CHAPTER 1

INTRODUCTION

1.1 Prelude

In recent years, miner's helmet is extensively deployed in large and medium sized coal mines for their flexibility of light weight and low power. Meanwhile ZigBee based wireless sensor networks are recently investigated due to their remote environment monitoring capabilities. Such a network can easily collect sensor data and transmit them in radio frequencies.

Combining these two advantages a smart new helmet is designed, which enable the helmet as a mobile node of ZigBee wireless sensor networks, gathering parameters from underground timely and quickly. It is convenient for centralized management to build real time surveillance on environment parameters, so potential safety problems can be avoided by early-warning intelligence.

Workers safety is one of the main aspects of industry especially in mining industry. In the mining industry safety is a very vital factor. To avoid any unwanted phenomena all mining industry follows some basic precaution and phenomena. Communication is the key factor for any industry today to monitor different parameters and take necessary actions accordingly to avoid any types of hazards. To avoid loss of material and damaging of human health, protection system as well as faithful communication system is necessary inside the underground mines. To increase both safety and productivity in mines, a reliable communication must be established between workers, moving in the mine, and a fixed command center. The wired communication system inside mines is not that much effective. The reliability and long life of conventional communications systems in critical mining environments has always been a problem. Inside mines due to harsh conditional situation the installation cost as well as maintenance cost is high for wired communication networks. It is very difficult to reinstall the wired communication system inside mines after a landslide or damage due to any reasons. If by any means some workers trapped inside mines due to the roof fall,

to maintain the continuity of the communication system is very much important to know the actual position and condition of the trapped workers.

1.2 Motivation

The most of the coal mines in north east region of the country are still in primitive state, the mining accidents here are also very frequent. The main reason is these accidents occur due to the presence of methane and carbon monoxide gas in theses mines. These gas are colorless, odorless and is undetectable by human sensors. The key to controlling such accidents is the prediction of outburst by implementing sensors and microcontrollers and to generate an alarm system before critical atmospheric level.

A continuous monitoring is necessary which again requires some effective and accurate sensing system. Several technique are adopted to sense the presence of these poisonous gas, among them use of semiconductor type gas sensor is very much effective. These sensors can be mounted in the coal miner's helmet. The system can provide prevention and precaution for accidents.

The proposed system comprises of two parts: helmet and control unit.
Miner's smart helmet is composed of rechargeable battery, led, sensors like temperature, humidity, carbon monoxide, etc. and the ZigBee module. So helmet could collect environmental parameters timely and transmit to wireless base station. This information is sent to the control unit. The LCD present in the control unit will display the sensor values.

The voice communication is provided between the miner and the control unit with the use of RF transceiver and ZigBee model. The key to controlling such accidents is the prediction of outburst by implementing sensors and microcontrollers and to generate an alarm system before critical atmospheric level.

1.3 Introduction to Smart Helmet

Coal is an important source of energy in industrial production, it plays very important role in the national economy. It is one of the most basic fossil energy in the world. It is also an important raw material in metallurgical and chemical industry. Coal mine incidents were unpredictable and it has many factors that the event of an accident, not only causes huge economic losses, but a direct threat to the safety of miners. Due to poor coal geological conditions, low level of information, small scale coal mines and other reasons, the coal mining mortality rate is still higher than world's measure coal-producing countries. Gas, flooding, dust and other incidents are still the major hazards in coal mine safety.

The system comprises of two parts: helmet and control unit. Miner's smart helmet is composed of rechargeable battery, led, sensors like temperature, humidity, carbon monoxide, etc. and the ZigBee module. So helmet could collect environmental parameters timely and transmit to wireless base station. This information is sent to the control unit. The LCD present in the control unit will display the sensor values. The voice communication is provided between the miner and the control unit with the use of RF transceiver.

Fig.1.1 Block diagram of the system

Due to poor coal geological conditions, low level of information, small scale coal mines and other reasons, the coal mining mortality rate is still higher than world's measure coal- producing countries.

The problems facing in the existing system, use of cables directly from helmet to the control unit will cause the loss of information due to aging and wearing of cables. This can be overcome by network of ZigBee which is wireless objectives of the proposed system and brief explanation about the block diagram. Next chapter deals with the different literature works done on the existing system.

1.4 Issues of the Helmet

The ZigBee range between transmitter and receiver should be high, properly, to have good communication to the transmitter has to transmit the signals continuously, so power should not go off. The transmitter and receiver should be synchronized. The maintenance of the system should be taken care.

In the helmet part there are not much complicated but the maintenance of server should be taken care and check the sensors whether they are in working condition. The information should be uploaded for each and every second to the base station and to worker.

1.5 Objectives

- To avoid unpredictable accidents during coal mining
- To ensure the safety of underground mine operations ,installation of environmental monitoring in the roadway to detect environmental parameters
- To improve the performance and efficiency of data transmission of the coal mine safety system
- To reduce the costs of extending the system

1.6 Outline of the Project

The section describes the stages gone through to complete this project work.

Table 1.1: Structure of Project work

Stage 1	The project work started with the literature survey, to understand the previous methods and technologies used to avoid the accident in the mining.
Stage 2	The various methods were analyzed from the survey and the best methods were taken into consideration for the project work.
Stage 3	The ZigBee Model wireless communication prototype was developed and the result obtained through it was analyzed.
Stage 4	The ZigBee Model wireless communication was analyzed and brought to a conclusion that system can be easily implemented in the real time.

1.7 Problem Statement

The existing monitoring systems underground of coal mine mostly use cable network. This kind of network has poor performance of expansion. The use of cables directly from helmet to the control unit will cause the loss of information due to aging and wearing of cables.

When an accident happens especially explosion, the sensors and cables usually were damaged fatally, and couldn't provide information for rescue search and detection events the overcome with the use of ZigBee which is wireless.

1.8 Organization of the Thesis

This chapter gives brief information about the causes for the miners accidents and also methods are discussed for the prevention of accidents. The method are taken into consideration to control the accident of miner for this project work

Chapter 2 being the literature survey is concerned about the ground work about the previously existing methods for the prevention of accidents. The methods such as detection of gas, temperature, humidity, light using different sensors, and RF module for wireless communication other methods are explained in this chapter.

Chapter 3 gives the fundamentals of the system. The hardware and software requirements are explained and briefed in this chapter.

Chapter 4 describes the methodology in brief used to prevent the accidents in order to provide safety and precaution to the coal mine.

Chapter 5 shows the working of RF transmitter and receiver in the form of flowchart to meet all the objectives of the project.

Chapter 6 shows the result obtained from the implemented prototype using method and snapshots represents the different levels of sensors worked.

Chapter 7 concludes the project with a brief conclusion of all work conducted to achieve the objectives of the project. The methods which can be used for the enhancement of the presently carried out work is also specified.

1.8 Applications

The project work has the great requirement and application in real time. The main aim of this project is to implement the system in each and every helmet, so that the huge number of accidents can be reduced. The important factor is that if any dangerous gas present in the environment that is arrive this sensed by this system and

provide an alarm to the base station and miner immediately and thus it safe guards many precious lives. The important applications are listed as follows

- It can be used in real time safety system.
- It can be used to the persons who are working in the underground.
- It can be applied at any weather conditions.
- It can also be used for road safety systems.

1.10 Summary

The chapter summarizes the major causes of miner's accidents in especially mining field. The introduction to protecting helmet and objectives of the project work are discussed.

CHAPTER 2

LITERATURE SURVEY

2.1 Introduction

An important chapter in venture work is literature survey. It gathers the information for the project work. It defines the problem statement, possible solutions and stimulations. In this section a detailed survey is carried out which helps in accumulation of knowledge towards the project work.

The literature survey provides overall information about the protecting system design for coal miners using embedded system in this project this is beneficial for the coal mining worker.

2.2 Literature review on a Protecting System Design for Coal Miners

Jiang [1] proposed safety plays an important role in mines. A number of parameters need to be monitored in coal mines as it can be hazardous for human life. It include exposure to high temperature, humidity, free oxygen and methane gas in that atmosphere. Genes an idea in which the helmets are used as monitoring devices. The wireless sensor networks are used for communication between the node and the base station. The methane sensor, the temperature sensor and the humidity sensor are used for sensing methane content, temperature and humidity respectively. The sensed signals are then sent to the base station using wireless sensor networks dynamic topology.

The sensor nodes convey the necessary information about the parameters to the base station. A gateway node is used in delivering the information from the sensor nodes to the base station. A hybrid protocol is used for routing purpose. Protocol combines advantages of both the proactive and reactive protocols. A sensor node has a microcontroller connected to the sensors, transmitter. In addition, it also gives an

indication to the workers if the values exceed the safety limit. Shall further be simulated with MATLAB.

Tian [2] explained the development of an embedded system to monitor harmful emissions in the coal. mines includes heavy gases such as co2, LPG and also other parameters like temperature, humidity will be high. Coal mine emission parameter like co2, LPG etc. can be continuously monitored by using gas sensor, temperature monitored by temperature sensor, and humidity is monitored by humidity sensor.

The hardware is placed inside the coal mines. Whenever poisonous gases, fire are detected by the sensors connected to the micro controller, will give buzzer for alert & transmits the data through ZigBee. The transmitted data will be received by the ZigBee receiver and this information will be passed to the higher authorities and emergency services by using GSM module. And information is having the details about the place, where the accident taken place by using GPS technology.

Zhu and Zhang [3] worked on the concept of helmet developed includes various features the two way communication, detection of the hazardous gases, providing notification in the case of helmet removal, collision, panics switch for emergency situations, continuous monitoring of the environmental conditions such as temperature and pressure in the mining industry and GPS is provided to track the location of the miner. Once the poisonous gas is detected the helmet opening gets closed and the oxygen supply is provided within the helmet for the miners by the opening of solenoid valve of the oxygen cylinder.

Panics switch is provided for the safety of the miners and it is used to provide alert signal to the control room during any emergency situations Temperature and pressure sensor are used for the continuous monitoring of environmental conditions .the information are sent to the control room through wireless network. The layout of the visualization is presented and displayed in the control room with the help of a lab view software .this paper presents the undertaken design detailing solutions to issues raised in previous research.

Koenig *et al*. [4] proposed the concept on flexible solution for underground mine workers' safety. A module of sensors and webcam are used for underground environment monitoring and analyzing measurement data through digital wireless communication technique is proposed with high accuracy, smooth control and reliability. A microcontroller is used here for gathering data and making decision, based on which the mine worker is informed through alarm as well as voice system. ZigBee, based on IEEE 802.15.4 standard is used for this short distance transmission between the hardware fitted with the mine worker and the ground control center. Also the wireless camera is used for visual distant monitoring purpose.

Fresco [5] proposed reasonable, flexible, uninterrupted monitoring system of underground mine workers on their protection and security. The atmosphere of mine exploitation is special and dangerous, how to real-time monitor and collect information on the different nodes, how to master the position of miner and atmosphere at any time, it is difficult problem for coal mine enterprise to urgently solve. Research there are two different sections.

The first section is tunnel section and another section is floor section. Tunnel section the sensors will sense the atmosphere conditions such as temperature, humidity, methane gas etc.., and this information is send to the microcontroller. Microcontroller as well as displays this information in the liquid crystal display (LCD).

The monitoring data is compared with the predefined threshold value, if the received value are exceeds the threshold value it sends the information to floor section by ZigBee. In floor section ZigBee receives the information and texts is send to the corresponding member and also making call through global system for mobile communication modem. The predefined stored voice provided by voice processor. And this section gets the acknowledgements from the receiver.

Maity [6] described the addresses a cost-effective, flexible solution of underground mine workers' safety. A module of Micro Electronics Mechanical Systems (MEMS) based sensors are used for underground environment monitoring and automating progression of measurement data through digital wireless communication

technique is proposed with high accuracy, smooth control and reliability. A microcontroller is used for collecting data and making decision, based on which the mine worker is informed through alarm as well as voice system. The voice system with both microphone and speaker, transforms into digital signal and effectively communicate wirelessly with the ground control center computer. ZigBee, based on IEEE 802.15.4 standard is used short distance transmission between the hardware fitted with the mine worker and the ground control center.

Wei and Li-li [7] done thesis work on the characteristics of coal mine environment, in this paper we propose a multi-parameter wireless sensor network monitoring system based on ZigBee technology for coal mine tunnel. The system can real-time monitor the underground environment and production parameters and intelligently give early warning by using a variety of sensors and wireless sensor network. It is flexible to add sensors and enhance stability of monitoring computer software through rs-485 communication protocol and hardware modular. Experiments have proved feasibility and good stability of the system.

Zhang *et al*. [8] explained the experimental results of radio propagation in two underground coal mines. Measurements were performed at 900 MHz on horizontal and vertical polarization in typical coal mine operational zones. Values of propagation loss in dB/100 m are derived. Additional losses due to coal mine curvatures and common coal mining equipment obstructions are also presented. A hybrid tunnel propagation model consisting of the free space propagation model and the modified waveguide propagation model is used to explain some measurement results. Based on these results, we believe that microcellular radio communications systems are feasible in coal mines.

Ling *et al*. [9] proposed a system of narrow space and harsh environment underground coal mines. Radio signals are transmitted, diffraction, attenuation, multipath and scattering are often very serious. The problems make the Wireless Sensor Network (WSN) system difficult to reach the set bit error rate when transmitting images. Which makes every node of the WSN work together, is adopted in the paper. In order to improve the system capability and reliability, virtual multi-antennas receive-diversity aided method is also used. The peculiarity of transmission underground coal

mines, the wireless transmission to take further advantage of and improve the reliability in data transmission. So it is possible for the WSN system to transmit image signals underground coal mines

Chaamwe *et al*. [10] proposed earth tremors and the accompanying ground falls constitute a major threat to underground mining operations in most underground mines in Zambia. Seismic monitoring is therefore an important exercise that ensures not only a safe working environment for workers but ensures the safety of communities living nearby the mines. Paper discusses seismic events monitoring at one of the biggest mines in Zambia called muffler copper mine. A study on seismic monitoring was carried out at the mine through observations, interviews and record inspections. The study revealed the different methods used over a period of time and it also revealed some major causes of seismicity at the mine. The paper then proposes the use of Wireless Underground Sensor Networks (WUSNS) to monitor seismic events in underground mines. wireless sensor networks uses sensors that are capable of not only sensing, but processing and transmitting data, hence reducing on the wiring that is characterized by the current-system.

Miao *et al.* [11] proposed based on introduction of the background and the limitations of present prediction methods for gas outburst in coal mines, focuses on introducing a new decision-making approach to coal and gas outburst prediction with multi-sensor information fusion. Two of the multi-sensor information fusion methods, were taken into account, and the improved combination rules of the d-s evidence theory in fuzzy sets was given for decision fusion. Practical experiment of gas outburst prediction is given to prove the efficiency and effectiveness of the new approach. The related experiments show that the novel approach with improved combination rules of the d-s evidence theory provides more rational results than each single prediction method.

Chan [12] worked on the local positioning systems are able to track physical assets or people. Systems can help, but are not limited to, factory automation, asset management. However, it is not easy to apply such systems at the factory level because they are limited by the challenging environment. Advanced wireless technologies

provide a chance to make such applications possible. One of the possible technologies is the ZigBee technology, whereas a brief review of the technology and specification of which is presented in this paper. Since the wireless local positioning systems could be represented as a sensor network, multi-agent system would be a good candidate to model such systems. In this connection, an agent-based wireless local positioning system with ZigBee technology is proposed. Based on this system, some applications are suggested.

Qiang *et al*. [13] proposed a systemon cost effective ZigBee-based wireless mine supervising system is presented in this article. Scheme used intelligent helmets as voice terminal and ultra-low-power nodes of wireless sensor network. The programmer adopted ZigBee wireless technology to build wireless sensor networks, realized realtime surveillance with early-warning intelligence on methane, temperature, humidity in mining area, and used speech communication to reduce potential safety problems in coal production.

Maity *et al*. [14] done work on the addresses an economical, supple, continuous monitoring system of underground mine workers' protection and security. a module of MEMS based sensors are used for monitoring underground parameters as per the requirement of the user and automating sequence of measuring data through digital wireless communication system is projected with high precision, soft control and reliability. A microcontroller based system is used for collecting and storing data and making decision accordingly, based on which the mine worker is informed through different alarm tone as well as voice system. The voice system with both microphone and speaker, converted into digital signal and successfully communicate wirelessly with the ground control center computer system. The communication system is reliable based on ZigBee, IEEE 802.15.4 standard. Transmission between the hardware circuits fitted with the mine workers and the ground control center computer system through some routers.

