

COAL MINE DISASTER DETECTION

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ABSTRACT

Safety is the most vital part of any type of industry. Negligence in the safety part may cause damaging of high-quality equipment hampering of production or may cause loss of human life also in extreme cases. In the mining industry, safety is a fundamental aspect of all. To avoid any types of unwanted phenomena all mining industry follows some basic precaution and phenomena. Communication is the most vital key factor today, to monitor different parameters continuously and to take necessary actions accordingly to avoid any types of hazards related to safety, production, security or managing of human resources.

To avoid loss of material and damaging of human health, security and safety system as well as reliable continuous faithful communication system is essential in the interior of the underground mines. To enhance security, safety and productivity in underground mines, a reliable communication system must be established between workers, working in the mine and a fixed base station. The communication network must not be interrupted at any moment and at any condition. Inside underground mines, the wired communication network system is not so effective.

Nowadays, coal miners suffer a lot from accidents in coal mines due to the complexity of mining environment. The number of accidents in coal mining is increasing day by day. There are many dangers in every mine. Environmental parameters are monitored to protect those who work in the mines. Miners are more susceptible to a variety of threats, including gas explosions, gas leakages, fire and severe changes in temperature and humidity. This project describes the monitoring system for coal mines using IoT module Wi-Fi. The module is equipped with a network of sensors such as a humidity sensor, gas sensors (for harmful gases), a temperature sensor, vibration sensor and the data from these sensors can be reliably transmitted using Wi-Fi. Most mining accidents are caused by slow data transmission, long range and loss in transmission. This problem can be solved with this wireless communication technology. The system uses a range of sensors all controlled by an Arduino controller in order to achieve this task and send the same to the Wi-Fi app through IoT module interfaced to the Arduino controller.

The project designed with Arduino Microcontroller is aimed to acquire the data of different parameters related to the coal mine. The set values can be programmed in the controller, for example temperature, when the temperature is exceeded more than the set value, immediately the controller activates the buzzer or the alarm. Likewise, the MQ 2 is used to sense the harmful gases, DHT 11 sensor for Temperature and Humidity measurement, vibration sensor for any explosions or earth quakes. All the parameters are continuously monitored, processed by the controller and simultaneously sends the same information to the android mobile Wi-Fi app through the Wi-Fi modem interfaced to the controller.

When any of the parameter goes abnormal, automatically buzzer will be activated and the information will be transmitted using Wi-Fi module. The required power supply for the entire module to operate is directly derived from the mains single phase supply. As we are using Wi-Fi module, the project work falls under the topic of IoT. IoT refers to the infrastructure of connected physical devices which is growing at a rapid rate as huge number of devices and objects are getting associated to the Internet. Weather monitoring is a very useful application of IoT and we are using it to upload the parameters values to an app. The system will inform the authorized persons about

any abnormal parameters when found by sending a notification to the user. After the user gets the notification, he can take the necessary actions.

An Android application is to be downloaded in the android device and connection with the Wi-Fi module is to be established to intimate the alerts from the controllers about the inputs, thereby reducing the manual process of monitoring. Wi-Fi (Short for **W**ireless **F**idelity) is a wireless technology that uses radio frequency to transmit data through the air. Wi-Fi has initial speeds of 1mbps to 2mbps. Wi-Fi transmits data in the frequency band of 2.4 GHz. It implements the concept of frequency division multiplexing technology.

INTRODUCTION

With science, it's always a step ahead you can think of. Just think of an operation you want to perform and you can embed it to be done automatically. It's nothing but Embedded Systems. Engineers' minds all over the world have done lots in this area which though is a boon from electronics engineering but requires sound knowledge of both electronics' hardware as well as software. Engineers from Multi remotes are here with a range of tested projects on Embedded Systems.

In the 21st century, there were lots of inventions, but at the same time there were pollutions, global warming and so on are being formed. So, it's too important to find the solution for sea weather monitoring system. IoT is a solution. In recent days, developments in computing and electronics technologies have triggered Internet of Things technology.

