 169	Damages some vegetation in combination with ozone.
Moderate	170 - 250	Damages some vegetation.
Poor	251 - 1999	Smell; increasing vegetation damage.
Very Poor	2000 or over	Increasing vulnerability for asthmatics and individual with bronchitis.

5.1.3 CARBON MONOXIDE (CO)

Carbon monoxide gas is colourless, odourless, tasteless and non irritating. It is only slightly higher than air. It is combustible but does not support combustion. It is soluble in water. In air it burns with a light blue flame to CO2.

Sources of CO

The production of the CO in a mine may be due to any one or more of the following cases:

- **Oxidation of coal and other carbonaceous matter:** Incomplete oxidation may result in its formation and under normal mining condition, the percentage found is negligible and harmless in return of a coal mine.
- **Explosives:** Explosives contain the amount of oxygen required for complete chemical reaction, but the chemical reaction when the explosive is blasted is seldom perfect and this results in the formation of CO.
- **Spontaneous Combustion:** This is a main source of production of dangerous percentage of CO in a coal mine. Active fire in an underground mine also forms CO in dangerous percentage.
- **Methane or Coal dust Explosion:** Gases produced by the explosion of methane coal dust invariably contain a large percentage of CO.
- **Underground Machinery:** Air compressor, run faultily, and exhaust gas of internal combustion engines like diesel locomotives, are common sources of production of CO. In fact, every machine some CO if proper lubricants are not used.

Impacts of CO

CO is a very poisonous gas and its affinity for the hemoglobin of the blood is nearly 300 times that of oxygen. If CO is present even in small quantities in the inhaled air, it is difficult for blood to absorb proper quantities of oxygen to support life. CO enters the circulation system and lessens oxygen conveyance to the organs and tissues. Individuals with coronary illness are especially touchy. Introduction to abnormal states is connected with weakness of vision, work limit, learning capacity and execution of troublesome undertakings.

Table 3-3 Health effects and Pollutant concentration breakpoints caused by CO

Category	Pollutant Concentration Breakpoints (ppb)	Health Effects
Very Good	0 - 12	No health Impacts
Good	13 - 22	No health impacts.
Moderate	23 - 30	Blood chemistry changes, but no noticeable damage.
Poor	31 - 49	Increased warning sign in smokers with heart disease.
Very Poor	50 or over	Increasing warning sign in non-smokers with heart disease; blurred vision; some clumsiness.

Typical sickness symptoms due to the high concentration of the CO are mild headache, fatigue, nausea and dizziness. A CO concentration of 12-13000 ppm is dead after 1-3 minutes. A CO concentration of 1600 ppm is deadly after one hour.

Table 3-4 Concentration of CO and Its exposure time

Conc. of CO in the air (ppm)	Breathing Time	Toxic Symptoms
9	Short term exposure	ASHRAE recommended maximum allowable concentration in living area.
35	8 hours	The maximum exposure allowed by OSHA in the workplace over an eight hour period.
200	2-3 hours	Slight headache, tiredness, fatigue, nausea and dizziness.
400	1-2 hours	Serious headache-other symptoms intensify. Life threatening after 3 hours.
800	45 minutes	Dizziness, nausea and convulsions. Unconscious within 2 hours. Death after 2-3 hours.
1,600	20 minutes	Headache, dizziness and nausea. Death within 1 hour.
3,200	5-10 minutes	Headache, dizziness, nausea. Death within 1 hour.
6,400	1-2 minutes	Headache, dizziness, nausea. Death within 25-30 minutes.
12,800	1-3 minutes	Death within 1-3 minutes

5.1.4 METHANE (CH4)

Methane is a colorless, odorless, tasteless, flammable gas and lighter than air. Because of the largest component of fire damp, it is commonly known as firedamp. Firedamp refers to the mixture of gases. Such mixture consists of practically methane with small traces of ethane (C2H6), and other **Sources of CH4**
Methane in mine is mainly released from five sources:
1. To recover methane in advance of mining from gob or goaf wells.

2. From ventilation air in underground mines (dilute concentrations of methane).

3. From an abandoned or closed mines, from which methane may leak out through the vent holes or through fissures or crevices in the earth.

4. Extremely flammable methane (CH4) or firedamp, as it is brought in numerous coal-fields, is framed in the last phases of coal arrangement, and due to the profundities and weights, it gets to be imbedded in the coal. As unearthings are made, methane gas is freed into the air.

5. Fugitive emissions from post-mining operations, in which coal keeps on give off methane as it is stacked away in pores and transported hydrocarbons, such as propane (C3H8) and butane (C4H10).

Impacts of CH4

Methane is a very poisonous gas. Methane gas causes headaches, reduces the oxygen level in the physical structure. If the oxygen level reduces to less than 12%, the individual can get to be unconscious and turn out to be dead in some cases. This gas symptoms are Nausea and vomiting, heart palpitations (which causes a painful sensation of the heart beating), memory loss, poor judgment, dizziness and blurred vision. Some patients also display flu-like symptoms. Methane gas is extremely inflammable. When it is burnt, carbon monoxide will be brought forth.

Table 3-5 Classification of Toxic gases and their hazardous limit

Name	Primary sources in mines	Hazards	Guidelines TLVs	Flammability limits in air (%)
Methane (CH_4)	Strata	Explosive, Breathing problem	1%;isolate electrical power 2%remote personnel	5 to 15
Carbon dioxide (CO_2)	Oxidation of carbon, fires, explosions	Increased heart rate and breathing	TWA=0.5% STEL=3.0%	
Carbon monoxide (CO)	Fires, Explosions, blasting, incomplete combustion of carbon compounds	Highly toxic, Explosive	TWA=0.05% STEL=0.04%	12.5 to 74.2
Sulphur dioxide (SO_2)	Oxidation of Sulphides, acid water on sulphide ores	Toxic, irritant to eyes, Throat and lungs	TWA=2 ppm STEL=5 ppm	
Nitrogen dioxide (NO_2)	IC engines, blasting, fumes, welding	Toxic, Throat and lung infections	TWA=3 ppm Ceiling: 5ppm	
Hydrogen Sulphide (H_2S)	Acid water on sulphides, Strata decomposition of organic materials	Highly Toxic, irritant to eyes and explosive	TWA= 10ppm STEL= 15ppm	4.3 to 45.5

TWA-- Time-weighted average (8 h shift and a 40 h work week)
STEL-- Short-term exposure limit (TWA concentration occurring more than 15 min).
Ceiling limit is the concentration that should not be exceeded at any time. This is relevant for the most toxic substances or those that produce in an immediate irritant effect.