Geetha [15] proposed cost effective ZigBee based wireless mine supervising system with voice over ZigBee (voz) is presented here. Smart helmet, enable the helmet as a mobile sensor node of ZigBee wireless sensor networks, gathering parameters the

temperature, humidity and illumination level of underground environment and will alert the central management unit in case of abnormal condition. A voice transmission system, based on the same low-rate ZigBee networks. So with environmental monitoring, the miners can communicate with control centers or with other miners through wireless speech communication.

Rezal *et al* [16] proposed Energy saving Hand Driven Battery Charger (HDBC) was developed. The HDBC is running by using human muscle power conversion. A voltage regulator the conversion of such power done. Storage system used batteries and a dummy model load was attached for the implement of lighting system. Charged and storage can be done by more useful way. System people can illuminate houses small energy consuming lights instead of being in darkness. Instead of making solar power a major one human muscle power for small charging lighting systems. Biking and pedal power systems was done before as a replacement of solar energy systems.

Hongjiang and Shuangyou.[17] Described on Continuous development of technology, it gives a new type system of coal mine safety based on ZigBee technology. The characteristics of wireless sensor networks and the mature communication technologies of can bus, it implements real-time monitoring and intelligent warning for underground environment and production parameters. System is equipped with a low power arm processor chip s3c2410 as the control of the core and ZigBee as a communications platform of wireless sensor networks. Through a lot of tests, many valuable data are collected from the actual environment, such as communications length, communication quality, power consumption and so on. The result of the experiment confirms the feasibility of the system design and its good stability.

Gaidhane *et al*. [18] worked on project focuses on a mine supervising system which is based on the cost effective ZigBee system. Developing a wireless sensor networks, realized real-time surveillance with early-warning intelligence on harmful gases, temperature, and humidity in mining area and used ZigBee communication to reduce potential safety problems in coal production using a ZigBee wireless technology. Three parameters are detected continuously by temperature sensor, gas sensor, humidity sensor and if they cross the pre-defined limit, then the user gets alert as the buzzer will

automatically turn on with led indications. With a ZigBee wireless positioning devices the system might be easily extended. The values of different sensors are continuously transmitted by ZigBee transmitter to the remote monitoring unit which are received by ZigBee receiver module.

Qiang *et al*. [19] developed cost effective ZigBee-based wireless mine supervising system is presented in this article. Intelligent helmets as voice terminal and ultra-low-power nodes of wireless sensor network. The programme adopted ZigBee wireless technology to build wireless sensor networks, realized real-time surveillance with early-warning intelligence on methane temperature, humidity in mining area, and used speech communication to reduce potential safety problems in coal production.

Kock and Oberholzer. [20] worked due to the complex environment of the coal mine, the accidents can occur at any time and often result in partial or total evacuation of mine personnel and could result in the loss of lives. Important and necessary to detect the accidents and generate a corresponding alarming disposal in time. The real-time complex alarming event detecting and disposal processing approach for coal mine safety using wireless sensor network. Firstly, model, offer fully customizable policies for event selection and consumption, and also describe the stateautomata-based complex event detection algorithm. Then, describe an event-driven service coordination pattern for the behavioral model, which is based on eventcondition-action triggering with control flow realized using decoupled publish/subscribe semantics.

Finally, the system implementation is presented and deployed in the coal mine, showing the effectiveness of the proposed approach. 1. Introduction safety is a major concern for the miners who work in underground coal mines. Coal mine accidents can occur at any time and often result in partial or total evacuation of mine personnel and could result in the loss of lives. environment monitoring in underground tunnels, which are usually long and narrow, with lengths of tens of kilometers and widths of several meters, has been a crucial task to ensure safe working conditions in coal mines where many environmental factors, including the amount of methane gas, carbon monoxide, temperature, and oxygen need to be monitored.

Li and Liu. [21] Worked on environment monitoring in coal mines is an important application of wireless sensor networks (WSNs) that has commercial potential. The discuss the design of a structure-aware self-adaptive by regulating the mesh sensor network deployment and formulating a collaborative mechanism based on a regular beacon strategy is able to rapidly detect structure variations caused by underground collapses. The further develop a sound and robust mechanism for efficiently handling queries under instable circumstances. A prototype is deployed with 27 mica2 motes in a real coal mine. The present our implementation experiences as well as the experimental results. Better evaluate the scalability and reliability conduct a large-scale trace-driven simulation based on real data collected from the experiments.

Hargrave *et al*. [22] proposed complex environment of the coal mine, the accidents can occur at any time and often result in partial or total evacuation of mine personnel and could result in the loss of lives. Therefore, it is important and necessary to detect the accidents and generate a corresponding alarming disposal in time. Paper proposed a real-time complex alarming event detecting and disposal processing approach for coal mine safety using wireless sensor network. Firstly we introduce the event and complex events model, offer fully customizable policies for event selection and consumption, and also describe the state-automata-based complex event detection algorithm describe an event-driven service coordination pattern for the behavioral model, which is based on event-condition-action triggering with bpel control flow realized using decoupled publish/subscribe semantics. Finally, the system implementation is presented and deployed in the coal mine, showing the effectiveness of the proposed approach. 1.

Introduction safety is a major concern for the miners who work in underground coal mines. Coal mine accidents can occur at any time and often result in partial or total evacuation of mine personnel and could result in the loss of lives. environment monitoring in underground tunnels, which are usually long and narrow, with lengths of tens of kilometers and widths of several meters, has been a crucial task to ensure safe working conditions in coal mines where many environmental factors, including the amount of methane gas, carbon monoxide, temperature, and oxygen need to be monitored.

Bhattacharjee et al. [23] worked on protozoan parasite Leis mania spp. exists as extracellular promastigotes in its vector whereas it resides and replicates as amastigotes within the macrophages of its mammalian host. As a survival strategy,Leis mania modulates macrophage functions directly or indirectly. The direct interference includes prevention of oxidative burst and the effector functions that lead to its elimination. The indirect effects include the antigen presentation and modulation of T cell functions in such a way that the effector T cells help the parasite survive by macrophage deactivation. Most of these direct and indirect effects are regulated by host cell receptor signaling that occurs through cycles of phosphorylation and dephosphorylating in cascades of kinases and phosphatases. This review highlights how .Leis mania selectively manipulates the different signaling pathways to ensure its survival.

Luckham. [24] proposed business process orchestration methods (e.g., service composition and workflow) are usually based on server-side middleware techniques and peRFormed in a rigid development process that requires professional skills. The emerging technology mash up helps to move web 2.0 into enterprises and leverage Investments, enabling end-users to draw upon contents, presentation or functionality logic from separated web sources to create innovative applications. Lightweight process mash up approach. .the fundamental principle of our approach is encapsulating business activities as browser-side components, and orchestrating them based on the eventdriven publish/subscribe communication paradigm. The component model is named bu (business unit), representing basic blocks in business process smashups. Based on bu, the approach leverages the concept of composite event to define complex process behavior on browser side, and consequently hides classic process constructs like conditional branching and looping, allowing end-users to create articulated business processes in a lightweight fashion.

Delamer and Lustra .[25] proposed the computer aided manufacturing using xml (camx) framework enables integrating electronics production systems using messageoriented middleware, offering standards-based communication among machines and control software applications. camx frameworks implement publish/subscribe of xml messages through an entity called the message broker (MSB), which provides the messaging service using a web-based interface. a challenge for

MSB-based systems is that they must scale to handle large volumes of messaging traffic, which is a characteristic of modern information-intensive manufacturing systems. This paper first tackles this challenge by presenting an array of architecture patterns for creating distributed MSB frameworks, focusing mainly on globally distributed federations and locally distributed clusters. A unified architecture is subsequently presented that leverages the different patterns by combining federated frameworks with locally distributed clusters into a unified set of architecture elements and interactions. A service-oriented approach is followed to provide a uniform interfaces for distributed MSB elements, whether federated or locally distributed.

The service-oriented approach is also used to dynamically discover resources and automatically invoke the (re)configuration and messaging services. The services are enriched with semantics in order to facilitate automatic discovery and selection of services using the semantic web services formal ontology. Semantic service advertisements are propagated using a peer-to-peer discovery protocol. The approach presented in this paper is not limited to the camx case and is generally applicable to distributed event-based manufacturing systems.

Kyusakov *et al*. [26] Proposed A large number of potential applications for wireless sensor and actuator networks (wsan) have yet to be embraced by industry despite high interest amongst academic researchers. Due to various factors such as unpredictable costs related to development, deployment and maintenance of wsan, especially when integration with existing it infrastructure and legacy systems is needed. Service-oriented architecture (soa) is seen as a promising technique to bridge the gap between sensor nodes and enterprise applications such as factory monitoring, control and tracking systems where sensor data is used. to date, research efforts have focused on middleware software systems located in gateway devices that implement standard service technology, such as devices profile for web services (dpws), for interacting with the sensor network.

Strategy provides for easy integration with legacy IT systems and supports heterogeneity at the lowest level. Two-fold analysis of the related overhead, which is the main challenge of this solution, is performed Quantification of resource

consumption as well as techniques to mitigate it are presented, along with latency measurements showing the impact of different parts of the system on system performance. A proof-of-concept application using Mulle - a resource-constrained sensor platform - is also presented.

Willing. [27] Work has discussed a selection of promising and interesting research areas in the design of protocols and systems for wireless industrial communications. Have selected topics that have either emerged as hot topics in the industrial communications community in the last few years (like wireless sensor networks), or which could be worthwhile research topics in the next few years (for example cooperative diversity techniques for error control, cognitive radio /opportunistic spectrum access for mitigation of external interferences).

Cucinotta *et al*. [28] proposed industrial automation platforms are experiencing a paradigm shift. New technologies are making their way in the area, including embedded real-time systems, standard local area networks like Ethernet Wi-Fi and ZigBee ip-based communication protocols, standard service oriented architectures (soas) and web services. An automation system will be composed of flexible autonomous components with plug & play functionality, self-configuration and diagnostics, and autonomic local control that communicate through standard networking technologies. however, the introduction of these new technologies raises important problems that need to be properly solved, one of these being the need to support real-time and quality-of-service (qos) for real-time applications. The describes a soa enhanced with real-time capabilities for industrial automation. The proposed architecture allows for negotiation of the qos requested by clients from web services, and provides temporal encapsulation of individual activities.

Possible to perform an a priori analysis of the temporal behavior of each service, and to avoid unwanted interference among them. After describing the architecture, experimental results gathered on a real implementation of the framework (which leverages a soft real-time scheduler for the linux kernel) are presented, showing the effectiveness of the proposed solution. The experiments were performed on simple case studies designed in the context of industrial automation applications.

Maity et *al*. [29] worked has discussed the addresses an economical, supple, continuous monitoring system of underground mineworkers' protection and security. A module of MEMS based sensors are used for monitoring underground parameters as per the requirement of the user and automating sequence of measuring data through digital wireless communication system is projected with high precision, soft control and reliability. A microcontroller based system is used for collecting and storing data and making decision accordingly, based on which the mine worker is informed through different alarm tone as well as voice system. The voice system with both microphone and speaker, converted into digital signal and successfully communicate wirelessly with the ground control centre computer system. The communication system is reliable based on ZigBee, IEEE 802.15.4 standard. Used for transmission between the hardware circuit fitted with the mine workers and the ground control center computer system through some routers.

Safety is the most vital part of any type of industry. Negligence in the safety part may cause damaging of high quality equipment hampering of production or may cause loss of human life also in extreme cases. The mining industry safety and security is a fundamental aspect of all. To avoid any types of unwanted phenomena all mining industry follows some basic precaution and phenomena. Communication is the most vital key factor today, to monitor different parameters continuously and to take necessary actions accordingly to avoid any types of hazards related to production, security, managing of human resources. To avoid loss of material and damaging of human health, security and safety system as well as reliable continuous faithful communication system is essential in the interior of the underground mines. To enhance security, safety and productivity in underground mines, a reliable communication system must be established between workers, moving in the mine, and a fixed base station. The communication network must not be interrupted at any moment and at any condition. Inside underground mines, the wired communication network system is not so effective.

The reliability and long life of conventional communications systems in harsh mining environments has always been a problem. Inside mines due to uncomfortable situation the installation cost as well as maintenance cost is high for wired communication networks. Very difficult to reinstall the wired communication system

inside mines after a landslide or damage due to any reason. Due to some reason any wire of the communication network damages, it may cause temporary interruption of the continuous process or may cause a long term break down of the system. Due to roof slide, if by any means some workers trapped inside mines, it is very much required to maintain the continuity of the communication system. Very much important to know the actual position and condition of the trapped workers. Monitor other parameters during this condition it is very much necessary to maintain the communication system as usual.

Accordingly, development of mine 102 monitoring system to accurately detect temperature, pressure, flammable and poisonous gas and to track underground miners and vehicles on real-time has significant meaning to safety production and rescue of underground mine disaster. Coal mine safety monitoring system based on wireless sensor network can timely and accurately reflect dynamic situation of staff in the underground regions to ground computer system.

A hybrid tunnel radio propagation model consisting of the free space propagation and the modified waveguide propagation is proposed in. but, using this popular radio communication inside mines has some disadvantages. When radio signals are transmitted, diffraction, attenuation, multi-path and scattering are often very serious. Wireless communication is the burning need today for the rapid, precise, flexible, safety, uninterrupted process in underground mines.

Donovan *et al*. [30] proposed efficient procedure for modeling medium frequency (mf) communications in coal mines is introduced. In particular, a hybrid approach is formulated and demonstrated utilizing ideal transmission line equations to model mf propagation in combination with full-wave sections used for accurate simulation of local antenna-line coupling and other near-field effects. Work confirms that the hybrid method accurately models signal propagation from a source to a load for various system geometries and material compositions, while significantly reducing computation time. With such dramatic improvement to solution times, it becomes feasible to perform large-scale optimizations with the primary motivation of improving communications in coal mines both for daily operations and emergency response.

Furthermore, it is demonstrated that the hybrid approach is suitable for modeling and optimizing large communication networks in coal mines that may otherwise be intractable to simulate using traditional full-wave techniques such as moment methods or finite-element analysis.

Throughout history, mining tragedies have emphasized the need for communication systems in the mining industry with improved survivability. In response to such types of disasters the .United States congress passed the mine improvement and new emergency response act (miner act) in 2006, considered to be the most significant mine safety legislation since the federal mine safety and health act of 1977. over the years, researchers have performed extensive research on the design optimization and implementation of communication systems for use in coal mining operations .a large range of frequencies have been proposed for various types of coal mine communications, ranging from very-high-frequency and ultrahigh-frequency technologies ,typically for in-mine daily operations, to emergency tracking systems based on very-low-frequency through-the-earth technologies. The mfs have also been proposed for in-mine communications which is the focus of this paper.

Identified for their ability to parasitically couple into conductor infrastructure within a mine tunnel and propagate large distances through various room-and-pillar architectures with relatively low attenuation in practice, this means that a medium frequency (mf) system may take advantage of existing conductor infrastructure in a coal mine, only requiring wireless handhelds for communications. Examples of typical conductors in mines include trolley rails, lighting and telephone wiring, and machinery power cables. Another advantage of mf signals is their ability to propagate hundreds of meters through the coal seam without man-made metal conductors present because the relative conductivities of the coal and surrounding rock layers can form a suitable waveguide.

Mandated by the miner act, current research efforts are to primarily focus on improving the survivability of existing technologies and developing new solutions for emergency tracking. Hence, the characteristics outlined above make mf communications attractive for day-to-day mining operations as well as in the event of

an emergency, although the low carrier frequency generally limits the system to a single channel. Result, there is a renewed interest in mf technologies to address this mandate.

2.3 Summary

This chapter summarizes the major contributions of the significant studies and a survey of existing works in the field of smart safety for a coal miners. The following major points are considered from the literature survey.

- The zig bee technology is employed to establish the communication between transmitter and receiver in order to transmit the data. The better efficiency and high speed of transmission is possible with use of this technology
- The fm modulator technology is employed to establish the communication between transmitter and receiver in order to transmit the data. The better efficiency and high speed of transmission is possible with use of this technology ❖ The FM modulator technique used for wireless communication.
- The helmet are embedded with a digital display to display the data sensed by the sensors of the particular field which is received from the transmitter.
- The miners should wear the helmet because the embedded system will be placed in the helmet.
- Through FM modulator the disadvantages of wired communication overcomes in terms of software application.
- The zig bee is better than other systems in communication using modulation to transmit the signal. The system also provides security for the transmitted data.
- In order to reduce the hardware complexity an alternate approach is pcb design. It covers less area and to achieve two-way communication this method is used.

