Safety System in Mining Industry Based on IoT

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Abstract— Underground mining industry comes to the category, where each and every parameter such as methane gas, high temperature, fire accidents and so on has to be monitored regularly. Safe production level of mine is still low, disasters in mines occur frequently, which lead to great loss of possession and life. The disasters happening in mines are due to the complexity of mine environment and the variety of work carried out in mine, so it is very necessary to monitor the working environment of mine. The system is implemented to monitor and control various parameters in the coal mines such as light detection, leakage of gas, temperature and humidity conditions, Fire detection in the mine. These all sensors are together considered as one unit and are placed in the coal mines. All the esteems of the sensors are continuously uploaded for analysis. The developed system is mainly implemented to improve the working condition inside the mines and also to ensure workers safety.

Keywords: Cloud Server, Safety system, Sensors, Arduino Platform

I. INTRODUCTION

The Internet of Things (IoT), is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The definition of the internet of things has evolved due to the convergence of multiple technologies, real time analytics, machine learning, commodity sensors, and embedded systems. The primary factor in running any industry successful is to ensure the safety of person working that work area. The underground mining industry comes to the same category, where each and every parameter such as methane gas, high temperature, fire accidents and so on monitor regularly. Every mining industry follows some basic precautions to avoid any type of unwanted phenomena. There are numerous mischance's happening in the mines, and the diggers are putting their lives in hazard by working in the mines, even once in a while they wind up losing their lives in the mines which is an unfortunate part. So, to stay away from this issue we will structure the mine security framework. In our work, we are going to tackle the issues by checking every one of the information gathered by the sensors which we will utilize and the observing is finished utilizing the cloud platform. controlling is possible by both automatically and manually. This IoT system is planned by bearing in mind all these factors i.e. it can measure temperature, fire humidity, gas. Thus, the intended system will give good solution for most of difficulties challenged in mine calamities.

II. RELATED WORK:

Boddapati Venkata Phani Gopal [1] implemented the safety coal system using different sensors and thinger.io platform to increase the safety of workers in mines and to prevent them from danger.

C. Shobana Nageswari1 [2] proposed that using this system variations in the surrounding conditions can be monitored and necessary precautions can be taken. It also provides the technique for tracking the position of the workers which enable the rescue team to provide immediate help in adverse conditions.

G. Pravin Gandhi [3] gives the basic idea for the life saving measures for miners and the concerned authorities. The MQ-7 gas sensor is more sensitive to carbon monoxide but can sense methane, LPG etc. Alarm triggers when sensor values cross the threshold value.

Bonala Ashwini [4] presents underground mines system can be usefully substituted by IoT security structure. The MCU unit is used to create an absolutely robotized surveying system with high exactness and consistency.

G. Prabhakar Reddy [5] designing IoT monitor, safety measures for mine workers which is most essential in underground mining areas. When a critical is detected alert is given by the system and the same statistics is communicated to webserver by initiating ESP8266 module based on wi-fi communication.

III. IMPLEMENTATION

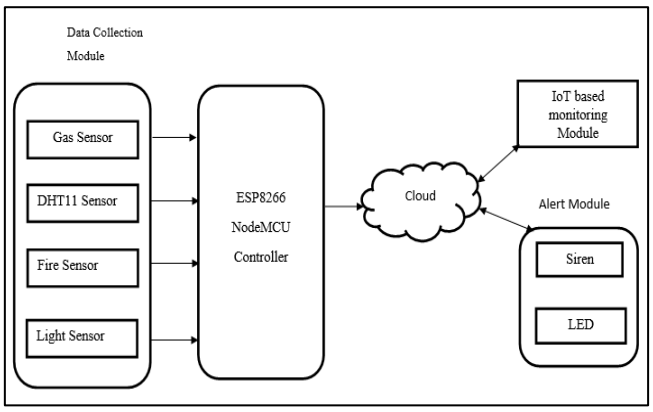


Fig. 1: Proposed system architecture

The above fig. shows the proposed system architecture. The architecture consists of four modules such as data collection module, micro-controller, IoT module and alert module. ESP8266 is a micro-controller which acts as interface for collecting data. IoT module transmits the data to the cloud. Alert module is used to give the alert message to authority in any case of emergency situations.

A. Light Sensor

The light sensor detects the presence of light in the mine. The detected light value will display in analog type. The

lighter present in mine the less analog will display on PC.

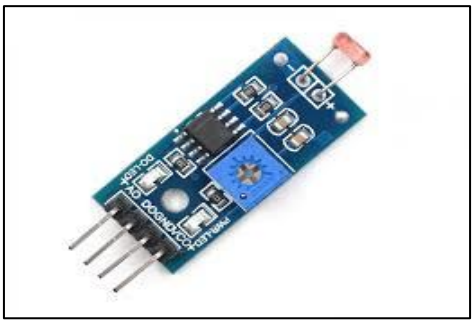


Fig2: Picture of Light sensor

B. Fire Sensor

In this picture the fire sensor detects the presence of fire in the mine. It detects Infrared Rays (IR). The fire sensor gives output of fire detection in digital values only. When fire is present in mines it will display 0 and in absence 1.