5.2 MINE TEMPERATURE AND HUMIDITY

Suitable temperature is one of the most important condition inside underground mines. It is important for coal mine worker to have proper temperature to work safely and effectively inside the mines. During working hour due to drilling or blasting inside mines, new surfaces are get opened up which may cause increase or decrease in temperature, so it is very much important to monitor temperature inside the mines. Lots of technologies have been developed for temperature measurement. Thermocouple, RTD, Thermistor, LM series sensors etc. can be used to measure the temperature changes inside the mines.

Temperature 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.

Humidity generally defined as the amount of water vapour present in the environment. Humidity can be divided into Absolute humidity and Relative humidity. Absolute humidity is the amount of water vapour present in the specific volume of air. And Relative humidity is the ratio of moisture in air to the maximum amount of moisture that air can hold. It is required to know the humidity inside the mines as it can affects chemical, physical and biological conditions of underground mines. The amount of water vapor in air can affect human comfort as well as physical processes inside the mines.so it is useful to have track on humidity inside the mines. Different sensors can be employed to measure humidity inside mines. There are sensors which are based on capacitive effect, some humidity sensors are polymer based. Sensors like SYSH220, HSM-20G etc. are good humidity sensors.

Humidity Sensor: These sensors convert humidity into output voltage. Based on a unique capacitive cell, these relative humidity sensors are designed for high volume, cost sensitive applications such as office automation, automotive cabin air control, home appliances, and industrial process control systems. They are also useful in all applications where humidity compensation is needed.

Table1. Features of temperature and humidity sensor

	Temperature sensor	Humidity sensor
Principle	The temperature sensor senses the environmental condition and produces corresponding voltage proportional to room temperature at the range of 10mv/°c.	By using humidity sensor humidity content of gas can be measured and relative humidity can be calculated from ratio between vapor pressure in air and to specified temperature.
Operating voltage	4V to 30V DC	5V DC
Power	Less than 60-µA	<3.0mA
Accuracy	0.5°C Ensured Accuracy	+/-5%RH
Range	−55°C to +150°C	10 to 90% RH
Output Voltage	For every 1°C increases in output voltage of 10mV	990 to 2970mV
Stability	Excellent	Good
Condition	Normal - 270mv Extreme - 380mv	Normal - 60 Extreme - 80
Problem	Temperature exceed - Explosion occur	Humidity abnormal - Difficulty to breathe
Application	Industrial and Remote Applications	Industrial and weather monitoring Applications

Gas Detection : Toxic and harmful gases like methane, carbon monoxide may be present in the surfaces of underground coal mines. During working hour, due digging or blasting of coal, methane or other harmful gas can explode and cause dangerous accidents. It is difficult to stop the emission of such harmful gases, but we can save the lives of coal worker by evacuating them, if such accidents occur. So it is important to detect these gases during digging of coal. Different sensors like MQ4, MQ5, TGS2611 etc. can be used to detect methane in underground coal mines.

Table 2. Features of gas sensor

	Gas Sensor
Operating voltage	less than 24volt DC
Principle	The gas sensor functions by determining the vicinity of gas by discharging corresponding amount of current in that device.
Temperature	20°C
Humidity	65%
O_2 concentration	21%
Concentration of CH_4	200-10000ppm
Smell of CH_4	Odorless
Atmospheric lifetime	12 to 15 years
Relative Density(Air=1)	0.6
Problem	Methane gas is increase - Asphyxiation problem occur.
Application	Waste Water Treatment, Battery Rooms, Mechanical/chiller Rooms, Mining

CHAPTER 6
DESCRIPTION OF HARDWARES

6.1 ATMEGA 32A MICROPROCESSOR

The Atmel® ATmega32A is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32A achieves throughputs close to 1MIPS per MHz. This empowers system designer to optimize the device for power consumption versus processing speed

FEATURES

❖ High-performance, Low-power Atmel AVR 8-bit Microcontroller

❖ Advanced RISC Architecture

– 131 Powerful Instructions
- Most Single-clock Cycle Execution
– 32 × 8 General Purpose Working Registers
– Fully Static Operation
– Up to 16MIPS Throughput at 16MHz
– On-chip 2-cycle Multiplier

❖ High Endurance Non-volatile Memory segments
– 32Kbytes of In-System Self-Programmable Flash program memory
– 1024Bytes EEPROM
– 2Kbytes Internal SRAM
– Write/Erase cycles: 10,000 Flash/100,000 EEPROM
– Data retention: 20 years at 85°C/100 years at 25°C(1)
– Optional Boot Code Section with Independent Lock Bits

❖ In-System Programming by On-chip Boot Program

❖ True Read-While-Write Operation

– Programming Lock for Software Security

❖ JTAG (IEEE std. 1149.1 Compliant) Interface
– Boundary-scan Capabilities According to the JTAG Standard
– Extensive On-chip Debug Support
– Programming of Flash, EEPROM, Fuses and Lock Bits through the JTAG Interface

❖ Atmel QTouch® library support Atmel
--8155I-ATmega32A_Datasheet_Complete-08/2016
– Capacitive touch buttons, sliders and wheels
– Atmel QTouch and QMatrix acquisition
– Up to 64 sense channels

❖ Peripheral Features
– Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
– One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
– Real Time Counter with Separate Oscillator
– Four PWM Channels
– 8-channel, 10-bit ADC

❖ 8 Single-ended Channels
❖ 7 Differential Channels in TQFP Package Only
❖ 2 Differential Channels with Programmable Gain at 1x, 10x, or 200x

– Byte-oriented Two-wire Serial Interface
– Programmable Serial USART
– Master/Slave SPI Serial Interface
– Programmable Watchdog Timer with On-chip Oscillator
– On-chip Analog Comparator

❖ Special Microcontroller Features

– Power-on Reset and Programmable Brown-out Detection
– Internal Calibrated RC Oscillator
– External and Internal Interrupt Sources

– Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby

❖ I/O and Packages

– 32 Programmable I/O Lines

– 40-pin PDIP, 44-lead TQFP, and 44-pad QFN/MLF

❖ Operating Voltages

– 2.7 - 5.5V

❖ Speed Grades

– 0 - 16MHz

❖ Power Consumption at 1MHz, 3V, 25°C

– Active: 0.6mA

– Idle Mode: 0.2mA

– Power-down Mode: < 1Ma

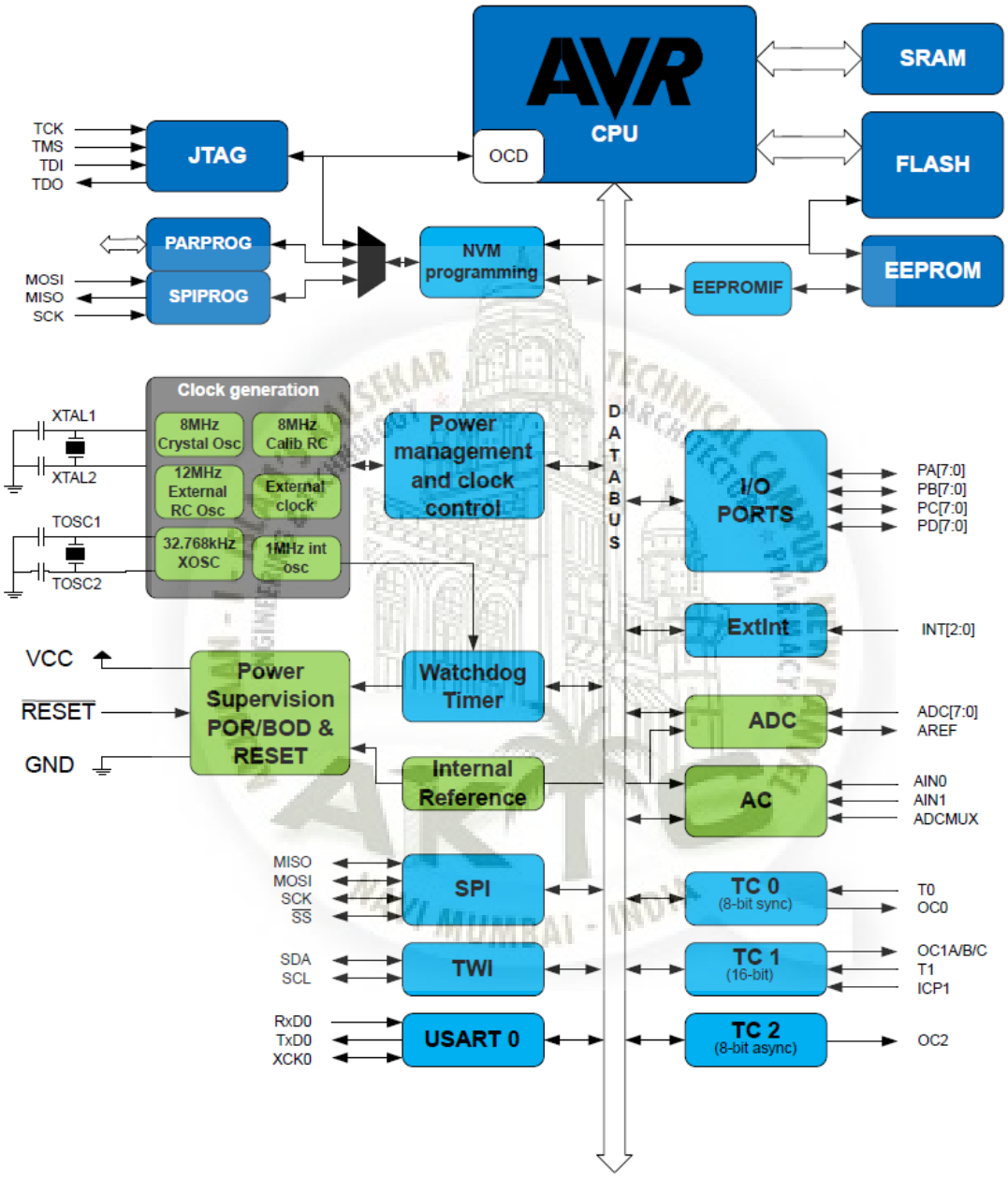
6.1.1 CONFIGURATION SUMMARY

Features	ATmega32A
Pin count	44
Flash (KB)	32
SRAM (KB)	2
EEPROM (KB)	1
General Purpose I/O pins	32
SPI	1
TWI (I^2C)	1
USART	1
ADC	10-bit, up to 76.9ksps (15ksps at max resolution)
ADC channels	8
AC propagation delay	Typ 400ns
8-bit Timer/Counters	2
16-bit Timer/Counters	1
PWM channels	4
RC Oscillator	+/-3%
VREF Bandgap	
Operating voltage	2.7 - 5.5V
Max operating frequency	16MHz
Temperature range	-55°C to +125°C
JTAG	Yes

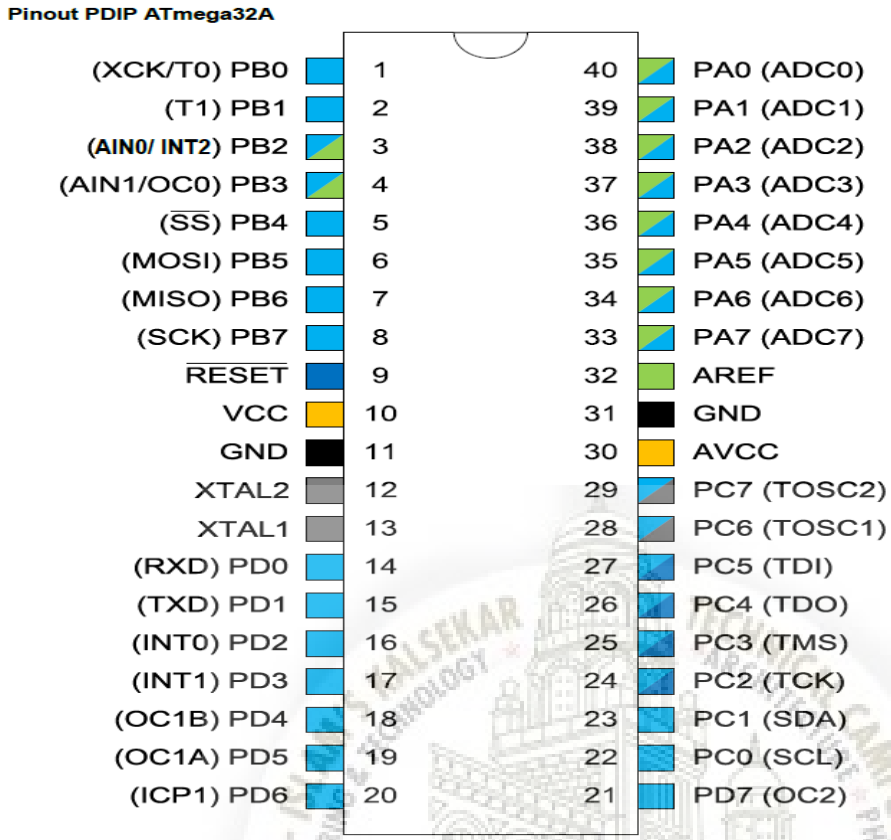
6.1.2 BLOCK DIAGRAM

Block Diagram

Figure 4-1. Block Diagram



6.1.3 PIN CONFIGURATIONS



VCC :Digital supply voltage.
GND :Ground.

