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Zigbee Based Intelligent Helmet for Coal Miners Safety Purpose

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Abstract: In recent days coal mining has been a very dangerous activity that can result in a number of adverse effects on the environment for example during mining operations methane, a known greenhouse gas, may be released into the air. Underground mining hazards include suffocation, gas poisoning, roof collapse and gas explosions. Keeping all these aspects in mind we designed a system, i.e. smart helmet using zigbee technology for monitoring the hazardous gases, abnormal temperature conditions and the humidity levels in the air. The improved safety features in our system dramatically increased life expectancy of the coal miners by alerting them about the hazards. In our system, the helmet is having the circuit with three sensors i.e. temperature, humidity and gas to monitor the conditions in coal mine. If there is any hazardous situation in the mine the helmet gives the information to the control station through the zigbee transmitter and the control station will alert the coal miner using the zigbee receiver by making the buzzer active which is positioned in the helmet so that a miner can have a chance to rescue his life from the hazards occurred in coal mines.

Keywords: Zigbee, LEDS, DC-DC Converters.

I. INTRODUCTION

The most important part of any type of industry is safety. In the mining industry safety and security is a first aspect of all. To avoid any types of unwanted conditions, every mining industry follows some basic precaution. Communication is the most vital key factor today, to monitor different parameters such as temperature, increasing humidity level, and carbon monoxide gas continuously using sensors such as LM35, gas sensor MQ2 and humidity sensor to take necessary actions accordingly to avoid any types of hazardous conditions and gives an alert using buzzer. To achieve safety in underground mines, a suitable communication system must be created between workers, moving in the mine, and a fixed base station. The wired communication network technology system will be not so effective. Under the mines due to uncomfortable situation the installation cost as well as maintenance cost is high for wired communication networks. For the successfully data transmission, in this work a low cost ZigBee is utilized in routers. A cost effective based mine supervising system with early warning security system on carbon monoxide, temperature, humidity in mining area is proposed.

II. PROJECT OBJECTIVE

This project focuses on a mine supervising system which is based on the cost effective IOT (ZigBee) system. Our project aims at developing a sensor networks, realized real-time surveillance with early-warning intelligence on harmful gases, temperature, humidity in mining area and used ZigBee communication to reduce potential safety problems in coal production using a ZigBee technology. All these three parameters are detected continuously by temperature sensor, gas sensor, humidity sensor and if they cross the pre-defined limit, then the user gets information about all three sensors and it displays on thing speaks site as the graphs and it will automatically updates the values to this site. With a Zigbee positioning devices the system might be easily extended. The values of different sensors are continuously transmitted by ZigBee transmitter to the remote monitoring unit which are received by Thingspeak site through IP address.

III. EXISTING METHOD

A. Led Type Helmets

Led type helmets are usually powered by three or four AA or AAA batteries. Systems with heavy batteries (4xAA or more) are usually designed so that the light emitter is positioned near the front of the head, with the battery compartment at the rear of the head. The headlamp is strapped to the head or helmet with an elasticized strap. It is sometimes possible to completely disconnect a headlamp's battery pack, for storage on a belt or in a pocket. Lighter headlamp systems are strapped to the user's head by a single band; heavier ones utilize an additional band over the top of the user's head. White LEDs were quickly adopted for use in headlamps due to their smaller size, lower power consumption and improved durability compared with incandescent bulbs. Power LEDs rated 1 watt or more have displaced incandescent bulbs in many models of headlamps. To avoid damage to electronic parts, a heatsink is usually required for headlamps that use LEDs that dissipate more than 1W. To regulate power fed to the LEDs, DC-DC converters are often used in 1W+ lights, sometimes controlled by microprocessors as shown in Fig.1. This allows

the LED to provide brightness that is not affected by a drop in battery voltage, and allows selectable levels of output. Following the introduction of LEDs for headlamps, sometimes combinations of LED and halogen lamps were used, allowing the user to select between the types for various tasks.

Fig.1.Head lamps.

Advantages:

- LED type helmets are extensively deployed in large and medium sized coal mines because of their flexibility of light weight and low power.
- White LEDs were quickly adopted for use in headlamps due to their smaller size,lower power consumption and improved durability compared with incandescent bulbs.

