IOT BASED COAL MINING SAFETY MONITORING SYSTEM USING NODE MCU

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ABSTRACT

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 controls the ventilation demand to mine workers depending upon present climate conditions within the mine field. This system utilizes 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, we will design 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.

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Keywords:wireless sensor network, coal mine monitoring ,the temperature, humidity, gas, vibration
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1. INTRODUCTION

IoT is nothing but the devices communicating with each other by using the internet. IoT applications vary on a large scale. European Research Cluster on the Internet of Things classifies major IoT applications as smart buildings, smart transportation, Smart energy, smart industry, smart health and the smart city as major areas. IoT is a trend-setting innovation in which all the data from sensors is

stored in the cloud where it can be easily accessed from the cloud. Sensors and actuators for gathering the data and sending across the internet are also included in this advancement. We use cloud not only to store data but also for data analysis, gathering, visualization.

In India, we have 493 coalmines present. Coal is the most vital asset in the world. These petroleum products are natural assets of the earth which help create power and for some, purposes. Coal is a non-sustainable source which can't be supplanted commonly by humans, there are numerous coalmine mischance happening in the mines, and the diggers are putting their lives in hazard by working in the coal mines, even once in a while they wind up losing their lives in the coal mines which is an unfortunate part. Mainly these mishaps are happening as a direct result of the old hardware and the wired systems, resulting in the terminate mischance's, spillage of the noxious gases in the coal mines are presenting immense dangers to the excavators inside the coalmines. They can't leave the mine if there is no legitimate lighting which coming about them to harm the mineworker's vision because of working under low lighting area. So to stay away from this issue we have structured the coalmine security framework. In our work, we have tackled the issues by checking every one of the information gathered by the sensors which we have utilized and the observing is finished utilizing the Thinger platform. Controlling is possible by both automatically and manually. The microcontroller here in the work we have utilized is Node MCU.

2. LITERATURE SURVEY

Dangeetal., [1] proposed design which is built on MSP430, Now a day's due to global warming and climate changes there are challenging situations in field of coal mine. To reduce the cost and improve the productivity along with product quality the atomization in the field of coal mine is indeed necessary, which will also reduce the mine workers efforts. This paper proposes a design of a wireless sensor network (WSN) with the help of MSP430xx controller which is able to monitor the temperature, humidity, gas and status of smoke in an underground mine. This system also controls the ventilation demand to mine workers depending upon present climate conditions within the mine field. This system utilizes low power, cost effective microcontroller MSP430, a temperature sensor LM35, humidity sensor SYSH220, smoke detector, gas sensor for sensing the mine climate parameters and a wireless Zigbee transceiver for remote logging of data at central location to control the climate state with the help of motor and valve control circuitry.

Lihuietal., [2] This paper designs a monitoring system for coal mine safety based on Zigbee wireless sensor network. The monitoring system collects temperature, humidity and methane values underground of coal mine through Zigbee sensor nodes around the mine, and then transmits the data to information processing terminal based on ARM. The terminal sends the data to the ground through Ethernet, and then the monitoring centre monitors the data and publishes them to the LAN for remote users to inquire. If the data is ultra-limit, the system can send SMS to related personnel of safety. This system has realized the real-time monitoring of working surface.

Kumar etal.,[3] Health monitoring systems become a hot topic and important research field today. Research on health monitoring were developed for many applications such as military, home care unit, hospital, sports training and emergency monitoring system. In this work, a portable real-time wireless health monitoring system is implemented using Programmable System on Chip (PSoC) and developed. The developed acquisition system is used for remote monitoring of patients' temperature, heart rate and oxygen saturation in blood i.e. pulse oximetry, pH level of blood, ECG. This system allows the physician able to understand patient's scenario on the computer screen by wireless module. Here low cost, low power consumption and flexible network topology ZigBee wireless module is used to sense the remote patient data. PSoC designer tool will be used for implementing the application and building the software.

RajkumarBodduetal., [4] developed a coal mine safety monitoring system, In this work, a safe Coal Mine Monitoring system which replaces the traditional coal mine monitoring systems which tend to be wired network systems. This 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 monitoring blind areas, where are lots of hidden dangers. Moreover, it is inconvenient to lay cables which are expensive and consume time. In order to solve the problems, we 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 mine. Zigbee technology provides a direction for scientists who commit to solve the safety monitoring problems of coal mine. The purpose of this study is to propose a solution suitable to mine wireless communication, safety monitoring, give a proof to the further study.

Ashishetal., [5] described a system that is based on ARM controller and different sensors like temperature sensor, humidity sensor and the gas sensor. An IR sensor is placed in the mine to check the conditions. The main purpose was to provide an implementable design scenario for underground coal mines using wireless sensor networks (WSNs). The main reason being that given the intricacies in the physical structure of a coal mine, only low power WSN nodes can produce accurate surveillance and accident detection data. The work mainly concentrated on designing and simulating various alternate scenarios for a typical mine and comparing them based on the obtained results to arrive at a final design. In the Era of embedded technology, the Zigbee protocols are used in more and more applications. Because of the rapid development of sensors, microcontrollers, and network technology, a reliable technological condition has been provided for our automatic real-time monitoring of coal mine. The underground system collects temperature, humidity and methane values of coal mine through sensor nodes in the mine; it also collects the number of personnel inside the mine with the help of an IR sensor, and then transmits the data to information processing terminal based on ARM.

