A

Project Part-II Report on

"COAL MINE SAFETY USING IOT"

Submitted in fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted by

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ADITYA COLLEGE OF ENGINEERING & TECHNOLOGY

Approved by AICTE, New Delhi , Permanently Affiliated to JNTUK, Kakinada & Accredited by NBA & NAAC(A^{+}) with CGPA of 3.4 recognized by UGC under the sections 2(f) and 12(B) of the UGC act 1956)**Aditya Nagar, ADB Road, Surampalem, E.G.Dt., - 533 437**

(2019-2023)

CERTIFICATE

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

This is to Certify that Technical Project Part-II Report Titled

"COAL MINE SAFETY USING IOT"

Being submitted by

M.Surya Chandrika	**19P31A04M4**
C.Kalyani	**19P35A04K5**
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In the partial fulfilment of the requirements for the award of Degree of Bachelor of technology in **ELECTRONICS AND COMMUNICATION ENGINEERING**. It is a record of bonafide work carried out by her/his under the esteemed guidance and supervision of Ms.K.M.V.V.L.Manasa during the academic year 2022-2023.

Project Guide

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ACKNOWLEDGEMENT

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With immense pleasure I would like to express my deep sense and heart full thanks to the management of **Aditya College of Engineering & Technology.**

With sincere regards**,**

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DECLARATION

We hereby declare that the project entitled "COAL MINE SAFETY USING LORA" has been undertaken by our batch, and the project part-II report is submitted to **ADITYA COLLEGE OF ENGINEERING AND TECHNOLGY,**, Surampalem in partial fulfillment of the requirements for the award of degree of **BACHELOR OF TECHNOLOGY** in **ELECTRONICS AND COMMUNICATION ENGINEERING.**

We also hereby declare that this project part-II have not been submitted in partial or full to any other university for any degree.

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INSTITUTE VISION AND MISSION

VISION:

To induce higher planes of learning by imparting technical education with

- International standards
- Applied research
- Creative Ability
- Value based instruction and to emerge as a premiere institute

MISSION:

Achieving academic excellence by providing globally acceptable technical education by forecasting technology through

- Innovative Research and development
- Industry Institute Interaction
- Empowered Manpower

DEPARTMENT VISION AND MISSION

Vision: To emerge as a center of excellence in education and research

Mission:

- To establish skill and learning centric infrastructure in thrust areas
- To develop Robotics and IOT based infrastructure Laboratories
- To organize events through industry institute collaborations and promote innovation
- To disseminate knowledge through quality teaching learning process.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Program Name: Bachelor of Technology (B.Tech) in Electronics and Communication Engineering.

PEO1: Graduates shall evolve into skilled professionals capable of handling interdisciplinary work atmosphere and excel in problem solving.

PEO2: Graduates shall inculcate the urge to progress in the chosen field of Electronics & Communication through higher education and research.

PEO3: Graduates shall ingrain professional values through Ethics based teaching learning process.

PEO4: Graduates shall exhibit leader ship skills and advance towards Entrepreneurship, Innovation and lifelong learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Program Name: Bachelor of Technology (B.Tech) in Electronics & Communication Engineering

PSO1: Industry ready in the arena of electronics & communication, VLSI, Robotics, Embedded Systems, IOT and allied fields.

PSO2: Acquire the required ability and knowledge to design, test, verify and develop innovative electronics projects through theoretical and laboratory practice.

PROGRAM OUTCOMES (POs)

PO1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. **Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, give and receive clear instructions.

PO11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply

these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B. Tech 4/4, I-SEMESTER

Course Outcomes

Upon completion of the course, students will be able to:

CO#	Course Outcomes	Blooms Taxonomy level
CO1	Identify the problem by applying acquired knowledge.	Remember
CO2	Use literature to identify the objective, scope and the concept of the work.	Apply
CO3	Analyse and categorize executable project modules after considering risks.	Analyse
CO4	Choose efficient tools for designing project modules.	Evaluate
CO5	Integrate all the modules through effective team work after efficient testing.	Create
CO6	Explain the completed task and compile the project report.	Understand

CO-PO/PSO MATRIX:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	3	3		3	3	3	3	3	3	3		
CO2		3		2		3	2	2	3	3	3	3		
CO3	3		3	3				2	3				3	2
CO4	3				2						2			3
CO5				3	2				3	3	2		3	
CO6									3	2	2			3
Course														

Signature of the Guide

CO-PO Justification

CO No.	PO/PSO	CL	Justification
CO1	PO1	2	Moderately mapped as we need basic concepts Arduino.
	PO2	2	Moderately mapped as we need to identify, analyze and formulatedifferent types of problems raised in different area
	PO3	2	Moderately mapped as we need to design solutions for problems on arduino and matlab
	PO5	2	Moderately mapped as we need to apply modern tools to the activities related to Arduino.
	PSO1	2	Moderately mapped as we will be able to understand importance of in real time applications.
	PSO2	2	Moderately mapped as we will need equipped laboratory infrastructure
CO2	PO1	2	Moderately mapped as we need to apply matlab techniques for the analysis of Digital signals.
	PO2	2	Moderately mapped as we need to analyze problems related to Arduino.
	PO3	2	Moderately mapped as we will be able to find the solution for the problem identified.
	PO4	2	Moderately mapped as we will be able to investigate the complex problems in the project.
	PO8	2	Moderately mapped as we need to have the basic idea about the rules tobe followed.
	PO9	2	Moderately mapped as we need to work together to study the tools andtechnologies.
	PSO1	2	Moderately mapped as we need to have to train ourselves industry ready in the field of electronics and communication
	PSO2	2	Moderately mapped as we will need equipped laboratory infrastructure
CO3	PO1	2	Moderately mapped as we should know about Network design techniques.
	PO3	2	Moderately mapped as we need design complex solutions related toCNN network realization.
	PO4	2	Moderately mapped as we will be able to investigate the complex problems in the project.
	PO8	2	Moderately mapped as we need to have the basic idea about the rules tobe followed.
	PO9	2	Moderately mapped as we need to work together to study the tools andtechnologies.
	PSO1	2	Moderately mapped as we need to have the basic idea about GANnetworks in practical application.

	PSO2	2	Moderately mapped as we will need equipped laboratory infrastructure
CO4	PO1	2	Moderately mapped as we need to have basic knowledge of CNNnetwork.
	PO5	3	Highly mapped as we need to know tools used related to CNN network.
	PO11	3	Highly mapped as the students will be able to manage the financial constraints.
	PSO2	2	Moderately mapped as we need to have the basic idea about GAN networks design in practical application.
CO5	PO4	2	Moderately mapped as we need to design solutions for CNN networks.
	PO5	2	Moderately mapped as we should know about modern tools used to for better CNN network design.
	PO9	2	Moderately mapped as we need to identify the risks involved in the project and its effect on society.
	PO10	2	It is moderately mapped as the we will be able to communicate their work in reviews and paper presentations.
	PSO1	2	Moderately mapped as we need to have to train ourselves industry ready in the field of electronics and communication
	PSO2	2	Moderately mapped as we need to have the basic idea about GAN networks design in practical application.
CO6	PO9	2	Moderately mapped as we need to work together to make the project better understandable.
	PO10	2	Moderately mapped as we need to have the basic idea about GAN networks design in practical application
	PO11	3	Highly mapped as team need to work on project management.
	PSO2	2	Moderately mapped as we need to have the basic idea about GAN networks design in practical application.