Port A (PA7-PA0): Port A serves as the analog inputs to the A/D Converter or 8-bit bi-directional I/O port(if the A/D Converter is not used). Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port B (PB7-PB0): Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active,even if the clock is not running. Port B also serves the functions of various special features.

Port C (PC7-PC0) :Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5(TDI), PC3(TMS) and PC2(TCK) will be activated even if a reset occurs. The TD0 pin is tri-stated unless TAP states that shift out data are entered. Port C also serves the functions of the JTAG interface and other special features of the ATmega32.**Vcc:** Digital voltage supply

Port D (PD7-PD0): Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port D also serves the functions of various special features of the ATmega32.

RESET: It is a RESET pin which is utilized to set the microcontroller ATmega32 to its primary value. During the beginning of an application the RESET pin is to be set elevated for two machine rotations.

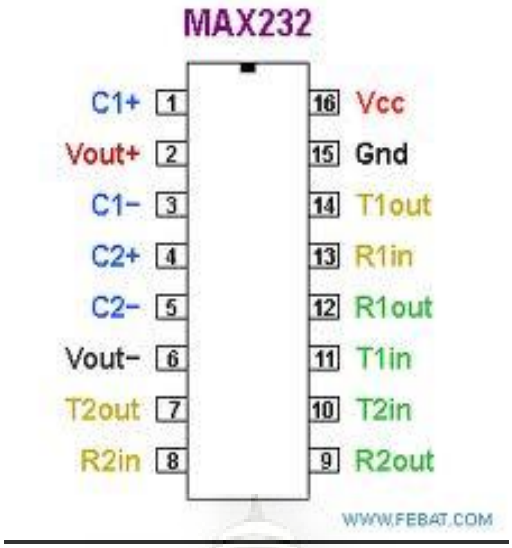
XTAL1: It is an input for the inverting oscillator amplifier and input to an internal clock operating circuit.

XTAL2: It is an output from an inverting oscillator amplifier.

AVcc: It is a supply voltage pin for A/D converter and Port A. It must be connected with Vcc.

AREF: AREF is an analog signal reference pin for the analog to digital convert

6.2 MAX 232 IC (DUAL DRIVER/RECEIVER)



Pin No	Function	Name
1	Capacitor connection pins	Capacitor 1 +
2		Capacitor 3 +
3		Capacitor 1 -
4		Capacitor 2 +
5		Capacitor 2 -
6		Capacitor 4 -
7	Output pin; outputs the serially transmitted data at RS232 logic level; connected to receiver pin of PC serial port	T_2 Out
8	Input pin; receives serially transmitted data at RS 232 logic level; connected to transmitter pin of PC serial port	R_2 In
9	Output pin; outputs the serially transmitted data at TTL logic level; connected to receiver pin of controller.	R_2 Out
10	Input pins; receive the serial data at TTL logic level; connected to serial transmitter pin of controller.	T_2 In
11		T_1 In
12	Output pin; outputs the serially transmitted data at TTL logic level; connected to receiver pin of controller.	R_1 Out
13	Input pin; receives serially transmitted data at RS 232 logic level; connected to transmitter pin of PC serial port	R_1 In
14	Output pin; outputs the serially transmitted data at RS232 logic level; connected to receiver pin of PC serial port	T_1 Out
15	Ground (0V)	Ground
16	Supply voltage; 5V (4.5V – 5.5V)	Vcc

FEATURES

1. In line with all the technical standard RS-232C
2.Only requires a single 5V power supply
3.Chip charge pump with a boost, voltage, polarity reversal ability to generate 10V and-10V voltage V
4.Low power consumption, the typical supply current of 5mA. The internal integration of two RS-232C driver
5.The internal integration of the two RS-232C receivers

6.+-30 V input levels.

6.3 ZIGBEE MODULE 802.15.14

Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, Zigbee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network.

The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as Wi-Fi. Applications include wireless light switches, home energy monitors, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics.[1] Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking (Zigbee networks are secured by 128 bit symmetric encryption keys.) Zigbee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

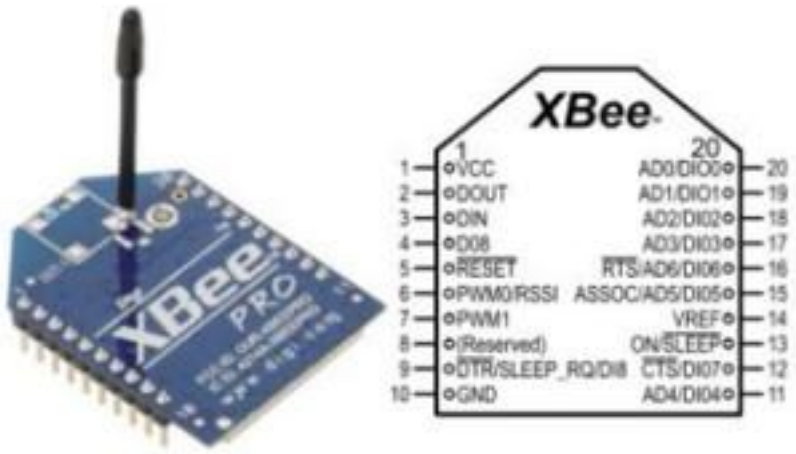
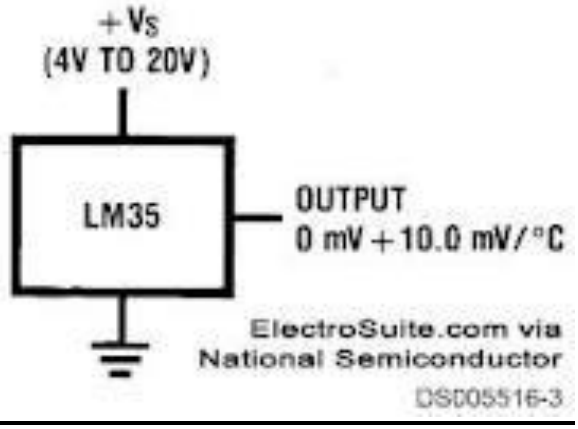
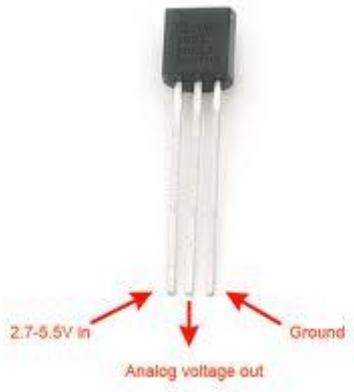


Table 1-02. Pin Assignments for the XBee and XBee-PRO Modules
(Low-asserted signals are distinguished with a horizontal line above signal name.)