Wakodeetal., [6] suggested a system that mainly used to monitor the concentration of dangerous gases in the coal mine. To provide safety the systems gives the alerts that will be helpful to the workers in the mine to save their lives. An alert switch is placed at the transceivers and receivers

side for emergency purpose. Today, safety of miners is a major challenge. Miner's health and life is vulnerable to several critical issues, which includes not only the working environment, but also the after effect of it. To increase the productivity and reduce the cost of mining along with consideration of the safety of workers, an innovative approach is required. Coal mine safety monitoring system based on wireless sensor network can timely and accurately reflect dynamic situation of staff in the underground regions to ground computer system and mobile unit.

Aartietal., [7] developed a system that monitors temperature, humidity, methane values in the coal mine and all the values are sent to the ARM9 processor and a using a Wi-Fi module the values are continuously updated in the webpage.

Dheerajetal., [8] 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 are 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.

Cheng etal., [9] Proposed a coal Mine safety Monitoring framework dependent on A wireless coal mine safety monitoring system based on ZigBee wireless sensor network and GPRS wireless remote transmission was established, which enjoys the characteristics of ZigBee technology, including quick networking and real-time parameter monitoring. With mature GPRS technology, remote data transmission was achieved and associated director can be informed through short message sent to his cell phone, which contributes to the early identification of serious accidents and real-time treatment, thus increasing the safety of coal mining.

3. PROPOSED SYSTEM

`In this proposed system the coal mine safety systems are fixed with gas sensor modules, temperature sensor, MEMS sensor and relays. We integrate all the sensors to the Node MCU. First we need to create an account in the ThingSpeak platform. 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 (Thinger.io) for analysis and also for further use. The temperature and humidity values are also monitored inside the coalmine. If in case any fire accidents occur, then immediately fire alert messages are sent to the authorized persons. The proposed system block diagram shown in figure 3.1.
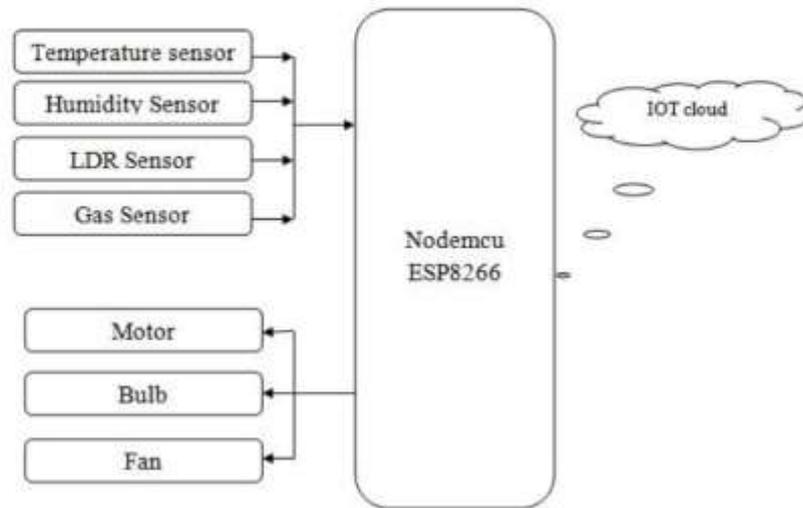
Fig 3.1 proposed system block diagram

GAS SENSOR:

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. Due to its black epoxy, the sensor is sensitive to infrared radiation. In fire fighting robot game, the sensor plays a very important role, it can be used as a robot eyes to find the fire source.
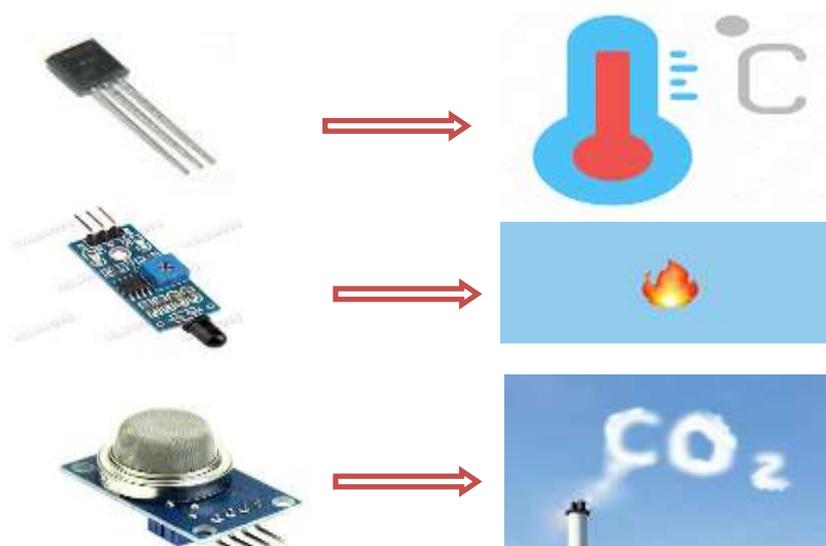

