Design Of Iot Based Coal Mine Safety System Using Nodemcu

Boddapati Venkata Sai Phani Gopal, Pakirabad Akash, P.S.G.Aruna Sri

ABSTRACT: ***In this paper, a coal mine safety system is implemented using a Thinger Io platform as a medium to transmit the data. 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 coal 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 to the thinger for analysis. Here the gas is continuously monitored if any uncertainties in the level of gas arise, then buzzer is used to alert the workers. In this system LDR sensor is utilized to detect the presence of light. Automatically light gets one and can be controlled using the LED button. In case if any fire occurs in the coal mine, then an alert notification is sent to the mail of the authorized person. Temperature and humidity values are also continuously monitored and displayed on the serial monitor and also in the thinger platform. The developed system is mainly implemented to improve the working condition inside the coal mines and also to ensure workers safety.***

Keywords –Cloud Server, Safety system, Sensors, Thinger.io

I. INTRODUCTION

Internet of Things (IoT) is nothing but the devices(things) communicating with each other by using the internet [1,2,3]. 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. Such an emerging technology can be used in various IoT applications like agriculture, health, smart home etc, to make the already existing systems more efficient. The key characteristics of the cloud include on-demand service provision, ubiquitous access, resource pooling and, elasticity.

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Boddapati Venkata sai Phani Gopal, B.Tech Student, Department of Electronics& Computer Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India.

, Pakirabad Akash, B.Tech Student, Department of Electronics& Computer Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India.

P.S.G.Aruna Sri, Assistant Professor, Department of Electronics& Computer Engineering, Koneru Lakshmaiah Education Foundation, Vaddeswaram, AP, India.

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's 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. In the underground coalmines light is an essential thing to convey their work, 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

II. LITERATURE REVIEW

Kumar et al[1] proposed design which is built on MSP430, In the coal mine various parameters like Temperature, humidity, gas and smoke are monitored. A Zigbee transceiver is placed at the center location and by using the motor climate state is controlled.

Lihui et al[2] implemented a system, where temperature, humidity, methane values of the coal mine are collected by the sensor nodes and the information is collected by ARM controller for processing, for communication purpose Zigbee is utilized. If any esteems goes high, then an SMS is sent to maintain the safety of the workers.

Madhu et al[4] developed a coal mine safety monitoring system by utilizing Temperature, humidity and the amount of carbon-dioxide present are checked. If any uncertain condition occur then message is sent with the help of GSM to the forest and fire departments

Ashish et al [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.

Wakode et al[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.

Aarti et al[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.

Dheerajet al[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

Dong et al[9]proposed a coal Mine safety Monitoring framework dependent on Zigbee and GPRS remote transmission was established. With GPRS innovation, remote information transmission was accomplished and informed through the short message sent to his cell phone, which adds to the early ID of genuine mishaps and continuous treatment, subsequently expanding the security of coal mining.

COAL MINE SAFETY SYTEM

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, buzzer and led. We integrate all the sensors to the Node MCU. First we need to create an account in the Thinger platform.

In this system we mainly have monitoring and controlling systems 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 gets 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 he monitored inside the coalmine. LDR sensor is used to measure the intensity of the light by varying its resistance value. If there is an obstacle to the LDR sensor then led gets on automatically. If in case any fire accidents occur, then immediately fire alert messages are sent to the authorized persons mail and also the link of the location is shared. Controlling system is completely done using thinger platform. In the thinger platform, we create widgets .by using the widgets we control buzzer and led manually.

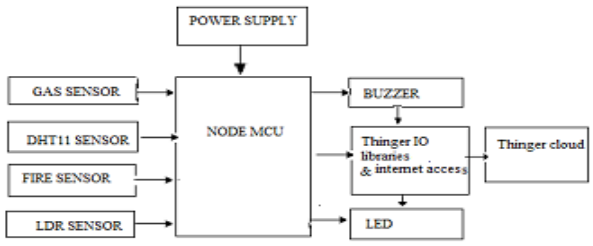

Fig. 1 represents an overview of the proposed system

Sensor:

Choosing a sensor is a difficult task, according to the application requirements we have to choose sensors, if the system has to sustain for long time sensors should work accurately, they should be reliable

Gas sensor:

Here mq2 gas sensor is used, in particular in using the mq2 sensor. It has a high sensitivity and a fast response rate. Gas sensor mainly comprises of four pins, where three pins are used A0, GND, VCC,A0 is an analog pin that is connected to the analog pin of Node MCU,GND is connected to GND, VCC supply is 3.3v.This sensor effectively detects gas leakage in industries and detect combustible smoke and gases.