Pin #	Name	Direction	Description
1	VCC	-	Power supply
2	DOUT	Output	UART Data Out
3	DIN / CONFIG	Input	UART Data In
4	DIO8*	Output	Digital Output 8
5	RESET	Input	Module Reset (reset pulse must be at least 200 ns)
6	PWM0 / RSSI	Output	PWM Output 0 / RX Signal Strength Indicator
7	PWM1	Output	PWM Output 1
8	[reserved]	-	Do not connect
9	DTR / SLEEP_RQ / DI8	Input	Pin Sleep Control Line or Digital Input 8
10	GND	-	Ground
11	AD4 / DIO4	Either	Analog Input 4 or Digital I/O 4
12	CTS / DIO7	Either	Clear-to-Send Flow Control or Digital I/O 7
13	ON / SLEEP	Output	Module Status Indicator
14	VREF	Input	Voltage Reference for A/D Inputs
15	Associate / AD5 / DIO5	Either	Associated Indicator, Analog Input 5 or Digital I/O 5
16	RTS / AD6 / DIO6	Either	Request-to-Send Flow Control, Analog Input 6 or Digital I/O 6
17	AD3 / DIO3	Either	Analog Input 3 or Digital I/O 3
18	AD2 / DIO2	Either	Analog Input 2 or Digital I/O 2
19	AD1 / DIO1	Either	Analog Input 1 or Digital I/O 1
20	AD0 / DIO0	Either	Analog Input 0 or Digital I/O 0

6.4 TEMPERATURE SENSOR LM35





The LM35 sensors are three-terminal devices that produce output voltages proportional to °C (10 mV/°C), so the nominal output voltage is 250 mV at 25°C and 1.000V at 100°C. These sensors can measure temperatures below 0°C by using a pull-down resistor from the output pin to a voltage below the "ground" pin. The LM35 sensor is more accurate (+ -1°C from -55°C to +150°C vs. + -3°C from -20°C to +100°C). The LM35 device is available in plastic TO-92 and SO-8 Packages and in a TO-46 metal can. 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 water level.

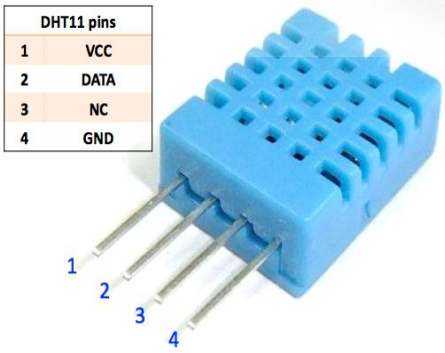
The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 μA from its supply, it has very low self-heating, less than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

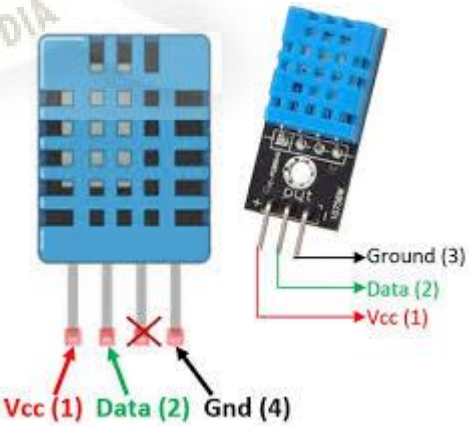
GENERAL FEATURES

- ❖ Calibrated directly in ° Celsius (Centigrade)
- ❖ Linear + 10.0 mV/°C scale factor
- ❖ 0.5°C accuracy guaranteeable (at +25°C)
- ❖ Rated for full −55° to +150°C range
- ❖ Suitable for remote applications
- ❖ Low cost due to wafer-level trimming
- ❖ Operates from 4 to 30 volts
- ❖ Less than 60 µA current drain
- ❖ Low self-heating, 0.08°C in still air
- ❖ Nonlinearity only ±1⁄4°C typical
- ❖ Low impedance output, 0.1 □□for 1 mA load

6.5 HUMIDITY SENSOR DHT11

The DHT11 is a basic, ultra-low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

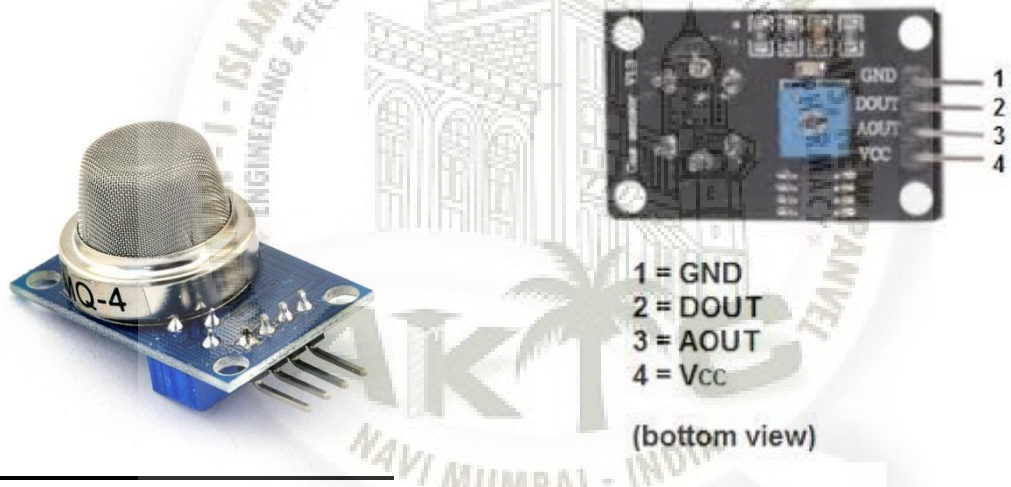




TECHNICAL DETAILS

- Low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 20-80% humidity readings with 5% accuracy
- Good for 0-50°C temperature readings ±2°C accuracy
- No more than 1 Hz sampling rate (once every second)
- Body size 15.5mm x 12mm x 5.5mm
- 4 pins with 0.1" spacing