Signature of the Guide

ABSTRACT

Generally, people working in mining areas, face many risk factors. In order to safe guard the people working inside the mine its environmental parameters should be monitored. **Machine to machine** (commonly abbreviated as **M2M**) refers to direct communication between devices using any communications channel, including wired and wireless. Machine to machine communication can include industrial instrumentation, enabling a sensor or meter to communicate the data it records (such as temperature, inventory level, etc.) to application software that can use it (for example, adjusting an industrial process based on temperature or placing orders to replenish inventory). LORA based wireless communication system is used for the interface between two Machines or two hardware units. Using these types of system we can easily move machine from one place to other without any rerouting of hardware cables.

In this proposed system, we have demonstrated wireless machine to machine communication between two hardware units; first one is **Sensor Unit** and second is **Control Unit**. Sensor unit uploads real-time data over LORA Module of 433MHz. Control unit retrieves these data from same server and switches On/Off the output device accordingly. Both this devices are communicated using Radio Frequency Network.

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LIST OF ABBREVATIONS

IOT	Internet Of Things
CSS	Chirp Spread Spectrum
LPWA	Low Power Wide Area
EMF	Electromotive Force
WiFi	Wireless Fidelity

CHAPTER 1

INTRODUCTION

Communication plays an important role in surveillance and safety for any industries. Generally, communication system is nothing but a transmitting and receiving of information from one end to other ends. It can be wire, wireless and both types. Structure and environment behaviour of underground mines is not easy to other industries. Therefore, Infrastructure of communication system are very complex and critical in underground mines. Climate checking and legitimate correspondence had been a critical assignment to guarantee safe working conditions and increment profitability in underground mines. Current communication and monitoring systems in underground mines are cable based or discrete in nature. Cable based communication and monitoring has limitations like that, Susceptible to failure during any type of cable breakage at the time of disaster, Possibility of sparks or flames because of any wrong design. Communication is only available from point to point, and cannot be established from anywhere else. Thus, there is an inability to communicate with immovable men, with the working surface expanded, a blind area for monitoring appears, and then new installation and maintenance is needed.

The process of Underground mining operation through human laborers is a highly unsafe scenario where the risks increase with the increase in distance from the ground. The mining operations with unsafe manners are due to different methodologies utilized by the miners for extricating diverse minerals. The longer the mine, the more prominent is the hazard. The safety measures execution is very poor, especially in the coal mine industries. Coal is an essential resource to every nation as it has many commercial applications. The most integral employments of coal are in the production of thermal power, cement, and steel production and as a fuel for numerous applications. The coal mines have numerous risky stipulations that include high temperature and humidity, discharge of destructive gases that make unsafe surroundings for specialists working there. Many employees are taking off their occupations in coal mines or no longer at all inclined to pick such employments as mining.

This creates a lot of challenges in the accessibility of employees for the coal mining industry. The security of laborers working in coal mine industries is increasing day by day through technologies. The progressive of innovation that enables the mine monitoring methods to become more sophisticated, however, explosions in underground coal mine still happen. The accidents of calamities in coal mines are mainly due to the harsh environments and unsafe working conditions. This makes the need of employing mine checking systems at a high level

for coal mines. It is quite hard to analyze all the environmental conditions constantly in a coal mine manually. This job can be effortlessly achieved with the help of economically viable wireless communication devices employed at the required position in coal mines.

1.1 PROBLEMS OCCURRED IN COAL MINE SAFETY

Today, the safety of miner workers is a significant challenge. Miner's health and life are helpless against a few basic issues, which incorporates the working environment, yet in addition its delayed consequence.

To extent profitability and diminish the expense of mining alongside the thought of the safety of miners, a creative and innovative methodology is required.

The proposed system comprises of two sections one to monitor the mineworker status and another one is the total monitoring section. In the mine laborer area, air contamination is primarily due to the outflows because of emissions of particulate matter and gases incorporate such as Sulphur dioxide (SO2), Nitrogen dioxide (NO2), Carbon monoxide (CO) and so forth we are utilizing two smoke sensors to monitor the diverse type of smoke level in the mine.

Safe production level of coal mine is still low, disasters in coal mine occur frequently, which lead to great loss of possession and life. The disasters happening in coal mine are due to the complexity of mine environment and the variety of work carried out in coal mine, so it is very necessary to monitor the working environment of coal mine. For a long time, coal mining companies often only pay attention to current interests when carrying out coal mining. However, insufficient attention has been paid to potential safety hazards and related problems that may arise during coal mining.

The ecosystem has caused serious damage and wasted a lot of coal resources. This has also caused serious obstacles and problems to the rational use of coal resources and also affected the safety of coal resources in China. The safety management of coal enterprises can not only make industrial production more stable, but also develop better. It is not only directly related to the interests of the enterprise, but also related to the personal safety and physical and mental health of employees. Solve potential safety hazards, maintain the safety of coal mine personnel, and promote the better development of China's coal industry. The common cause of many safety management problems is the weak implementation of the system, and the implementation of regulations and operating procedures has been neglected, modified, or even seriously violated regulations. For certain security incidents, the vast majority of violations are ranked first, and the accidents are later. In order to save energy, some employees do not strictly implement safety rules and regulations and are accustomed to work based on experience.

CHAPTER 2

LITERATURE SURVEY

Shashank Kumar, the term of Industry 4.0 (German Industry 4.0), commonly recognized nowadays, occurred in the public domain in 2011 at the Hanover Trade Fair as the name for the common initiative of the representatives of business, policy and science promoting the idea of strengthening the competitiveness of the German industry (Müller et al., 2018; Rao and Prasad, 2018). The German federal government liked the idea so much that they decided to make Industry 4.0 an integral part of the government initiative "High-Tech Strategy for Germany 2020", whose objective is to promote Germany as a global leader of technological innovation (Pereira and Romero, 2017; Zhou et al., 2015; Jabber et al., 2018; Androdiecious, 2017[1].

Beata Ślusarczyk., Paper selected for this section has discussed the production process and some advanced design of shop floor in the manufacturing industry by using cyber-physical system (CPS) and smart object. Majority of papers discussed about the internet of things (IoT) and their implication part. S. Wang et al., (2015) in his paper explained smart object-based shop floor. Shop floor with the smart agent and the advanced tool that converted the simple system into the self-organizing system has discussed. IoT and CPS are used to make all the machines and tools smart. CPS and IoT enabled various agents are then classified into different agents for the easiness of collecting the big data feedback and facilitate coordination among them. For better coordination, an intelligent negotiation mechanism has presented by Wang et al. To get the significant visualization of co-ordination of smart objects, virtual engineering object (VEO) technology has introduced by S. Shafiq et al., (2015)[2].