Fig. 2. Picture of Gas sensor

Fire Sensor:

Here Fire sensor is used to detect the fire in the coal mines. Fire sensor mainly comprises of four pins, where three pins are used A0,GND, VCC,A0 is analog pin that is connected to analog pin of Node MCU, GND is connected to GND, VCC supply is 3.3v .

Fig 3: Picture of Fire sensor

LDR Sensor:

LDR sensor mainly consists of four pins A_0, 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 Node MCU

Fig4: Picture of LDR Sensor

DHT11 Sensor:

DHT11 Sensor is used to check the temperature and humidity values inside the coalmines.DHT11 sensor consists of three pins, power supply of dht11 is 3.3v,Gnd pin is connected to GND pin of NodeMCU, Digital pin of a dht11 sensor is connected to Digital pin of NodeMCU.

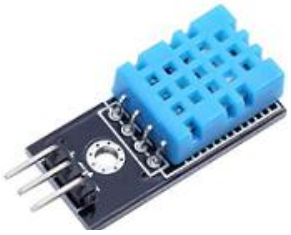

Fig5: Picture of DHT11 sensor

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) and is of low cost when compared to other microcontrollers /processors like Arduino and Raspberry pi. Node MCU is connected to ultrasonic sensors, gas sensor, temperature sensor, IR sensor. All the values are connected and send to Cloud server.

Fig. 6. Photo representing Node MCU

The ESP8266 is designed and manufactured by Espressif Systems. NodeMCU contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs just $2 USD a piece. The features like establishing a Wi-Fi connection with just a few lines of code, Plug and play mode, Programmable Wi-Fi module and Arduino like software and hardware I/O made NodeMCU an IoT Tool that is best suitable for various applications based on IoT. It has a deep sleep mode which consumes 60mA is useful for the low power consumption of an application. Some more features of NodeMCU are:

- 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.

THINGER.IO Platform:

It is an open source platform for IoT. It provides scalable cloud infrastructure for connecting things, devices. With the Thinger io, devices can be controlled from internet within minutes.

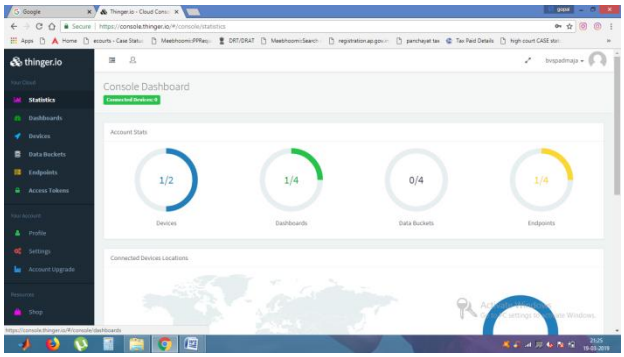

Fig 7:image of Thinger io platform.

To use the thinger platform first create an account in the thinger platform. In the console a dashboard, it will show the number of devices connected. It can connect up to 4 devices at a time in the platform. In Devices, you can manage and access the item .it displays how many devices are connected in the project. A dashboard is created using an dashboard id ,Each dashboard can be connected to different sensors and actuators .Widgets is created in the dashboard for monitoring the values .In Data buckets, here we can access and manage your buckets .Data buckets are used to store the historic information about the project .End points are used to communicate with third party devices, here in endpoints can be called by devices to make the HTTP request ,sending emails etc.

