IOT BASED COAL MINE HAZARDS MONITORING AND PREDICTION SYSTEM

J COMPONENT PROJECT REPORT
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Table of content:

S.N.	Contents	Page no.
I	Introduction	03
II	Literature review/ related work	04
III	Problem definition	25
IV	Implementation	26
V	Flow diagram	27
VI	Circuit components in proteus simulator	28
VII	Final circuit	30
VIII	Working system	31
IX	Test case	31
X	Test case result analysis	32
XI	Basic algorithm	32
XII	Code	33
XIII	Code in Arduino compiler	37
XIV	Results and conclusion	39
XV	Future work	40
XVI	Datasets	42
XVII	References	44

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Abstract:

Coal is one of the cheapest source of energy being utilized since centuries and its mining is one of the most dangerous job in the world with high fatality rate. Even in modern era, the mining techniques and security protocols are primitive. IoT has great scope for development and innovation in the field of mining. The reason for high fatalities are unexpected accidents and poor security systems. We aim to develop an Iot based hazard detection and prediction system that can warn the workers of any possible accidents or unsafe conditions so that they can go to the safe place before any mishaps happen and minimize the damage. This paper proposes a model that will work to monitor the hazardous gas levels, oxygen levels, temperature and climate condition and work extensively to get the fatality rate of coal mine workers low.

Keywords: Fatality rate, accidents, Hazard detection, prediction, safety, sensors

I. INTRODUCTION

As overall daily use of coal and gases is increasing day by day, these customary resources need development for maltreatment of oil and gas resources. At present time IoT (internet of things) is developing many programs in different fields, to protect people from the harm of gases and highly intense temperatures we need to build a coal mining safety product for helping the human community. The oil business is a little bit at a time moving towards knowledge.

Different sensors presented at the well site can assemble data set up an IoT circumstance. Internet of Things is nothing but the devices(things) communicating with each other by using the internet. IoT applications vary on a large scale. Sensors and actuators for gathering the data and sending it

across the internet are also included in this advancement. If any kind of explosion occurs, the wired network will get damaged and it is very difficult to replace it.

Standard coal mine noticing structures are consistently wired association systems that expect a critical part in choosing coal mine prosperity. In the event that any sort of blast happens, the wired organization will get harmed and it is undeniably challenging to supplant it. It will require some investment utilization to fix those networks.

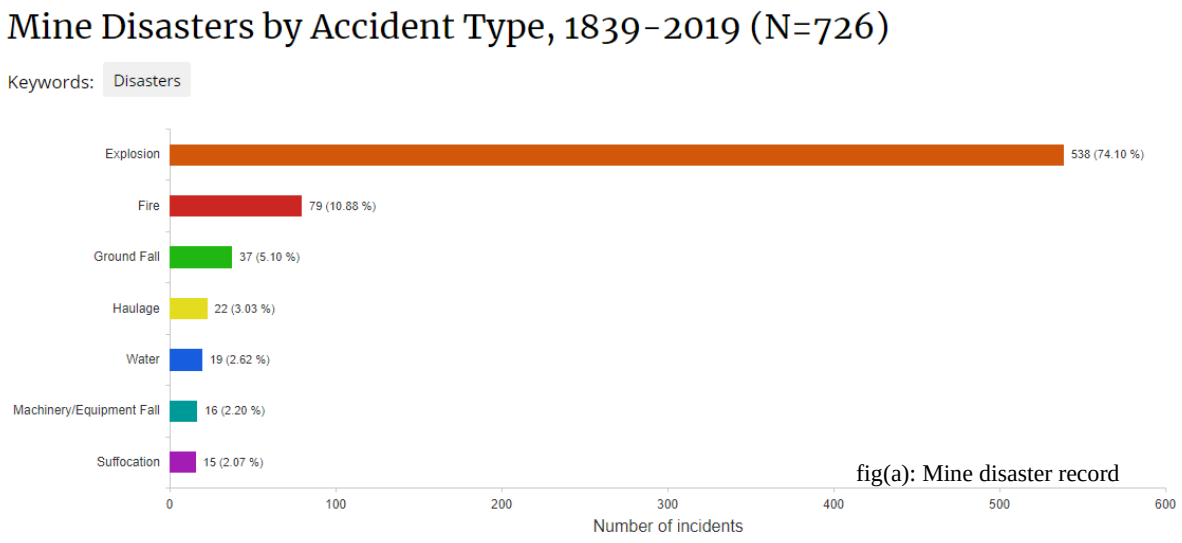
To beat this, the coal mineshaft security estimation framework utilizing Internet of Things was planned and executed. The gadget involves making a Wireless Sensor Network (WSN) utilizing an Arduino UNO regulator to follow the underground mine's condition. This further develops creation wellbeing control and diminishes coal mineshaft mishaps.

Remote sensor networks are comprised of an enormous number of miniature sensor hubs that have a little volume and minimal expense and can be conveyed anyplace, while laying link for underground checking is a perplexing, tedious, and exorbitant operation.

To overcome this, the coal mine safety measurement system using the Internet of Things was designed and implemented. The model is made up of a gas sensor, a temperature sensor, and a humidity sensor (AM2302), Heart beat sensor, Vibration sensor, Blood rate sensor, MEMS sensor, A power supply unit, LED dis The model is made up of a gas sensor, a temperature sensor, and a humidity sensor (AM2302), Heart beat sensor, Vibration sensor, Blood rate sensor, MEMS sensor, A power supply unit, LED display and a buzzer.

The main objective of the work is designing internet of things based harmful gas and temperature detecting and alerting system. The hazardous gases like LPG and propane were sensed and displayed each and every second in the LCD display. If these gases exceed the normal level, then an alarm is generated immediately and also an alert message (SMS) is sent to the authorized person.

The advantage of this automated detection and alerting system over the manual method is that it offers quick response time and accurate detection of an emergency and in turn leading faster diffusion of the critical situation.



fig(a): Mine disaster record

II. Literature Review/ Related Work

U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 2010-151, Report of Investigations 9679, 2010 May: 1-49

Taking into account expansive in-mine coal dust atom size review and gigantic degree impact tests, the National Institute for Occupational Safety and Health (NIOSH) proposes one more standard of 80% complete incombustible substance (TIC) be required in the affirmation avionics courses of bituminous coal mining tunnels without a hint of methane. MSHA assessors consistently screen rock dust inerting attempts by get-together residue tests and assessing the degree of TIC, which recalls assessments of the clamminess for the models, the flotsam and jetsam in the coal, and the stone buildup. These rules relied upon two critical disclosures: an outline of coal dust particle size that was acted during the 1920s, and colossal degree impact tests coordinated in the U.S. Organization of Mines' Bruceton Experimental Mine (BEM) using dust particles of that outline's size reach to choose the proportion of inerting material expected to thwart impact causing. Mining development and practices have changed essentially since the 1920s, when the primary coal dust particle outline was performed. Similarly, it has been conclusively shown that as the size of coal dust particles decreases, the impact hazard increases.

Idea: Given these components, NIOSH and MSHA led a joint study to decide the scope of coal molecule sizes found in dust tests gathered from admission and return aviation routes of U.S. coal mineshafts. Results from this study show that the coal dust found in mines today is a lot better than in mines of the 1920s. This increment in fine residue is probably because of the expansion in automation.

Implementation: Considering this new exhaustive residue review, NIOSH directed extra huge scope blast tests at the Lake Lynn Experimental Mine (LLEM) to decide the level of rock cleaning important to decrease blasts. The tests utilized Pittsburgh crease coal dust mixed as 38% short 200 cross section and alluded to as medium-sized residue. This medium-sized mix was utilized to address the normal of the best coal molecule size gathered from the new residue review.

Outcome: Blast tests show that medium-sized coal dust required 76.4% TIC to forestall blast engendering. Indeed, even the coarse coal dust (20% less 200 lattice or 75 microm), agent of tests got from mines during the 1920s, required around 70% TIC to be delivered latent in the bigger LLEM, a level higher than the current guideline of 65% TIC.

Disadvantage: Given the aftereffects of the broad in-mine coal dust molecule size studies and huge scope blast tests, NIOSH suggests another norm of 80% TIC be needed in the admission aviation routes of bituminous coal mineshafts without methane. The overview results demonstrate that sometimes there are no considerable contrasts between the coal dust molecule size circulations consequently and admission air courses in the present coal mineshafts. The overview results show that the current prerequisite of 80% TIC consequently aviation routes is as yet fitting without foundation methane.[1]

Nikoloz Chikhradze et al 2017 IOP Conf. Ser.: Earth Environ.

Analysis has revealed the following major disadvantages of the existing blast suppression automatic systems:

1. Lack of reliability of the effectiveness of a blast identification device in complex underground openings, especially under long-term operation;

2. Low speed of the blast energy absorber activation;

3. Inadequate discharge of a blast absorbing agent required for reducing excess pressure and temperature to an acceptable value, as well as the inability to operate in limited underground facilities.

Idea: The selection of a protection structure and the design of its separate components was preceded by a series of experiments which included:

- testing of methods of blast identification and absorber activation in tunnels, as well as a comparative analysis of their reliability and speed;

- experimental study of the reduction of blast overpressure by different damping agents and the selection of an efficient damping agent;

- testing of models of key components of an absorber

Implementation: The sensors and the case in which the sign handling and transmitter modules are worked in are fixed on the passage roof or divider. The sensors are associated with the sign handling gadget through a course the most extreme length of which is 15m. The quantity of sensors (least 2 and greatest 6) and their areas are chosen by the setup of the passage to be ensured and a potential blast site, on one or the two sides of the concealment segment. A high velocity concealment area and long-haul activity segment pipes are fixed on the passage roof with the goal that they don't discourage the ordinary working of the passage. A sign beneficiary module, a control block and hydro office are put in an exceptional specialty in a passage divider. Testing was led in the passage of the underground test base of the Mining Institute. Burrow sizes: tallness – 2.2 m, width – 2.2 m, all out length – 150 m, upheld by supported cement. The concealment area at the order of the commencement signal produces custom fitted scattering water fog along chosen areas.

Outcome: A quick, long-acting structure for shoot balance in underground workplaces was made. It is expected for conditions portrayed by a risk of repeated impacts and coming about fire, for instance for the limitation of the results of methane/coal dust impacts in coalmines. The covering structure impelled at the request for the beginning sign produces specially designed dissipating water haze with drop sizes in the extent of 25-400 micron along picked portions of an entry. [2]

Tanay Mittal 20BKT0105

Boddapati Venkata Sai Phani Gopal, Pakirabad Akash, P.S.G.Aruna Sri. Design Of Iot Based Coal Mine Safety System Using Nodemcu. International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-6, April 2019

Idea and implementation: This system was designed to monitor coal mines with numerous parameters such as light detection, leakage of gas, temperature, humidity conditions and fire detection. Data is transmitted using Thinger IO platform to implement the system. To provide safety, the system gives the alerts that will be helpful to the workers in the mine to save their lives. The mine safety is designed using gas sensor modules , LDR sensor, temperature sensor, humidity sensor, fore sensor, buzzor and LED. All the sensors are integrated to the Node MCU.

The Node MCU is used as a gateway. It has inbuilt Wi-Fi module which used to send the sensor data to cloud for storage and analysis. The main reason behind selecting NodeMCU is that the sensors used in our project uses only digital pins and one analog pins are required. Also, it consumes less power (3.3v) and is of low cost when compared to other microcontrollers /processors like Arduino and Raspberry pi.