Bozena Gajdzik 1, Sandra Grabowska 2, and Sebastian Saniuk 3, The first step of literature review was used the bibliometric analysis [3]. The following keywords were selected in the bibliographic analysis: "Pathway to Industry 4.0", "Implementation of Industry 4.0", "Application of Industry 4.0", "Roadmap (to) for Industry 4.0" and "For Industry 4.0". framework".The choice of keywords was consistent with the adoption research objective, which was to find the answer to the question: Industry 4.0, how to implement step-by-step? The period of analysis was 2011–2020. From 2011 on, the popularization of industry 4.0 begins and continues for years to come. Analyzing the results of a scientific database review of adopted keywords, it was found that most of the publications were in the database for keywords: "Implementation of Industry 4.0[3].

COAL MINE SAFETY MONITORING ANDALERTING SYSTEM [4] Authors:S. R. Deokar et al Miner's health and life is vulnerable to several critical issues, which includes not only the working environment, but also the after effect of it. To increase the productivity and reduce the cost of mining along with consideration of the safety of workers, an innovative approach is required. 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 and mobile unit. The air pollution from coal mines is mainly due to emissions of particulate matter and gases include sulphur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO) etc. To monitor the concentration level of harmful gases, semiconductor gas sensors are used. Due to any reason, if a miner falls down also proper treatment is not provided to them at that time, so many number of miners would die. To overcome this problem the system provides an emergency alert to the supervisor if a person falls down by any reason. Some workers are not aware of safety and they do not helmet. A Limit switch was then used to successfully determine whether a miner has removed his helmet or not. This system also provides an early warning, which will be helpful to all miners present inside the mine to save their life before any casualty occurs. The system uses Zigbee technology and GSM for transmission of data. There is alert switch at receiver and transmitter side for emergency purpose.

The Underground Mining Area WSN Localization Algorithm[5]. Authors:Shailendra Kumar Rawat et al The main aim or goal of our research work is to localize the workers working in mining area exactly or with minimum localization error. Network formation in mining area is always very crucial. Laborers working in mining area need strong availability of network so that when they go down or deep in a mining area they can be rescued easily. It can only be possible when we know the exact location of the worker working in the particular area. For this, we need better localization scheme. Many recent developments have been made in the field of mining area. Random forest scheme, SVM based regressive localization, Wi-Fi based localization, and these are some schemes developed so far. RSSI and Trilateration works for both indoor and outdoor localization.

CHAPTER 3

3.1 EXISTING METHOD

Earlier communication between two machines or two units can be possible using Wired (LAN) based Network or GSM based communication. Using this type of communication between hardware device increase data loss due to wire breakage or delay between data transfer due to increase in wire resistance. These types of system required lot of physical maintenance. Mobility between wired based communications is not possible, and if we have to shift machine from one place to other, than we have reroute all communication cables. The coal mines have numerous risky stipulations that include high temperature and humidity, discharge of destructive gases that make unsafe surroundings for specialists working there. Many employees are taking off their occupations in coal mines or no longer at all inclined to pick such employments as mining.

This creates a lot of challenges in the accessibility of employees for the coal mining industry. The security of laborers working in coal mine industries is increasing day by day through technologies. The progressive of innovation that enables the mine monitoring methods to become more sophisticated, however, explosions in underground coal mine still happen. The accidents of calamities in coal mines are mainly due to the harsh environments and unsafe working conditions. This makes the need of employing mine checking systems at a high level for coal mines. It is quite hard to analyze all the environmental conditions constantly in a coal mine manually. This job can be effortlessly achieved with the help of economically viable wireless communication devices employed at the required position in coal mines.

Equipment that uses M2M capabilities to ensure M2M Devices inter-working and interconnection to the communication network. Gateways and routers are the endpoints of the operator's network in scenarios where sensors and M2M devices do not connect directly to the network. Thus, the task of gateways and routers are twofold. Firstly, they have to ensure that the devices of the capillary network may be reached from outside and vice versa. These functions are addressed by the access enablers, such as identification, addressing, accounting etc., from the operator's platform and have to be supported at the gateway's side as well. Thus, platform and gateway form a distributed system, where generic and abstract capabilities are implemented on the gateway's side. Consequently, there will be a control flow between gateway and operator's platform that has to be distinguished from the data channel that is to transfer M2M application data. Secondly, there may be the need to map bulky internet protocols to their lightweight counterpart in low-power sensor networks. However, the latter

application might lose its relevance since there are implementations of IPv6 for sensor networks available, that allow an all-IP approach.

In existing system zigbee network has implemented for transferring the measured parameters. This system measures the parameters like temperature sensor and moisture sensor. The measured sensor details are transferred based on zigbee network. Thereceived details are displayed on LCD. In many realistic cases.

The system consists of gas sensor, vibration sensor, temperature sensor, humidity sensor. The gas sensor is used to monitor whether there is leakage of gas or not. The temperature sensor is used to monitor whether the temperature is high or not. The humidity sensor is used to monitor the humidity at the particular region.