Fig 3.2 Interfacing of Gas sensor

NODEMCU:

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 post a data cloud for view remotely and also it will enable the actuator to controlling the emergency appliances.
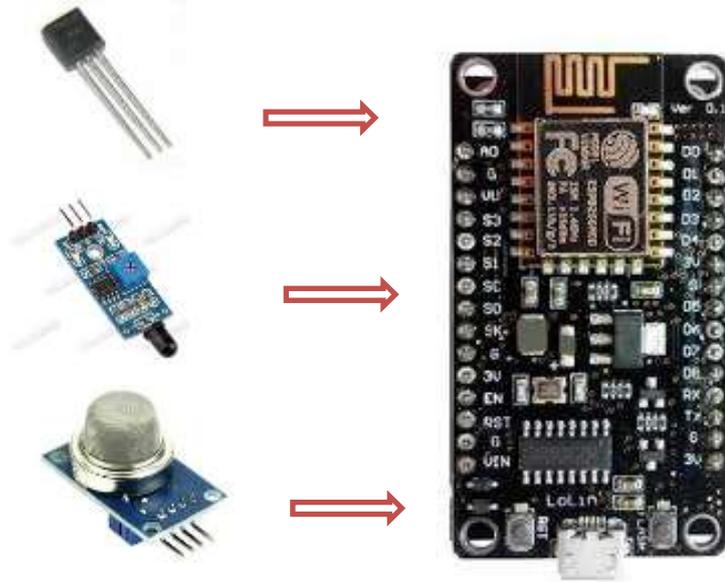
Fig 3.3 Interfacing of Node MCU

RELAY:

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts.
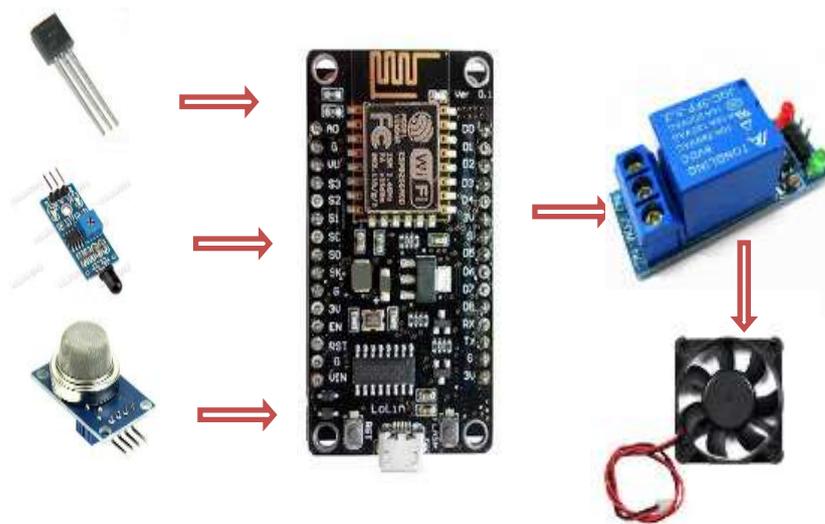
Fig 3.4 Interfacing of Relay

4. RESULTS AND DISCUSSION

In this chapter, we discuss the various simulation output results.

Humidity Output

The Humidity simulation output result shown in figure 4.1.

Fig 4.1 Humidity vs Time

From this simulation result, sensor will measure and report moisture and air temperature. According to the moisture, the output will be varied.

Temperature Output

The Temperature simulation output result shown in figure 4.2

Fig 4.2 Temperature vs Time

This will measure the temperature level in the mining process. If the emperature increases, the output of the graph will be vary.

Light Output

The light simulation output result shown in figure 5.3.

Fig 4.3 Light intensity vs Time

LDR sensor will sense the light intensity and that value is noted. According to the light intensity, the output graph will be varying.

Gas Output:

The gas simulation output result shown in figure 4.4.

Fig 4.4 Gas vs Time

The gas sensor detects or measures the poisons gas in the mining process. According to the gas level, the output of the graph will be varied.

5.5 Vibration Output:

The vibration simulation output result shown in figure 4.5.

Fig 4.5 Vibration vs Time

This sensor detects the vibration of the ground coil during the process. According to the level of vibration, the graph will be vary.

5 .CONCLUSION

A Coal mine safety monitoring system is developed to provide clearer and more point to point perspective of the underground mine. This system is displaying the parameters on the serial monitor at the underground section where sensor unit is installed as well as on the monitoring unit; it will be helpful to all miners present inside the mine to save their life before any casualty occurs. Alarm triggers when sensor values cross the threshold level. Implementation of Coal mine safety system is implemented using Fire sensor, Gas sensor to increase the safety of the workers in the coal mine and to prevent them from danger, by using this system constant checking of the coalmine and alerting the worker is done. The system is cost-effective and efficient.

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