IOT BASED SMART MINE SAFETY SYSTEM USING ARDUINO

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Abstract- In today's life safety is the major challenge for all the mining workers. The mining safety system ensures the hazard free working environment. The main purpose of the project is to reduce the mining accident and improve the working conditions. IoT based mine safety system has various sensors for several purpose and the Arduino Uno is used for better reliability. All the sensors are together considered as a unit and this system is placed in the mining industry. The various parameters such as temperature and humidity value, light intensity level, poisonous gas level in the air and trace of flame are observed from the working area by the sensors. These sensors values are sent to the Arduino for further process and if the values exceed the threshold level an alert message is sent to the mining control room. In any emergency situations the buzzer is used to alert the workers who are working inside the mining working area. The RF transmitter sends the accelerometer value to the Arduino. The wifi module enables the internet access to the mining safety system. All the sensed values are printed on ThingSpeak website which gives the Application Programming Interface (API) key to interface the system and ThingSpeak.
Keywords- Internet of Things, Arduino, ThingSpeak, API key, Mining safety system

I. INTRODUCTION

Internet of Things (IoT), also sometimes referred to as the Internet of Everything (IoE), consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware. These devices, often called "connected" or "smart" devices, can sometimes talk to other related devices, a process called machine-to-machine (M2M) communication, and act on the information they get from one another . Humans can interact with the gadgets to set them up, give them instructions or access the data, but the devices do most of the work on their own without human intervention. Their existence has been made possible by all the tiny mobile components that are available these days, as well as the always-online nature of our home and business networks.

Mining is one of the most dangerous trades all over the world. In some countries, underground miners lack safety, social guarantees and in case of injury may be left to cope without assistance [1]. The mining industry has the highest incidence of occupational deaths among all industries. Common causes of occupational deaths include rock falls, fires, explosions, methane intoxication, and electrocution [3]. To overcome all these disasters, a better communication technology which has intelligent sensing and warning system is required. For this, IoT technology is chosen for the communication inside the mining industry [4].

II.   CHALLENGES IN MINING SECTOR

Mining is known as the killer industry due to it is dangerous for the health of miners who often have to work in unsafe conditions in underground mines. Frequent accidents occur in mines due to collapse of roofs and water flooding. Mining activities are a major cause for deforestation. Major environmental issues facing modern mining include water resources risks & impacts, air pollution, greenhouse gas emissions & climate change, growing energy needs and scarcity of light.

Environmental impacts of mining can occur at local, regional, and global scales through direct and indirect mining practices. Impacts can result in erosion, sinkholes, loss of biodiversity, or the contamination of soil, groundwater, and surface water by the chemicals emitted from mining processes. Workers fell off ladders, slipped on rocks, inhaled silica dust, or suffered from mercury, lead or arsenic poisoning. Many got sick from drinking dirty water and living too close together. Miners faced immediate dangers, as well as health problems that developed over time.

III.   METHODOLOGY

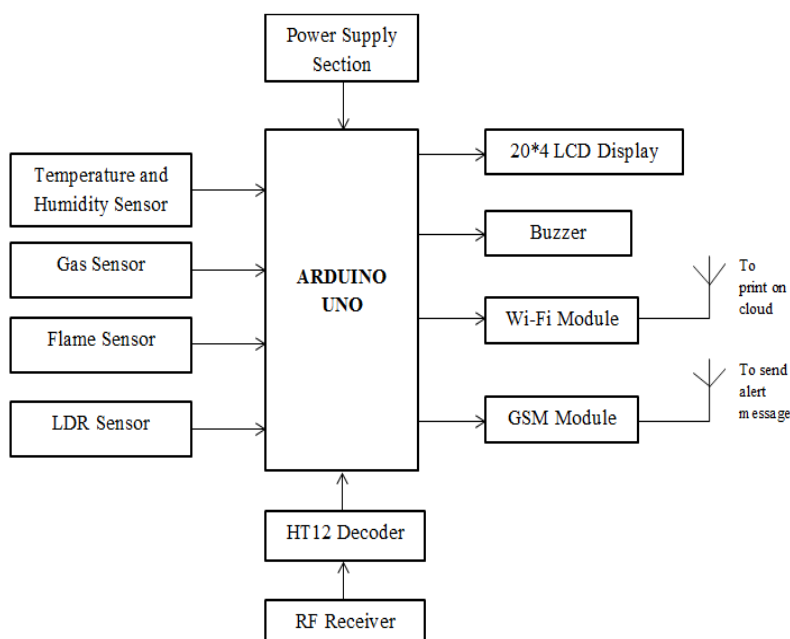The mine safety system consists of various sensors along with Arduino uno microcontroller.