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CHAPTER 3

FUNDAMENTALS OF THE SYSTEM

This chapter discusses the fundamental components of the proposed system and it briefs about the system requirements. The system is designed to provide safety for a coal miners from a dangerous gas. The main task of the system is wireless communication. The system requirement has to be taken care for the specific operation to be performed. The system requires specific components such as ZigBee module, battery, Buzzer, LCD Display, Arduino nano, Arduino uno3, Carbon Monoxide Sensor (MQ7), Light Dependent Resistor, Temperature and Humidity Sensor (DHT11) for the operation. The basic principle, block diagram and pin configuration of the components are discussed below.

3.1 Functional Requirement

The functional and basic requirements for the proposed system may be best understood taking into account the basic block diagram of the system as shown in Fig.3.1 Miner's smart helmet is used as mobile wireless sensor network node which is composed of rechargeable battery, LED lamp and ZigBee communications module. So helmet, could collect production parameters timely and transmit to wireless base station.

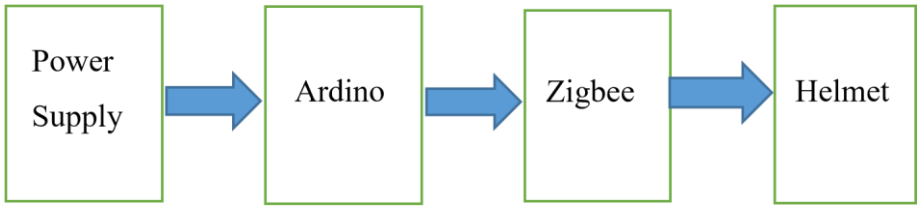

Fig. 3.1: Block Diagram of the Proposed System

Control unit can send speech instruction to miners through ZigBee networks and miners can also receive calling from others working at different coal phase smoothly through the smart helmets. Also the light sensor sensing the light intensity gives it to the controller. Based on the light intensity, the controller automatically adjusts the LED light of the helmet.

3.2 Software Requirement

The arduino language is based on C/C++. It links against avr libc and allows the use of any of its functions. The open-source Arduino software makes it easy to write code and upload it to the board. It runs on Windows, mac os x, linux. Software can be used with any Arduino board. In this project, we are making use of Arduino with ATmega328P microcontroller.

Arduino language uses most of the syntax and semantics of standard C, e.g.main() function, variable definition, data type declaration, conditional statements (if, switch case, break, continue, return), loops (while, for), functions, structures, e.g., setup (), loop () function, bitwise operators, arithmetic operations, math operations, interrupt functions.

Proteus 7.0 is a Virtual System Modeling (VSM) that combines circuit simulation, animated components and microprocessor models to co-simulate the complete microcontroller based designs.

This is the perfect tool to test the microcontroller designs before constructing a physical prototype in real time. This program allows users to interact with the design using on-screen indicators and or LED and LCD displays and, if attached to the PC, switches and buttons.

Proteus 7.0 is the program to use when we want to simulate the interaction between software running on a microcontroller and any analog or digital electronic device connected to it.

Proteus 7.0 is a Virtual System Modeling (VSM) that combines circuit simulation, animated components and microprocessor models to co-simulate the complete microcontroller based designs

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3.3 Hardware Requirements

The required Hardware for this project is as follows:

Table 3.1: Hardware Requirements

SL.NO	List of Components
1	Temperature and Humidity Sensor(DHT11)
2	Light Dependent Resistor
3	Carbon Monoxide Sensor(MQ-7)
4	Arduino Uno3 Board
5	LCD Display
6	Switch array
7	Buzzer
8	ZigBee module

3.3.1 DHT11 (Temperature and Humidity Sensor)

This DF Robot DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

DHT11 digital temperature and humidity sensor shown in Fig.3.2 is a composite Sensor contains a calibrated digital signal output of the temperature and humidity. Application of a dedicated digital modules collection technology, the temperature and humidity sensing technology, is to ensure that the product has high reliability and excellent long-term stability.

The sensor includes a resistive sense of wet components and an NTC temperature measurement device, and connected with a high-performance 8-bit microcontroller.

Humidity measurement can be done using dry and wet bulb hygrometers, dew point hygrometers, and electronic hygrometers. There has been a surge in the demand of electronic hygrometers, often called humidity sensors. The technical specifications are as listed in table below.

Table 3.2: Technical Specifications of DHT11 Sensor

Item	Measurement range	Humidity accuracy	Temperature accuracy	Resolution	Package
DHT11	20-90%RH 0-50˚C	±5%RH	±2˚C	1	4 pin single row

DHT11 digital temperature and humidity sensor shown in Fig.3.2 is a composite Sensor contains a calibrated digital signal output of the temperature and humidity. Application of a dedicated digital modules collection technology, the temperature and humidity sensing technology, is to ensure that the product has high reliability and excellent long-term stability.

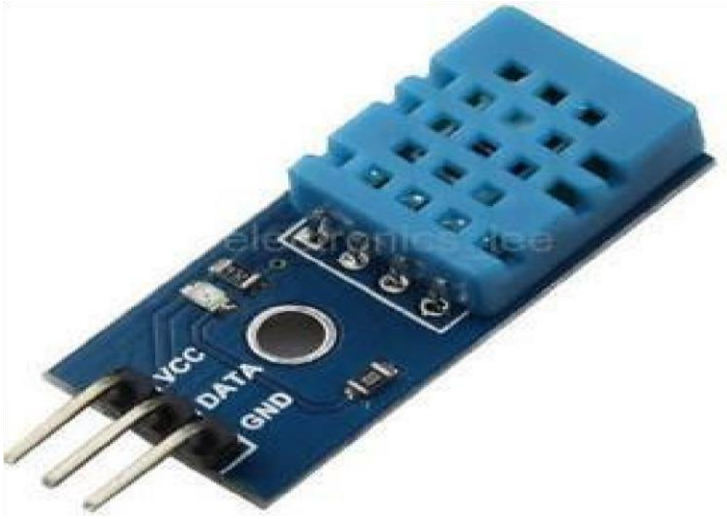

Fig. 3.2: DHT-11 Sensor

The Features of DHT11 are

- ❖ Low cost
- ❖ Relative humidity and temperature measurement
- ❖ Excellent quality
- ❖ Fast response
- ❖ Strong anti-interference ability
- ❖ Long distance signal transmission
- ❖ Digital signal output ❖ Precise calibration

3.3.2 Light Dependent Resistor Sensor (LDR)

A photo resistor or light-dependent resistor (LDR) or photocell is a light controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits, and light and dark-activated switching circuits.

A photo resistor is made of a high resistance semiconductor. In the dark, a photo resistor can have a resistance as high as several mega ohms (MΩ), while in the light, a photo resistor can have a resistance as low as a few hundred ohms. If incident light on a photo resistor exceeds a certain frequency, photons absorbed by the semiconductor

give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photo resistor can substantially differ among dissimilar devices. A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor. A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, for example, silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities, also called dopants, is added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (that is, longer wavelengths and lower frequencies) are sufficient to trigger the device.

Fig.3.3 Light Dependent Register

3.3.3 Carbon Monoxide Sensor (MQ-7)

The carbon monoxide sensor is simple to use, sense the carbon monoxide in the air. The pin diagram of MQ-7 is as shown in Fig. 3.4.A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and can interfaces with a control system so a process can be automatically shut down. A gas detector can sound

an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals.

Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacture processes and emerging technologies such as photovoltaic. They may be used in firefighting.

Gas leak detection is the process of identifying potentially hazardous gas leaks by sensors. These sensors usually employ an audible alarm to alert people when a dangerous gas has been detected. Exposure to toxic gases can also occur in operations such as painting, fumigation, fuel filling, construction, excavation of contaminated soils, landfill operations, entering confined spaces, etc

Fig. 3.4: Pin diagram of MQ-7 Sensor

All of these sensors are used for a wide range of applications and can be found in industrial plants, refineries, pharmaceutical manufacturing, fumigation facilities, paper pulp mills, aircraft and shipbuilding facilities, hazmat operations, waste-water treatment facilities, vehicles, indoor air quality testing and homes.

For detecting Carbon Monoxide gas the MQ-7 is a good choice. It is cheap and works well. The sensor itself returns a analog voltage that can be converted using an ADC, for more information see this link. The converted value can be used in

calculations to get the ppm value of the detected gas. The supply voltage for the sensor is 5 V. The heather on this gas sensor needs a 5 V signal for 60 seconds and then 1.4 v for 90 seconds. During those 90 seconds of lower voltages the analog values can be read. Other technical specifications can be found here along with data for a conversion formula from resistance to gas concentrations.

Specifications

Table 3.3: Standard work condition of MQ-7

Symbol	Parameter name	Technical condition	Remark
Vc	circuit voltage	5V±0.1	Ac or Dc
V_H (H)	Heating voltage (high)	5V±0.1	Ac or Dc
V_H (L)	Heating voltage (low)	1.4V±0.1	Ac or Dc
R_L	Load resistance	Can adjust	
R_H	Heating resistance	33Ω±5%	Room temperature
$T_{H(H)}$	Heating time (high)	60±1 seconds	
$T_{H(L)}$	Heating time (low)	90±1 seconds	
PH	Heating consumption	About 350mW	

The sensor needs to be wired up in the way specified on this MQ-7 wiring example page. The A_{OUT} terminal gives an analog voltage output in proportion to the amount of carbon monoxide the sensor detects. It can change the threshold level by adjusting the potentiometer to either raise or lower the level. The more CO it detects, the greater the analog voltage it will output.

Table 3.4: Environment conditions of MQ-7

Symbol	Parameters	Technical conditions	Remark
Tao	Using temperature	-20 °C -50	
Tas	Storage temperature	-20 -50	Advice using scope
RH	Relative humidity	Less than 95%RH	
O_2	Oxygen concentration	21%(stand condition) the oxygen concentration can affect the sensitivity characteristic	Minimum value is over 2%

Table 3.5: Sensitivity characteristic of MQ-7

symbol	Parameters	Technical parameters	Remark
Rs	Surface resistance Of sensitive body	2-20k	In 100ppm Carbon Monoxide
a(300/100ppm)	Concentration slope rate	Less than 0.5	Rs (300ppm)/Rs(100ppm)
Standard working condition	Temperature -20℃±2℃ relative humidity 65%±5% RL:10KΩ±5%		
	Vc:5V±0.1V VH:5V±0.1V VH:1.4V±0.1V		
Preheat time	No less than 48 hours	Detecting range: 20ppm-2000ppm carbon monoxide	

Conversely, the less CO it detects, the less analog voltage it will output. If the analog voltage reaches a certain threshold, it will send the digital pin D_{OUT} high. Once this D_{OUT} pin goes high, the Arduino will detect this and will trigger the LED to turn on, signaling that the CO threshold has been reached and is now over the limit.

3.3.4 Arduino Uno3

Arduino is an open-source physical computing platform based on a simple I/O board and a development environment that implements the Processing/Wiring language. Arduino can be used to develop stand-alone interactive objects or can be connected the software on computer. This allows for faster transfer rates, no drivers needed for Linux or Mac and the ability to have the Uno show up as a keyboard, mouse, joystick, etc. The Pin diagram of Arduino Uno3 is as shown in Fig. 3.5.

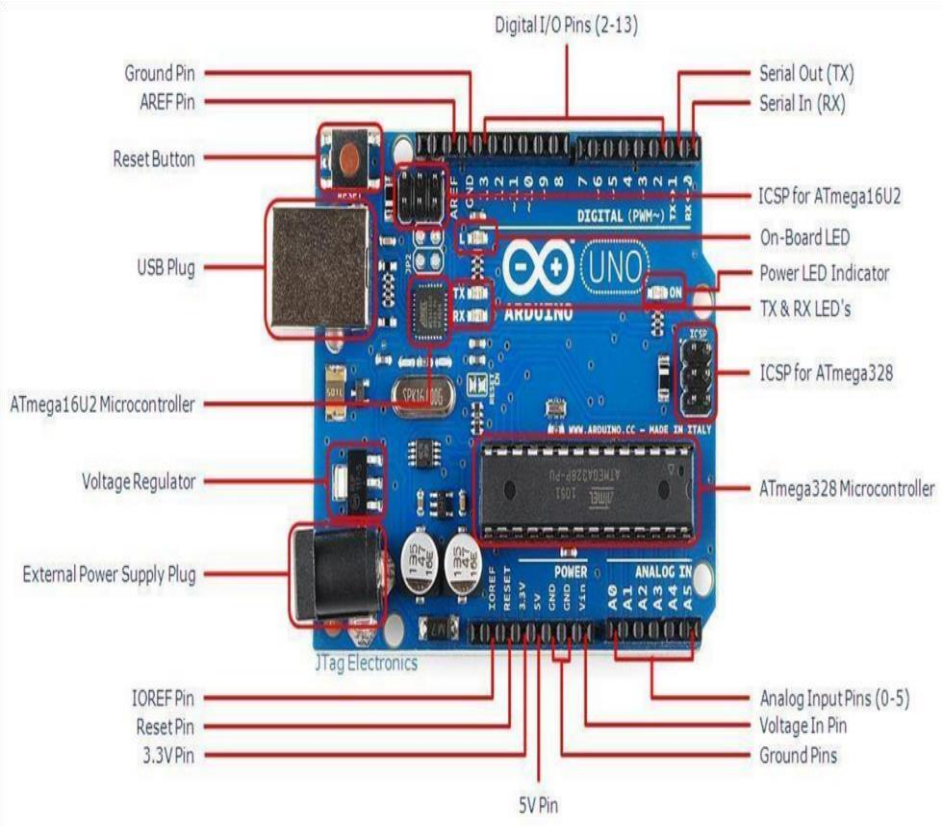

Fig. 3.5: Pin diagram of Arduino Uno3

The Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, USB connection, a power jack, an ICSP header, and a reset button.

It contains everything needed to support to the microcontroller. Simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI

USBto-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB to serial converter.

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery.

The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the boot loader); It has also 2 KB of SRAM and 1 KB of EEPROM. Each of the 14 digital pins on the Uno can be used as an input or output, using pin Mode(), digital Write(), and digital Read()functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50KOhms.

It contains everything needed to support to the microcontroller. Simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB to serial converter.

The Features of Arduino Uno3

- Microcontroller ATmega328 Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory 32 KB of which 0.5 KB used by boot loader
- SRAM 2 KB
- EEPROM 1 KB

3.3.5 Liquid Crystal Display (LCD)

A liquid crystal coating is the heart of the display which is sandwiched between two polarized glasses. LCD's are available in various shapes and sizes depending on the configurations. A 16x2 LCD shown in the image below can display 32 characters with 16 characters in each row .The principle behind the LCD is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. The untwisting of molecules causes the angle of light which is passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter

Figure 3.6: Liquid Crystal Display

As a result a little light is allowed to pass the polarized glass through a particular area of the LCD. Thus the particular area will become dark compared to other. The LCD works on the principle of blocking light. The LCD‘s are constructed by arranging the reflected mirrors at the back. An electrode plane is made of indium tin oxide which is kept on top and a polarized glass with a polarizing film is also added on the bottom of the device. The complete region of the LCD has to be enclosed by a common electrode and above it should be the liquid crystal matter.

The term liquid crystal is used to describe a substance in a state between liquid and solid but which exhibits the properties of both. Molecules in liquid crystals tend to arrange themselves until they all point in the same specific direction. This arrangement of molecules enables the medium to flow as a liquid. Depending on the temperature and particular nature of a substance, liquid crystals can exist in one of several distinct phases. Liquid crystals in a nematic phase, in which there is no spatial ordering of the molecules, for example, are used in LCD technology.

One important feature of liquid crystals is the fact that an electrical current affects them. A particular sort of nomadic liquid crystal, called Twisted Nematics (TN), is naturally twisted. Applying an electric current to these liquid crystals will untwist them to varying degrees, depending on the current's voltage. LCDs use these liquid crystals because they react predictably to electric current in such a way as to control the passage of light.