Outcome:

The system has following features:

- Voltage:3.3V.
- Wi-Fi Direct (P2P), soft-AP.
- Operating current Average: 80mA
- Flash memory attachable: 16MB max (512K normal).
- Integrated TCP/IP protocol stack.
- Processor: Tensilica L106 32-bit.
- Processor speed: 80~160MHz.
- RAM: 32K + 80K.
- GPIOs: 17 (multiplexed with other functions).
- +19.5dBm output power in 802.11b mode
- 802.11 support: b/g/n.

The system is cost-effective and efficient. [3]

Ayush Kanaujiya 20BCE748

Grivas, G., Chaloulakou, A., Kassomenos, P., 2008. An overview of the PM10 pollution problem, in the metropolitan area of Athens, Greece. Assessment of controlling factors and the potential impact of long-range transport. Sci. Total Environ. 389, 165–177

The study analyzed PM10 concentration data collected by the Greek air quality monitoring network at 8 sites over the Greater Athens Area, for the period of 2001–2004. The primary objectives were to assess the degree of compliance with the EU-legislated air quality standard for PM10 and also provide an overall statistical examination of the factors controlling the seasonal and spatial variation of concentrations, over the wider urban agglomeration. Daily concentrations, averaged over the whole study period, ranged between 32.3 and 60.9 μg m−3 . The four-year average concentration of PM10 at five sites exceeded the annual limit value of 40 μg m−3 , while most of the sites surpassed the allowed percentage of exceedances of the daily limit value (50 μg m−3), for each of the four years.

The seasonal variation of PM10 levels was not found to be uniform across the eight sites, with average cold-period concentrations being higher at four of them and warm period concentrations being significantly higher at three sites, which also displayed recurring annual variation of monthly concentrations. Concentration levels displayed moderate spatial heterogeneity. Nevertheless, significant inter-site correlations were observed (ranging between 0.55 and 085). The determination of the spatial correlation levels relied mainly on site types rather than on inter-site distances.

Monitoring sites were classified accordingly using cluster analysis in two groups presenting distinct spatiotemporal variation and affected by different particle formation processes. The group including urban sites was mainly affected by primary, combustion-related processes and especially vehicular traffic, as it was also deduced through the examination of the diurnal distribution of particulate levels and through factor analysis. On the contrary, suburban background sites seemed more affected by particle transport from more polluted neighboring areas and secondary particle formation through gaseous precursors, both processes aided from favouring meteorological conditions.

The association of the PM10 levels with backwards trajectories was also examined, in an attempt to account for the possible long-range transport of particles in Athens. It was found that a notable part of area-wide episodic events could be attributed to trans-boundary transport of particles, with the origins of some severe dust outbreaks traced back to the Sahara Desert and the Western Mediterranean. [4]

Pratik Panda 20BKT0104

Kumarsagar "Design of Monitoring system for Coal mine safety based on MSP430", International Journal of Engineering Science Invention (IJESI) Volume2, Issue 7, July 2013

Idea: Lately, it is for the most part used in the fields of our lives, consistent assessment, military, keen traffic, environmental noticing, savvy weapon, and so on Stood out from the traditional mine checking, we use far off sensor networks in coal mining tunnel security noticing. It appreciates three basic advantages:

It is pointless to lay connections, and can be presented in noticing outwardly weakened locales to diminish the costs of widening the structure. More number of centres can be coordinated to discard outwardly disabled districts. Far off sensor nodes can make general correspondence and appropriate the objective.

The node points are thick, which can ensure data acquiring high accuracy and capability of data transmission, and comprehend the steady seeing of coal mining tunnel working environment; Sensor node with a particular handling limit, storing limit, data mix are extraordinary for remote noticing.

Implementation: The proposed hub arrangement of remote sensor network comprises of Zigbee remote handset module, low power MSP430 as MCU of the framework and sensors of temperature, stickiness, downpour identification and soil dampness and engine valve control circuit for controlling the solenoid valves. SPI sequential correspondence port interfaces the Zigbee remote correspondence module and the microcontroller module. The MSP430 regulator is low power and practical and utilizes five low-power modes. The MSP430G2553 series are super low-power contradicting message microcontrollers with worked in 16-bit clocks, up to 24 I/O contact sense-empowered pins, an adaptable simple comparator, and underlying correspondence capacity utilizing the all-inclusive sequential correspondence interface. Furthermore, have a 10-bit simple to-advanced (A/D) converter. The program of slave sensor hub regulator is intended to gather the gas, temperature, smoke location and stickiness data, and speak with the expert hub like clockwork by the remote Zigbee handset module.

Outcome: Remote Zigbee module is arranged as collector or base station. It is associated with the host PC through sequential port. Information got by have PC is then put away in the information base and latest worth is displayed on the screen by the GUI (Graphical User Interface) created in Visual Basic 6. It can show the gas, temperature, smoke alarm and moistness data of each sensor hub. It additionally can set the edge of the coal mineshaft by the executive. This framework additionally shows sensor information on the LCD which is associated with slave sensor hubs.

Advantages: Remote sensor networks applied in observing coal mineshaft security gets through the conventional strategies and thoughts, which works on the useful capacity and adaptability of checking framework. This framework not exclusively can screen a wide range of boundaries under the coal mineshaft, yet in addition can alert consequently when climate boundaries are unusual to surpass the restriction, which assist with working fair and square of checking wellbeing creation and decrease mishap in the coal mineshaft.[5]

Tanay Mittal 20BKT0105

WEI Qiupinga , ZHU Shunbinga,b, DU Chunquana, Study on key technologies of Internet of Things perceiving mine.

At the moment, a lot of research on IOT application in mine safety production have been conducted. Willard South African Company began wearing RFID tags on miner's caps in 2003 to help with mine administration. Chen Rongguang and others who use RFID identification technology produced the first set of KJ69 mining personal positioning systems to address issues such as staff location monitoring and automatic attendance statistics. IoT application technology in deep mines may accomplish exact environment perception and early-warning for flooding, fires, gas explosions, dust explosions, cave, coal and gas outburst, hazardous gases, and other varied situations, hazard factors For underground coal miners, the system can also provide exact positioning and automatic identification, as well as early warning of severe hazards. Examine the risks associated with wireless radiation igniting mine gas. The antenna, operating frequency, multiplexing methods, modulation, and other impacts are studied as well as the limit power and energy of radio waves to detonate gas. [6]

Ayush Kanaujia 20BCE2748

LiHui "Design of Monitoring system for Coal mine safety based on Wireless sensor Networks" 2008 International Conference on Mechatronic and Embedded systems and Applications (ASME)

Idea: In this proposed framework the coal mineshaft wellbeing frameworks are fixed with gas sensor modules, temperature sensor, MEMS sensor and transfers. We incorporate every one of the sensors to the Node MCU. To begin with, we want to make a record in the ThingSpeak stage. In this framework we basically have observing and controlling frameworks. In checking framework, we screen every one of the information from various sensors. Gas sensor identifies the gas in the coal mineshaft climate. In case the gas level surpasses the ordinary level, then, at that point, the bell gets high so the diggers get advised. These sensor esteems are ceaselessly transferred to the cloud (Thinger.io) for examination and furthermore for additional utilization. The temperature and dampness esteems are likewise observed inside the coalmine. In the event that in the event that any fire mishaps happen, quickly fire ready messages are shipped off the approved people.

Implementation: Gas sensor for use to detect the presence of a dangerous LPG leak in your car or in a service station, storage tank environment. The sensor has excellent sensitivity combined with a quick response time. The sensor can also sense iso-butane, propane, LNG and cigarette smoke. The Grove - Flame Sensor can be used to detect fire source or other light sources of the wavelength in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor.

Nodemcu-Esp8266 act as brain of our system, the host controller is acquiring various sensor data like gas, fire and Temperature and it will be posting a data cloud for view remotely and also it will enable the actuator to controlling the emergency appliances.

Outcome: A Coal mine wellbeing observing framework is created to give more clear and more highlight point viewpoint of the underground mine. This framework is showing the boundaries on the chronic screen at the underground segment where sensor unit is introduced just as on the observing unit; it will be useful to all excavators present inside the mine to save their life before any loss happens. Caution triggers when sensor esteems pass the boundary level. Execution of Coal mine security framework is carried out utilizing Fire sensor, Gas sensor to build the wellbeing of the specialists in the coal mineshaft and to keep them from risk, by utilizing this framework steady checking of the coalmine and cautioning the labourer is finished. The framework is savvy and effective.[7]

Tanay Mittal 20BKT0105

Kanmani et al., 9(6): June, 2020

Idea and Implementation: In this proposed framework the coal mineshaft wellbeing frameworks are fixed with gas sensor modules, the light reliant resistor (LDR sensor), temperature/moistness sensor, fire sensor, heart beat sensor, signal and LED. We interface every one of the sensors to the Node MCU. The Node MCU which has inbuilt Wi-Fi module is utilized to send the detected information to cloud for capacity and investigation. It is reasonable for different IOT based applications and attachment and play mode and it has Arduino like programming and equipment instruments. Gas sensor identifies the gas in the coal mineshaft climate, in case the gas level surpasses the typical level then the bell gets high so the excavators gets informed. The temperature and dampness esteems are likewise be checked inside the coal mineshaft. LDR sensor is utilized to quantify the force of the light by fluctuating its opposition.

Conclusion: The Internet of Things which is the inescapable in data innovation associates us to this present reality of things. Hence, the security of laborers is made conceivable by various sensors like the fire sensor, gas sensor, LDR Sensor, heartbeat sensor, etc. Remote framework simplifies our work and furthermore its expense effective. Hub MCU the regulator which gathers and faculties every one of the information from sensors and passes to the cloud server. The cloud which performs more prominent activity when it gets the information it consequently changes the sensors and cautions the coal mineshaft laborers without the need of the client. This large number of things save the specialists from the risky circumstances and assists them with working without pressure. It additionally saves their significant time and shield their mine from any undesirable misfortunes. [8]

Tanay Mittal 20BKT0105

Zhang Yinghuaa , Fu Guanghuaa , Zhao Zhigangb , Huang Zhiana,*, Li Hongchenb ,Yang Jixingb , DISCUSSION ON APPLICATION OF IOT TECHNOLOGY IN COAL MINE SAFETY

This paper proposes an ***intelligent safety supervision of coal mine.*** It provokes supervising institutions at all levels adopt IOT technology to communicate with mining enterprises and establish effective tracking systems and database systems, achieving dynamic supervision and

early warning against illegal production through remote inspection, and using data collected by sensors to aid emergency rescue, accident investigation and so forth. It assists in some key safety concerns. Some are:

i. Tracking supervision of underground personnel:

Through adopting IOT technology, closed loop controlling of all types of workers, operated equipments and working environment can be achieved.

ii. Monitoring and warning of environment:

Through adopting IOT technology, environmental parameters in mine can be detected and stored, and used as important basis of accident identification and accountability confirmation after accidents occur, providing important reference for investigation and handling of accidents

iii. Monitoring and warning of device

Whole process monitoring of safe explosives used in mine. Normal operation of significant and critical equipments such as boring machine, conveyor, elevator, fans and so forth is important guarantee for safety of coal mine.

iv. Supervision of management:

Management and supervision of emergency plan, rescuing equipment and rescuing team and implementation of operating procedures.[9]

Ayush Kanaujiya 20BCE2748

G.Saranya, B.Madhu Pharkavi, P.Priyanka and L.Rashika, IOT BASED COAL MINING SAFETY MONITORING SYSTEM USING NODE MCU, ISSN NO : 2347-3150

This paper proposes a design of a wireless sensor network (WSN) with the help of ARM controller which is able to monitor the temperature, humidity, gas, vibration and status of smoke in an underground mine. This system also controlled the ventilation demand to mine workers depending upon present climate conditions within the mine field. This system utilized low power, cost effective ARM, DHT11 sensor, smoke detector, gas sensor for sensing the mine climate parameters and Wi-Fi for remote logging of data at central location to control the climate state with the help of motor and valve control circuitry. Traditional coal mine monitoring systems tend to be wired network systems, which play an important role in coal mine safe production. With continuous enlarging of exploiting areas and extension of depth in coal mine, many laneways become blind areas, where in there are lots of hidden dangers. Moreover, it is inconvenient to lay cables which are expensive and consume time. In order to solve the problems, they designed a coal mine safety monitoring system based on wireless sensor network, which can improve the level of monitoring production safety and reduce accident in the coal mines Wireless sensor network is composed of a large number of micro-sensor nodes which have small volume and low cost.