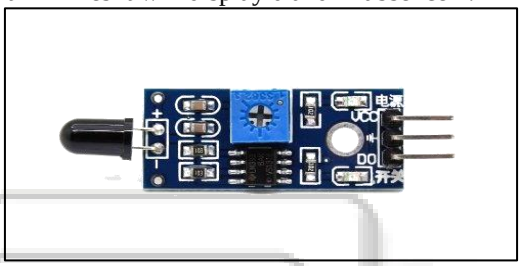


Fig3: Picture of Fire sensor

C. DHT-11 Sensor

It is advanced sensor. It uses its own library. The DHT sensor detects both humidity and temperature in mine. It provides analog values. DHT sensor converts the digital values into analog automatically and displays it.

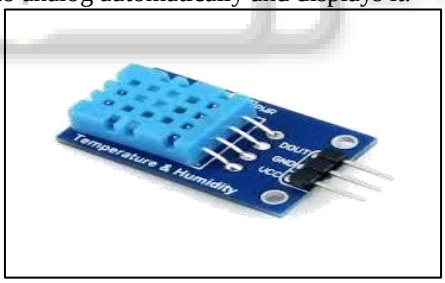


Fig4: Picture of DHT11 sensor

D. Gas Sensor

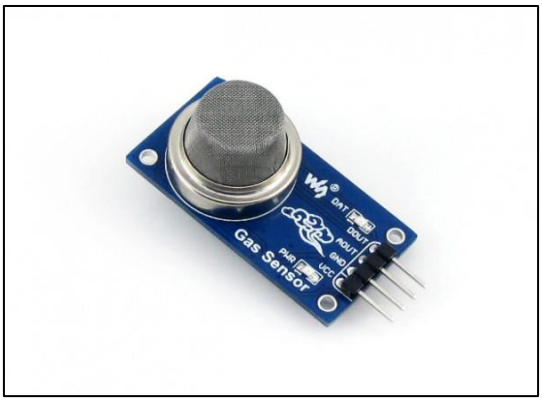
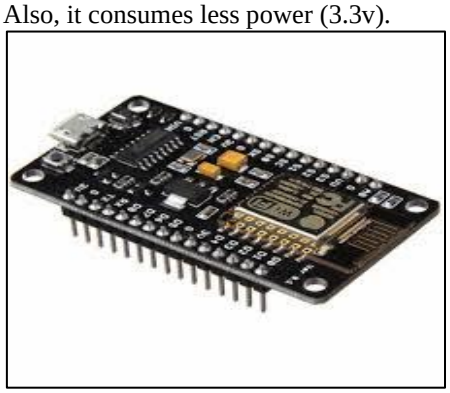


Fig5: Picture of Gas sensor

E. NodeMCU

The Node Micro Controller Unit (NodeMCU) is used as a gateway. It has inbuilt Wi-Fi module which is 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).



IV. MODULES

1) Data Collection Unit:

This module consists of all the sensors setup along with the micro-controller ESP8266 and IoT module, alarm and LED's. The live data from each sensor is obtained as an analog signal and it is sent to the micro-controller. Gas sensor is used to find leakage in the mines. Mostly CO2, CO, SO2 gases are present in the mines. It detects the leakage of gas & send message to the authority. It has a high sensitivity and a fast response rate. Fire sensor is used to detect the fire in the mines. If it detects the fire then it sends information to cloud through ESP8266-12E. Light sensor mainly consists of four pins A0, GND, Digital pin. The power supply for the sensor is 3.3v and the GND pin of a sensor is connected to GND pin of Node MCU, the digital pin of LDR sensor to digital pin of ESP8266-12E. It will detect the light presence in the mines & message will send to the authority. DHT11 is humidity/temperature sensor. It will detect the temperature & humidity in mines. It will send message to the authority. It consists of 3 pins & power supply will be of 3.3V.

2) Interface Unit:

The Node Micro Controller Unit (ESP8266) is used as a gateway. It has inbuilt Wi-Fi module which is used to send the sensor data to cloud for storage and analysis. The main reason behind selecting ESP8266 is that the sensors used in our project uses only digital pins and one analog pin are required. ESP8266 an IoT tool that is best suitable for various applications based on IoT.

3) IoT based monitoring Unit:

An IoT module is a small electronic device embedded in objects, machines and things that connect to wireless networks and sends and receives data. The data from the IoT module goes to the cloud storage. This module is designed in such a way that it records different conditions of the mine. Embedded with technology, these devices can communicate over the internet, and they can be remotely monitored and controlled.

4) Alert Unit:

Siren is used to alert the system in case any accidents. We are controlling the siren with switch widgets created in the cloud platform. LED is used to represent the presence of light in the mines. If there is any uncertain condition occurred it will show the different light according to situation to the authority. The categories that falls under alerts are as follows: minimal risk, risk and emergency. The minimal risk includes low alert levels. The risk level includes definite alert levels and the emergency level includes high alert levels of data found.

V. CONCLUSION

Safety is a major concern in the mining industry. We are designing this system to provide security in mining industry. For this we are using different sensors that takes input data and sends it to PC via microcontroller. The data displayed shows the values of analog and digital signals. Further work includes implementation of remaining modules. Implementation is going to be done using cloud, IoT monitoring module and alerting system. After implementation, deployment of system would be carried out to check the real time use.

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