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3.3.6 Working of LCD

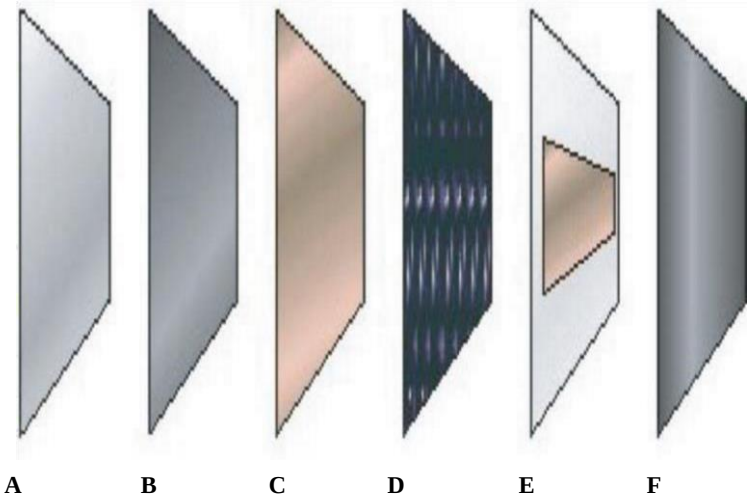

Figure 3.7: Fundamental of LCD

The (Liquid Crystal Display) LCD is shown in Figure 3.6. It has a mirror (A) in back, which makes it reflective. A piece of glass (B) with a polarizing film on the bottom side, and a common electrode plane (C) made of indium-tin oxide on top. A common electrode plane covers the entire area of the LCD. Above that is the layer of liquid crystal substance (D). Next comes another piece of glass (E) with an electrode in the shape of the rectangle on the bottom and, on top, another polarizing film (F), at a right angle to the first one.

The electrode is hooked up to a power source like a battery. When there is no current, light entering through the front screen of the LCD then it will simply hit the mirror and bounce right back out. But when the battery supplies current to the electrodes, the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle untwist and block the light in that particular region from passing through that region. That makes the LCD show the rectangle as a black area. If any of the letter is to be displayed it takes its particular action

The light passes through the front of the LCD, is reflected by the mirror and bounced back. As the electrode is connected to a battery the current from the battery

will cause the liquid crystals between the common-plane electrode and the electrode shaped like a rectangle to untwist. Thus the light is blocked from passing through.

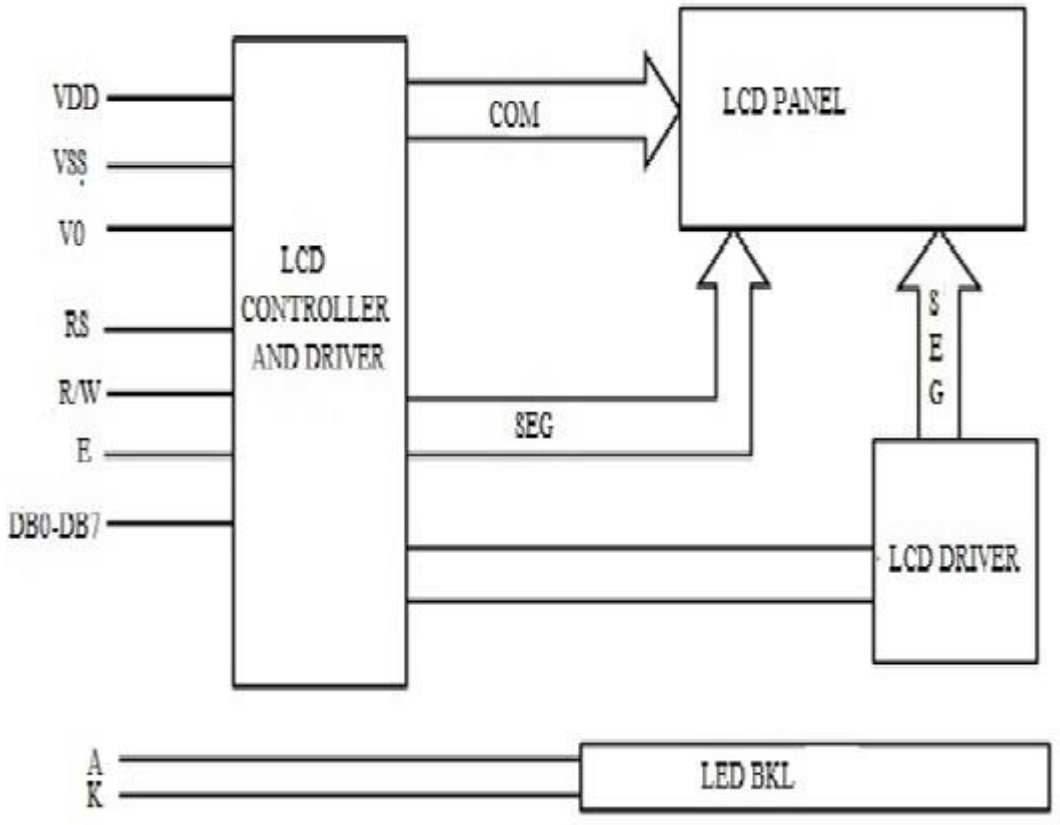

Figure 3.8: Block diagram of LCD

The liquid crystals between the common-plane electrode and the electrode shaped like a rectangle untwist and block the light in that particular region from passing through that region. That makes the LCD show the rectangle as a black area. If any of the letter is to be displayed it takes its particular action

3.3.7 Switch Array

An SPST switches are used to accept and reject of goods. The switch is a momentary action switch. It is interfaced with MCU as a input sensor. The switch array is shown in Fig. 3.9.

Fig. 3.9: Switch array

FEATURES

- Rail-to-Rail Analog Input Range
- Serial Interface
- Low-Power PD: 35 nw
- TTL and CMOS Compatible
- Any Combination of 8 SPST to the Output
- High Speed TON: 170 ns

Benefits

- Low Signal Distortion
- Devices Can Be Chained for System Expansion
- Reduced Board Space
- Reduced Switch Errors

- ❖ Reduced Power Supply Requirements
- ❖ Simple Interfacing

3.3.7 Buzzer

A Buzzer or Beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Buzzer is a transducer device which give alarm when an object is about to search mode. In this project, we make use of piezoelectric buzzer

It converts the electrical signal into sound signals. It consists of a number of switches connected to a control unit. Buzzers are offered in lightweight compact sizes from the smallest diameter of 12mm to large Piezos electric sounders.

Fig. 3.10: Buzzer

A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

Specification of Piezoelectric Buzzer

- Item No.: PB24P34D
- Ratings
- Outline Drawing and Dimensions
- Electrical Requirements
- Operating Temperature Range: - 20 °C ~ + 105°C
- Storage Temperature Range: - 40 °C ~ + 105°C
- Case material: PC UL 94HB
- Dimensions: Items Specifications Test Conditions 5-1
- Sound Pressure Level 85dB min.
- Continuous Tone Input Voltage: 9.0V DC Distance: 10 cm
- Oscillating Frequency 3.0 ± 0.5 KHz 5-3.
- Current Consumption 9.0 mA max. At 9.0 VDC

3.3.8 ZigBee Module

ZigBee Module is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. Temco has developed a embedded antenna of wireless data communication module, which adopts standard ZigBee wireless technology. This module is in line with the Industry Standard applications of wireless data communication module.

This module can achieve transparent data transmission between many devices, and it can form a MESH network. This device has the characteristics of small volume, ultra-low power consumption and low-cost. It can be either as an independent data transmission termination or be easily embedded into a variety of products to form a short-range wireless data transmission solution. 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 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.

The low power consumption limits transmission distances to 10– 100 meters line-of-sight, depending on power output and environmental characteristics. 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.

ZigBee was conceived in 1998, standardized in 2003, and revised in 2006. The name refers to the waggle dance of honey bees after their return to the beehive. This device network has the characteristics of electric power-saving, reliability, low cost, large capacity and security, and it can be widely used in various fields of automatic control. The target application domains are aimed at industry, home automation, telemetry and remote control, vehicle automation, agriculture automation, medical care and so on, such as lighting control automation, wireless data acquisition and monitoring sensor, oil field, electric power, mining and logistics management etc.
ZigBee module is shown in Fig. 3.9.

Fig. 3.11: ZigBee module

Some Specifications of ZigBee are as Follows

- **Technical Data:** Environment of Use Industry Standard
- **Maximum Transmission Distance:** Internodes Barrier Free: 200 meters.
- **Wireless Frequency:**2.4G ISM License-free Frequency Band
- **Channel Mode:**16 Channels Can Be Specified or the Best Channel
- **Antenna Configuration:** Built-in 2.4G Ceramics Antenna
- **Network Structure:** Star Topology Network, Cluster Tree Network,
- **Network ID:** 255 Network ID Can Be Specified
- **Node Type:** Center Node, Routing Node, Terminal Node, or Software Set
- **Serial Rate:** 1200-115200
- **Send Mode:** Broadcast Send or Destination Address Send
- **Working Voltage:** DC-3.3V
- **Peak Current:** 40MA

Some Advantages of Using ZigBee Module are

- **Low cost:** Because of dramatically simplifying the protocol, ZigBee reduces the requirements for the communications controller. It is protocol patent fee free
- **Low rate:** ZigBee can work at the low rate of 20 ~ 250 kbps
- **Short range**: Transmission range is generally between 10 ~ 200 m (32.8feet~ 656feet)
- **Short time delay:** The response speed of ZigBee is very fast, in general, it merely need 10ms from the into work state and it merely need 20 ms from nodes connect into the network state
- **High capacity:** ZigBee can adopt star topology, tree topology and mesh network structure, composing of up to 65, 000 network node

The radio design used by ZigBee has few analog stages and uses digital circuits wherever possible. Though the radios themselves are inexpensive, the Zig-bee Qualification Process involves a full validation of the requirements of the physical layer. All radios derived from the same validated semiconductor mask set would enjoy the same RF characteristics. An uncertified physical layer that malfunctions could cripple the battery lifespan of other devices on a ZigBee network. ZigBee radios have very tight constraints on power and bandwidth. Thus, radios are tested with guidance given by Clause 6 of the 802.15.4-2006 Standard. Products that integrate the radio and microcontroller into a single module are available.

This standard specifies operation in the unlicensed 2.4 to 2.4835 [28]GHz (worldwide), 902 to 928 MHz (Americas and Australia) and 868 to 868.6 MHz (Europe) ISM bands. Sixteen channels are allocated in the 2.4 GHz band, with each channel spaced 5 MHz apart, though using only 2 MHz of bandwidth. The radios use directsequence spread spectrum coding, which is managed by the digital stream into the modulator. Binary phase-shift keying (BPSK) is used in the 868 and 915 MHz bands, and offset quadrature phase-shift keying(OQPSK) that transmits two bits per symbol is used in the 2.4 GHz band.

The raw, over-the-air data rate is 250Kbit/s per channel in the 2.4 GHz band, 40 Kbit/s per channel in the 915 MHz band, and 20 Kbit/s in the 868 MHz band. The actual data throughput will be less than the maximum specified bit rate due to the packet overhead and processing delays. For indoor applications at 2.4 GHz transmission distance may be 10–20 m, depending on the construction materials, the number of walls to be penetrated and the output power permitted in that geographical location.[29] Outdoors with line-of-sight, range may be up to 1500 m depending on power output and environmental characteristics The output power of the radios is generally 0-20dB (1100 mW)

3.3.9 Battery

The usage of "battery" to describe a group of electrical devices dates to Benjamin Franklin, who in 1748 described multiple Leyden jars by analogy to a battery of cannon (Benjamin Franklin borrowed the term "battery" from the military, which refers to weapons functioning together.

Italian physicist Alessandro Volta built and described the first electrochemical battery, the voltaic pile, in 1800. This was a stack of copper and zinc plates, separated by brine-soaked paper disks that could produce a steady current for a considerable length of time. Volta did not understand that the voltage was due to chemical reactions. He thought that his cells were an inexhaustible source of energy, and that the associated corrosion effects at the electrodes were a mere nuisance, rather than an unavoidable consequence of their operation, as Michael Faraday showed in 1834.

Although early batteries were of great value for experimental purposes, in practice their voltages fluctuated and they could not provide a large current for a sustained period. The Daniell cell, invented in 1836 by British chemist John Frederic Daniell, was the first practical source of electricity, becoming an industry standard and seeing widespread adoption as a power source for electrical telegraph networks. It consisted of a copper pot filled with a copper sulfate solution, in which was immersed an unglazed earthenware container filled with sulfuric acid and a zinc electrode.

These wet cells used liquid electrolytes, which were prone to leakage and spillage if not handled correctly. Many used glass jars to hold their components, which made them fragile and potentially dangerous. These characteristics made wet cells unsuitable for portable appliances. Near the end of the nineteenth century, the invention of dry cell batteries, which replaced the liquid electrolyte with a paste, made portable electrical devices practical.

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars.[1] When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode.] The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device.

When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved additionally to include devices composed of a single cell.

Primary batteries are used once and discarded; the electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary (rechargeable) batteries can be discharged and recharged multiple times using an applied electric current; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium ion batteries used for portable electronics such as laptops and smart phones.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smart phones, to large lead acid batteries used in cars and trucks, and at the largest extreme, huge battery banks the

size of rooms that provide standby or emergency power for telephone exchanges and computer data centers.

According to a 2005 estimate, the worldwide battery industry generates US$48 billion in sales each year, with 6% annual growth. Batteries have much lower specific energy (energy per unit mass) than common fuels such as gasoline. In automobiles, this is somewhat offset by the higher efficiency of electric motors in 777producing mechanical work, compared to combustion engines.

❖ Primary

Primary batteries, or primary cells, can produce current immediately on assembly. These are most commonly used in portable devices that have low current drain, are used only intermittently, or are used well away from an alternative power source, such as in alarm and communication circuits where other electric power is only intermittently available.

Disposable primary cells cannot be reliably recharged, since the chemical reactions are not easily reversible and active materials may not return to their original forms. Battery manufacturers recommend against attempting to recharge primary cells. In general, these have higher energy densities than rechargeable batteries, but disposable batteries do not fare well under high-drain applications with loads under 75 ohms (75 Ω). Common types of disposable batteries include zinc–carbon batteries and alkaline batteries.

❖ Secondary

Secondary batteries, also known as secondary cells, or rechargeable batteries, must be charged before first use; they are usually assembled with active materials in the discharged state. Rechargeable batteries are (re)charged by applying electric current, which reverses the chemical reactions that occur during discharge/use. Devices to supply the appropriate current are called chargers.

The oldest form of rechargeable battery is the lead–acid battery, which are widely used in automotive and boating applications. This technology contains liquid electrolyte in an unsealed container, requiring that the battery be kept upright and the area be well ventilated to ensure safe dispersal of the hydrogen gas it produces during overcharging.

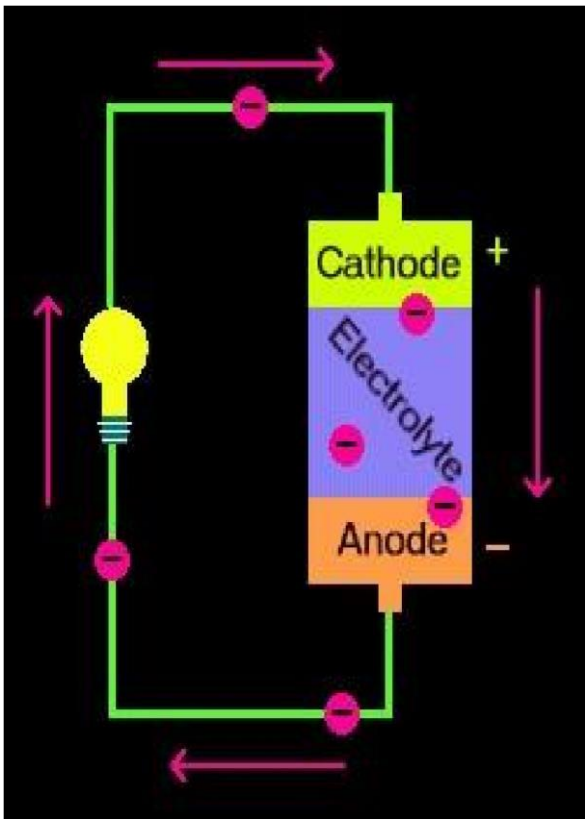

Fig. 3.12: Basic battery operation

The lead–acid battery is relatively heavy for the amount of electrical energy it can supply. Its low manufacturing cost and its high surge current levels make it common where its capacity (over approximately 10 Ah) is more important than weight and handling issues. A common application is the modern car battery, which can, in general, deliver a peak current of 450 amperes.