In their proposed system the coal mine safety systems are fixed with gas sensor modules, temperature sensors, MEMS sensors and relays. All the sensors are integrated with NodeMCU.

ThingSpeak platform was used to collect and monitor data and make predictions Their proposed system is basic and simple to build. Due to its simplicity, it can be deployed at a low economic cost.[10]

Pratik Panda 20BKT0104

S.Kumari , T.K Divya , K. Keerthana , S.Nisha , S.Pallavi, IOT based Coal Mine Safety Monitoring and Controlling. International Journal of Advanced Engineering Research and Science (IJAERS). [Vol-7, Issue-3, Mar- 2020] https://dx.doi.org/10.22161/ijaers.73.56 ISSN: 2349-6495(P) | 2456-1908(O)

Idea and implementation: The paper proposes an early advice system for the threat of sand plug subject to twofold logarithmic curve. Directly off the bat, the coupled time region assessment and GRNN figuring are used to envision the oil weight and bundling pressure parameters in the twofold logarithmic curve slant sand plug risk advised. The time game plan examination computation is proposed which can be foresee the oil weight and bundling pressure in the early notification model, and the GRNN estimation is used to update the desire realizes the time region assessment.

Disadvantages: Intellectualization is an issue territory. Despite smart early rebuke of risks, examination of quick control after the occasion of threats worth uncommon centrality.

Outcome: This examination needs to process and analyze the data accumulated from the well site page reliant on the Internet of Things and enormous data correspondence. Furthermore, the time game plan examination procedure is applied to anticipate the oil weight and bundling pressure. The time desire for the breaking sand square reprimand is ensured by the advancement estimate. The GRNN computation is used to improve the time course of action examination count for oil weight and set the serendipitous occasion pace of the foreseen results. Finally, the improved AP gathering estimation is used to improve the twofold logarithmic curve slant breaking sand chance caution model[11]

Ayush Kanaujiya 20BCE2748

Dheeraj "IoT in mining for sensing, Monitoring and prediction of underground mines Roof support", conference on recent information and advancement technology 2018.

They suggested a framework that values of all the parameters that are monitored are stored and visualized in the cloud and those can be controlled using smart phone so that safety of the coal mine workers is maintained. Digital transformation is emerging as a driving force to revolutionize the world around us. Digitalization will play defining role in the mining industry too where connectivity plays a gigantic role. The idea is to embed more and more things with electronics, sensors, and software to allow things to communicate and exchange data with each other possibly but not necessarily via the Internet.

Their implementation used a Mobile Roof Supports (MRS) developed jointly by Indian Institute of Technology (ISM), Dhanbad. To differentiate it from the normal MRS, they are named as "Self-Advancing Goaf Edge Support" (SAGES).

Their design includes a robust IoT communication infrastructure in underground mining to enhance safety and provide information in real-time which results in a quick response to critical

situations. The SAGES equipped with array of wireless sensors forming a network is one of the keys building blocks and foundational technology for the Internet of Things [7] and other devices for the online underground to surface transmission of data pertaining to roof behavior, support behaviour and mine atmosphere at the working locations of SAGES.[12] Pratik Panda 20BKT0104

Daniel Minoli DVI Communications New York, NY, USA Kazem Sohraby South Dakota School of Mines and Technology Rapid City, SD, USA Jacob Kouns Risk Based Security Richmond, VA, USA

Idea: He penetration of sensing-and-connectivity-enabled electronic chips (microprocessors) coupled to all kinds of physical items is projected to skyrocket in the next years. whether at the plant (for example, process control), or in the office building in the city (for example, for smart building management)(For example, for a number of applications such as traffic and transportation)resource management), and in utility networks (e.g., for energy efficiency).management), and in major traffic corridors (e.g., for airports).movement control), and in the house (for example, appliance and lighting control).environment control), in or with people (for example, location-based services, e-health monitoring), and in a variety of other applications. circumstances.

Implementation: IoT Sec is a major attention in IoT system design. The overreaching purpose is to comfortable every tool, each subnetwork(e.g., facet community or fog), each delivery or center network, and every analytics-, provider- or storage-device. One wishes to provide security for all techniques at every layer of the architecture. Authors have described a working version that may assist a targeted safety dialogue, which we check with because the Open structures IoT Reference model (OSiRM). See desk1. This layered version well-know but intuitive, hourglass stack. The seven layers of this version are as follows.The OSiRM is somewhat comparable however now not same to a model developed by the ITU, however the advantage is that it lends itself to an intuitive and organic understanding of the environment, with an eye to security issues.

Outcome: OSiRM consists of 3 protection-related mechanism nation-states that efficiently can exist independently at each layer Authorization & Authentication (A&A); Encryption & Key control (E&KM); and believe & identity management(T&IM) (other mechanisms may be brought to the version layer sir deemed appropriate.) in this OSiRM version there may be optimized differences for a given security function at exceptional layers, as well as specializations which could arise with the type of element and/or kind of software. See desk 1 again. For example, in the Fog Networking layer one might use a 64-bitencryption algorithm, at the same time as in the "statistics Aggregation" or "information Centralization" layer one may use a 256-bit encryption algorithm. As captured by means of this version, some endpoints would possibly

Networking" or "facts Aggregation"layer), at the same time as other greater complicated and extra strategic endpoints(e.g., some actuator controlling a dam or a SCADA-based lengthy-haul electricity grid) can also rent a extra state-of-the-art full packet inspection firewall. The firewalling characteristic can (andin all likelihood should) independently additionally exist on the higher layers ofthe OSiRM. [13]

Manoj kumar,20BKT0152

Design and Implementation of Portable Health Monitoring system using PSoC Mixed Signal Array chip D.J.R.Kiran Kumar, Nalini Kotnana

Idea and implementation: On this paper, a coal mine safety device is applied the use of a Thinger Io platform as a medium to transmit the data. The machine is implemented to monitor and control diverse parameters inside the coal mines inclusive of mild detection, leakage of gasoline, temperature and humidity situations, fire detection in the coal mine. these all sensors are together considered as one unit and are positioned inside the coal mines. all of the esteems of the sensors are continuously uploaded to the thinger for analysis. here the fuel is continuously monitored if any uncertainties inside the level of gas rise up, then buzzer is used to alert the workers. in this machine LDR sensor is utilized to hit upon the presence of mild. mechanically light gets one and may be managed using the LED button. In case if any fireplace occurs in the coal mine, then an alert notification is sent to the mail of the legal character. Temperature and humidity values are also constantly monitored and displayed on the serial display and also in the thinger platform. The evolved system is mainly carried out to improve the running situation in the coalmines and additionally to ensure workers safety.

Outcome: International magazine of new technology and Engineering (IJRTE) ISSN: 2277-3878, volume-1, difficulty-3, August 2012 65 Fig. thirteen(a) Parameters prepared to feel records perceived in laptop. (b) Sensed facts from temperature sensor DS18b20. (c) Sensed statistics from coronary heart beat sensor unit. (d) Sensed statistics from pulse oximetry sensor unit. (e) pH stage and (f) ECG waveform. VII. conclusion This paper affords implementation and design of wi-fi sensor network for actual-time health monitoring system by means of the use of ZigBee wi-fi widespread. So finally we finish that Programmable gadget on Chip (PSoC) has been the fee effective implementation used for wi-fi recording and transmission device of bio-medical signals. And it is very beneficial to the far flung patients. the usage of a microcontroller as the building block of the wi-fi recorder has the blessings of intelligence, compact length, and reliability. via the useful resource of this particularly incorporated microcontroller, outside additives, and consequently wirings are saved to a minimum. The intelligence of this tool is due to the processor itself, which should deal with simple pre- processing duties. The maximal throughput of the A/D conversion and the information transmission is ready 40 Kbits in step with 2d, accordingly, limiting the packages to low-frequency signals, along with ECG, EMG, and EEG. in addition benefit of this tool is its low-power consumption, that's appealing for transportable programs. furthermore, this component became also layout on a motherboard to boom its mechanical electricity. The change of various front-stop modules is consequently sped up. we hope that the machine need to be tailored for minimizing the device’s length and permit for everyday life utilization.[14]

Manoj kumar,20BKT0152

International Journal of Engineering Sciences & Research Technology (A Peer Reviewed Online Journal)

Implementation and idea: Many hazards will occur at some point of mining operations in underground coal mines, which could be very volatile to the protection and fitness of the workers. those troubles show up because of extraction of coal from the mines. Coal which could be very integral mineral performs most important function in electricity production. In India we've 430 coal mines at gift. There can be mischances occur in mines and it leads the employees to position their lives into critical state of affairs. we're the usage of Node MCU controller for monitoring the mine areas and people protection. It's a low-value open supply IOT platformand has inbuilt wi-fi connection. Sensors which can be used here are temperature and humidity sensor, heartbeat price sensor, flame sensor, LDR sensor, gasoline sensor. For measuring temperature and humidity inside the coal mine we are the use of DHT11 sensor. at some stage in mining leakage of toxic gases including carbon monoxide and methane are detected by way of the gas sensors and also it warns in risky conditions. light is very crucial for deeper mining operations so we are the use of LDR sensors for measuring mild intensity. Alarm is used in emergency conditions, likewise heartbeat sensors are used to screen the people heartbeat. The records's gathered from the sensors are stored in the cloud server without delay.

In this proposed system the coal mine safety systems are fixed with gas sensor modules, the light dependent resistor (LDR sensor), temperature/humidity sensor, fire sensor, heart beat sensor, buzzer and LED. We connect all the sensors to the Node MCU.