Fig. 1 Block Diagram of Mining Unit

This unit is placed at various places in mining industry to absorb the working environment. The Fig.1 shows the block diagram of mining unit which consist of sensors and display unit. The sensed values are absorbed by the Arduino uno and stored to the cloud. If the mining parameters increased beyond the threshold level an alert message is sent to the control room. If any trace of flame is found the buzzer will ON to alert the workers in mining unit. The safety system consist of THD11 (Temperature and Humidity sensor), MQ11(Flame sensor), Gas sensor

and LDR sensor to monitor the physical parameters of mine unit which is difficult to predict for human beings. Along with it consist of buzzer, LCD display, wi-fi module and GSM module.
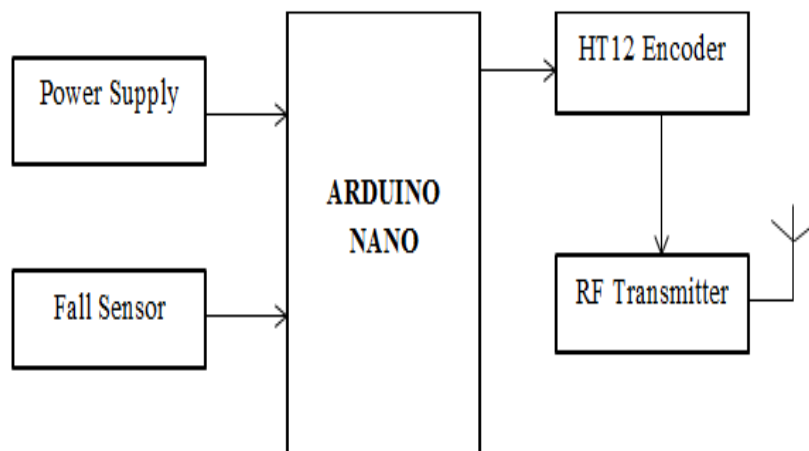

Fig. 2 Block Diagram of Miners unit

Miners unit shows in Fig.2 is given to each individual worker present in the mining industry to monitor the worker health conditions.

IV. PROJECT DESCRIPTION

Arduino based mine safety system consists of various sensors which are connected to controller and sensed values from these sensors are send to the mobile application. Workers start to utilize various monitoring and controlled system in order to increase the working condition. Help of automation of environmental parameters like temperature, humidity and poisonous gases are monitored and control the system which can help the workers to secure their life. The design implements IoT technology using an android device, a main controlling unit (MCU), sensors to measure various parameters and alert system, which will be used to ensure the security of workers. When a significant impact occurs, the fall detector will start diagnosing the fall. Before the alert is transmitted, a vibration pre-alarm starts. During this time, the alarm can be cancelled by moving the arm. This avoids false alarms. The device is also able to avoid any false alarm by analyzing the fall and detecting if it should send an alarm or not. The automatic trigger will only be activated if the person wearing the detector is unable to push the button, for example in case of unconsciousness or immobility. The detector is not activated in all fall situations, such as, where no significant impact occurs. The fall sensor which integrated into the Arduino nano is given to the individual worker to monitor their health condition

V. RESULT ANALYSIS

The physical parameters of temperature and humidity, light intensity value and concentration of gas molecules are measured from the environment of mining and these values are stored on cloud. These results can be viewed as a plot through the thingSpeak website and it can be stored for future analysis. If any uncertainty is found, immediate action can be taken.

ThingSpeak is an open-source Internet of Things application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. Thingspeak provides channels to store the retrieved data by the IoT technology. Each channel includes 8 fields for any type of data, 3 location fields, and 1 status field. Once ThingSpeak channel is allocated, the date is stored in the channel and it can be stored for future analysis.
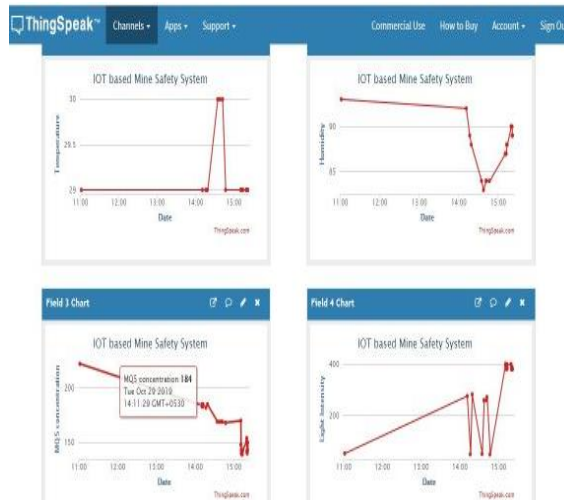
Fig. 3 Display of Sensors output as a plot

Fig. 3 shows the result of mining unit which is sensed by various sensors. This graph describes the measurements of sensors at various time where the x axis shows the time and y axis shows the measurements. The plot remains straight line while the system is under normal conditions. The curves in the plot occur while the value are increased or decreased at any instant of time. Thingspeak is a Matlab supported IoT Analytics platform. It is a free web service that collects and store sensor data in the cloud and develops Internet of Things applications. The results can be viewed as graph in which the fields are predefined. Here four fields are chosen to store temperature, humidity, toxic gas concentration and light intensity level. The sensed values are updated via the internet on Thingspeak. It can show the time and location of the system work. The temperature and humidity are inversion together. One parameter is increased where another one is decreases in the particular place. The toxic gas level is the overall concentration of toxic gases such as methane, carbon monoxide and LPG. As the concentration increases it is known that the hazardous increase in the environment. The light intensity level denotes the brightness of the area. These are the important parameters for the mining industry which help to improve the working environment and reduce the mining accidents.