The sealed valve regulated lead–acid battery (VRLA battery) is popular in the automotive industry as a replacement for the lead–acid wet cell. The battery uses an immobilized sulfuric acid electrolyte, reducing the chance of leakage and extending shelf life. Batteries immobilize the electrolyte. Batteries have three parts, an anode (-), a cathode (+), and the electrolyte. The cathode and anode (the positive and negative

sides at either end of a traditional battery) are hooked up to an electrical circuit. The electrons wants to rearrange themselves to get rid of this difference. But they do this in a certain way. Electrons repel each other and try to go to a place with fewer electrons.

The chemical reactions in the battery causes a buildup of electrons at the anode. This results in an electrical difference between the anode and the cathode. You can think of this difference as an unstable build-up of the electrons. The electrons wants to rearrange themselves to get rid of this difference. But they do this in a certain way. Electrons repel each other and try to go to a place with fewer electrons.

In a battery, the only place to go is to the cathode. But, the electrolyte keeps the electrons from going straight from the anode to the cathode within the battery. When the circuit is closed (a wire connects the cathode and the anode) the electrons will be able to get to the cathode. In the picture above, the electrons go through the wire, lighting the light bulb along the way. This is one way of describing how electrical potential causes electrons to flow through the circuit.

However, these electrochemical processes change the chemicals in anode and cathode to make them stop supplying electrons. So there is a limited amount of power available in a battery.

When you recharge a battery, you change the direction of the flow of electrons using another power source, such as solar panels. The electrochemical processes happen in reverse, and the anode and cathode are restored to their original state and can again provide full power.

The 9-volt battery, is a common size of battery that was introduced for the early transistor radios. It has a rectangular prism shape with rounded edges and a polarized snap connector at the top. This type is commonly used in walkie-talkies, clocks and smoke detectors.

Fig. 3.13: 9 V battery

The nine-volt battery format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in rechargeable form in nickel cadmium, nickel-metal hydride and lithium-ion. Mercury-oxide batteries of this format, once common, have not been manufactured in many years due to their mercury content. Designations for this format include NEDA 1604 and IEC 6F22 (for zinc carbon) or MN1604 6LR61 (for alkaline). The size, regardless of chemistry, is commonly designated PP3—a designation originally reserved solely for carbon-zinc, or in some countries

Most nine-volt alkaline batteries are constructed of six individual 1.5 V LR61 cells enclosed in a wrapper. These cells are slightly smaller than LR8D425 and can be used in their place for some devices, even though they are 3.5 mm shorter. Carbon zinc types are made with six flat cells in a stack, enclosed in a moisture-resistant wrapper to prevent drying. Primary lithium types are made with three cells in series.

In 2007, 9-volt batteries accounted for 4% of alkaline primary battery sales in the US. In Switzerland in 2008, 9-volt batteries totaled 2% of primary battery sales and 2% of secondary battery sales.

Table 3.6 9V battery specification

Product Type	9 Volt, Non-Rechargeable
Chemistry	LiMnO2
Voltage (Nominal)	9.0 V
Capacity (Nominal)	1.2 Ah
Certifications	UN 38.3, UL 2054, UL 217, IEC 60086-4:2014
PTC (Re-settable Fuse)	Yes
Operating Temperature	-20 to 60 °C
Storage Temperature	-40 to 60 °C

3.3.10 Frequency Modulation (FM)

It is the encoding of information in a carrier wave by varying the instantaneous frequency of the wave. In analog frequency modulation, such as FM radio broadcasting of an audio signal representing voice or music, the instantaneous frequency deviation, the difference between the frequency of the carrier and its center frequency, is proportional to the modulating signal.

Digital data can be encoded and transmitted via FM by shifting the carrier's frequency among a predefined set of frequencies representing digits - for example one frequency can represent a binary 1 and a second can represent binary 0. This modulation technique is known as frequency-shift keying (fsk). fsk is widely used in modems and fax modems, and can also be used to send morse code. Radio teletype also uses fsk. Frequency modulation is widely used for FM radio broadcasting. it is also used in telemetry, radar, seismic prospecting, and monitoring newborns for seizures via erg two-way radio systems, music synthesis, magnetic tape-recording systems and some video-transmission systems.

Fig. 3.14: FM Modulator

In radio transmission, an advantage of frequency modulation is that it has a larger signal-to-noise ratio and therefore rejects radio frequency interference better than an equal power amplitude modulation (am) signal. For this reason, most music is broadcast over FM radio.

Frequency modulation and phase modulation are the two complementary principal methods of angle modulation; phase modulation is often used as an intermediate step to achieve frequency modulation. These methods contrast with amplitude modulation, in which the amplitude of the carrier wave varies, while the frequency and phase remain constant.

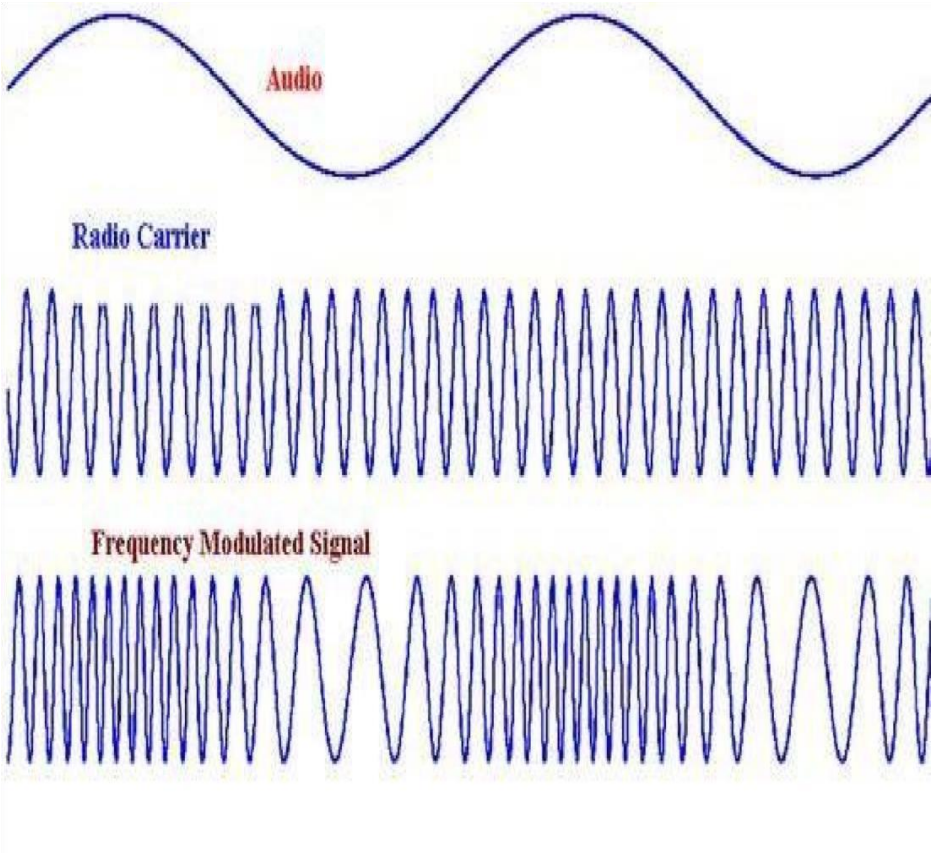

Fig. 3.15 FM Waveforms

3.3.11 Arduino Nano

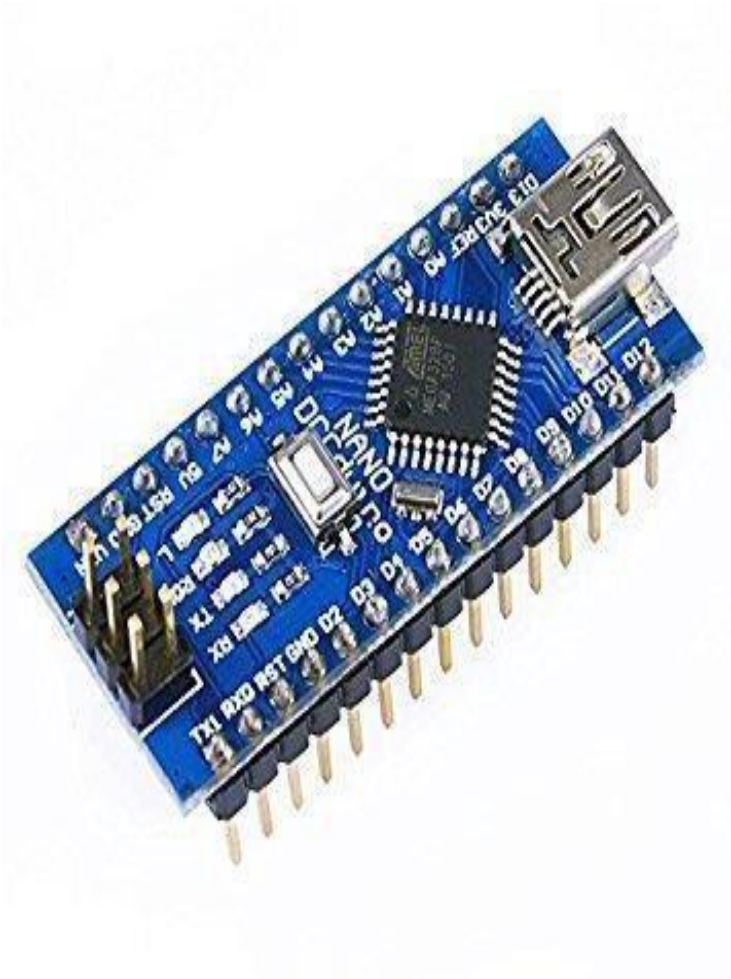

Fig. 3.16 Arduino Nano

Nano's got the breadboard ability of the arduino and the Mini USB with smaller footprint than either, so users have more breadboard space. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, GND on one top, power and ground on the other).

This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It is two layers. That make it easier to hack and more affordable.

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Features

- Automatic reset during program download
- Power OK blue LED
- Green (TX), red (RX) and orange (L) LED
- Auto sensing/switching power input
- Small mini-B USB for programming and serial monitor
- ICSP header for direct program download
- Standard 0.1” spacing DIP (breadboard friendly)
- Manual reset switch

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, Maxims).

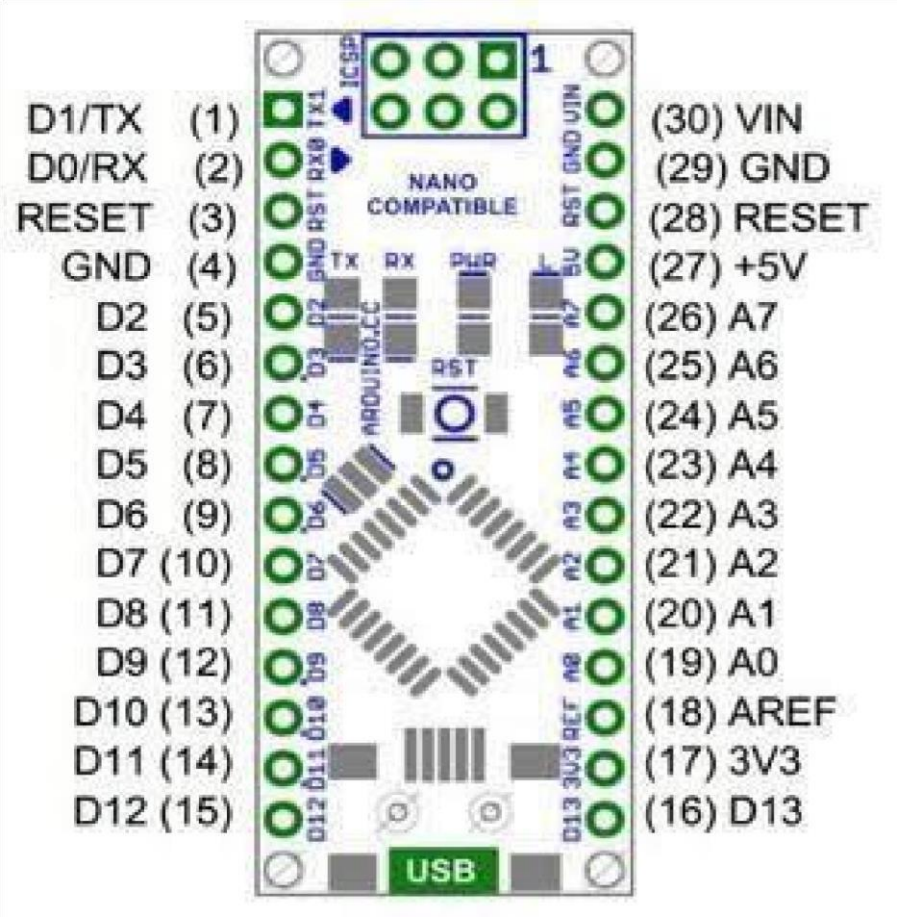

Fig. 3.17 : Arduino Nano pin configuration

Specifications

- Microcontroller Atmel ATmega328
- Operating Voltage (logic level) 5 V
- Input Voltage (recommended) 7 12 V
- Input Voltage (limits) 6 20 V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 8 DC Current per I/O Pin 40 mA
- Flash Memory 32 KB
- SRAM 2 KB
- EEPROM 1 KB
- Dimensions 0.70” x 1.70”

3.3.12 Helmet

A hard hat is a type of helmet used in workplace environment such as Industrial or Construction sites to protect the head from injury due to falling objects, impact with other objects. Suspension bands inside the helmet's weight and the force of any impact over the top of the head, a suspension also provides the space of approximately 30mm between the helmet's shells. In this project, the sensors such as Temperature, Humidity and Carbon monoxide, LDR are placed inside the helmet.

Fig. 3.18: Image of Helmet

3.3.13 Microphone

Microphones are used in many applications such as telephones, hearing aids, public address systems for concert halls and public events, motion picture production, live and recorded audio engineering, sound recording , megaphones, radio and television broadcasting and in computers for recording voice, speech recognition, VoIP, and for non-acoustic . Several different types of microphone are in use, which employ different methods to convert the air pressure variations of a sound wave to an electrical signal. The most common are the dynamic microphone, which uses a coil of wire suspended in a magnetic field; the condenser microphone, which uses the vibrating diaphragm as a capacitor plate, and the piezoelectric microphone, which uses a crystal of piezoelectric material.

In order to speak to larger groups of people, a need arose to increase the volume of the human voice. The earliest devices used to achieve this were acoustic megaphones. Some of the first examples, from fifth century BC Greece, were theater masks with horn-shaped mouth openings that acoustically amplified the voice of actors in amphitheaters. In 1665, the English physicist Robert Hooke was the first to experiment with a medium other than air with the invention of the "lovers' telephone" made of stretched wire with a cup attached at each end.

Fig. 3.19: Image of a Speaker use as microphone

German inventor Johann Philipp Reis designed an early sound transmitter that used a metallic strip attached to a vibrating membrane that would produce intermittent current. Better results were achieved with the "liquid transmitter" design in Scottish American Alexander Graham Bell's telephone of 1876 – the diaphragm was attached to a conductive rod in an acid solution. These systems, however, gave a very poor sound quality.

3.4 Summary

This chapter discusses the fundamental components of the proposed system and it briefs about the system requirements. . The system is designed to provide safety for a coal miners from a dangerous gas. The main task of the system is wireless communication. The system requirement has to be taken care for the specific operation to be performed.

CHAPTER 4

METHODOLOGY

The protecting system design for a coal miners from a dangerous gas and for a wireless communication. The system works like Consists of smart helmet wireless stations and Cable network .Control unit can send speech instructions to miners can also receive calling from others working at different coal phase smoothly through smart helmet

This project is intended for underground coal mining. Here we are making use of the sensors to find the environmental parameters like temperature, humidity, carbon monoxide. These sensors will sense the environmental parameters and sends to the arduino Uno 3 microcontroller.

This microcontroller will converts the analog into the digital signal and sends the information to the ZigBee. ZigBee consisting of the in-built coder and it will send the data information to the controller unit.

4.1 Proposed System

The proposed system consists of two fundamental units

- Transmitter unit

  Transmitter unit will interface in both Helmet and control side.

- Receiver unit

  Receiver unit will interface in both Helmet and control side.

4.2 Block Diagram of the Helmet

The Proposed system consisting of the Helmet Unit, as shown in the Fig. 4.1. The helmet unit consisting of the Carbon monoxide, Temperature and Humidity, Light sensors. The sensors will sense all the environmental parameters and sends it to the control unit. The carbon monoxide will sense the carbon monoxide in the air. The aout

terminal gives an analog voltage output in proportion to the amount of carbon monoxide the sensor detects.