Outcome: The Internet of Things which is the widespread in information technology connects us to the real world of things. Thus, the safety of workers is made possible by different sensors such as the fire sensor, gas sensor, LDR Sensor, heartbeat sensor and so on. Wireless system makes our work simpler and also its cost efficient. Node Mcu the controller which collects and senses all the data from sensors and passes to the cloud server. The cloud which performs greater action when it receives the data it automatically adjusts the sensors and warns the coal mine workers without the need of the user. All these things save the workers from the dangerous situations and helps them to work without stress. It also saves their valuable time and protect their mine from any unwanted losses.[15]

Manoj Kumar, 20BKT0152

An Integrated Environment Monitoring System for Underground Coal Mines—Wireless Sensor Network Subsystem with Multi-Parameter Monitoring

Idea: Safety is the top priority of coal mine production and plays an important role in it. In recent years, China has gained great achievements in the field of coal mine production safety, but the situation is still severe. In China, coal mining is mainly carried out underground, where the geological conditions are complicated . Along with coal mining at greater depths, the amount of gas emission increases, and thus the risk of coal and gas outbursts grows. Besides, there are other natural factors that can cause disasters in underground mines, such as rock bursts, coal dust explosions and water leaks. With the addition of narrow working space, poor lighting, and many hidden dangers in each coal mining procedure, heavy casualties may occur for slight

carelessness. Hence, the hazardous natural conditions and the adverse working conditions make underground coal mines full of numerous risk sources and hidden dangers.

Implementation:

In this architecture, the WSN is composed of three types of nodes: sink nodes, routing nodes and sensor nodes. The sink node establishes a WSN based on the ZigBee protocol . The routing node and the sensor node connect to a sink node to join a WSN. Environmental information about the underground coal mine are collected by the sensor nodes, and are sent to the GMDC through the sink nodes. According to the landform of the coal mine and the environmental monitoring requirements, different WSNs may consist of different kinds of sensors to collect different environment information. The environmental information that the CMS and the WSNs collect are transmitted to the GMDC via the optical fiber backbone network. After receiving the information, the GMDC can know the environmental conditions of the underground coal mine in real time, such as the level of gas and CO, and can rapidly respond to urgent cases. In this case, the monitoring of the environment of the underground coal mine and early warning of dangers could be achieved effectively. In addition, the connection between the GMDC and Internet make it possible for the remote manager to monitor and manage the overall safety conditions of local coal mines.

Outcome: The technologies used in the proposed system are all designed based on their suitability for the underground coal mine surveillance application, therefore some of them may not be so advanced in theory, but they were selected because they could make the system working smoothly as a whole. The proposed system has some good features such as universality and expansibility, and we anticipate it can be used for environment monitoring for other relevant fields.[16]

Manoj kumar,20BKT0152

Safety Monitoring System in Coal Mine Using IoT
Sathishkumar N1 , Manoj A M2 , Muniraj K2 , Naveenkumar M2 , Praveen C2 1 Assistant Professor, KPR Institute of Engineering and Technology, Coimbatore, Tamilnadu, India.

Idea: The extraction of coal from the sector is referred to as coal mining. Coal is used as a gas in the metallic and cement enterprise to extract iron from ore and to manufacture cement. every parameter in the underground mining industry should be managed on a regular foundation, including methane gas, excessive temperatures, fire incidents, and so on. the extent of safety in coal mines is still negative, ensuing in fatalities. A coal mineshaft salvage motion is profoundly perilous due to diverse elements. it is in particular volatile for rescuers to enter a coal mineshaft burrow in a debacle without in advance interest to the climate because resulting blasts are in all likelihood going to appear at any second. it's miles alongside those traces basic to recognize volatile weather information like poisonous gases and high temperatures, simply as to direct a visible review of excavators caught in a fell passage via the imploded burrow. these facts would resource rescuers in devising a strategy and equipping themselves to carry out the rescue operation defensively. This paper proposes a design for coal mines a good way to reduce the harm due to a coal mine coincidence and allow for a more powerful rescue operation.

Implementation :

The conventional approach of using wired network networks for coal mine control, i.e. laying underground cables or parallel lines, proved inconvenient for safety reasons. In the underground mining area, the methane gas level present in the mine is detect by Electronic Gas Sensor. The climatic conditions in underground mine including temperature and humidity is measures by the Temperature sensor. The vibrations occurring in the mines while mining is detect using the Vibration sensor. This senses the vibration level and occurrence of earthquake can be known easily. With a power supply given, the data which the various sensors collects are fed to the Arduino UNO ,the numbers are displayed in the LCD display module. The numbers also checks with the maximum level each parameters like gas, pressure, temperature, vibration etc., using the IoT module. If the number crosses the predefined level, the buffer buffers and gives alert to the miners. The machine collects data in a coal mine using a sensor network based on (MEMS) Micro Electrical Mechanical Systems. The sensor module is made up of MEMS sensors that range in size from 1 to 100 micrometres. The Arduino receives the sensed data and transmits it. The mining staff are notified when a parameter's extreme condition is detected.

Outcome: Coal mine security framework is actualized utilizing Gas sensor, Temperature sensor, Vibration sensor, and MEMS sensor to expand the wellbeing of the coal mineshaft representatives and to guard them. The use of IoT in this device allows for continuous monitoring of the coalmine and alerting of the workers. The device is both reliable and cost-effective.[17]

ManojKumar,20BKT0152

G. Pravin Gandhi IV YR , B. Priyadharshini III YR, Coal Mine Accidents Detection and Automation System.

Idea and implementation: There's coal mine alert systems that is built using sensors and WSN.The coal mine intelligent monitoring system, through the mine field of ZigBee nodes to collect a variety of wireless data, through the switch to downhole monitoring sites which adopts a ring network connection that can communicate conveniently. In addition the system sets up a backup underground control and monitoring stations. The data is transmitted using Ethernet connection. It includes wireless data acquisition subsystem based on ZigBee network, industrial Ethernet transmission subsystem and remote monitoring system.

The architecture consists of two modules such as a Send and Receive Module and Cloud data storing and processing using JSP Module. The sensor modules includes the CO and CG sensors, Methane sensor, smoke sensor, SO2 sensor Temperature and Humidity, Pressure sensor which are interfaced using an AVR controller(AtMega32) for collecting the data. IOT module to transmit data to the cloud. The JSP page acquisite data and process data to reliable units for data comparison and exchange.

Outcome:

The above paper proposes the basic idea for the life saving measures for the miners and the concerned authorities and also the cost their total resource cost. The sensors used for demonstration of concept are general. The MQ-7 gas sensor is more sensitive to carbon monoxide but can sense methane, butane, LPG, hydrogen, smoke, etc. We found more heating of sensor if operated for long time. It is noise free and has low power platform. With use of sophisticated sensors, the system can work with more accuracy in real time.[18]

Ayush Kanaujiya 20BCE2748

Moridi, M.A., Kawamura, Y., Sharifzadeh, M., Chanda, E.K., Wagner, M., Jang, H., Okawa, H., 2015. Development of underground mine monitoring and communication system integrated ZigBee and GIS. Int. J. Min. Sci. Technol.

Idea: A robotized underground mine observing and correspondence framework dependent on the mix of new innovations is acquainted with advance security and wellbeing, functional administration and cost-adequacy. The proposed framework reconciliation thinking about Wireless Sensor Network (WSN) helped Geographic Information System (GIS) empowers to screen and control underground mining applications from surface office. In light of the capacities of WSNs, ZigBee network is adjusted for close to constant observing, ventilation framework control and crisis correspondence in underground mine. ZigBee hubs were created to detect natural ascribes like temperature, dampness and gases fixation; turning ON and OFF ventilation fans; and messaging crisis messages. A trigger activity plan for checked properties better than average and edge esteem limits is modified in the surface GIS the board server. It is intended to turn the helper fans on from a distance or naturally in orange condition and sending departure messages for underground excavators in risky (red) condition.

Implementation: The whole arrangement of the tried underground WSN is made out of various ZigBee hubs like organizer, switches and end gadgets. The remote organization at first is made by organizer (passage) to join different hubs. Two-sided correspondence was given between the organizer and end gadgets to send and get messages and readings momentarily taken by their sensors. Switches with the capacity of detecting the climate were utilized to hand-off correspondence through the organization. Also, sending and getting messages and controller of ventilation fans are empowered by the surface organizer dependent on the planned programming. To arrangement WSNs, power utilization and high unwavering quality of parcel conveyance are the most worries. For the previous case, ZigBee hubs are arranged to communicate information in longer periods when the mine is in protected and transient conditions which is caused to expand the existence of batteries. In last option case, diverse time stretches are considered for information conveyance of climate detecting to keep away from network clog and plausibility of parcels misfortune. The power use of immediate and substituting flows (DC/AC) for the ZigBee hubs (aside from the organizer) were intended to work under battery and mine site power supply, separately.

Outcome: Mine safety and health were improved by intelligent maps supporting spatio-temporal data and coordinate of ZigBee nodes in this experiment. The final outputs of GIS management

server are comprised of 3D visualisation monitoring of underground mine tunnels and messages texting for alert and alarm conditions. The web-GIS is another application supporting the GIS management server to promote the underground monitoring and communication system.[19]

Tanay Mittal 20BKT0105

VALDO HENRIQUES AND REZA MALEKIAN, (Member, IEEE)

Idea: The framework was totally planned from first standards, this incorporates the sensor equipment, gadget equipment, PCB format, programming calculations, just as a graphical UI. The proposed framework planned looks at and executes specific usefulness that addresses the previously mentioned weaknesses or constraints progressively mining climate observing. The framework considers checking of numerous various zones inside the mine, the assurance of excavators from unreasonable commotion levels and the capacity of estimation information for reasons for reference. Foundation on current techniques for acquiring and handling the referenced surrounding qualities has been examined. Next the framework outline from an undeniable level viewpoint will be talked about. The outcomes introduced from this framework show its legitimacy. These outcomes are then utilized as the reason for the conversation and end.

Implementation: The main part of the framework is the estimation hub (FU1). This part ought to be liable for all estimations made. The estimation hub ought to contain a wide range of sensors that will return esteems, for example, gas fixation, temperature, dampness, wind stream and noise levels. These qualities should then be moved through a remote connect to information assortment station (FU2); this station will have the vital equipment (a remote module and a microcontroller, interfaced to a PC) programming to play out the necessary handling, showing and capacity of qualities. Notwithstanding this the information assortment station is additionally liable for delivering a security conspire for laborers utilizing the qualities gathered. The estimation hub and the information assortment hub ought to impart just through the ZigBee remote convention. The variety of various sensors is the focal point of this venture without which the production of the ideal framework would be strange. The surrounding conditions gave are taken care of into the sensors. The temperature (FU1.1), wind stream (FU1.2) and dampness (FU1.3) sensors are made from first standards. The most significant of these is the wind current sensor which will recognize the measure of air development inside the mine. The residue (FU1.4), noise (FU1.5) and gas (FU1.6) sensors are off-the-rack parts with flagging plan.

Outcome: The system is put through a series of tests. Each test had a focus on a specific subsystem. These results are summarized in the table. [20]

Tanay Mittal 20BKT0105

IoT in Mining for Sensing, Monitoring and Prediction of Underground Mines Roof Support

Idea and implementation:

At present the SAGES, which is deployed in underground mines, only stores the data in an electronic data logger operated by a chargeable battery. The data need to be downloaded manually from the data logger using a wired communication to the industrial portable computers in the underground. The warning lights are mounted on the SAGES machine. Analysis of downloaded data are carried out offline after elapsed of certain time and hence the data analysis hardly become useful in quick decisions making process in mines. The Smart SAGES is to be developed having facility to extend the support for other sensors such as temperature, gas etc.