6.6 GAS SENSOR MQ4



This is a very easy to use low cost semiconductor Gas Sensor Module with analog and digital output. This module uses MQ4 Methane gas sensor as a gas sensing element. It requires no external components just plug in Vcc & ground pins and you are ready to go. For Digital output the threshold value can be easily set by an on-board potentiometer. Using this module, you can easily interface MQ4 Methane (CNG) gas Sensor to any Microcontroller, Arduino or even Raspberry Pi. Since this Gas Sensor module is sensitive to Methane it is also small sensitivity to alcohol & smoke.

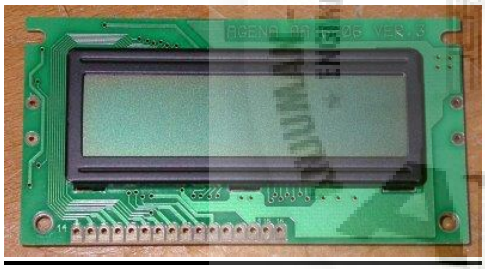
SPECIFICATION OF MQ4 GAS SENSOR MODULE

- Power Supply: 5 Volts
- Interface Type: Analog & Digital
- High Sensitivity to Methane & small sensitivity to smoke & alcohol
- Low Cost.
- Stable & Long Life.
- On board Power indication.

The instruction of Wiring:
1. VCC: positive power supply (5V)
2. GND: power supply is negative
3. DO: TTL switching signal output
4. AO: analog signal output

Module Applications:
Suitable for home or factory methane gas , natural gas and other monitoring devices to test natural gas, methane 300 to 10000ppm;

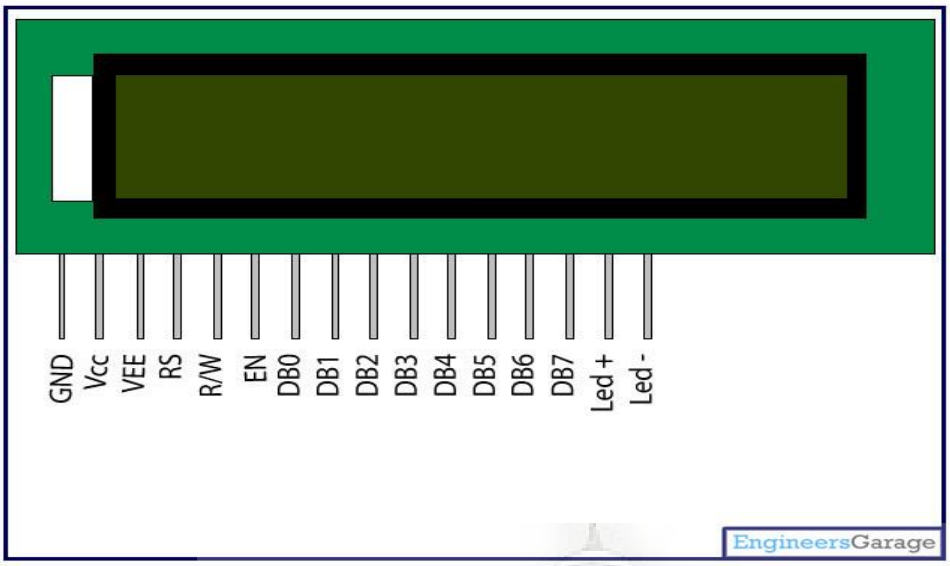
6.7 LCD 16*2



A **liquid crystal display** (**LCD**) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystal (LCs). LCs does not emit light directly.

LCDs are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpits display, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have replaced cathode ray tube (CRT) displays in most applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in. LCDs are, however, susceptible to image persistence.

PIN DESCRIPTION



A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4

12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

SPECIFICATIONS

- 16 characters wide, 2 row
- Drive method is 1/16 duty cycle
- Character structure is 5*8 dots
- White text on blue background
- Connection port is 0.1" pitch, single row for easy bread boarding and wiring
- Pins are documented on the back of the LCD to assist in wiring it up
- Single LED backlight included can be dimmed easily with a resistor or PWM and uses much less power than LCD with EL (electroluminescent) backlights
- Can be fully controlled with only 6 digital lines! (Any analog/digital pins can be used)
- Built in character set supports English/Japanese text
- Up to 8 extra characters can be created for custom glyphs or 'foreign' language support
- Comes with necessary contrast potentiometer and strip of header

6.8 SOFTWARE'S TO BE USED

AVR STUDIO

The new AVR STUDIO IDE has been designed to enhance developer's productivity, enabling faster, more efficient program development .AVR STUDIO introduces a flexible window management system, enabling you to drag and drop individual windows anywhere on the visual surface including support for multiple monitors .the AVR STUDIO IDE from AVR combines project management ,make facilities, source code editing, program debugging and complete simulation in one powerful environment the AVR STUDIO development is easy to use and helping you quickly creates embedded programs that work .The AVR STUDIO editor and debugger are integrated in a single application that provides a seamless embedded project development environment

BASCOMM

It is software for burning the program into the processor

EXPRESS PCB AND TINA TI

It is a schematic editor for designing circuit diagrams. Parts can be placed on many sheets and connected together through ports