III. RESULT AND DISCUSSION

Experimental Setup:

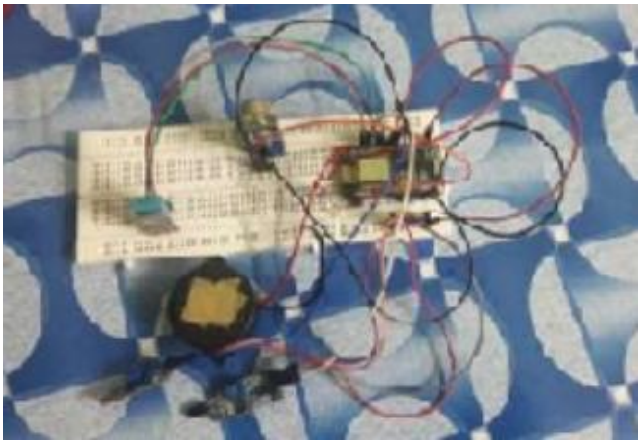

Fig8: Set up of coalmine safety system

All the values of the sensors are collected by NodeMCU and are sent to Thinger io

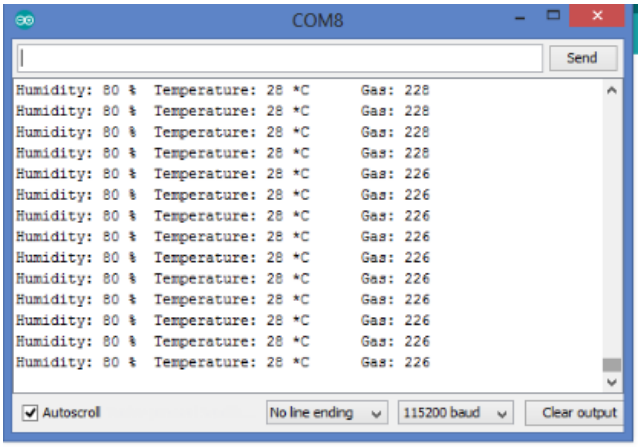

Fig9: screenshots representing the values and the message displayed on the serial monitor

The Temperature, Humidity and gas values are displayed on the serial monitor.

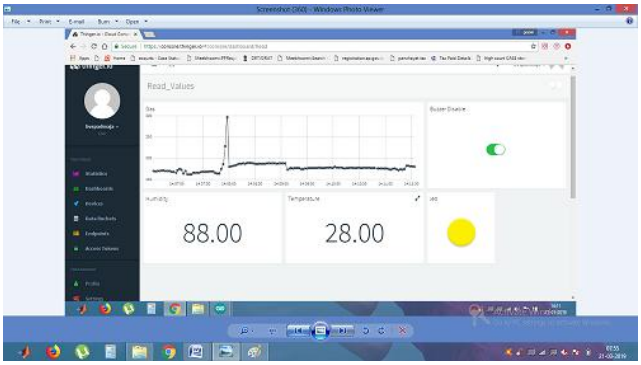

Fig 10:screenshots values of all the sensors displayed on the Cloud using widgets.

We are controlling the buzzer with switch widgets created in the cloud platform. When the light is not detected in the coal mines then the yellow button represents the absence of light in the coal mine. If any uncertain conditions occur then notification is sent to the mail of the authorized person.

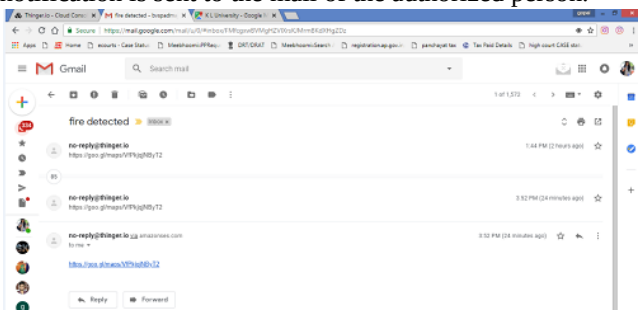

Fig 11: Screenshots showing the alert messages to the email is there is a chance of catching the fire

IV. CONCLUSION:

Implementation of Coal mine safety system is implemented using Fire sensor, Gas sensor, LDR sensor, DHT11 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 by using Thinger io. The system is cost-effective and efficient

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AUTHORS PROFILE

Boddapati Venkata saiphaniGopal
Student in department of Electronics and computer Engineering BTech 1V/1V in Koneru Lakshmaiah Education foundation, Vaddeswaram AP India

Pakirabad Akash
Student in department of Electronics and computer Engineering BTech 1V/1V in Koneru Lakshmaiah Education foundation, Vaddeswaram AP India

P.S.G.Aruna Sri
working as an associate professor in ECM Dept., Koneru Lakshmaiah ducation Foundation,Vaddeswaram, AP India.