Outcome: The digital transformation of the mining agency is inevitable due to huge advantage's form the increase in the productivity till cost savings. IoT is the major technology that will disrupt mining corporation in appealing its goal of digitalization. it's miles obvious that IoT will make SAGES smarter. it's going to help inside the efficient, and effective monitoring of the desilking area through Leiting sensors data that is transmitted to the cloud storage for the online real-time data processing for decision making. The prediction of the SAGES performance can be achieved using advanced data mining techniques. These predictions and generated knowledge can help in improving the performance, and the reliability of the machine and make the mine safe, and reductive.[21]

Manoj kumar,20BKT0152

Security and channel noise management in cognitive radio networks

Ananda Kumar Haldorai, Arulmurugan Ramu

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Idea: A large number of users in the cognitive spectrum poses a significant challenge to the efficiency and security of the spectrum communication. The cryptosystem is utilized in spectrum allocation to ensure confidentiality and integrity. Different spectrum management systems are formulated in a manner that ensures the implementation of various cryptosystems. For this reason, the necessary management techniques are essential as they enhance the network security in the spectrum . Moreover, spectrum security management ensures authentication, authorization, allocation, distribution, secure key generation, identification, and rekeying . The critical management frameworks shown in research work are grouped into three significant categories: decentralized essential spectrum administration, centralized spectrum key distribution, and management spectrum key frameworks. In the central spectrum processing scheme, a primary spectrum key (PSK) is present, applicable in the control of the broad management of the spectrum frameworks.

Implementation: The proposed McEliece spectrum generation scheme ensures confidentiality in the unrestricted segment. Forward and backward collusion and secrecy attacks might be evaluated with the primary user segment. This section includes the comparison of various crypto key organization schemes considered in terms of spectrum management, allocation, communication, and computation. The various methods include Fake attacks, Information Tampering, the system recommended in can donate the Service Repudiation, and is recommended in and represents the reply attacks. Moreover, we have simulated the recommended secondary key provision system over the noisy spectrum channel to enable the comparisons of the parameters provided in the next section.

Outcome: The spectrum management framework applies the McEliece cryptosystem in the cognitive radio networks to reduce the noise in spectrum channels. The PSK provides every CR users primary and secondary keys based on the application of the McEliece private key cryptosystems. The proposed PKC protected with the private key guarantees the reliability and privacy of the system. The uniqueness of the spectrum nodes provided in the secondary user is applicable in partial parameters of the secondary keys for spectrum authentication. The hash functions are applied to ensure the security of the secondary-key administration. The selected mechanism is formulated to allow the robustness of the recommended spectrum security and channel noise management that is improved radically. The pseudorandom noises of the channels are produced to improve user security. The comparison of the recommended framework with the others indicates that our proposed approach is considered with more robustness, security, minimal storage, and communication cycle. Therefore, the recommended spectrum key management system is sufficient in the cognitive radio network for effective encryption, efficiency, and reliability during handover procedures.[22]

Manoj Kumar,20BKT0152

Coal mine safety monitoring system based on ZigBee and GPRS, Jie Cheng, Dianwu Gao, Junfei Wang and Dongge Wen, Applied Mechanics and Materials Vol. 422 (2013) pp 215-220, 2013

Implementation:

Based on the demand analysis of coal mine monitoring system, introducing GPRS and ZigBee technology and combining their advantages together, a set of wireless network topology appropriate for coal mine monitoring was designed in this paper by using the wireless networking transmission of many sensors instead of the traditional method. This network is composed of an integral wireless network system based on ZigBee wireless sensor node data and GPRS-based network transmission system. The wireless networking process of ZigBee was described, the equipment installation and network accessing were studied, the feasibility of conversion between ZigBee protocol data and TCP/IP protocol data in GPRS network was discussed, and GPRS as well as ZigBee gateways were designed.

Advantages:

Power-saving: As the work cycle is very short, the power consumption of sending and receiving information is low, and it has adopted a variety of power-saving modes, ZigBee technology can guarantee two AA battery supporting the service time of nodes up to six months to two years.

Low cost: The initial cost of the module is estimated to be 6 U.S. dollars, and with the technological development and rising production, the cost can be further reduced, besides, the ZigBee protocol is not patented.

Flexible work frequency: The work frequency of ZigBee is flexible, the frequencies used are 2.4GHz (global), 868MHz (Europe) and 915MHz (USA), and all of them are unlicensed frequencies.

Safe: ZigBee has provided the functions of data integrity checking and authentication; the encryption algorithm has adopted the common AES-128, meanwhile, the layers of the protocol stack can determine its security attributes flexibly.

Outcome:

The wireless networking process of ZigBee was described, the equipment installation and network accessing were studied, the feasibility of conversion between ZigBee protocol data and TCP/IP protocol data in GPRS network was discussed, and GPRS as well as ZigBee gateways were designed.[23]

Pratik Panda,20BKT0104

Prof. A. H. Ansari, Karishma Shaikh, Pooja Kadu, Nikam Rishikesh, "IOT Based Coal Mine Safety Monitoring and Alerting System", International Journal of Scientific Research in Science, Engineering and Technology

Idea and Implementation:

This paper proposes a monitoring system that contains several components like PIC board, Xbee module and Zigbee USB interfacing boards, LCD and different sensors along with other components. The coal mine safety issues are tackled by each of the information collected by the sensors, and analyzing them using the Thinger system. In this system we mainly have monitoring and controlling systems. In monitoring system, we monitor all the data from different sensors. Gas sensor detects the gas in the coal mine environment. If the gas level exceeds the normal level, then the buzzer gets high so that the mine workers get notified. These sensor values are continuously uploaded to the cloud. for analysis and also for further use. The temperature and water level values are also monitored inside the coalmine and send data control unit through ZigBee

Outcome:

The proposed system, when temperature is more than 500C, gas concentration is more than 50 and humidity is more than 250 then the designed system will show alert message on lcd display and buzzer will sound. Hence it helps to prevent dangerous hazard.[25] Ayush Kanaujiya 20BCE2748

M. Shakunthala, C.Raveena, B. Saravanan, S. Sanjay Kumar4, R. Sandeep Saran, "IOT Based Coal Mine Safety Monitoring and Controlling"

This paper proposes to monitor the status of workers and the data upload to the cloud using IoT as well as send data wireless to the monitoring station. In the existing method, there is no data transmission from the mine section to the monitoring station for monitoring the status of mine workers and the atmosphere. So, it is very difficult to monitor the status of all the mine workers the system is build using particular sensors sort out subject to accelerometer used to screen the surroundings parameters of underground mine place and drives each and every identified parameter/characteristic to ARDUINO based ATmega2560 Microcontroller Unit (MCU). The MCU unit is used to create an absolutely surveying system with high exactness, smooth control and constancy. Exactly when an essential condition is recognized caution is given by the structure and comparative estimates are passed onto the webserver by beginning ESP8266 module subject to Wi-Fi correspondence. The recognized assortments in the characteristics have appeared on web server pages that make less requests for the underground control center to screen and to make major quick moves to prevent genuine damage. At the same time using the ZIGBEE transceiver module to transmit data from the mine section which can be monitored and immediate action to be taken.

Outcome:

This project proposes the basic idea for the life saving measures for the miners and the concerned authorities and also the cost of their total resource.[26]

Ayush Kanaujiya 20BCE2748

III. PROBLEM DEFINITION

Coal mineshafts are inclined to the unsafe mishaps and human setbacks. The specialists have quite possibly the most perilous job. Deadly/Non-lethal mishaps happen at a normal of like clockwork in coal mineshaft locales. Word related sickness like injury, hearing misfortune, dust illnesses of the lungs are not uncommon. Catastrophes because of harmful gases like carbon monoxide, methane, and so forth can cause extraordinary measure of harm in a matter of seconds.

The fundamental target of our work is planning IOT based hurtful gas and temperature identification and anticipation framework. This framework intends to quantify the gas levels of various gases like methane, propane, carbon monoxide, carbon dioxide, and so forth 24*7 so it can caution the specialists in case there are any spillages or the gas level has arrived at risky degrees of fixation. It additionally will be consistently distinguishing the temperature and moistness levels and caution everybody assuming the conditions are getting hazardous.

This multitude of information will be straightforwardly given to the specialists and approved expert in LCD screen which guarantees precise identification and fast reaction time. This improves the framework than the manual strategy. Every one of the information gathered likewise can be utilized to anticipate the hazardous conditions and times ahead of time and caution everybody well ahead of time so everybody can reach to wellbeing.

To evaluate the cool of a mine, we propose the utilization of mine air quality record (MAQI) and the warm solace list (TCI) for precise discovery of mining conditions.

$$\mathbf{MEI = 0.7 * (MAQI)+0.3 * (TCI)}$$

$$\mathbf{MAQIp = [(MAQIHi - MAQILo) / (BPHi - BPLo)] \times (Cp - BPLo) + ILo}$$

where, MAQIP is the index value for pollutant p, CP is the input concentration of a given pollutant p, BPHi is the higher breakpoint that is ≥CP, BPLo is the lower breakpoint that is ≤CP, MAQIHi is the index breakpoint value corresponding to BPHi, and MAQILo is the index breakpoint value corresponding to BPLo. The MAQI values have been categorized into five status categories: very good, good, moderate, poor, and very poor.

This system will supervision of underground personnel safety, monitor and warn of the environment, monitor proper machine operations and supervise the management and alarm them of any hazards.

IV. IMPLEMENTATION

HARDWARE REQUIRED

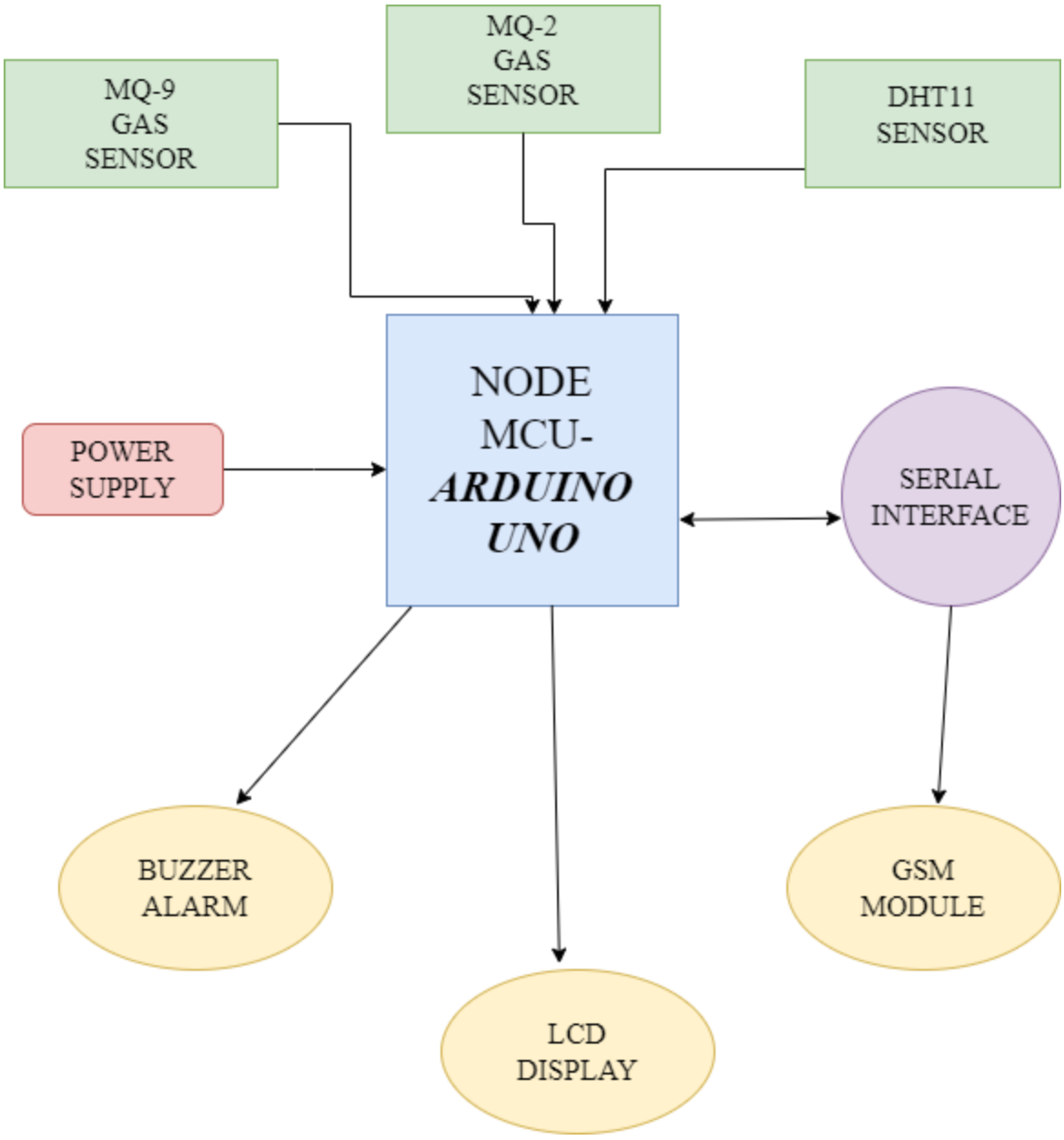
- Arduino uno
- Gas sensors
  MQ-2 and MQ-9