It can change the threshold level by adjusting the potentiometer to either raise or lower the level. The more CO it detects, the greater the analog voltage it will output. Conversely, the less CO it detects, the less analog voltage it will output. If the analog voltage reaches a certain threshold, it will send the digital pin DOUT high. Once this DOUT pin goes high, the Arduino will detect this and will trigger the LED to turn on, signaling that the CO threshold has been reached and is now over the limit.

DHT11 digital temperature and humidity sensor is a composite Sensor contains a calibrated digital signal output of the temperature and humidity. This DF Robot DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability.

This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs. It contains everything needed to support the microcontroller. It will convert the analog information to digital information, and then transmit it to the control part via wireless ZigBee.

Device has the characteristics of small volume, ultra-low power consumption and low-cost. It can be either as an independent data transmission termination or be easily embedded into a variety of products to form a short-range wireless data transmission solution.

Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology, is to ensure that the product has high

reliability and excellent long-term stability. The light dependent sensor is works on the principle of photo conductivity. It is the automatic dark detector sensor. As the light level decreases and LDR meets the maximum threshold resistance, the circuit automatically switches on the LED.

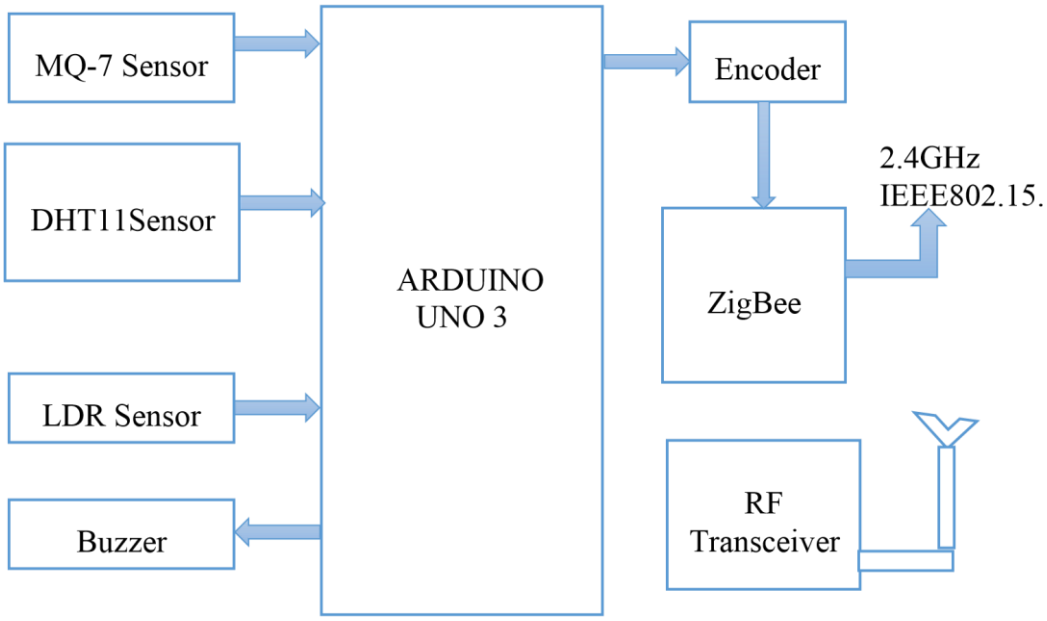

Fig. 4.1: Block Diagram of the Helmet at the Transmitter side

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs. It contains everything needed to support the microcontroller. It will convert the analog information to digital information, and then transmit it to the control part via wireless ZigBee. This module can achieve transparent data transmission between many devices, and it can form a MESH network. This device has the characteristics of small volume, ultra-low power consumption and low-cost. It can be either as an independent data transmission termination or be easily embedded into a variety of products to form a short-range wireless data transmission solution.

4.3 Block Diagram of the Control Unit

The control unit consisting of the LCD display, switch array. The information coming from the ZigBee will be decoded and pass to the Arduino. Then all the needed information will be displayed on the LCD. It is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. If any abnormal environmental parameters found, then the controller press the switch and the buzzer at the helmet unit will get alert. When the control center decides the parameters are abnormal then they can make a call to the coal miner through the same ZigBee module.

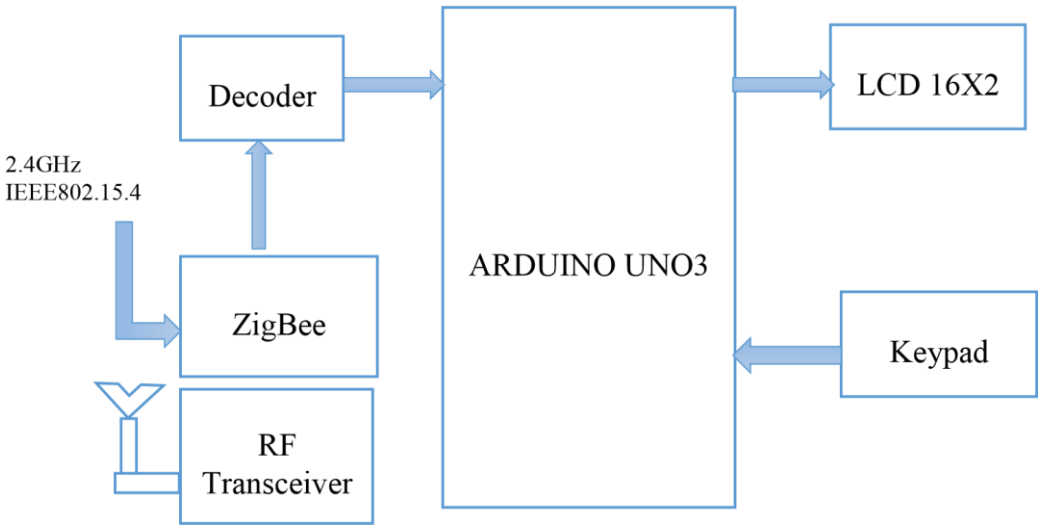

Fig. 4.2: Block Diagram of the control unit at the Receiver side

ZigBee is an IEEE 802.15.4based specification for a suite of high-level communication protocols used to create personal area networks with small, low power digital radios. The wireless network includes the wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that is requires short-range low-rate wireless data transfer.

The ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks,

the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level. RF transceiver will supports for the voice communication. This transmitter will interfaces in both Helmet and control side.

The wireless transmitter circuit built around transistor T1 (BF494) is a basic low-power variable-frequency VHF oscillator. A varicap diode circuit is included to change the frequency of the FM transmitter and to provide frequency modulation by audio signals. The output of the oscillator is about 50milliwatts. RF transmitter block diagram.

Transistor T2 (2N3866) forms a VHF-class A power amplifier. It boosts the oscillator signals' power four to five times. Thus, 200-250milliwatts of power is generated at the collector of transistor T2.

Potentiometer VR1 is used to vary the fundamental frequency whereas potentiometer VR2 is used as power control. For hum-free operation, operate the wireless FM transmitter on a 12V rechargeable battery pack of 10 x 1.2-volt Ni-Cd cells. Transistor T2 must be mounted on a heat sink. Do not switch on the transmitter without a matching antenna. Adjust both trimmers (VC1 and VC2) for maximum transmission power. Adjust potentiometer VR1 to set the fundamental frequency near 100 MHz.

4.4 Flow Chart

The system communicates in Mesh network using MAC protocol [6].The flow chart of the transmitter system is given next each time the router is awaked by an awaking signal generated by the coordinator, the coordinator is asking for the data from router. This method is called pull method and is superior in those case where there are more number of router. This is because if two or more router is transmitted at the same time, coordinator is not able to fetch the data and may crash. In this system another important technique is used, called token passing. During transmission of data, router passes a token with the data to coordinator that data is transmitted. When the coordinator gets the token with the data it sends an acknowledgement signal to the router and stop sending awaking signal to that router.

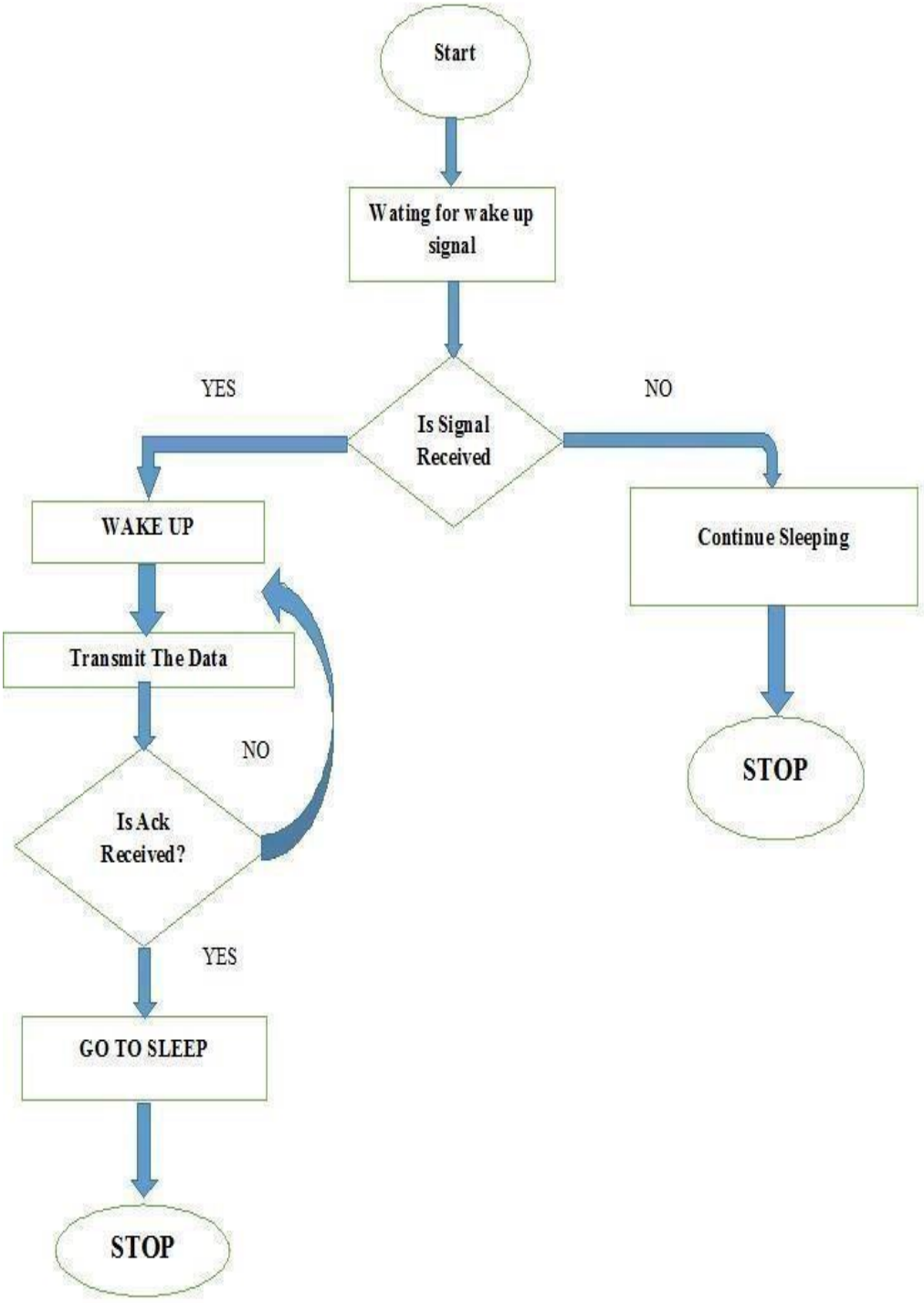

Fig 4.3: Flow Chart

It then sends awaking signal to the next router and the process keeps continuing. Data can be continuously monitored using a hardware (microcontroller) Set up or by using Lab-View software.

4.5 PCB DESIGN

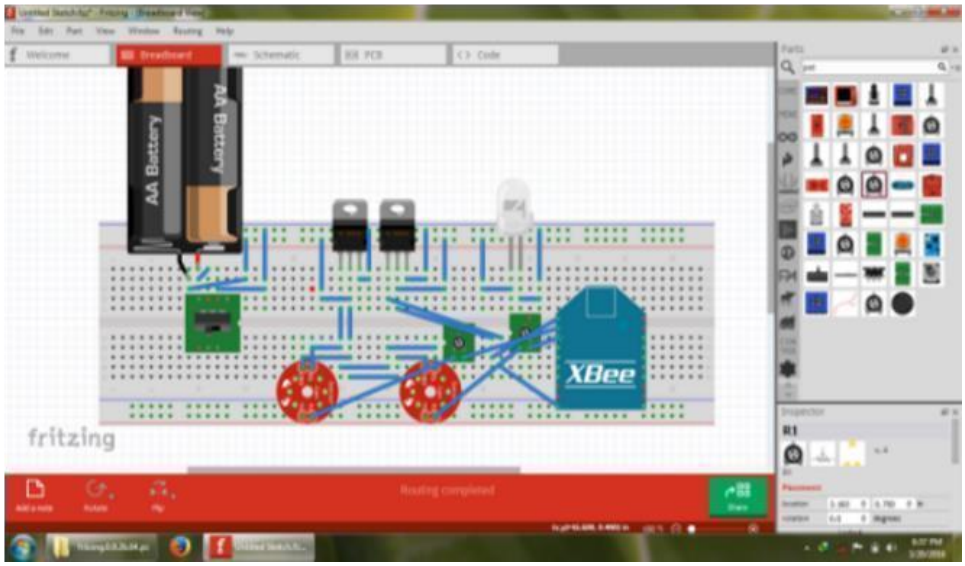

Fig. 4.4: PCB Design

The helmet circuit is designed in Frizzing, a GUI used by electronic engineers for designing electronic circuit equipped with various features like bread board view, schematic view, PCB view and also auto routing the voltage regulator 7805 and LM 351 T are used for voltage regulation. MQ7 and MQ2 are used for sensing CH4 and CO respectively. The Bee is of series 2, having a range of 2000 meter at the line of sight.

4.6 Auto CAD Design

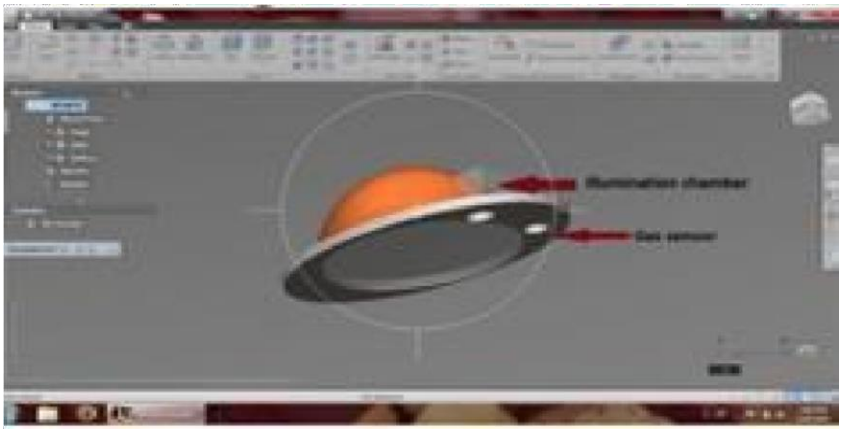

Fig. 4.5 Auto Cad Design

The helmet is designed in Auto-CAD inventor fusion and is given in the As seen in the above Fig. a 3D image of the device is obtained as marked in the diagram sensor, X-Bee, and the other circuit component is kept in the helmet inside the illumination chamber. Gas sensor are kept vertically, facing the ground.

4.7 Summary

This chapter discusses the methodology of the proposed system and it briefs about the transmitter and receiver systems. The working and signal flow from the transmitter to receiver module is explained in this section with the help of flowcharts. The section also explains about the circuits of transceivers.

CHAPTER 5

IMPLEMENTATION

5.1 Introduction

The Proposed system consisting of the Helmet Unit, as shown in the Fig. 4.1.The helmet unit consisting of the Carbon monoxide, Temperature and Humidity, Light sensors. The sensors will sense all the environmental parameters and sends it to the control unit. The carbon monoxide will sense the carbon monoxide in the air. The AOUT terminal gives an analog voltage output in proportion to the amount of carbon monoxide the sensor detects.

5.1.1 Proposed System

It can change the threshold level by adjusting the potentiometer to either raise or lower the level. The more CO it detects, the greater the analog voltage it will output. Conversely, the less CO it detects, the less analog voltage it will output. If the analog voltage reaches a certain threshold, it will send the digital pin DOUT high. Once this DOUT pin goes high, the Arduino will detect this and will trigger the LED to turn on, signaling that the CO threshold has been reached and is now over the limit.