BLOCK DIAGRAM

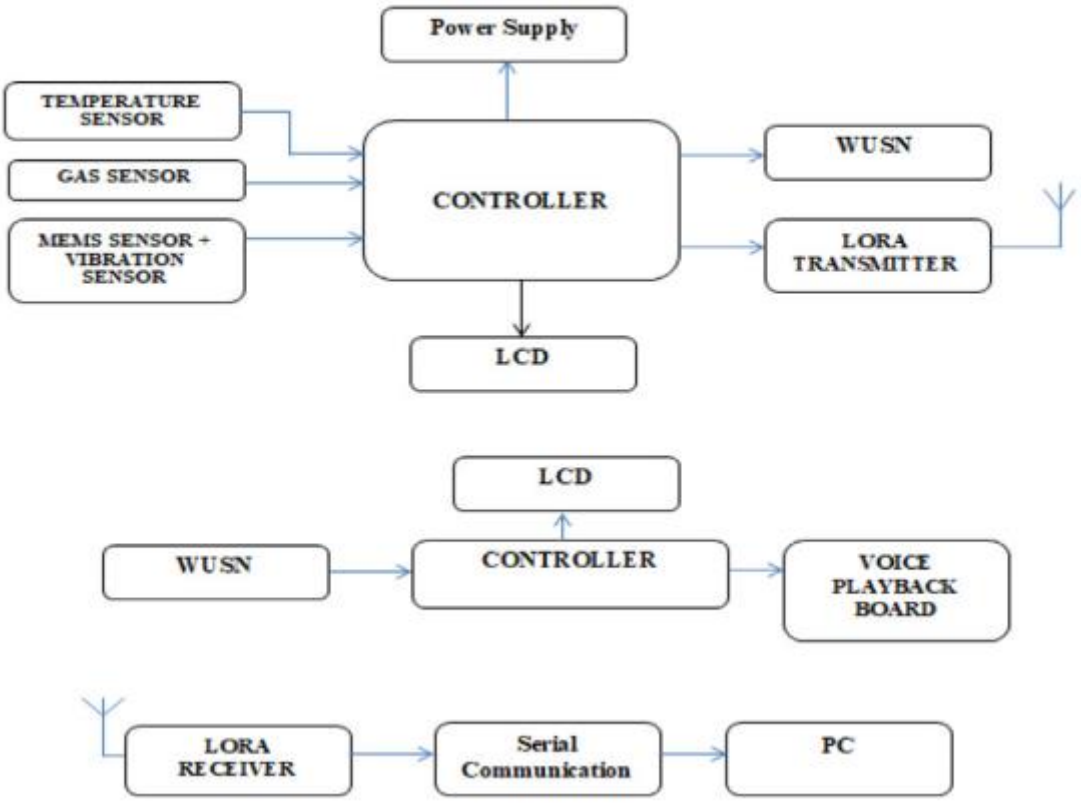

Fig No.3.1 Block Diagram of coal Mine Safety Using LORA

3.2 HARDWARE COMPONENTS

3.2.1 ARDUINO BOARD

Arduino Nano is a small, compatible, flexible and breadboard friendly Microcontroller board, developed by Arduino.cc in Italy, based on ATmega328p
(Arduino Nano V3.x) / Atmega168 (Arduino Nano V3.x).

It comes with exactly the same functionality as in Arduino UNO but quite in small size.

It comes with an operating voltage of 5V, however, the input voltage can vary from 7 to 12V.

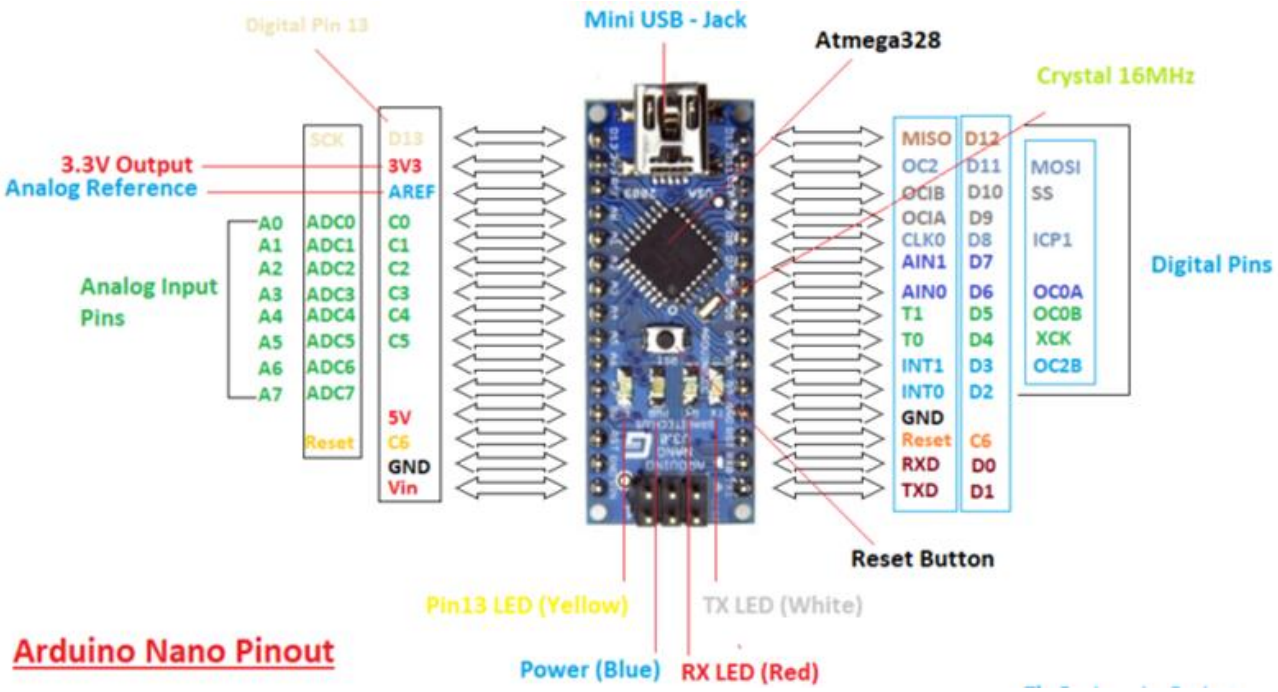

Fig No. 3.2 Arduino Nano Board

Arduino Nano Pinout contains 14 digital pins, 8 analog Pins, 2 Reset Pins & 6 Power Pins. Each of these Digital & Analog Pins are assigned with multiple functions but their main function is to be configured as input or output.

They are acted as input pins when they are interfaced with sensors, but if you are driving some load then use them as output.

Functions like pinMode() and digitalWrite() are used to control the operations of digital pins while analogRead() is used to control analog pins.

The analog pins come with a total resolution of 10bits which measure the value from zero to 5V.

Arduino Nano comes with a crystal oscillator of frequency 16 MHz. It is used to produce a clock of precise frequency using constant voltage.

There is one limitation using Arduino Nano i.e. it doesn't come with DC power jack,

means you can not supply external power source through a battery.

This board doesn't use standard USB for connection with a computer, instead, it comes with Mini USB support.

Tiny size and breadboard friendly nature make this device an ideal choice for most of the applications where a size of the electronic components are of great concern.

Flash memory is 16KB or 32KB that all depends on the Atmega board i.e Atmega168 comes with 16KB of flash memory while Atmega328 comes with a flash memory of 32KB. Flash memory is used for storing code. The 2KB of memory out of total flash memory is used for a bootloader.

SRAM can vary from 1KB or 2KB and EEPROM is 512 bytes or 1KB for Atmega168 and Atmega328 respectively.

This board is quite similar to other Arduino boards available in the market, but the small size makes this board stand out from others.

It is programmed using Arduino IDE which is an Integrated Development Environment that runs both offline and online.

No prior arrangements are required to run the board. All you need is board, mini USB cable and Arduino IDE software installed on the computer. USB cable is used to transfer the program from computer to the board.

3.2.2 MQ2 SENSOR

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a **Smoke gas sensor** that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current.

The **gas sensor module** consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. This current is known as heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it.

The connecting leads of the sensor are thick so that sensor can be connected firmly to the circuit and sufficient amount of heat gets conducted to the inside part. They are casted from copper and have tin plating over them. Four of the six leads (A, B, C, D) are for signal fetching

while two (1,2) are used to provide sufficient heat to the sensing element.

The pins are placed on a Bakelite base which is a good insulator and provides firm gripping to the connecting leads of the sensor.