The alert message is sent to mine control room if any unwanted issues occur. The buzzer in the mining unit is automatically ON when trace of flame is found and fall sensor detects the human uncertainty, at the same time the alert message is sent via internet by utilizing the GPS module. Fig 4 shows the screenshot of alert message which is sent to the control room.
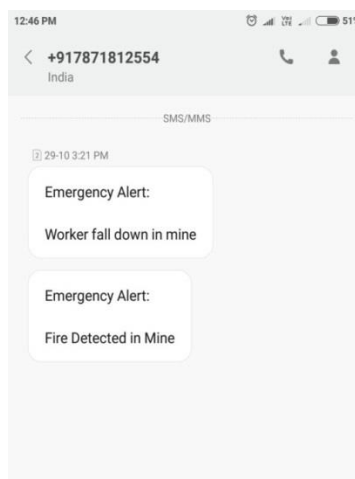

Fig. 4 Display of Emergency Alert

VI. CONCLUSION

In this proposed method, a prototype for mine safety system is developed using Arduino microcontroller. This system is a combination of hardware and software components. The hardware part consists of different sensors whereas the software part consists of an android based application connected to the Arduino board and other hardware components using Internet of Things (IoT). The android based application consists of signals and a database in which readings are displayed from sensors and are inserted using the hardware. The improvement in mine safety system using wireless network is a solution to achieve safety as well as improvement in mining projects. This research tries to automate the process of monitor the mining unit and produce updates though the mobile networks. The hardware components of this system interfaces with all the sensors. This project is used for the optimization use of mining field without the intervention of human by using sensors that senses the environment using Microcontroller that turn ON/OFF the buzzer automatically according to the danger situation

REFERENCES

[1]. Ankit Singh, Upendra Kumar Singh, "IoT in Mining for Sensing, Monitoring and Prediction of Underground Mines Roof Support", IEEE, 2018..

[2]. Boddapati, Pakirabad, "Design of Iot Based Coal Mine Safety System Using Nodemcu", ISSN, vol 8,Issue 6, 2019

[3]. Bonala Ashwini,D.Ravi kiran Babu, "IoT Based Coal Mine Safety Monitoring and Control Automation", IOSR- JCE, vol 20,Issue 6,pp 21-2, 2018.

[4]. S.R.Deokar,J.S.Wakode ,"Coal Mine Safety Monitoring and Alerting System", IRJET, vol 4,Issue 3,pp 2146-2149, 2017.

[5]. K.Hari Prasad, Kannappan.A, "Poisonous GAS and Radiation Detection Monitoring using IoT", IJESC, vol 6,Issue,12,pp3959-3962,2016.

[6]. K.Harshitha,K.Sreeja et.al., "Zigbee Based Intelligent Helmet for Coal Miners Safety Purpose", IJITE, vol 6,Issue 1,pp 403-406, 2016.

[7]. Jagadeesh R,R Nagaraja, "IoT based Smart Helmet for unsafe event detection for mining industry", TRJET, vol 4,Issue 1,pp 1487-1492, 2017.

[8]. Kannappan.A,K.Hari Prasad, "Toxic Gas and Radiation Detection Monitoring using IoT", IJEDR,vol 5,Issue 2,pp1762-1768, 2017.

[9]. Khairul Anwar Bapujee, Nahur Khair Alang Md Rashid, "Wireless Wide Area Radiation Monitoring Network using IoT", Journal of Intelligent Manufacturing & Mechatronics, vol 1,Issue 1,pp14-20, 2018.

[10].S.Lavanya, A.Kishore Reddy "Hazards Detection Using Smart Helmet Sensing Technology in the Mining Industry", ISSN, vol 6, Issue 11,pp 1120-1124, 2017.

[11].Mangala Nandhini. V "IoT based Smart Helmet for Ensuring Safety in Industries", IJERT, Volume 6,Issue 04, PP 1-4, 2018.

[12].Manigandan Muniraj1, "Geo Tagged Internet of Things (IoT) device for Radiation Monitoring", IEEE, PP432-436, 2017.

[13].Ravi K Kodali and Shubhi Sahu, "IoT Based Safety System for Coal Mines", IEEE Internet of Things Journal, PP 147-150, 2018.

[14].G.Ravi Kumar, B.Keerhi ReddY, "IoT Based an Intelligent Helmet for Wireless Sensor Network", IJESRT, vol 3,pp 88-92, 2018.

[15].Shruti P, Borkar, V.B.Bar, "IoT Based Smart Helmet for Underground Mines", ISSN, vol 1,Issue 9,pp 52-56, 2018.