- DHT11 sensor
- LCD display
- Toggle
- Buzzer
- Jumper Wires

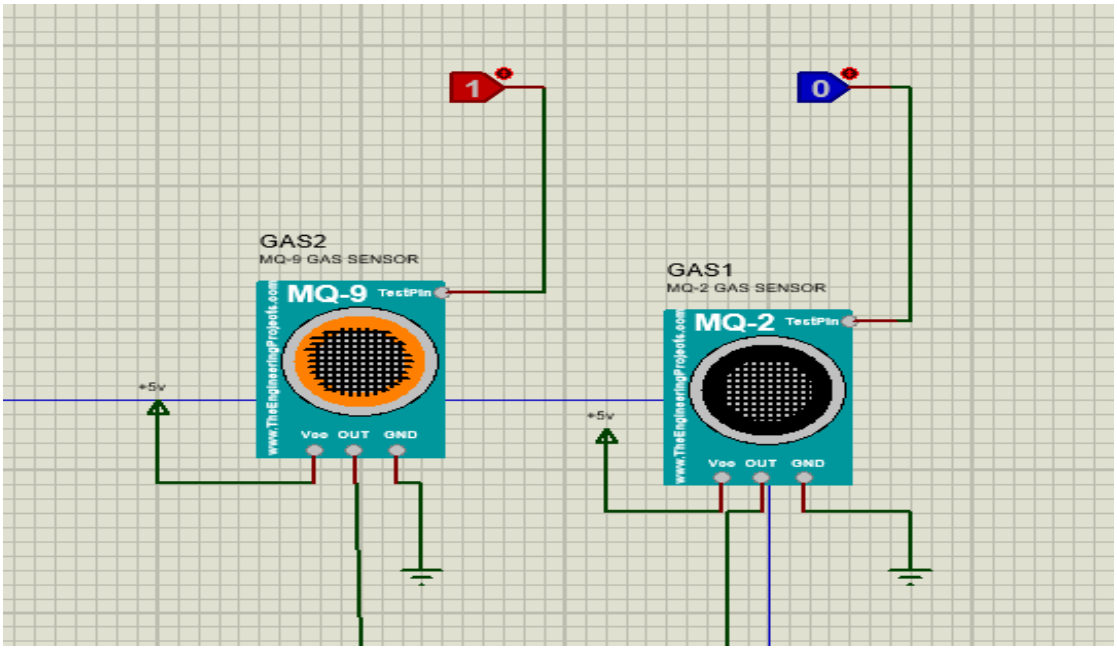
SOFTWARE REQUIRED

- Arduino compiler
- Proteus 8 professional

V.FLOW DIAGRAM



VI. CIRCUIT COMPONENTS IN PROTEUS SIMULATOR:



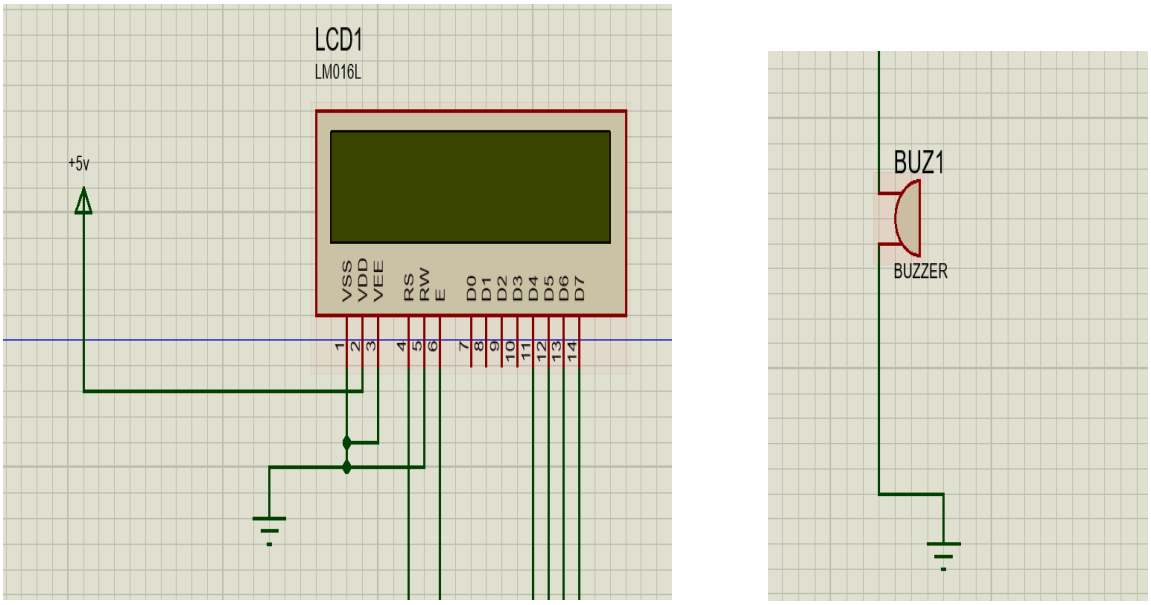
(Figure-1)

In figure-1 we can see two gas sensors **MQ_2** and **MQ_9.**

MQ_9 gas sensor is mostly used to detect carbon monoxide and flammable gases. It has good sensitivity to carbon monoxide. It has long life and low cost. It has a simple drive circuit. MQ_9 gas sensor is a domestic gas leakage detector. It is mostly used in industrial area, because it is portable gas detector. Length 32mm, width 20mm, hight 16mm, weight 5gm and operating voltage is 5v with 150 mA current consumption. In our circuit MQ_9 gas sensor is connected to a 5V power source and output is connected to pin 8 in Arduino UNO board, to detect toxic flammable gases. The sensor value only reflects the approximated trend of gas concentration in a permissible error range, it DOES NOT represent the exact gas concentration. The detection of certain components in the air usually requires a more precise and costly instrument, which cannot be done with a single gas sensor.

MQ_2 gas sensor is used to detect the methane, butane, LPG and smoke. In this sensor VCC pin powers the module, typically the operating voltage is +5v. Operating Voltage is +5V. Simply power the module with 5V and you should notice the power LED on the module to glow and when no gas it detected the output LED will remain turned off meaning the digital output pin will be 0V. Remember that these sensors have to be kept on for pre-heating time (mentioned in features above) before you can actually work with it. It has weight 16gm, dimensions 130mm x90mm x32mm. it has wide detecting scope, stable and long lifetime and fast response and high sensitivity. Hot swapping the grove may lead to IC burnout, please turn off the power of the main board before swapping grove. Gas Sensor (MQ2) module is useful for gas leakage detecting (in home and industry). It can detect LPG, i-butane, methane, alcohol, Hydrogen, smoke and so on. Based on its

fast response time. measurements can be taken as soon as possible. Also, the sensitivity can be adjusted by the potentiometer.



(Figure-2)

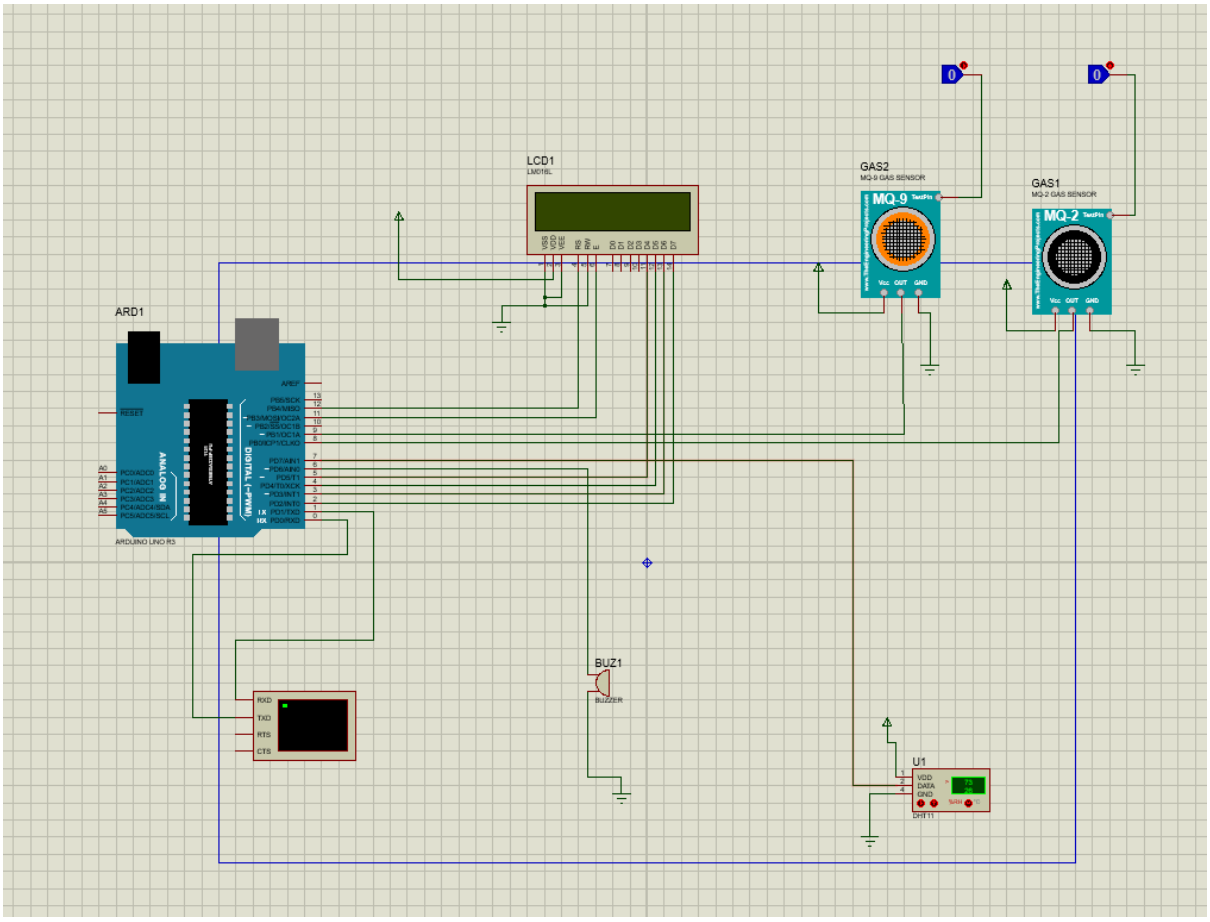
In figure-2 we have two components first one is LCD (LM016L) and second one is buzzer. The most used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. we will discuss about character-based LCDs, their interfacing with various microcontrollers, various interfaces (8-bit/4-bit). Pin no. 1, Power supply (GND), 2-power supply,3-conrast adjust,4-0 for instruction input and 1 for data input,5-0 for write mode and 1 for read mode,6-enable signal,7-data bus line 0,8-data bus line 1,9- data bus line 2,10- data bus line-3,11- data bus line 4,12- data bus line 5,13- data bus line 6,14- data bus line 7. The most used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers.
Most LCDs with 1 controller has 14 Pins and LCDs with 2 controller has 16 Pins (two pins are extra in both for back-light LED connections). Pin description is shown in the table below. this is all about LCD 16×2 datasheet, which includes what is a 16X2 LCD, pin configuration, working principle, and its applications. The main advantages of this LCD device include power consumption is less and low cost. The main disadvantages of this LCD device include it occupies a large area, slow devices and the lifespan of these devices will be reduced due to direct current. So, these LCDs use AC supply with less than 500Hz frequency.