IV. PROPOSED METHOD

A. Smart Helmet Using ZigBee

Keeping all these drawbacks in led type helmets, design a system, i.e.; smart helmet using zigbee technology. Meanwhile ZIGBEE based wireless sensor networks are recently investigated due to their remote environment monitoring capabilities. Such a network can easily collect sensor data and transmit by radio. By integrating these two advantages we design a new smart helmet, which can be enable as a mobile node of zigbee wireless sensor networks, gathering parameters from underground timely and quickly. Moreover miners can also exchange information from control center through wireless communication.

B. Block Diagram

It contains transmitter and receiver sections the below fig.2 shows the transmitter block diagram of Smart Helmet for Coal Miners using ZigBee Technology.

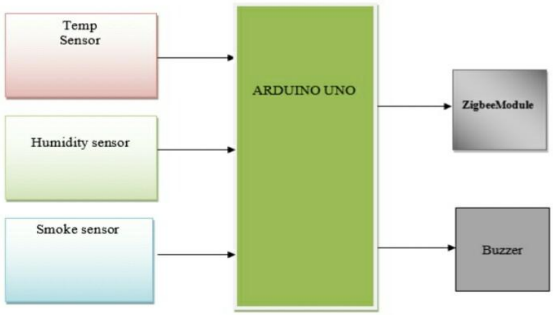

Fig.2. Block diagram of smart helmet using zigbee technology.

B. Working of The Project

As shown in above block diagram, helmet unit consist of microcontroller (AT328P), Zigbee communication module, temperature sensor (LM35), humidity sensor (DHT11), gas sensor (MQ2), power supply (adaptor 12v). Three sensors (temperature, humidity, gas) which are connected to microcontroller AT328P .These three sensors are connected to the adc ports of microcontroller to convert the analog values into digital form. The sensors available in the helmet collect the temperature, humidity and gas information and send this information to the remote monitoring unit. Low rate Zigbee is used for data transmission. When the control center detects the parameters are sends remote control area which is Thing speak sites through IP address. A temperature sensor (LM35) shows the present temperature every 10 min it plot the graph with respect the values in Thing speak site. Similarly remaining sensors sense respective values and post controlling area i.e. Thing speak site trough IP address. All values shows in the form graph representation.

C. Aurdino Controller

The Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started as shown in Fig.3.

Fig.3.Aurdino controller.

D. Temperature Sensor (LM 358)

We use LM35 Precision Centigrade Temperature Sensors whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full -55 to +150°C temperature range as shown in Fig.4. Low cost is assure by trimming and calibration at the wafer level. The LM35's low output impedance, linear output and precise inherent calibration make interfacing to readout or control circuitry especially easy.

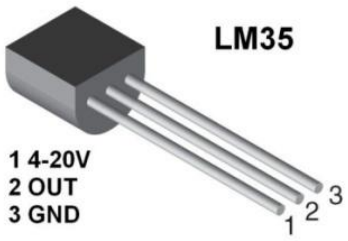

Fig.4.Temperature sensor.

E. Smoke Sensor

Fig.5.Smoke sensor.

Features:

- High sensitivity to LPG, natural gas , town gas
- Small sensitivity to alcohol, smoke.
- Fast response
- Stable and long life
- Simple drive circuit

F. Humidity Sensor DHT11

A humidity sensor senses, measures and regularly reports the relative humidity in the air. It measures both moisture and air temperature. Relative humidity, expressed as a percent, is the ratios of actual moisture in the air to the highest amount of moisture air at that temperature can hold as shown in Fig.6. The warmer the air is, the more moisture it can hold, so relative humidity changes with fluctuations in temperature.

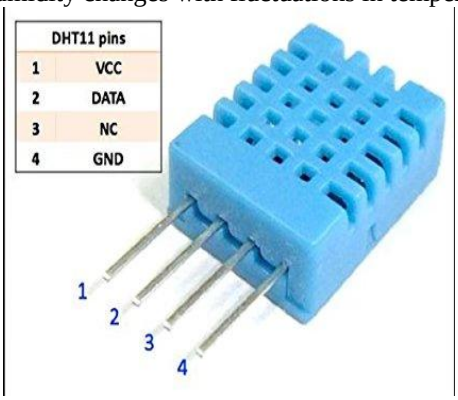

Fig.6.Humidity sensor.