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and the temperature and humidity sensing technology, is to ensure that the product has high reliability and excellent long-term stability.

This device has the characteristics of small volume, ultra-low power consumption and low-cost. It can be either as an independent data transmission termination or be easily embedded into a variety of products to form a short-range wireless data transmission solution.

Figure 5.1: Transmitter block diagram of proposed system

Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology, is to ensure that the product has high reliability and excellent long-term stability. The light dependent sensor is works on the principle of photo conductivity. It is the automatic dark detector sensor. As the light level decreases and LDR meets the maximum threshold resistance, the circuit automatically switches on the LED.

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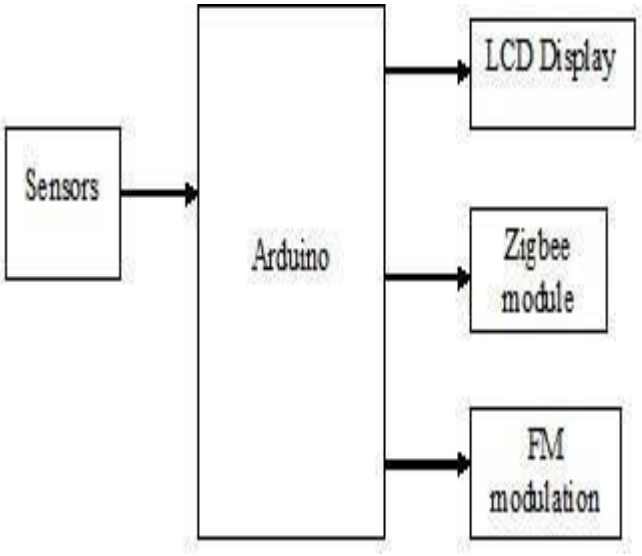

Figure 5.2: Receiver block diagram of proposed system

It is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. If any abnormal environmental parameters found, then the controller press the switch and the buzzer at the helmet unit will get alert.

The control center decides the parameters are abnormal then they can make a call to the coal miner through the same ZigBee module. The ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level.

5.2 System architecture

The entire system consists of smart helmet, wireless stations and cable network. Wireless base station is a gateway between ZigBee wireless network and cable network. Miner's smart helmet is used as mobile wireless sensor network node which is composed of rechargeable battery, LED lamp and ZigBee communications module. So intelligent

helmets could collect production parameters timely, then transmit to wireless base stations, finally upload the data to ground control center through communications cables.

Monitoring Centre can send speech instruction to miners through underground networks, yet miners can also receive calling from others working at different coal face smoothly through smart helmets. It is a good Monitoring Mine Safety System both under normal circumstances and unexpected accident

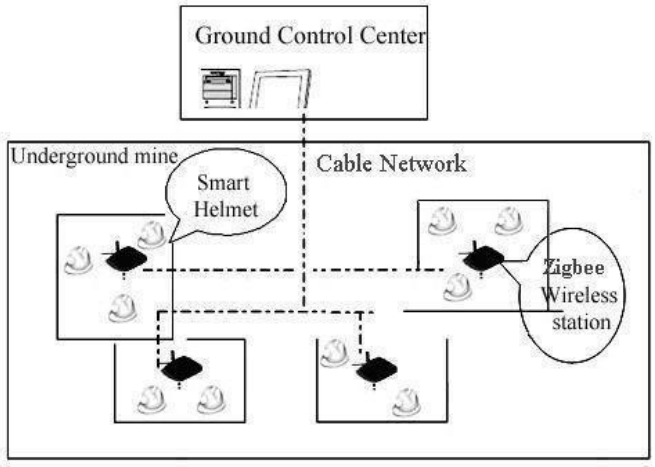

Fig.5.3 Structure of the system

5.3 Summary

This chapter discusses the implementation of protecting system design for coal miners for monitoring and control the accident that occurs due to dangerous gas .The creation of helmet and sensor interfacing and dumping of a software code is explained. The implementation of ZigBee system is easier than other systems. The system can be easily monitored from one place.

CHAPTER 6

RESULTS AND DISCUSSION

6.1 Results

In this chapter the result is discussed for wireless communication system using ZigBee module. The hardware and software are implemented in prototype. This chapter shows the working of prototype and also the result obtained.

6.1.1 Results of ZigBee Technology

The ZigBee wireless communication system consists of transmitter and receiver, which communicates with one another using pre-defined radio frequency range.

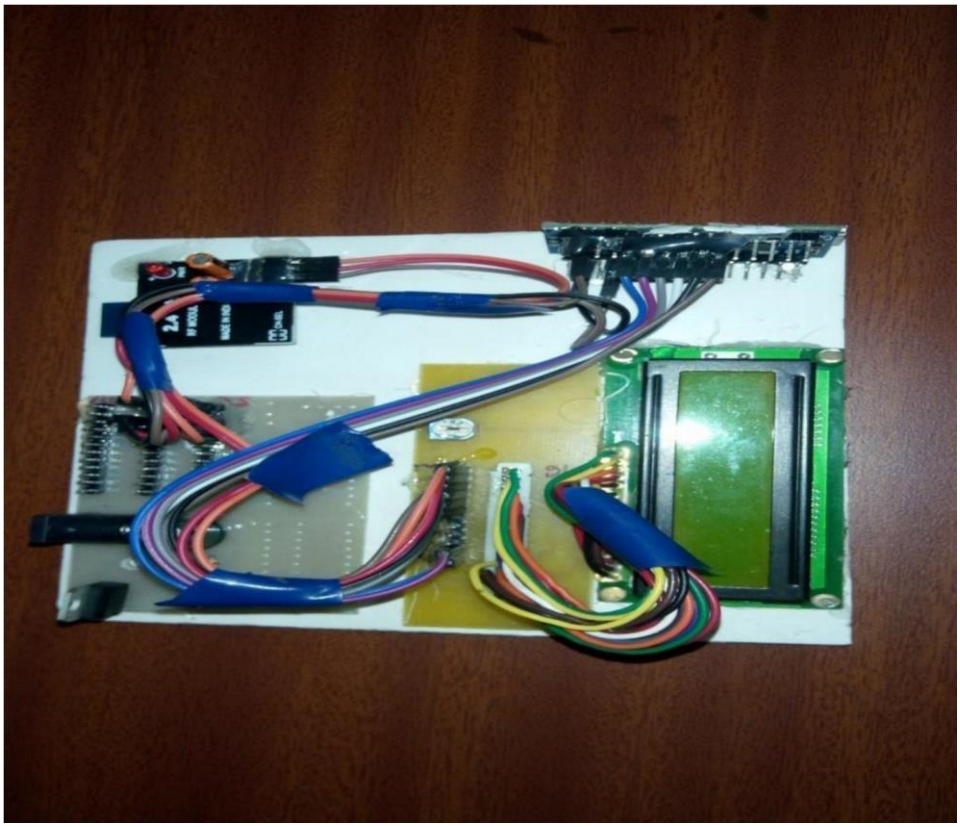

Fig.6.1: The assembling part of the base station

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins, 6 analog inputs. It contains everything needed to support the microcontroller. It will convert the analog information to digital information, and then transmit it to the control part via wireless ZigBee.

Fig.6.2: The assembling part of the helmet

The ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance.

The light dependent sensor is works on the principle of photo conductivity. It is the automatic dark detector sensor. As the light level decreases and LDR meets the maximum threshold resistance, the circuit automatically switches on the LED.

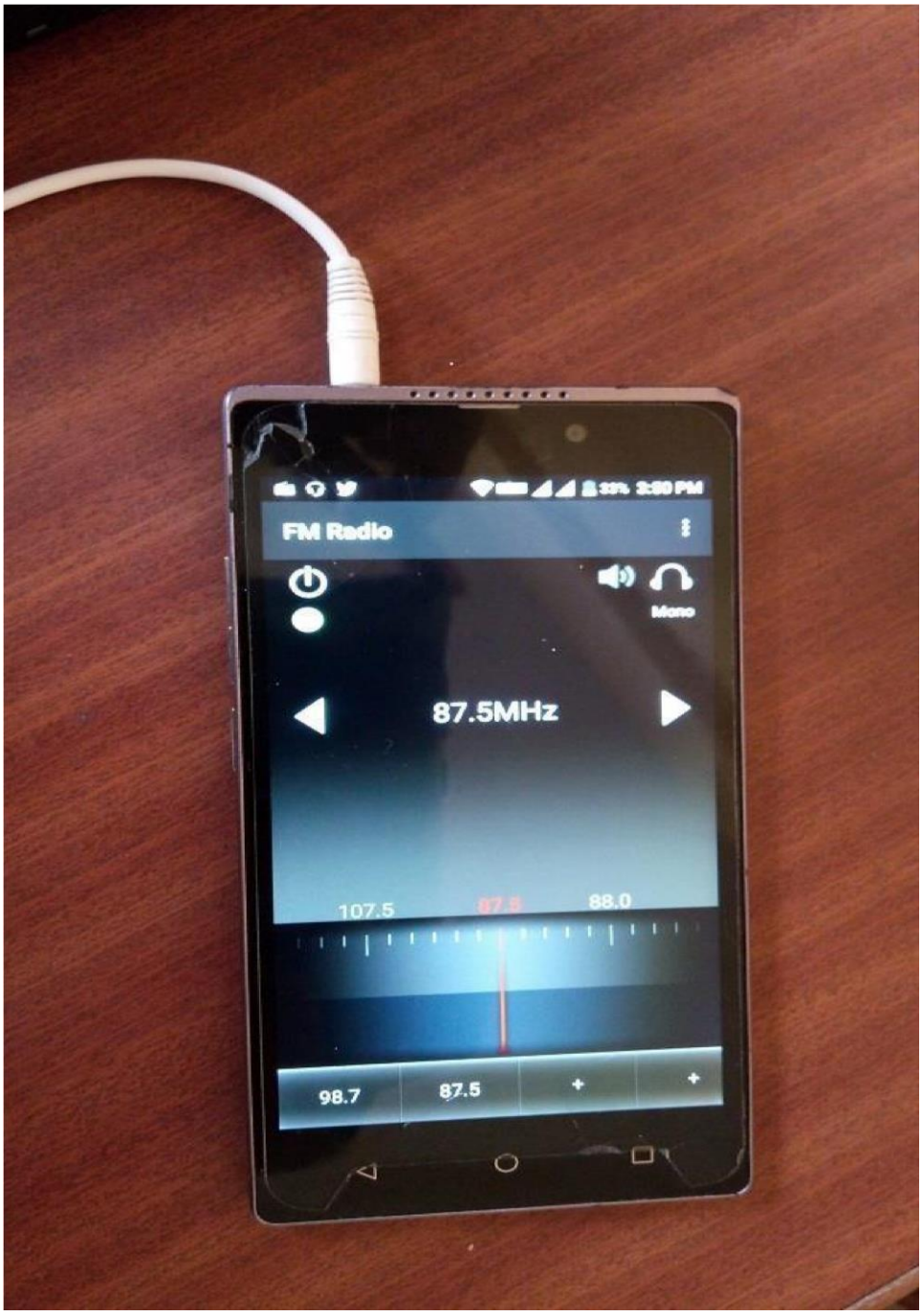

Fig.6.3: Communicating device at base station

The different sensors are fixed in the transmitter part for sensing dangerous gas temperature humidity. The sensed data particular area is transmitted in the form of both analog as well as digital forms.

Receiver part is the controlling unit of the prototype. In underground mining the temperature, humidity, dangerous gas increases and the sensor can be set the threshold as per the user requirement.

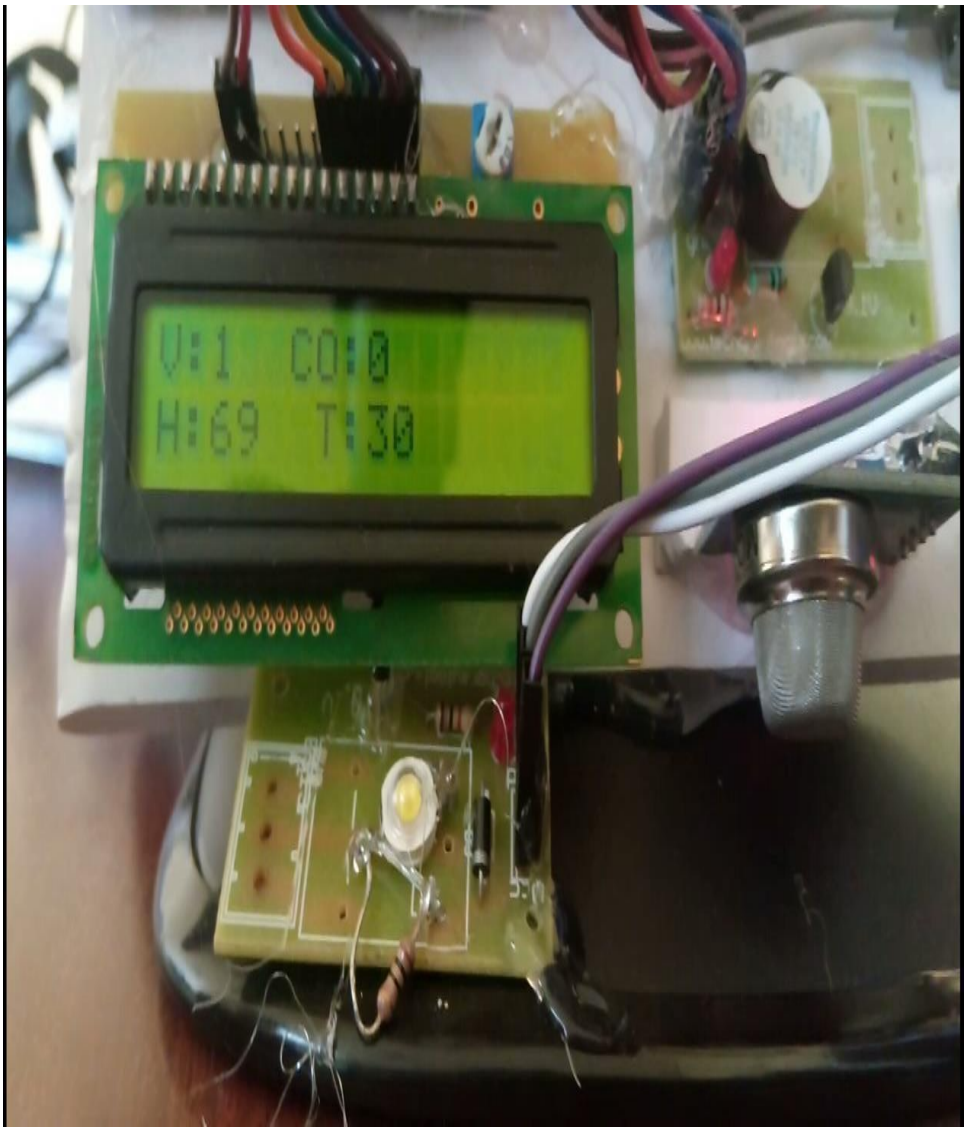

Fig.6.4: Temperature sensor

The Fig. **6**.4 shows the temperature sensor working. When the miner will be working in the mining underground there miners may get the temperature variation it is harmful to the workers so the temperature variation will be sensed by sensor the user will set the threshold as per miners required after caressing the threshold voltage the buzzer alarm get activated