In figure 2, talking about buzzer. **Buzzer** is a small yet efficient component to add sound features to our project/system. It is **v**ery small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications. Alarming circuits, where the user must be alarmed about something and

communication equipment and automobile electronics and it is a portable equipment due to compact size. There are some features of buzzer. Rated voltage: 6V dc, operating voltage is 4-8V, current should less than 30mA, resonant frequency should approximately 2300Hz and it should small and neat sealed package. A buzzer should breadboard and perf board friendly.

The **DHT11** is a commonly used **Temperature and humidity sensor.** The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers.
The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So, if you are looking to measure in this range then this sensor might be the right choice for you.

VII. FINAL CIRCUIT



(Figure-3)

- In figure-3 we have the complete circuit diagram for temperature, gas and humidity measurement. We have MQ_2 gas sensor which is connected to the 8th pin of Arduino uno.

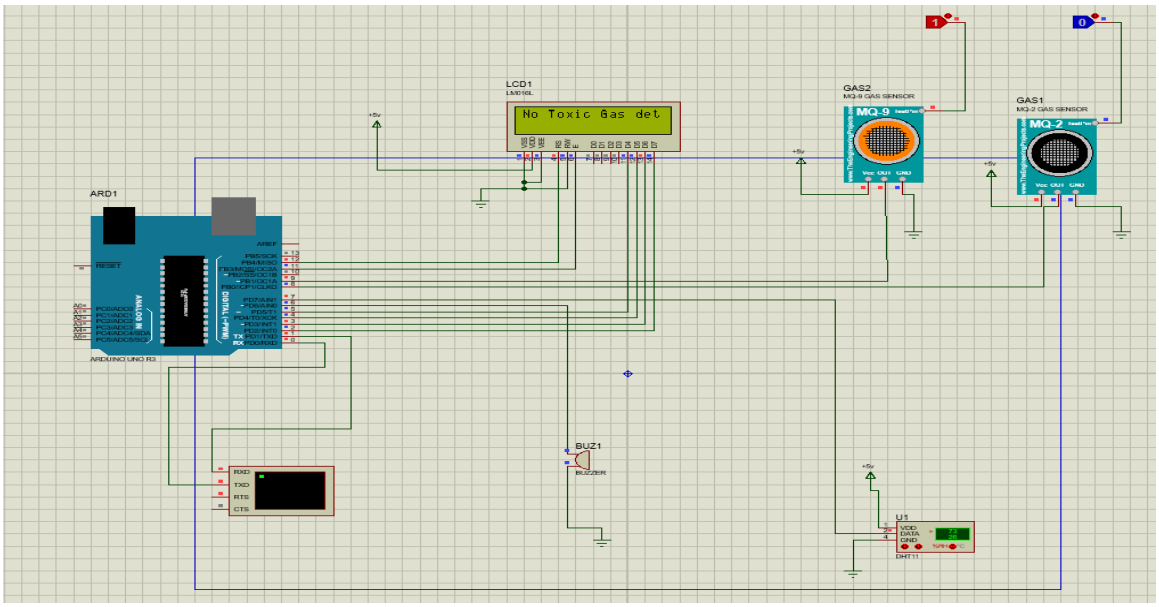
- MQ_9 gas sensor to detect smoke in the environment is connected to 9th pin of Arduino uno.
- 0th and 1st pin of Arduino uno are connected to virtual terminal to represent and show the current conditions in environment.
- DHT11 is connected to 7th pin of Arduino uno to detect the temperature and humidity in the environment of coal mine.
- The 6th pin of Arduino uno is connected to the buzzer.
- 11,12,13,14 data pins of LCD are connected to 2,3,4,5 pins of Arduino uno.

VIII. WORKING SYSTEM

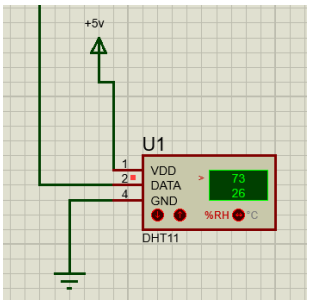
our current scenario can have multiple cases, for example, humidity can more than threshold values so it will reflect on our LCD as well as on out virtual terminal. For second condition temperature value can be more than threshold value. There are many cases.

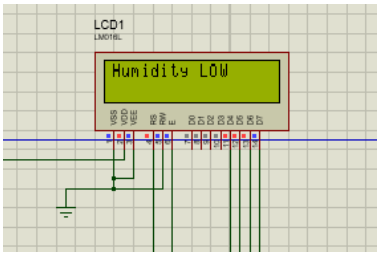
Let's check our results:

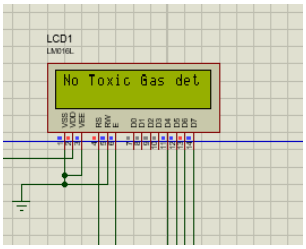
IX. TEST CASE

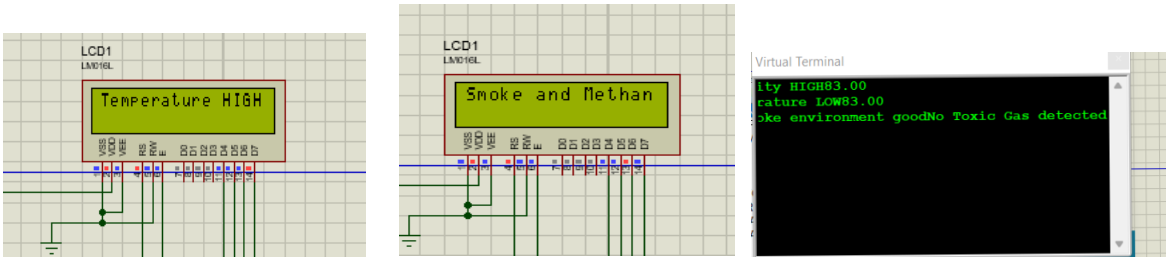


(Figure-4)









(Figure-5)

X. TEST CASE RESULT ANALYSIS

Figure-4 is case scenario and figure-5 represents the results for the out scenario. In our following scenario our MQ_2 sensor's toggle is off means there is no gas so it results we can see that it's showing that to toxic gas detected. Now coming to MQ_9 gas sensor we have our toggle is on means it's showing 1 so gases are there in environment so in results we can see that smoke and methane detected. Whenever the gas is going to be detected, our buzzer will automatically perform an action. As we can see that our temperature value in sensor is 26 and humidity is 73 so we can conclude that temperature is more than threshold value which is 25 and humidity is less than threshold value which is 75. As per results we can see in LCD that temperature is high, and humidity is low. So, this scenario is showing that our electronic circuit and code is working perfectly without any error and interrupt. The last picture of virtual terminal shows the message generated that will be sent to the authorised personnel through the GSM Module.

A **GSM Module** is designed for wireless transfer of data through Short Messaging Service (SMS). This module can receive serial data from the MCU and transmit the data as a SMS to the host server. It is useful in generating quick alerts to the concerned authorities for a faster response time to a risky situation.

This module is used here to notify the authorised personnel about abnormal readings from the sensors so that quick action can be taken.

XI. BASIC ALGORITHM

To detect if the conditions inside the coal mine have become unsafe:

execute Initial set-up and data collection

repeat

if humidity percentage > 75

print HIGH HUMIDITY

sound buzzer

else

print HUMIDITY NORMAL

if temperature > 25

print HIGH TEMPERATURE

else

print NORMAL TEMPERATURE

if MQ_2_detection = TRUE

print METHANE AND SMOKE DETECTED

else

print SAFE ENVIRONMENT

if MQ_9_detection = TRUE

print TOXIC GASES DETECTED

else

print SAFE ENVIRONMENT

until user decides to keep running

XII. CODE

```
#include<LiquidCrystal.h>
#include "DHT.h"
#define DHTPIN 7
#define DHTTYPE DHT11
DHT dht(DHTPIN,DHTTYPE);
```

```
LiquidCrystal lcd(12,11,5,4,3,2);
int Gas1=9;
int Gas2=8;
int Buzzer=6;

void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  dht.begin();
  pinMode(Buzzer,OUTPUT);
  lcd.begin(16,2);
}

void loop() {
  // put your main code here, to run repeatedly:
  float h=dht.readHumidity();
  float t=dht.readTemperature();
  if(h>=75)
  {
    lcd.setCursor(0,0);
    lcd.print("Humidity HIGH");
    Serial.print("Humidity HIGH");
    Serial.println(h);
    tone(Buzzer,1000);
    delay(1000);
    noTone(Buzzer);
  }
  else
```

```
{
  lcd.setCursor(0,0);
  lcd.print("Humidity LOW");
  Serial.print("Humidity LOW");
}
delay(1000);
lcd.clear();

if(t>=25)
{
  lcd.setCursor(0,0);
  lcd.print("Temperature HIGH");
  Serial.print("Temperature HIGH");
  Serial.println(h);
  tone(Buzzer,1000);
  delay(1000);
  noTone(Buzzer);
}
else
{
  lcd.setCursor(0,0);
  lcd.print("Temperature NORMAL");
  Serial.print("Temperature NORMAL");
  Serial.println(h);
}
delay(1000);
noTone(Buzzer);
```

```
if(digitalRead(Gas1)==HIGH)
{
  lcd.setCursor(0,0);
  lcd.print("Smoke and Methane detected");
  Serial.print("Smoke and Methane detected");
  tone(Buzzer,1000);
  delay(1000);
  noTone(Buzzer);
}
else
{
  lcd.setCursor(0,0);
  lcd.print("No smoke environment good");
  Serial.print("No smoke environment good");
}
delay(1000);
lcd.clear();

if(digitalRead(Gas2)==HIGH)
{
  lcd.setCursor(0,0);
  lcd.print("Toxic Gas detected");
  Serial.print("Toxic Gas detected");
  tone(Buzzer,1000);
  delay(1000);
  noTone(Buzzer);
}
else
```