G. Zigbee Module

Zigbee system structure consists of three different types of devices such as Zigbee coordinator, Router and End device. Every Zigbee network must consist of at least one coordinator which acts as a root and bridge of the network. The coordinator is responsible for handling and storing the information while performing receiving and transmitting data operations. Zigbee routers act as intermediary devices that permit data to pass to and fro through them to other devices. End devices have limited functionality to communicate with the parent nodes such that the battery power is saved as shown in the fig.7. The number of routers, coordinators and end devices depends on the type of network such as star, tree and mesh networks.

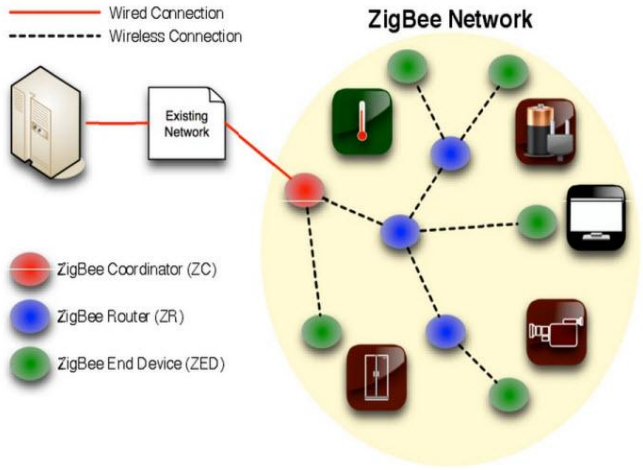

Fig.7. Zigbee Architecture.

V. RESULTS

The below fig.8shows the hardware kit to implement the smart helmet for coal miner's safety purpose.

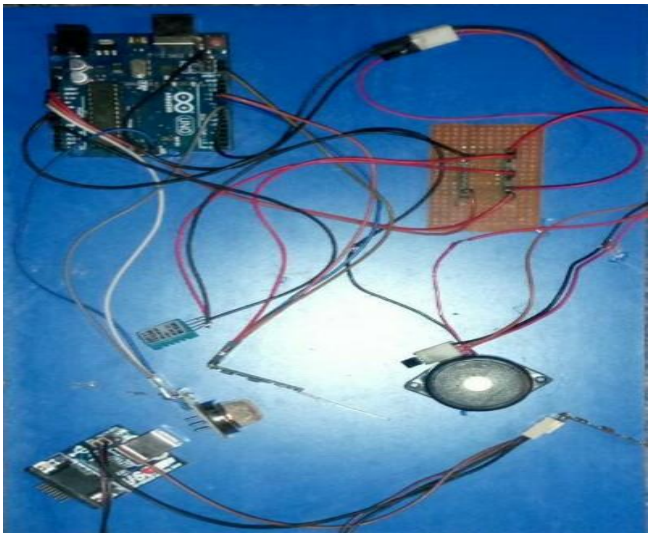

Fig.8. smart helmet for coal miner's safety purpose.

The above kit consists of arduino board , the temperature sensor(LM35), ,the humidity sensor(DHT11), and the gas sensor (MQ-2),and the Zigbee transmitter and the Zigbee receiver. After implementation of code successfully ,we see

the results in readings in serial monitor and their respective values in form of Fig.9 in serial plotter.