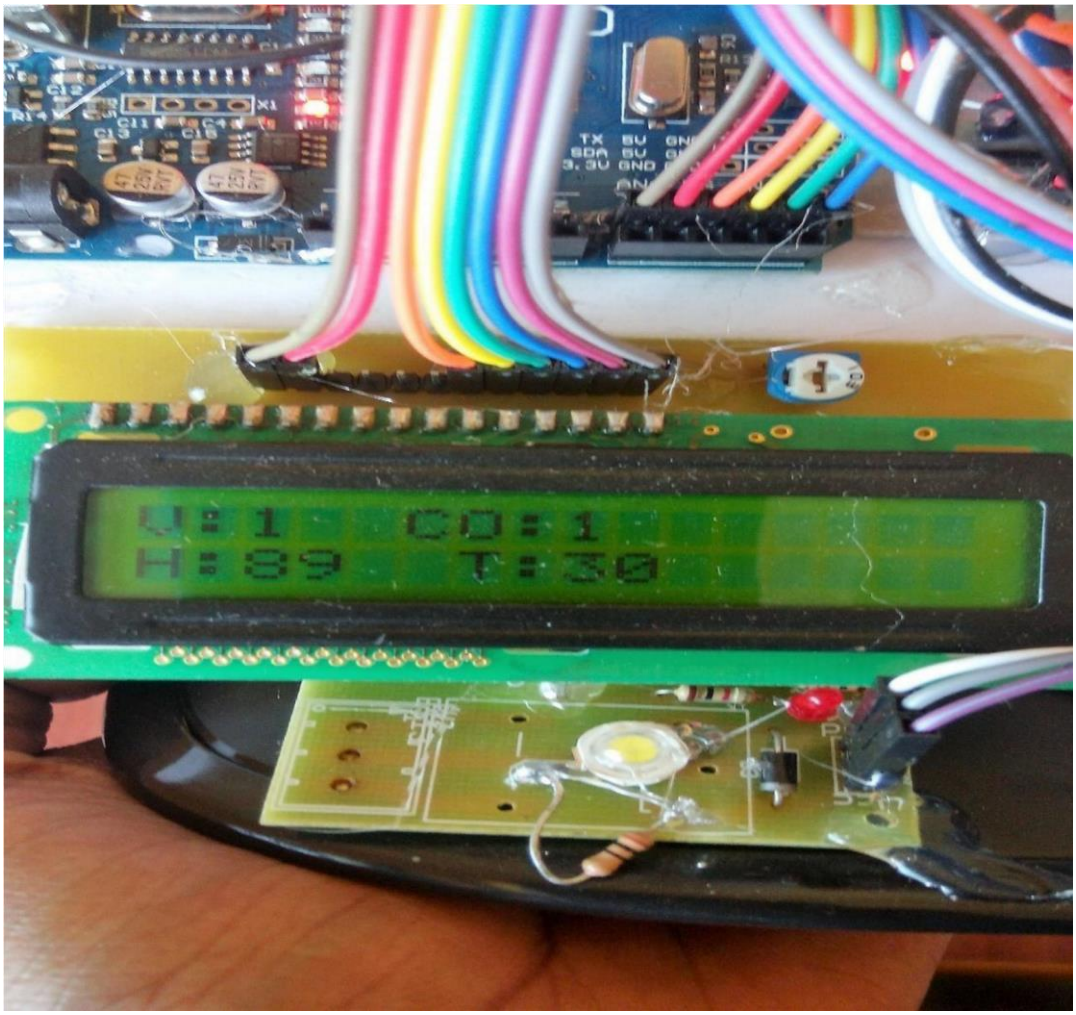

Fig.6.5: Humidity sensor

The Fig.6.5 shows the humidity sensor working. When the miner will be working in the mining underground there miners may get the humidity variation it is harmful to the workers so the temperature variation will be sensed by sensor the user will set the threshold as per miners required after caressing the threshold voltage the buzzer alarm get activated

The Fig.6.6 shows the gas sensor working. When the miner will be working in the mining underground there miners may get the dangerous gas arrival it is harmful to the workers so the gas will be sensed by sensor after sensing the buzzer alarm get activated

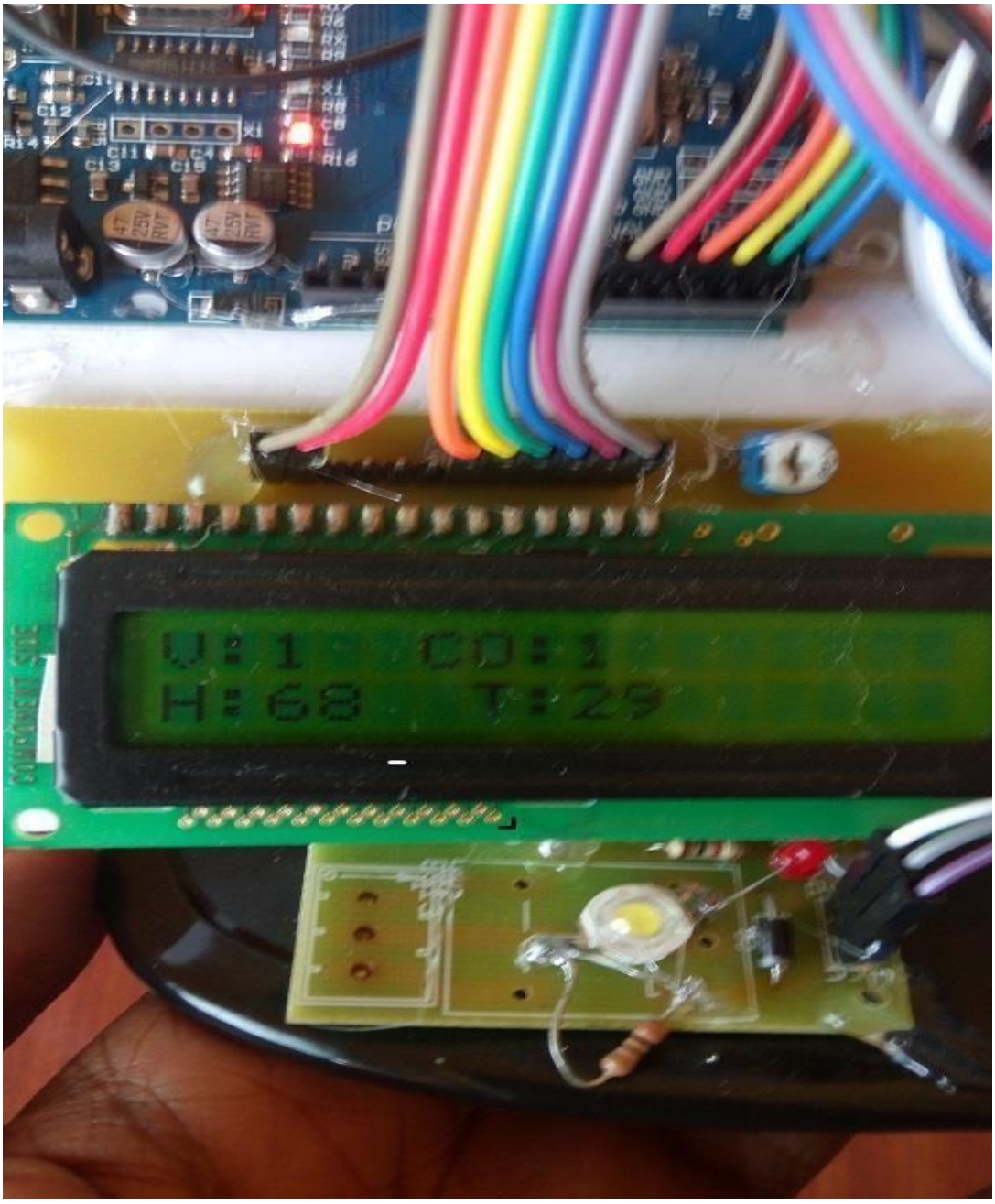

Fig.6.6: gas sensor

The Fig.6.7.shows the LDR working. When the miner will be working in the mining underground there may automatic power loss may occurs if there any power loss occurs LDR is used if power gets of atomic LDR is turned on light placed on helmet gets activated.

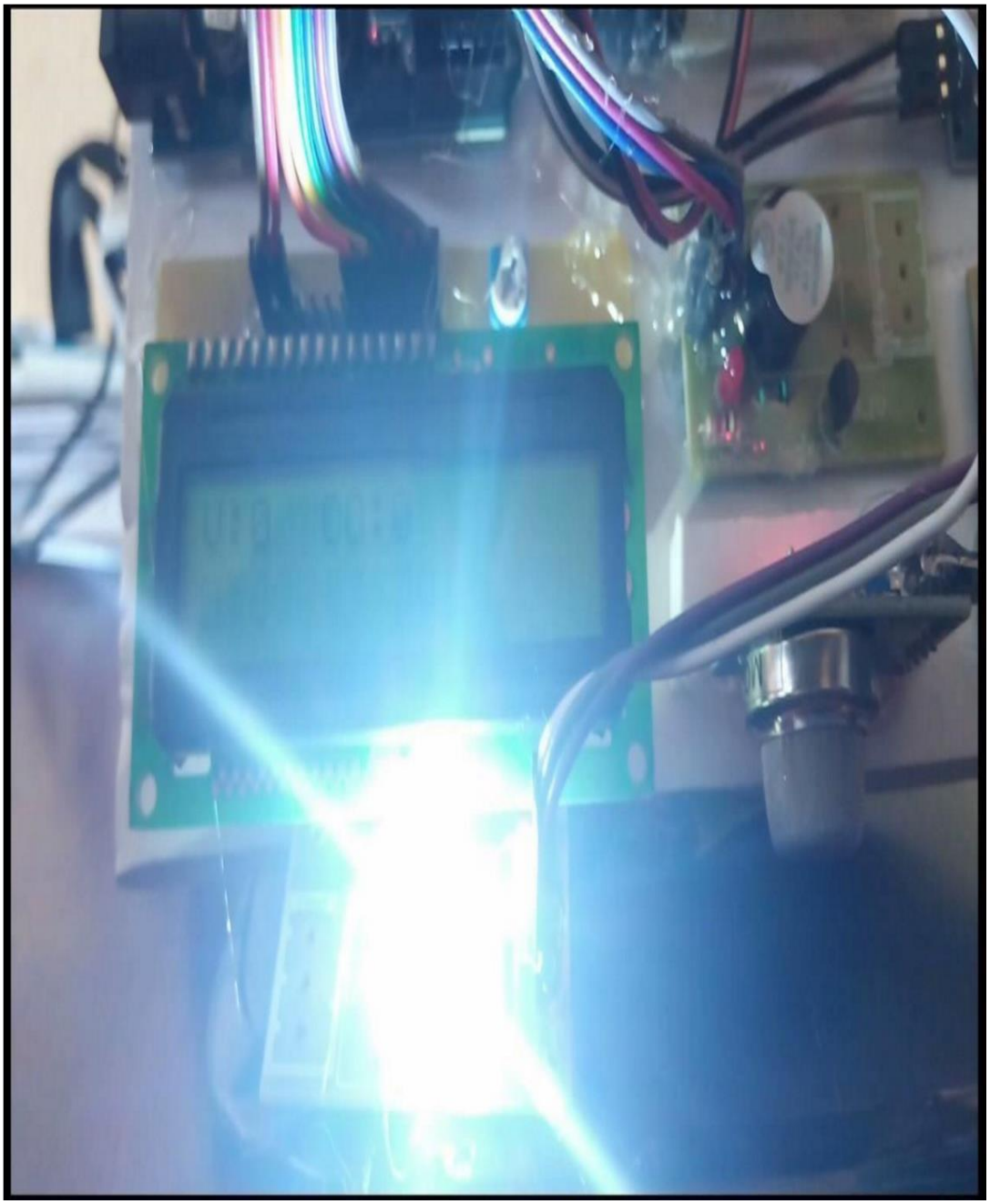

Fig.6.7. LDR

The Fig.6.8 FM modulator shows the wireless communication .When the miner will be working in the mining underground there if miners wants to communicate with the base station FM modulator is used to transmit a voice data to base station at base station the owner will communicate by connecting his mobile FM at frequency range of 87.5

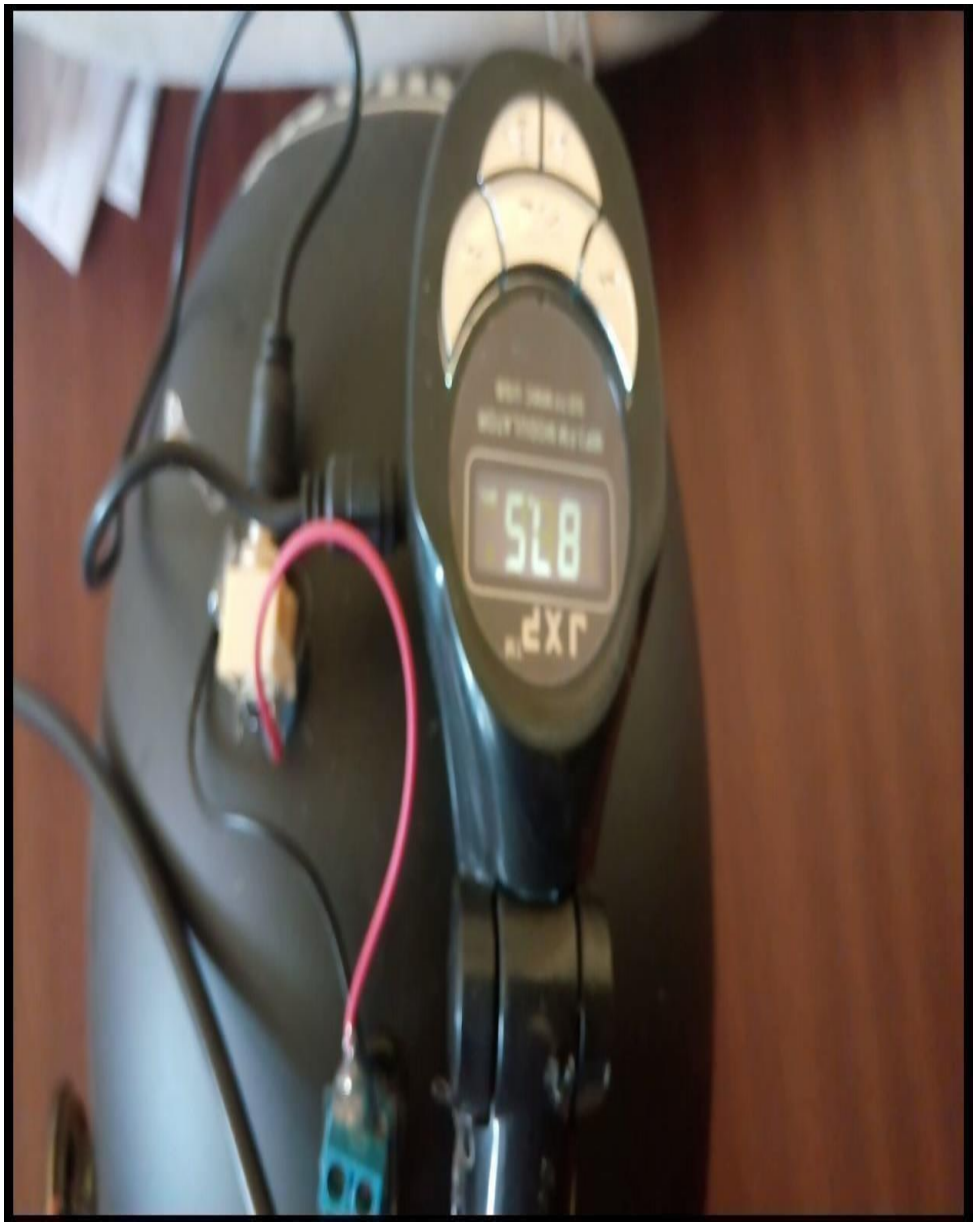

Fig.6.8.FM Modulator

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CHAPTER 7

CONCLUSION AND SCOPE FOR FUTURE DIRECTIONS

7.1 Conclusion

The literature survey of methodologies on protecting system design for coal miners the importance and trade-offs between the implementation parts. The objectives of the project work are fixed based on these trade-offs. The Objectives of this project work are mentioned in section 1.4. To meet these objectives the wireless communication and ZigBee model system are proposed. The wireless communication system provides wireless communication transmitted signal and the system is efficient compared to other system.

The wired communication system has a drawback its cost and maintenance is high and aging of wires so the loss of data appears. The drawbacks are overcome by Zig Bee technique which cover large area and also provides two-way communication. The important aspect is that even the gap has to be built in terms of technology. The proposed system is much more accurate and easy to implement in the real time. As the different zones like mining, underground working on Arduino software. The emergency requirements like first aid, help line services can be intimated to the miners. The project work aims at the implementation of system in real time application. The contributions of this system are as follows

- The wireless communication system is proposed and developed to provide communication between base station and miner.
- The ZigBee system is proposed and developed to provide precaution and safety to the miner.

7.2 Scope for Future Directions

The proposed work has great advantage and also it has some limitations, and every limitation is subject for research there are various methods to alert the miner from the dangerous gas , a lot of research can be conducted in this field. The Zig Bee technology is the new method to alert and respond according to it in the underground climate as the Zig Bee technology has various other futures which are required for the miner and also for the base station .The additional features are mentioned in the implementation.

- The proposed system can be modified by creating the server to meet the requirement in real time application.
- The proposed work has a great application in the coal mining. The most of resource is taken from the underground mining through the Zig Bee system and interfacing with the sensors activates and alert the miners if any dangerous gas, temperature, humidity variations occurs buzzer will get on.
- In future the methodology can be extended for further improvement using GSM modules