This image shows the hollow sensing element which is made up from Aluminum Oxide based ceramic and has a coating of tin oxide. Using a ceramic substrate increases the heating efficiency and tin oxide, being sensitive towards adsorbing desired gas' components (in this case methane and its products) suffices as sensing coating.

Fig No.3.3 MQ2 Sensor

The leads responsible for heating the sensing element are connected through Nickel-Chromium, well known conductive alloy. Leads responsible for output signals are connected using platinum wires which convey small changes in the current that passes through the sensing element. The platinum wires are connected to the body of the sensing element while Nickel-Chromium wires pass through its hollow structure.

Features

- Continuous Analog output
- 3-pin interlock connector
- Low cost and compact size

Standard Working Condition

Symbol	Parameter Name	Technical Condition	Remarks
V_C	Circuit voltage	5V±0.1	AC or DC
V_H	Heating voltage	5V±0.1	AC or DC
R_L	Load resistance	adjustable	
R_H	Heater resistance	33Kohm±5%	Room temperature
P_H	Heating consumption	Less than 800mW	

Table No.3.4 MQ2 Sensor working conditions

3.2.3 MQ6 SENSOR

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a **LPG gas sensor** that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element. This adsorption creates a potential difference on the element which is conveyed to the processor unit through output pins in form of current.

Fig No.3.5 MQ6 Sensor

The **gas sensor module** consists of a steel exoskeleton under which a sensing element is housed. This sensing element is subjected to current through connecting leads. This current is known as heating current through it, the gases coming close to the sensing element get ionized and are absorbed by the sensing element. This changes the resistance of the sensing element which alters the value of the current going out of it.

The connecting leads of the sensor are thick so that sensor can be connected firmly to the circuit and sufficient amount of heat gets conducted to the inside part. They are casted from copper and have tin plating over them. Four of the six leads (A, B, C, D) are for signal fetching while two (1,2) are used to provide sufficient heat to the sensing element.

The pins are placed on a Bakelite base which is a good insulator and provides firm gripping to the connecting leads of the sensor.

This image shows the hollow sensing element which is made up from Aluminum Oxide based ceramic and has a coating of tin oxide. Using a ceramic substrate increases the heating efficiency and tin oxide, being sensitive towards adsorbing desired gas' components (in this case methane and its products) suffices as sensing coating.

The leads responsible for heating the sensing element are connected through Nickel-Chromium, well known conductive alloy. Leads responsible for output signals are connected using platinum wires which convey small changes in the current that passes through the sensing element. The platinum wires are connected to the body of the sensing element while Nickel-Chromium wires pass through its hollow structure.

This is a simple-to-use liquefied petroleum gas (LPG) sensor, suitable for sensing LPG

(composed of mostly propane and butane) concentrations in the air. The MQ-6 can detect gas concentrations anywhere from 200 to 10000ppm.

This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance. The drive circuit is very simple; all you need to do is power the heater coil with 5V, add a load resistance, and connect the output to an ADC.

3.2.4 LM-35 TEMPERATURE SENSOR

LM35 is a precision IC **temperature sensor** with its output proportional to the temperature (in ^{o}C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With **LM35**, temperature can be measured more accurately than with a Thermistor. It also possess low self heating and does not cause more than 0.1 ^{o}C temperature rise in still air.

The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every ^{o}C rise/fall in ambient temperature, *i.e.*, its scale factor is 0.01V/ ^{o}C.

Pin Description:

Pin No	Function	Name
1	Supply voltage; 5V (+35V to -2V)	Vcc
2	Output voltage (+6V to -1V)	Output
3	Ground (0V)	Ground

Table No. 3.6 Pin Descriptions

Here is a commonly used circuit. For connections refer to the picture above.

In this circuit, parameter values commonly used are:

V_c = 4 to 30v

5v or 12 v are typical values used.

$R_a = V_c / 10^{-6}$

Actually, it can range from 80 K**W** to 600 K**W** , but most just use 80 K**W**.

CHAPTER 4

PROPOSED SYSTEM

In this proposed system, we have designed to demonstrate a Machine to Machine Communication using IoT Technology. This System is designed using two Microcontroller Board, Wi-Fi Module, Sensor – LPG / Propane Sensor, Temperature Sensor, Smoke Sensor , Relay circuit and Output Loads.

This System is divided into two Sections, i.e. **Machine A** and **Machine B**. Machine A includes the **Sensor Unit** and Machine B includes the **Control Unit**. Sensor unit is designed using Arduino Nano Microcontroller, Node MCU, LCD Module Smoke Sensor, LPG Sensor and Temperature as main components. Sensor Unit update the Gas and Temperature Data over IoT server using Wi-Fi module. Control unit is designed using Node MCU, LCD Module, Relay Module, Buzzer Module, Motor Driver and DC Motor as main components. Control Unit Retrieves this data from IoT Server and Control the Load (Such as DC Motor, Buzzer and Fan) according to the Predefined values in the Microcontroller. Both units Communicates between each other using Internet Technology. If the Sensor Parameter crosses the Threshold level than high alert buzzer sound will be produced. If Temperature Sensor Parameter Increased than Fan will be switched on and if LPG or Smoke Sensor Parameter increases than DC Gear Motor (as Gate) will be opened. This Machine to machine Interface system can be operated from anywhere in the World wirelessly. LCD Module are interfaced to Digital Pin of Arduino 2,3,4,5,6,7. Control devices such as DC Motor and Buzzer are connected to 8,9 Pins. Sensor modules are connected to Analog Pins of Arduino and Wifi Module are connected to 10,11 Pins of Arduino.

The power supply setup of the system contains a step down transformer of 230/12V, used to step down the voltage to 12VAC. To convert it to DC, a bridge rectifier is used. 7805 voltage regulator is used regulate 12V Dc to +5V that will be needed for microcontroller and other components operation. Filter Capacitor are used to remove ripple from DC Voltages.