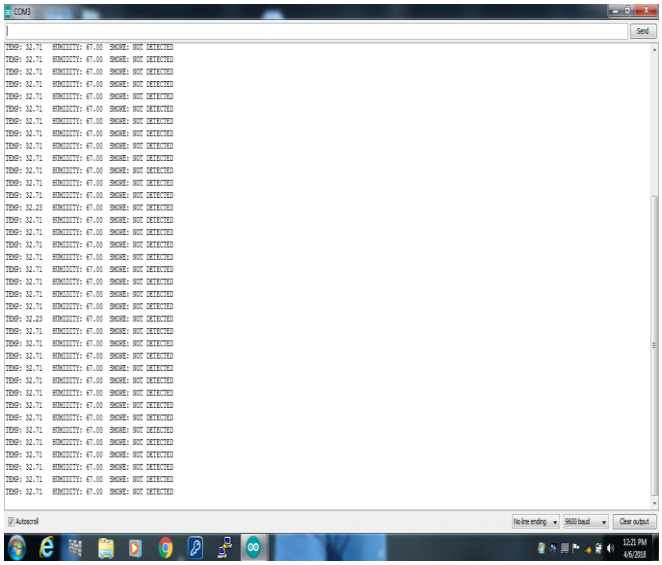

Fig.9. Readings in serial monitor.

Here, we see the three parameters like temperature variations, humidity levels and smoke detection. In the code, we set the temperature to 40degrees. so, upto that temperature reading comes normally if they exceeds that 40 degrees they readings are change, and they give alert message like temperature is high and greater than 40°C at the same time in helmet also the buzzer will on to alert the coalminer the temperature is high. As per the temperature increases, the humidity level also increases .if the smoke is not detected they show smoke is not detected, otherwise they show smoke detected and they give alert to miner as well as person who work in base station in their respective PC. As well as the variations in humidity and increase level of harmful gases. they shows the graphs as per the extend the limit. Below Fig.10 shows the parameters variations in serial plotter, according the person going under the earth, the values are changes constantly as per the variations occur in earth.

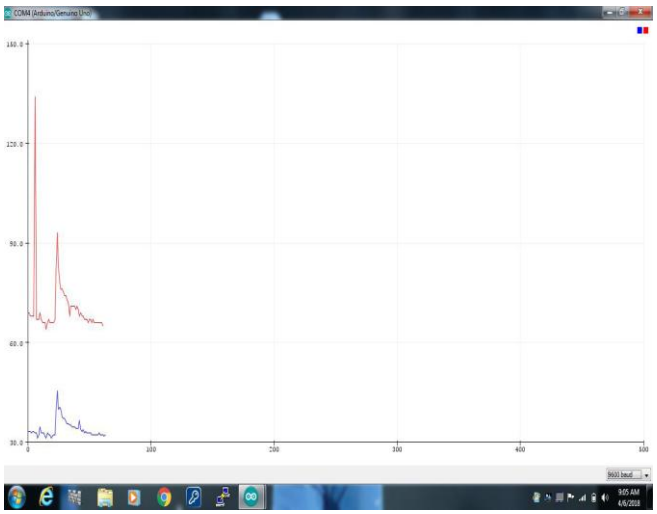

Fig.10. Graph in Serial Plotter.

Advantages:

- Safety monitoring of the environment.
- Improved services in coal mining.
- Providing wireless connection security.
- Zigbee based wireless sensor networks are recently investigated due to their remote environment monitoring capabilities ,such a network can easily collect sensor data and transmit by radio.
- Quick searching of the coal miners working under the earth and can be able to give the warning in hazardous situation.
- Here we using the Zigbee technology, we reduce the cost of the helmet also comparedto wifi technology.

Applications:

- It can be used to the persons who are working in the underground at coal mines.
- It can used at any weather conditions such as any harmful gases, temperature variations and humidity level increases.
- It can be used to locate the person where he is working under the earth in coal mines.

VI. CONCLUSION

As the system requirement and the required components can be easily made available this project can be implemented easily. It will provide the safety to coal miners and change the way of their working as well as system controlling the various environmental changes in mines. It has been presented the original design of the low power Zigbee sensor system with an extremely reduced cost. It is reliable system with quick and easy installation. The system might be easily extended. It will improve system scalability and extend accurate position of underground miners in future.

Future Scope: The system also can be easily extended with Zigbee image transmission facility in future. It will improve scalability of underground environment and extend accurate position of miners. In future, with the help of Zigbee module and GUI (software part), we can avoid railways accidents, road accidents, submarine accidents etc.

VII. REFERENCES

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