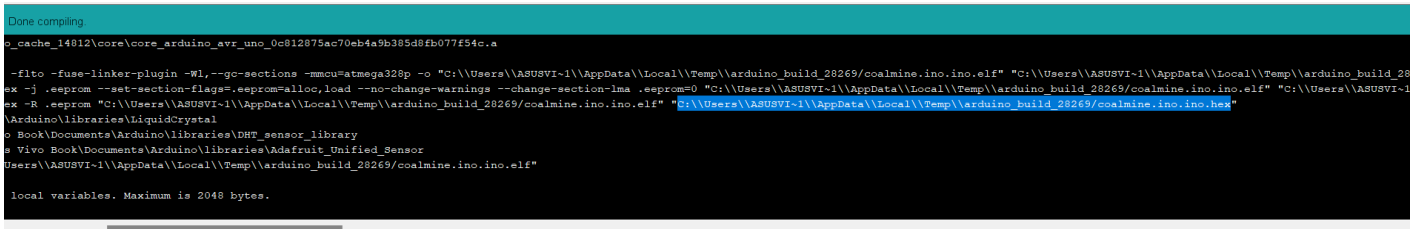
```
 {
    lcd.setCursor(0,0);
   lcd.print("No Toxic Gas detected");
   Serial.print("No Toxic Gas detected");
 }
 delay(1000);
 lcd.clear();
}
//code by: Manoj Kumar
```

XIII. CODE IN ARDUINO COMPILER

```
#include<LiquidCrystal.h>
#include "DHT.h"
#define DHTPIN 7
#define DHTTYPE DHT11
DHT dht(DHTPIN,DHTTYPE);
LiquidCrystal lcd(12,11,5,4,3,2);
int Gas1=9;
int Gas2=8;
int Buzzer=6;

void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  dht.begin();
  pinMode(Buzzer,OUTPUT);
  lcd.begin(16,2);
}

void loop() {
  // put your main code here, to run repeatedly:
  float h=dht.readHumidity();
  float t=dht.readTemperature();
  if(h>=75)
  {
    lcd.setCursor(0,0);
    lcd.print("Humidity HIGH");
    Serial.print("Humidity HIGH");
    Serial.println(h);
    tone(Buzzer,1000);
    delay(1000);
    noTone(Buzzer);
```

```
  }
  else
  {
    lcd.setCursor(0,0);
    lcd.print("Humidity LOW");
    Serial.print("Humidity LOW");
  }
  delay(1000);
  lcd.clear();

  if(t>=25)
  {
    lcd.setCursor(0,0);
    lcd.print("Temperature HIGH");
    Serial.print("Temperature HIGH");
    Serial.println(h);
    tone(Buzzer,1000);
    delay(1000);
    noTone(Buzzer);
  }
  else
  {
    lcd.setCursor(0,0);
    lcd.print("Temperature NORMAL");
    Serial.print("Temperature NORMAL");
    Serial.println(h);
  }
  delay(1000);
  noTone(Buzzer);


  else
  {
    lcd.setCursor(0,0);
    lcd.print("Temperature NORMAL");
    Serial.print("Temperature NORMAL");
    Serial.println(h);
  }
  delay(1000);
  noTone(Buzzer);

  if(digitalRead(Gas1)==HIGH)
  {
    lcd.setCursor(0,0);
    lcd.print("Smoke and Methane detected");
    Serial.print("Smoke and Methane detected");
    tone(Buzzer,1000);
    delay(1000);
    noTone(Buzzer);
  }
  else
  {
    lcd.setCursor(0,0);
    lcd.print("No smoke environment good");
    Serial.print("No smoke environment good");
  }
  delay(1000);
  lcd.clear();

  if(digitalRead(Gas2)==HIGH)
  {
    lcd.setCursor(0,0);
    lcd.print("Toxic Gas detected");

    Serial.print("Toxic Gas detected");
    tone(Buzzer,1000);
    delay(1000);
    noTone(Buzzer);
  }
  else
  {
     lcd.setCursor(0,0);
    lcd.print("No Toxic Gas detected");
    Serial.print("No Toxic Gas detected");
  }
  delay(1000);
  lcd.clear();

}
```

(Figure-6)



(Figure-7)

The following picture (Figure-6) shows that our code has run successfully. In Arduino compiler compiling process has done. The code has included the libraries like LiquidCrystal and DHT11. We have assigned the pin numbers and variables as we are going to use in circuit. T and H represents temperature and humidity. Gas 1 and gas 2 represents the MQ-2 and MQ-9 gas sensors. According to code if humidity is more than 75 then it is dangerous condition. Also, if temperature is more than 25 so it is critical situations and worker should leave as soon as possible. For a reference we have took these values as per weather and location we can change these values. Gas 1 (MQ-2) will find if the smoke and methane gas, most common in coal mine, are there or not. If yes, then it will immediately push the Buzzer and warn all the workers and following authorities. Gas 2 (MQ-9) will figure it out that is there any toxic gas is present or not. After getting any sign of toxic gas it will push the buzzer. The gap between every iteration is approximately 9.5 second.

In figure-7 we can see a location of a hex file that represents the temporary location of the compiled code. We can get hex file by enabling preference icon in compiler. We need this hex file to operate our code in proteus simulator. We must paste this link there in program file option. This process will connect both simulators. So that whenever we simulate the circuit in proteus we can operate the code also, the only constraint is we need to open both files at same time.

XIV. RESULTS AND CONCLUSION

An IoT based embedded system for coal mine hazard detection and prevention system was designed and implemented using various IoT components.

Here, the main sensors used were MQ_9, which is sensitive to carbon mono-oxide and flammable gases, and the MQ_2 which is used to detect Methane, Butane, LPG and smoke when in excessive concentrations.

The other important sensor used here is the DHT11 sensor, this sensor detects the temperature as well as the humidity. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and it provides a digital output based on the levels.

These outputs from the sensors are relayed to the MCU i.e., Arduino Uno here, which has the given code loaded on it, based on the values produced by the sensors, the code is traced and the MCU gives output signals to the components attached to it to alert the workers of the mine.

If the recorded values are not within the normal parameters, the connected buzzer is sounded to alert the workers, the warning is also displayed on the LCD display connected to the MCU. This also prompts an alert message in the form of a SMS, and it is sent to the authorized personnel through the GSM.

Thus, this system helps is detecting and predicting any hazardous situation inside the mine based on the sensors, and in a dangerous situation, helps alerting the concerned people, and thus preventing and potential disaster or injuries from happening. It ensures the safety of the miners working. This generates a quick enough response to avert any risky situation.

XV. FUTURE WORK

1. After including most of the work of existing literary surveys and research papers we can say that there are many theoretical circuits and designs but the number of implemented projects is very low. In our IoT-BASED COAL MINE HAZARDS MONITORING AND PREDICTION, we have used only two gas sensors but in real-life scenarios, we can use multiple gas sensors like MQ 1, MQ 2, MQ 3, and MQ 136.

2. Due to a lack of equipment and resources, we were not able to implement vibration sensors and sensors related to the body area network which can help us to calculate the ECG, heart rate, and pulse rate. The gas sensors and the critical level of the respective gas should be known, and then this system can be implemented for detecting various gases either in the domestic area such as places of educational institutions, residential and industrial areas which avoids endangering human lives.

3. As we know that during the period when the worker does their jobs in mine it's hard to review all the workers again and again, so the device can help in this process and make it simple. A vibration sensor can help us to find the possibilities of the earthquake, as we know that it's really difficult to estimate and predict the earthquake but at least we can get some advantages from it.

4. While talking about the sensors we can say that fire sensors also can be used for any condition of fire. Explosives and shot firing, Mine fire (due to methane aka garam gas), and Miners' lamps, flame safety lamps, and general lighting are some basic problems in a coal mine. future aspect point of view, there are many more things which can be implemented for safety purpose. This system provides quick response rate and the diffusion of the critical situation can be made faster than the manual methods.

5. But there are some constraints regarding the project first of all-electric circuits should be safe themselves because the density of methane, in the coal mine, is abnormal than the normal environment, so sparking shouldn't be there. cost plays a big role in every project and work, while using this much hardware, it may become a problem as cost-effectiveness. In the current scenario, there are very less cost-effective designs are there so in the future this problem can be solved.

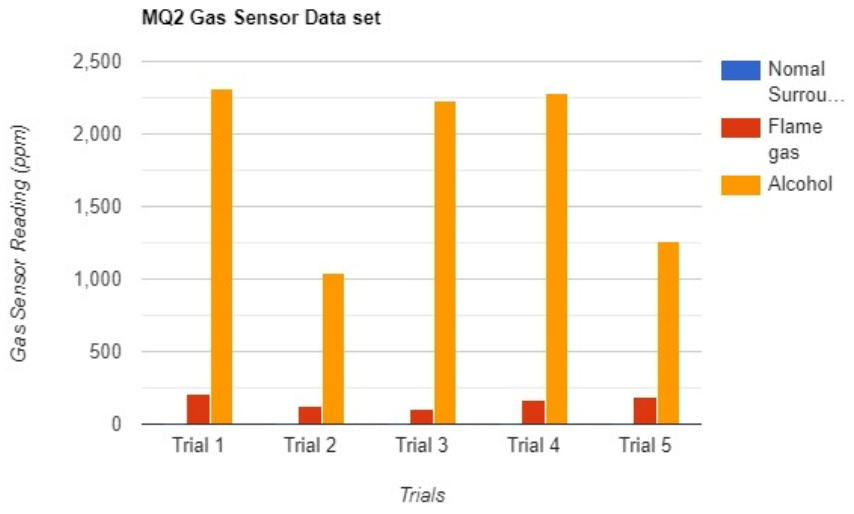
6. Some equipment contains their alternatives like instead of using an Arduino board we can use a microcontroller while building a setup on a large scale these points may refer. This system will provide a quick response rate and the diffusion of the critical situation can be made faster than the manual and already existing methods.

XVI. DATASETS

Experimental Results of MQ2 Gas Sensor

Gas sensor reading (ppm)

SCENARIO	1ST TRIAL	2ND TRIAL	3RD TRIAL	4TH TRIAL	5TH TRIAL	AVERAGE	PPM STANDARD
NORMAL SURROUNDING	0.07	0.07	0.07	0.06	0.06	0.07	0-8
FLAME GAS	21.29	122.95	103.91	164.64	186.72	157.9	100-300
ALCOHOL	2314.89	1038.53	2229.55	2286.1	1260.68	1825.95	1000-2000



***Since the value of normal surrounding nearly equal to zero, its bar is not visible in the above bar-graph.

The average reading for normal surrounding was 0.07ppm, for flame gas was 157.9ppm, and that for alcohol was 1825.95ppm where the standard ppm values for them are 0-8, 100-300, 1000-2000 respectively.

DTH11 SENSOR DATASET

***source: www.kaggle.com/edotfs/dht11-temperature-and-humidity-sensor

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17.Safety Monitoring System in Coal Mine Using IoT

Sathishkumar N1 , Manoj A M2 , Muniraj K2 , Naveenkumar M2 , Praveen C2 1 Assistant Professor, KPR Institute of Engineering and Technology, Coimbatore, Tamilnadu, India.

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