4.1 BLOCK DIAGRAM

SENSOR UNIT

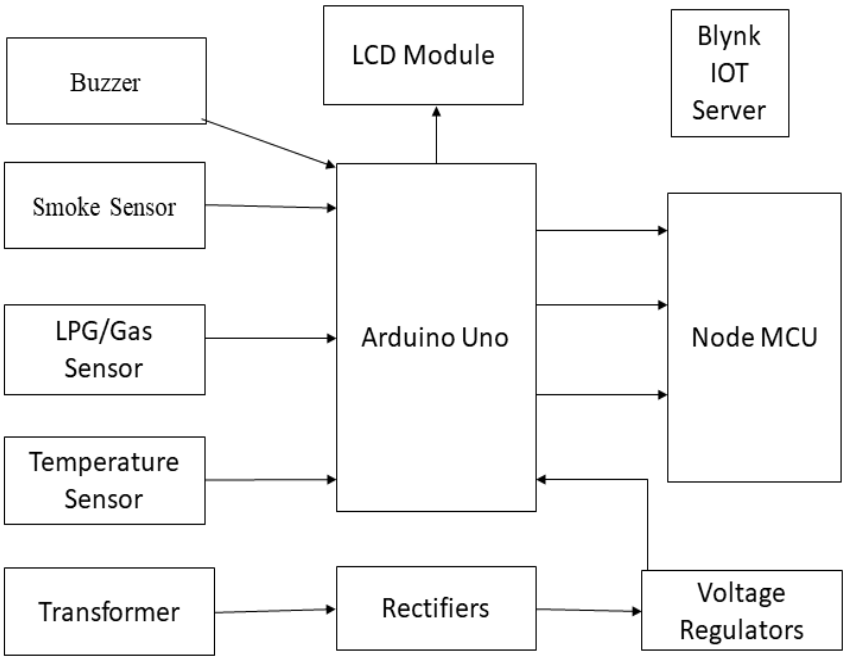

Fig No.4.1 Sensor Unit

CONTROL UNIT

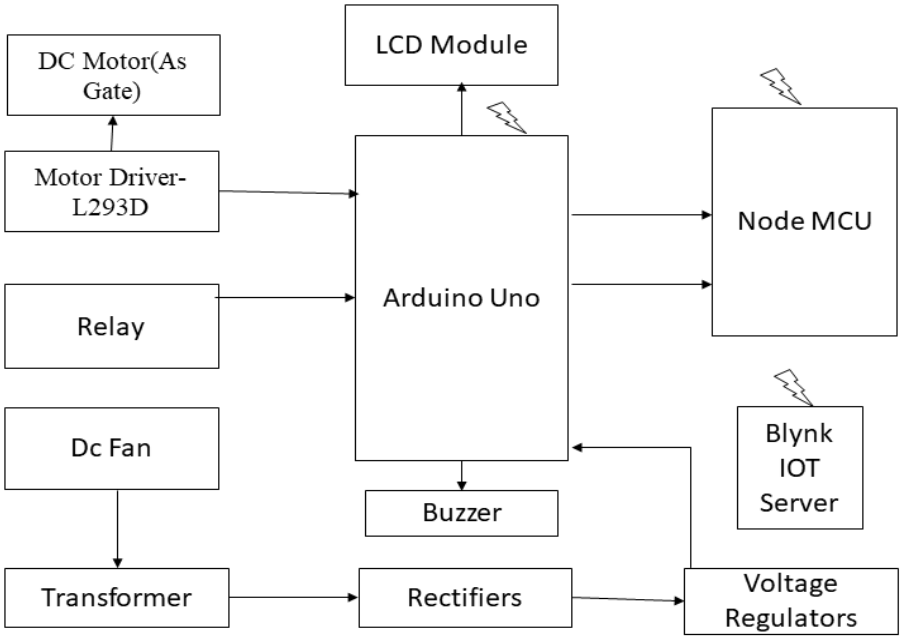

Fig No.4.2 Control Unit

4.2 DC MOTOR

A DC motor is an electric motor that runs on direct current power. In any electric motor, operation is dependent upon simple electromagnetism. A current carrying conductor generates a magnetic field, when this is then placed in an external magnetic field, it will encounter a force proportional to the current in the conductor and to the strength of the external magnetic field. It is a device which converts electrical energy to mechanical energy. It works on the fact that a current carrying conductor placed in a magnetic field experiences a force which causes it to rotate with respect to its original position.

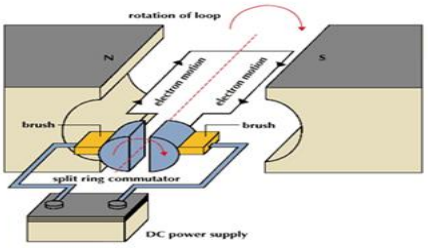

Fig No.4.3 Dc Motor

Practical DC Motor consists of field windings to provide the magnetic flux and armature which acts as the conductor.

4.3 Brushless DC Motors Work

The input of a DC motor is current/voltage and its output is torque. Understanding the operation of DC motor is very simple from a basic diagram is shown in below. DC motor basically consist two main parts. The rotating part is called the rotor and the stationary part is also called the stator. The rotor rotates with respect to the stator.

The rotor consists of windings, the windings being electrically associated with the commutator. The geometry of the brushes, commutator contacts and rotor windings are such that when power is applied, the polarities of the energized winding and the stator magnets are misaligned and the rotor will turn until it is very nearly straightened with the stator's field magnets.

As the rotor reaches alignment, the brushes move to the next commutator contacts and energize the next winding. The rotation reverses the direction of current through the rotor winding, prompting a flip of the rotor's magnetic field, driving it to keep rotating.

4.4 L293D Motor Driver IC

L293D is a typical Motor driver or Motor Driver integrated circuit which is used to drive direct current on either direction. It is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge Motor Driver integrated circuit (IC). The L293D can drive small and quite big motors as well.

H bridge is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards.

Most DC-to-AC converters (power inverters), most AC/AC converters, the DC-to-DC push–pull converter, most motor controllers, and many other kinds of power electronics use H bridges. In particular, a bipolar stepper motor is almost invariably driven by a motor controller containing two H bridges.

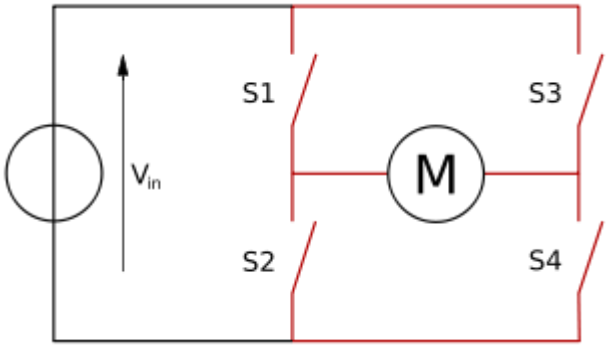

Fig No.4.4 H-Bridge

4.4.1 L293D Logic Table

Lets consider a Motor connected on left side output pins (pin 3,6). For rotating the motor in clockwise direction the input pins has to be given with Logic 1 and Logic 0.

- Pin 2 = Logic 1 and Pin 7 = Logic 0 | Clockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 1 | Anticlockwise Direction
- Pin 2 = Logic 0 and Pin 7 = Logic 0 | Idle [No rotation] [Hi-Impedance state]
- Pin 2 = Logic 1 and Pin 7 = Logic 1 | Idle [No rotation]

In a very similar way the motor can also operated across input pin 15,10 for motor on the right hand side.

4.5 TRANSFORMER

A **transformer** is an electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. Electromagnetic induction produces an electromotive force across a conductor which is exposed to time varying magnetic fields. Commonly, transformers are used to increase or decrease the voltages of alternating current in electric power applications.