Internet of Things can be described as the network of electronics devices communicating among them by the help of a controller. The IoT is a collection of devices that work together in order to serve human tasks in an efficient manner. It combines computational power to send data about the environments. These devices can be in form of sensors, appliances, embedded systems, and data analysis microchips. This project presents a low-cost fire monitoring system, which is a solution for extinguishing the fire instantaneously. Microcontrollers and sensors are used for that system.

IOT has proven extremely efficient in its ability to churn out piles of data, where it stands to improve and which will be an area of focus in recent times, is in its analytic capabilities. Learning how to derive meaning from the ones and zeroes as they pour in and, more importantly, act on that knowledge while it is still relevant, will be the challenge many businesses begin to tackle in 2017. The Internet of Things, or IoT, has changed the frequency with which we interact with machines. Last year, there were an estimated 6 billion IoT devices in use, and it is not only consumers using them. Everyone, from organizations to governments is looking at IoT to streamline processes and improve productivity in newer ways. The utility industry is going through a unique process of innovation and evolution. Renewables, IoT, and Electric Vehicles, among others, are dramatically changing the way we manage and interact with energy. This revolution comes along with new products and services, competition from outsiders, significant regulatory changes, and a savvier and more demanding consumer.

This project presents a low power, cost-effective, and IOT based wireless sensor network that provides an intelligent surveillance and safety system for underground my applications. This small size, low power device is easily interfaced with desired miniature size sensors (Gas, Humidity and Temperature). This network can be easily placed in underground mines and it provides an effectively surveillance and safety system for underground miners. Especially, it provides the real-time data communication between miners and surface control room through highly secure, reliable

wireless IOT communication. The proposed system improves the existing miner's safety and early warning surveillance in underground mining operations.

The mining safety systems can include:

- **Fixed gas detection systems** - a [gas detector](#) can monitor flammable and toxic gases, including methane, carbon monoxide and CO₂. We can monitor a full range of different gases at different sensitivity levels.
- **Environmental monitoring** - air and gas flow, temperature and humidity sensors measuring changes to your mining operations make sure that conditions remain safe.

A hazardous area is a location or confined space where there is likely to be clouds of dust, humidity, flammable gases or vapors, temperatures, etc. This could cover many industries, from underground mines and tunnels to oil rigs. Many of these workplaces also carry a risk of gases; so for the safety of your workers and valuable machinery, there is need for the environmental monitoring and gas detection systems.

However, not every product is suitable for use in a hazardous area. Electrical equipment used in a hazardous area, whether it's lighting, an environmental monitoring system or a telephone, needs to be specially designed so that it will not cause an explosion. This is known as intrinsic safety or IS, a standard requirement for any electronic device in mines and tunnels. Features of an intrinsically safe device include:

- Low voltage and current controlled with resistors
- Minimum surface temperature
- Robust heat and spark proof casings
- Isolating relays within circuits

The Gas Sensor (MQ2) module is useful for gas leakage detection (home and industry). It is Suitable for detecting H₂, LPG, CH₄, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time. Measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer.

Description about the sensing circuits of the individual parameters is explained in the further chapters. The demo module is constructed with gas sensor that is connected to the Arduino controller through trigger circuit designed using comparator. When harmful gas is detected, gas sensor will provide a logic signal to the controller. The same way temperature, explosions or earth quakes and humidity sensors are also interfaced to the controller. All these parameter values are read and will be transmitted when any of the parameter goes abnormal automatically through Wi-Fi.