CHAPTER 7

SOFTWARE IMPLEMENTATION

```
/*
        XBee Based Physical Parameter Monitoring System for Mining Using AVR ATmega32


 */
#define F_CPU 1000000UL
#include <avr/io.h>
#include <util/delay.h>
#include <string.h>
#include <stdio.h>
#include "LCD_16x2_H_file.h"
// ***************************************************************************
// Macros and Defines
// ***************************************************************************
#define BAUD 1200
#define MYUBRR F_CPU/16/BAUD-1
// ***************************************************************************
// Function Prototypes
// ***************************************************************************
void usart_init(uint16_t ubrr);
void usart_putchar( char data );
void usart_pstr (char *s);
#define degree_sysmbol 0xdf
// ***************************************************************************
// usart Related
// ***************************************************************************
void usart_init( uint16_t ubrr)
        {
    UBRRH = (uint8_t)(ubrr>>8);                    // Set baud rate
    UBRRL = (uint8_t)ubrr;                        // Enable receiver and transmitter
    UCSRB = (1<<RXEN)|(1<<TXEN);
```

```
    UCSRC = (1<<URSEL)|(3<<UCSZ0);        // Set frame format: 8data, 1stop bit
        }

void usart_putchar(char data)
        {
    while ( !(UCSRA & (_BV(UDRE))) );              // Wait for empty transmit buffer
    UDR = data;    // Start transmission
        }

void usart_pstr(char *s)
        {
   while (*s)     // loop through entire string
         {
     usart_putchar(*s);
     s++;
    }
        }

void ADC_Init()
        {
        DDRA = 0x00;                    /* Make ADC port as input */
        ADCSRA = 0x87;                  /* Enable ADC, with freq/128  */
        ADMUX = 0x40;                  /* Vref: Avcc, ADC channel: 0 */
        }

int ADC_Read(char channel)
{
        ADMUX = 0x40 | (channel & 0x07);                    /* set input channel to read */
        ADCSRA |= (1<<ADSC);                               /* Start ADC conversion */
        while (!(ADCSRA & (1<<ADIF)));                    /* Wait until end of conversion by polling ADC interrupt
flag */
        ADCSRA |= (1<<ADIF);                              /* Clear interrupt flag */
        _delay_ms(1);                                     /* Wait a little bit */
        return ADCW;                                     /* Return ADC word */
```

```
}


int main()
	{
		MCUCSR|= (1<<JTD);
		MCUCSR|= (1<<JTD);

		char Temperature[10],Humidity[10],a;
		float celsius;

		DDRD |= 1 << PIND7;//pin7 of portD as BUZZER OUTPUT

	DDRD &= ~(1 << PIND6);//pin6 of portD as BUZZER INPUT

	PORTD |= 1 << PIND6;

		LCD_Init();		/* initialize 16x2 LCD*/
		ADC_Init();		/* initialize ADC*/
		usart_init ( MYUBRR );

		while(1)
		{
		 if(bit_is_clear(PIND,6))
		 {
				_delay_ms(10);
				a=1;
			while(a==1)
			{
			 PORTD |= 1 << PIND7;

			 LCD_Clear();
			 LCD_String_xy(1,0,"GAS IS DETECTED");
```

```
                usart_pstr("HAZARDOUS GAS DETECTED:\n\r");

                _delay_ms(3000);
                a=0;
            }
    }
        a=0;
  PORTD &= ~(1 << PIND7);
        usart_pstr("NO HAZARDOUS GAS DETECTED:\n\r");

        celsius = (ADC_Read(0)*4.88);

        celsius = (celsius/10.00);

        _delay_ms(1000);

        sprintf(Temperature,"%d%cC  ", (int)celsius, degree_sysmbol);
/* convert integer value to ASCII string */
        int i=celsius,hum=celsius+32;
        usart_pstr("Mine Temperature: ");

        usart_pstr(Temperature);

        usart_pstr("Degree\n\r");

        if(i>celsius)
        hum=hum-1;
        else
        hum=hum+1;
        sprintf(Humidity,"%d  ", (int)hum);
        usart_pstr("Mine Humidity: ");
```

```
            usart_pstr(Humidity);

            usart_pstr("%\n\r");

            LCD_String_xy(1,0,"TEMP");
            LCD_String_xy(1,6,"GAS");
            LCD_String_xy(1,11,"HUMID");
            LCD_String_xy(2,0,Temperature);          /* send string data for printing */
            LCD_String_xy(2,6,"No");                 /* send string data for printing */
            LCD_String_xy(2,12,Humidity);            /* send string data for printing */
            LCD_String_xy(2,15,"%");
            memset(Temperature,0,10);
        }
    return 0;
}
```

```
/*
 * LCD_16x2_C_file.c
 * http://www.electronicwings.com
 *
 */


#include "LCD_16x2_H_file.h"                        /* Include LCD header file */
void LCD_Command (char cmd)                         /* LCD command write function */
{
    LCD_Data_Port = cmd;                            /* Write command data to LCD data port */
    LCD_Command_Port &= ~((1<<RS)|(1<<RW));         /* Make RS LOW (command reg.), RW LOW (Write) */
    LCD_Command_Port |= (1<<EN);                    /* High to Low transition on EN (Enable) */
    _delay_us(1);
    LCD_Command_Port &= ~(1<<EN);
    _delay_ms(3);                                   /* Wait little bit */
```

```
}

void LCD_Char (char char_data)                    /* LCD data write function */
{
    LCD_Data_Port = char_data;                    /* Write data to LCD data port */
    LCD_Command_Port &= ~(1<<RW);                 /* Make RW LOW (Write) */
    LCD_Command_Port |= (1<<EN)|(1<<RS)           /* Make RS HIGH (data reg.) and High to Low transition on
EN
                                                  (Enable) */
    _delay_us(1);
    LCD_Command_Port &= ~(1<<EN);
    _delay_ms(1);                                 /* Wait little bit */
}

void LCD_Init (void)                              /* LCD Initialize function */
{
    LCD_Command_Dir |= (1<<RS)|(1<<RW)|(1<<EN);   /* Make LCD command port direction as o/p */
    LCD_Data_Dir = 0xFF;                          /* Make LCD data port direction as o/p */

    _delay_ms(20);                                /* LCD power up time to get things ready, it should always >15ms */
    LCD_Command (0x38);                           /* Initialize 16X2 LCD in 8bit mode */
    LCD_Command (0x0C);                           /* Display ON, Cursor OFF command */
    LCD_Command (0x06);                           /* Auto Increment cursor */
    LCD_Command (0x01);                           /* Clear LCD command */
    LCD_Command (0x80);                           /* 8 is for first line and 0 is for 0th position */
}

void LCD_String (char *str)                       /* Send string to LCD function */
{
    int i;
    for(i=0;str[i]!=0;i++)                        /* Send each char of string till the NULL */
    {
        LCD_Char (str[i]);                        /* Call LCD data write */
    }
```

```
}

void LCD_String_xy (char row, char pos, char *str)          /* Send string to LCD function */
{
    if (row == 1)
        LCD_Command((pos & 0x0F)|0x80);          /* Command of first row and required position<16 */
    else if (row == 2)
        LCD_Command((pos & 0x0F)|0xC0);          /* Command of Second row and required position<16 */
    LCD_String(str);                             /* Call LCD string function */
}

void LCD_Clear()

    LCD_Command(0x01);                           /* clear display */
}
```

CHAPTER 8
ADVANTAGES AND APPLICATIONS

ADVANTAGES:

- Safety monitoring of the environment.
- Improved Services in coal mining.
- Providing Wireless connection security
- Prevent from the high temperature, humidity and harmful gases
- Quick Searching and can able to give the warning.