A varying current in the transformer's primary winding creates a varying magnetic flux in the transformer core and a varying magnetic field impinging on the transformer's secondary winding. This varying magnetic field at the secondary winding induces a varying electromotive force (EMF) or voltage in the secondary winding due to electromagnetic induction.

A Transformer takes in electricity at a higher voltage and lets it run through lots of coils wound around an iron core. “. A single-phase Transformer can operate to either increase or decrease the voltage applied to the primary winding. Because the current is alternating, the magnetism in the core is also alternating. Also around the core is an output wire with fewer coils. The magnetism changing back and forth makes a current in the wire. Having fewer coils means less voltage. When it is used to “decrease” the voltage on the secondary winding with

respect to the primary it is called a **Step-down Transformer**. When a Transformer is used to "increase" the voltage on its secondary winding with respect to the primary, it is called a **Step-up Transformer**.

Fig No.4.5 Transformer

However, a third condition exists in which a transformer produces the same voltage on its secondary as is applied to its primary winding. In other words, its output is identical with respect to input. This type of Transformer is called an **"Impedance Transformer"** and is mainly used for impedance matching or the isolation of adjoining electrical circuits.

4.6 VOLTAGE REGULATORS

A **voltage regulator** is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

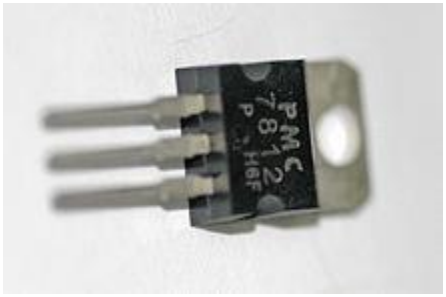

Fig No.4.6 Voltage Regulator

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile

alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

4.7 BUZZER

A **buzzer** or **beeper** is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

Fig No.4.7 Buzzer

Type of buzzers

4.7.1 Electromechanical

Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

4.7.2 Mechanical

A joy buzzer is an example of a purely mechanical buzzer. They require drivers.

4.7.3 Piezoelectric

Fig No.4.8 Piezoelectric disk beeper

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.

4.8 RELAY

A **relay** is an electrically operated switch. Many relays use an electromagnet to mechanically

Operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

Fig No.4.9 Relay

4.8.1 Basic design and Operation

A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts (there are two in the relay pictured). The armature is hinged to

the yoke and mechanically linked to one or more sets of moving contacts. It is held in place by a spring so that when the relay is de-energized there is an air gap in the magnetic circuit. In this condition, one of the two sets of contacts in the relay pictured is closed, and the other set is open. Other relays may have more or fewer sets of contacts depending on their function. The relay in the picture also has a wire connecting the armature to the yoke. This ensures continuity of the circuit between the moving contacts on the armature, and the circuit track on the printed circuit board (PCB) via the yoke, which is soldered to the PCB

CHAPTER 5

SOFTWARE TOOLS

5.1 Blynk Server and IoT Platform

Blynk is a Platform with iOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet.

It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets.

It's really simple to set everything up and you'll start tinkering in less than 5 mins.

Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your Arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the **Internet Of Your Things**.

Create a Blynk Project

Click the “Create New Project” in the app to create a new Blynk app. Give it any name.

Blynk works with hundreds of hardware models and connection types. Select the Hardware type. After this, select connection type. In this project we have select WiFi connectivity.

The ***Auth Token*** is very important – you’ll need to stick it into your ESP8266’s firmware. For now, copy it down or use the “E-mail” button to send it to yourself.

Widgets To The Project

Then you’ll be presented with a blank new project. To open the widget box, click in the project window to open.

We are selecting a button to control Led connected with NodeMCU.

1. Click on Button.
2. Give name to Button say led.

3. Under OUTPUT tab- Click pin ansd select the pin to which led is connected to NodeMCU, here it is digital pin 2, hence select digital and under pin D2. And Click continue.

Under MODE tab- Select whether you want this button as "push button" or "Switch".

You have successfully created a GUI for Arduino.

Upload The Firmware

Now that your Blynk project is set-up, open Arduino and navigate to the ESP8266_Standalone example in the File > Examples > Blynk > Boards_WiFi> ESP8266_Standalone menu.

Stand Alone Programming Code:

Before uploading, make sure to paste your authorization token into the auth [] variable. Also make sure to load your Wifi network settings into the Blynk.begin(auth, "ssid", "pass") function.

After the app has uploaded, open the serial monitor, setting the baud rate to 9600. Wait for the “Ready” message.

Then click the “Run” button in the top right corner of the Blynk app. Press the button and watch the LED

Then add more widgets to the project. They should immediately work on the ESP8266 without uploading any new firmware.

5.2 ARDUINO IDE

The **Arduino integrated development environment (IDE)** is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.[2]

The source code for the IDE is released under the GNU General Public License, version 2.[3] The Arduino IDE supports the languages C and C++ using special rules of code structuring.[4] The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution.[5] The Arduino IDE employs the program *argued* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

Audience

This tutorial is intended for enthusiastic students or hobbyists. With Arduino, one can get to know the basics of micro-controllers and sensors very quickly and can start building prototype with very little investment.

This tutorial is intended to make you comfortable in getting started with Arduino and its various functions.

Prerequisites

Before you start proceeding with this tutorial, we assume that you are already familiar with the basics of C and C++. If you are not well aware of these concepts, then we will suggest you go through our short tutorials on C and C++. A basic understanding of microcontrollers and electronics is also expected.

ADVANTAGES

There are several advantages of using IoT (Internet of Things) technology for coal mine safety:

Real-time monitoring: IoT sensors can be placed throughout the mine to detect various environmental factors such as temperature, humidity, gas levels, and air quality. This data can be collected and analyzed in real-time to identify potential safety hazards and take preventive measures.

Remote monitoring: IoT technology allows mine operators to remotely monitor and control various aspects of the mine, such as ventilation, equipment operation, and worker location. This can help to reduce the risk of accidents and improve overall safety.

Improved communication: IoT devices can be used to establish communication between workers and management, allowing for faster response times in case of emergencies or safety incidents.

Predictive maintenance: IoT sensors can be used to monitor the condition of mining equipment and detect potential faults before they lead to breakdowns or accidents. This can help to reduce downtime and improve safety.

Data-driven decision making: IoT technology provides a wealth of data that can be analyzed to identify safety trends and improve safety protocols. This can help mine operators to make more informed decisions about safety procedures and investments in safety equipment and training.

Overall, using IoT technology for coal mine safety can help to reduce the risk of accidents and improve the safety of workers and equipment.

DISADVANTAGES:

While IoT (Internet of Things) technology offers numerous benefits for coal mine safety, there are also some potential disadvantages to consider:

Cost: Implementing IoT technology can be expensive, especially for small or medium-sized mines. The cost of purchasing and installing sensors, data storage, and analysis tools can add up quickly.

Cybersecurity risks: IoT devices are vulnerable to cyberattacks, which can compromise the safety of both workers and equipment. It is important to ensure that proper cybersecurity measures are in place to protect sensitive data and prevent malicious attacks.