Any Micro-controller, that functions according to the program written in it. Here the program is prepared in such a way, so that the system performs the function of establishing a digital communication between two distant units. The program is nothing but an instruction set, this is often prepared in binary code, & are referred as machine code, there by this software is called as machine language. Writing a program in such a code is a skilled and very tedious process. It is prone to errors because the program is just a series of 0's and 1's and the instructions are not easily comprehended from just looking at the pattern. An alternative is to use an easily comprehended form of shorthand code for the patterns 0's and 1's. Micro controller can read and it can store the information received from the remote-control unit. Micro-controllers are dedicated to one task and run one specific program. The program is stored in ROM (read-only memory) and generally does not change. If there are any modifications in the function,

or errors in the software, the existing program must be erased from the chip & again modified program must be loaded in the chip through chip burner.

HARDWARE DETAILS

The IC's and other important components used in this project work, procured from the Hyderabad Electronics Market. The details or data sheets of the IC's are down loaded from the Internet. The following are the web sites that can be browsed for collecting the data sheets.

1. [www. Texas Instruments.com](http://www.Texas Instruments.com)
2. www. National semiconductors.com
3. www. Fairchild semiconductors.com

The following are the components used in the project work:

1. Arduino Uno Micro-controller board
2. Gas Sensor (MQ2)
3. Temperature and Humidity Sensor (DHT 11)
4. Vibration Sensor
5. Wi-Fi
6. Voltage regulator
7. BC 547 Transistor
8. LCD

The required PCB'S (Printed Circuit boards) for the project work fabricated by SUN RISE CIRCUITS, Kushaiguda Industrial Estate, Hyderabad. Kushaiguda Industrial Estate is very famous for fabricating the Industrial grade PCB's.

CONCLUSIONS

The mine safety system is implemented with gas sensor, vibration sensor and DHT11 sensors to improve the safety of miners and prevent hazards. This system is used to continuously monitor the mine and employees are alerted via WiFi. This system is inexpensive and effective. The use of a wireless sensor network improves the safety of a coal mine. The wireless connection is more flexible, eliminates the need for reconnection and greatly improves the performance and efficiency of data transfer in mining security systems. When we parameter values to a computer, the saved values can be used to identify them before a risk occurs. This helps to rescue the miners at right time and save their lives.

The project work is successfully designed, tested and a demo unit is fabricated and the results are found to be satisfactory. Since it is a prototype module, a simple module is constructed, which can be used for many applications. While designing and developing this proto type module, we have consulted few experts those who are having knowledge in embedded systems and these professionals working at different organizations belongs to Hyderabad helped us while fabricating this project work. Since it is a prototype module, much amount is not invested. The whole machine is constructed with locally available components. Some of the modifications must be carried out in design to make it as real working system.

By keeping the embedded devices in the environment for monitoring enables self protection (i.e., smart environment) to the environment. To implement this need to deploy the sensor devices in the environment for collecting the data and analysis. By deploying sensor devices in the environment, we can bring the environment into real life i.e. it can interact with other objects through the network. Then the collected data and analysis results will be available to the end user.

The major and critical task is preparing the software for performing the tasks depending on the inputs. The performance of the module purely depends on the software (code) we define in the controller. The technology utilized here is for developing the prototype module only; it has to be enhanced to develop it into a real working system.

REFERENCES:

The following are the references made during the development of this project work.

Text Books:

1. Linear Integrated Circuits – By: D. Roy Choudhury, Shail Jain
2. Digital Electronics. By JOSEPH J. CARR
3. Fundamental of Radio Communication: By A. SHEINGOLD
4. Basic Radio and Television: By S.P. SHARMA
5. Digital and Analog Communication System By: K. Sam Shanmugam
6. Relays and their applications - By: M.C. SHARMA
7. Op-Amps Hand Book - By: MALVIND
8. The concepts and Features of Micro-controllers - By: Raj Kamal
9. The 8051 Micro-controller Architecture, programming & Applications - By: Kenneth J. Ayala
10. Programming and customizing the 8051 Micro-controller - By: Myke Predko
11. Electronic Circuit guide book – Sensors – By JOSEPH J. CARR

Catalogs:

- (1) TEXAS - LINEAR IC's manual
- (2) SIGNETICS - DIGITAL IC's manual