APPLICATIONS:

- Safety monitoring in case of fire in the house
- Can act as alarming system in home automation
- Can be applied to the persons who are working in the underground.
- Can be applied at any weather Conditions

CHAPTER 9

CONCLUSION AND FUTURE SCOPE

CONCLUSION

The study on real time monitoring of toxic gases and other parameters present in underground mine has analyzed using wireless sensor network. A real time monitoring system is developed to provide clearer and more point to point perspective of the underground mine. This system is displaying the parameters on the LCD at the underground section where sensor unit is installed as well as on the monitoring unit; it will be helpful to all miners present inside the mine to save their life before any casualty occurs. Alarm triggers when sensor values cross the threshold level. This system also stores all the data in the computer for future inspection. From the experiments and observations, the following conclusion can be drawn:

(i) Each node in a particular framework functions as the pioneer robot when all its parameters are configured properly.

(ii) Sensor nodes can reconfigure remotely over a wireless network and most of the processing done in software on computer side.

(iii) The calibration equations of gas sensors may have affected the accuracy of the ppm results.

This is a low cost and lifelong system. The overall cost will be around 15000-18000 while using 4 sensors and one audio IC also other components mentioned in this report.

FUTURE SCOPE

Zigbee has a very promising future in front of it.

1. Using additional sensors we can monitor other parameters as well (Tilt, vibration, fire, and audio)

1. Can be used as a wearable device.

2. Can be used as a monitoring real time

COMPONENTS LIST

- Atmega 32A Microcontroller
- Max 232 Interface IC
- Zigbee Module 802.15.14(Tx & Rx)
- Temperature Sensor (LM35) Module
- Humidity Sensor (DHT11) Module
- Gas Sensor Mq-7
- Lcd 16*2
- Pcb's For Microcontroller, Lcd
- Resistors, Capacitors, Led's, Main Cords, Crystal Oscillator.Potentiometer.
- IC Base, Soldering Wire, Connecting Wires
- Rs232 To Usb Interfacing Cable

REFERENCES

1)Design and Implementation of Coal Mine Physiological Parameters Monitoring Protocol, Swarup S. Mathurkar, Shubhada S. Thakare International Journal on Recent and Innovation Trends in Computing and Communication ,Volume: 5 Issue: 1

2) Intelligent Mining: A Monitoring and Security System for Coal Mine Workers, Nisha Dube1, Prof. K.S. Ingle International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 5, Issue 1, January 2016,

3) Coal Mine Monitoring System for Rescue and Protection using ZigBee, Shilpa Lande, Prof.Matte P.N, International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 4 Issue 9, September 2015,

4) Safety Scheme for Mining Industry using ZigBee, N. Krithika* and R. Seethalakshmi,Indian Journal of Science and Technology, Vol 7(8), 1222–1227, August 2014, ISSN (Print) : 0974-6846 ISSN (Online) : 0974-5645

5) A Coal Mine Safety System using Wireless Sensor Network, Vijaya Kumari Doddi 1, N.Anuradha , International Journal of Professional Engineering Studies, Volume II/Issue 1/JAN2014 page 1-6,

6) A Measurement of Medium Range of Underground Coal Mine Using Wireless Sensor Network, K.Sujitha, R.Jeevanatham, International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 3 Issue XI, November 2015ISSN: 2321-9653

7) Rescue And Protection System For Coal Mine Workers By Using WSN, Prof.Swapnil D.Patil ,Ms. Bagane R. S. ,Ms. Khandekar M.V.,Ms. Misal T. A. ,Ms. Sayyad M. S, IJARIIE-ISSN(O)-2395-4396, Vol-3 Issue-2 2017.

8) Robot Based Wireless Monitoring and Safety System for Underground Coal Mines using Zigbee Protocol: A Review
Sachin M. Ledange, Swarup S. Mathurkar,International Journal of Science, Engineering and Technology Research (IJSETR), Volume 5, Issue 1, January 2016

9) Safety Helmets For Coal Miners Using Zigbee TechnologyMonika Prasad1, Deovrat Singh2, Rishabh Sachdeva3,
Priyanka Singh4, Mr.Manoj Vishnoi5IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 3, Issue 2, April-May, 2015ISSN: 2320 – 8791 (Impact Factor: 1.479)

10) Intelligent safety system for coal miners
Beena M Varghese, Binisha Balan, Neethu Varghese, Reshma Gangadharan, Shaima PK M A College of Engineering, Kothamangalam, Kerala. International Journal of Engineering and Innovative Technology (IJEIT) Volume 4, Issue 9, March 2015

11.Prof. Himanshu K. Patel et.al "GSM based flexible calling system for coal monitoring workers" International Journal of Engineering Trends and
Technology (IJETT) - Volume4Issue4- April 2013.

12) https://www.pantechsolutions.net/microcontroller-tutorials/how-to-interface-lcd-with-lpc2148-arm7-development-board

13).http://www.aplusinc.com.tw/exec/product.php?mod=show&cid=45&pid=APR9301&lg=E

14) http://binaryupdates.com/atmega32 -microcontroller/.

15)http://www.micropik.com/PDF/dht11.pdf

16)http://www.worldcoal.org/coal-society/safety-issues/

17)https://www.sparkfun.com/datasheets/Sensors/Biometric/MQ-7.pdf
18)https://www.sparkfun.com/datasheets/Sensors/Biometric/MQ-4.pdf

19)http://ftp1.digi.com/support/documentation/90000976_V.pdf

20)Kumari Archana*, Abdul Wasay Mudasser "ZigBee and WIFI based mine safety application" International Journal of Scientific and Research Publications,
Volume 4, Issue 1, January 2014.

21))http://ftp1.digi.com/support/documentation/90000886_V.pdf

22)https://www.sparkfun.com/datasheets/Sensors/Biometric/atmega32.pdf

23)https://www.sparkfun.com/datasheets/Sensors/Biometric/LM35.

pdf

24).http://www.aplusinc.com.tw/exec/product.php?mod=show&cid=45&pid=APR9301456&lg=E