Maintenance and upkeep: IoT sensors and devices require regular maintenance and upkeep to function properly. This can be challenging in a mining environment, where dust, moisture, and other environmental factors can cause wear and tear on equipment.

Training and adoption: Implementing new technology requires training and adoption from

workers, who may be resistant to change or unfamiliar with the technology. This can lead to resistance or delays in implementation.

Data overload: IoT sensors can generate a large volume of data, which can be overwhelming for mine operators to analyze and interpret. It is important to have proper data management and analysis tools in place to make the most of the data generated by IoT devices.

Overall, while there are some potential disadvantages to using IoT technology for coal mine safety, the benefits of improved safety and risk reduction outweigh the challenges. With proper planning, implementation, and maintenance, IoT can be an effective tool for improving safety in coal mines.

APPLICATIONS:

There are several applications of IoT (Internet of Things) technology for coal mine safety:

Environmental monitoring: IoT sensors can be used to monitor various environmental factors such as temperature, humidity, gas levels, and air quality. This data can be collected and analyzed in real-time to identify potential safety hazards and take preventive measures.

Equipment monitoring: IoT sensors can be used to monitor the condition of mining equipment and detect potential faults before they lead to breakdowns or accidents. This can help to reduce downtime and improve safety.

Worker safety monitoring: IoT devices can be used to monitor the location and condition of workers in the mine. This can help to identify potential safety hazards and ensure that workers are safe and accounted for in case of emergencies.

Predictive maintenance: IoT sensors can be used to predict when mining equipment requires maintenance or repairs. This can help to reduce downtime and improve safety.

Communication and collaboration: IoT devices can be used to establish communication between workers and management, allowing for faster response times in case of emergencies or safety incidents.

Remote control: IoT technology allows mine operators to remotely monitor and control various aspects of the mine, such as ventilation, equipment operation, and worker location. This can help to reduce the risk of accidents and improve overall safety.

Training and education: IoT technology can be used to develop training programs and educational materials to improve safety awareness and best practices among workers.

Overall, the applications of IoT technology for coal mine safety are diverse and can help to improve the safety of workers and equipment in the mine.

CONCLUSION

Implementation of safety measures in port operations primarily targets the protection of operating machinery where sensors and switches are employed to deliver safety for workers. For high movement and risk of port laborers, the observation and management of the workers in the port are not executable with the present technologies

M2M as an application holds the promise of bringing benefit to both telecom operators and vendors. For service providers it is an opportunity as low-bandwidthM2M services can be readily overlaid onto the current user services network. Vendors are expected to profit from selling both M2M-capable devices, and from the network expansion brought about by increased throughput. However, it comes with change in business model and value chain. There are questions regarding the role of operators in the value chain. Also, M2M services may have their own specific characteristics which might be different from services in which humans directly influence communication flow. The standardization in the direction of special handling or optimization of the network for M2M specific service will lead for better support of M2M communications.

Further this system can be extended by adding GSM based SMS service to sensor unit. Using it the user can get alert message if any sensor unit crosses the threshold range

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APPENDIX

```
#include<LiquidCrystal.h>

LiquidCrystal lcd(6, 7, 2, 3, 4, 5);  // sets the interfacing pins


int smoke=0, lpg=0, temp=0;


void setup()

{

 Serial.begin(9600); // SERIAL MONITOR SETUP

 Serial.println("Wireless Machine to Machine Communication using IOT and 3 Sensor - SENSOR UNIT");


 pinMode(9,OUTPUT); // SMOKE

 pinMode(10,OUTPUT); // LPG

 pinMode(11,OUTPUT);// TEMP


 pinMode(13, OUTPUT); // BUZZER

 digitalWrite(13, LOW);


 digitalWrite(9,LOW);

 digitalWrite(10,LOW);
```

```
digitalWrite(11,LOW);


lcd.begin(16, 2);  // initializes the 16x2 LCD
lcd.clear();
lcd.setCursor(0,0);
lcd.print("WIRELESS MACHINE");
lcd.setCursor(0,1);
lcd.print("2 MACHINE  COMM.");
delay(1000);


lcd.clear();
lcd.setCursor(0,0);
lcd.print("USING SMOKE, LPG");
lcd.setCursor(0,1);
lcd.print("AND TEMP SENSORS");
delay(1000);


lcd.clear();
lcd.setCursor(0,0);
lcd.print("* INITIALIZING *");
lcd.setCursor(0,1);
```

```
 lcd.print(" ** SENSORS ** ");
 delay(10000);
 delay(6000);
}

void loop()
{
checksensors();
}

void checksensors()
{
getsmoke(); // GET SMOKE SENSOR VALUE
getlpg();   // GET LPG SENSOR VALUE
gettemp();  // GET TEMP SENSOR VALUE

// PRINT SENSOR VALUE ON LCD

 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("S: ");
```

```
lcd.setCursor(9,0);

lcd.print("L: ");

lcd.setCursor(0,1);

lcd.print("T: ");


lcd.setCursor(3,0);

lcd.print(smoke);

lcd.setCursor(12,0);

lcd.print(lpg);

lcd.setCursor(3,1);

lcd.print(temp);


// CHECK SENSORS CONDITION


if(temp>40)

{

digitalWrite(11,HIGH);

digitalWrite(13, HIGH); // BUZZER ON

Serial.println("Temperature High");

lcd.clear();

lcd.setCursor(0,0);
```

```
lcd.print("HIGH TEMPERATURE");
delay(1000);
}
else
{
digitalWrite(11,LOW);
digitalWrite(13, LOW); // BUZZER OFF
}

if(lpg>700)
{
digitalWrite(10,HIGH);
digitalWrite(13, HIGH); // BUZZER ON
delay(50);
Serial.println("LPG Leakage");
lcd.clear();
lcd.setCursor(0,0);
lcd.print("LPG LEAKAGE");
delay(1000);
}
else
```

```
{
digitalWrite(10,LOW);
 digitalWrite(13, LOW); // BUZZER OFF
}

if(smoke>600)  // ADJUST HERE FOR SMOKE SENSOR
{
digitalWrite(9,HIGH);
digitalWrite(13, HIGH); // BUZZER ON
Serial.println("HIGH SMOKE ");
delay(50);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("HIGH SMOKE");
delay(1000);
}
else
{
digitalWrite(9,LOW);
digitalWrite(13, LOW); // BUZZER OFF
}
```

```
delay(1000);



}
void getsmoke()
{
smoke=analogRead(A2);
Serial.print("Smoke");
Serial.println(smoke);


}

void getlpg()
{
lpg=analogRead(A1);
Serial.print("lPG");
Serial.println(lpg);
}

void gettemp()
{
```

```
temp=analogRead(A0);

temp=temp/2;

temp=temp-5;

Serial.print("Temperature");

Serial.println(temp);

}
```