Safety Monitoring System for Mining Applications using Raspberry Pi based on Internet of Things

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Abstract- A smart helmet has been developed that is able to detect hazardous events in the mine industry. In the development of the helmet we have considered the hazards such as detection of hazardous gases, obstacle detection, helmet on/off and Water level detection. These sensors data is transmitted using wireless communication module that is ZigBee which is connected to 8051 microcontroller. At receiver section one more ZigBee is connected to the Raspberry Pi board which is used to share the data on server web page through internet.

I. INTRODUCTION

A mine is thought to be a plant that produces helpful mineral with a given rate of metal and given amount, while the cost of mining is relied upon to be least cost. Land states of any mine are controlled by nature. They are capricious [1]. The different natural parameters of mine framework, for example, methane, carbon monoxide, temperature, oxygen et cetera, are right now utilizing the customary link transmission. Therefore really mine methane, carbon monoxide gas gathering zone motorized mining face, for example, the dead gob link security parameters cannot be checked, so they can not anticipate the caution [2]. Mining venture movement is liable to high dangers due to its size, vulnerability, unpredictability, high expenses and excavator's wellbeing [3]. The discharge of lethal gasses from coal crease thus prompts air contamination in mine territory. It extremely influences excavator's wellbeing [4]. The more profound a mine is, the more terrible and more hazardous diggers' work is and the more costly excavators' work is. Several research methods were invented to detect the poisonous gases that get evolved in the coalmine and harm coal miner but those methods got failed. Likewise in the past several other research methodologies were followed to identify the status of helmet on the miner head whether it is placed on head or off the head of coal miner. But it gave a poor result. When any obstacle hits hard, then it may to critical health problem [5]. All this events lead to loss of human lives.

Hence few innovative methods are introduced in this project which provides high security to the coalminer during their work in the coalmine and in other words it saves several human lives. The methods in this project identify the poisonous gases immediately after they get evolved and intimates to the miner and the central control system about the gases concentration level also.tis project also finds the status of the helmet using Ir sensor and intimates to the miner to have it on the head. This project also identifies the obstacle detection using sensor and water level detection using the soil moisture sensor. This project introduces advanced methods using microcontrollers, sensors, zigbee network and computer system screen.

II. LITERATURE SURVEY

In several countries mining is the major economic resource for the country. Generally most of the mining industries are coalmining. The mining is generally carried out under the earth. So it means the work is done in a dangerous environment where it expects several human lives to be sacrificed in the mining industry under the earth due to the unfortunate accidents that occur in the coalmine [6]. The past research identified those hazardous events and tried a lot to solve those problems but those methods went in vain.

Generally in the coalmine the workers work with equipments which create heavy noise [7]. In this noisy environment it will be difficult for any worker to have conscious about the fellow worker. So in this situation if any hazardous event happens to any worker like experiencing hard bumps on head when helmet is removed, evolution of poisonous gases in the area where a miner is present or getting dipped into area where water content is heavy. Then in all this events human life would be in danger situation.

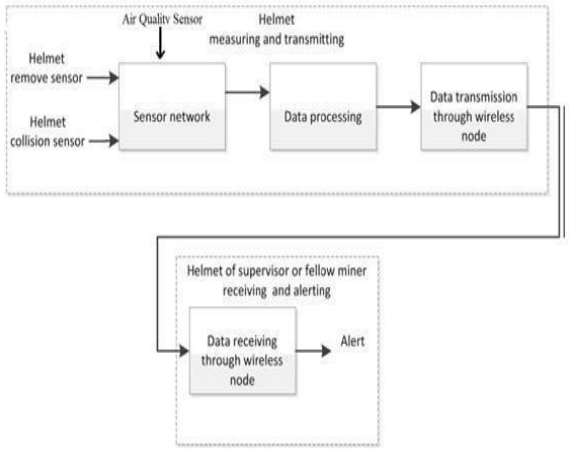

Fig.1: Existing system Block Diagram to provide safety to the worker

In the past they have used electro chemical sensor which identifies poisonous gases like CO, SO_2 and NO_2 using SGX sensors [8]. Generally mostly CO gets evolved and its concentration level should less than 6ppm.if its concentration is greater than 6ppm it leads to health problem. But usage of this electro chemical sensor dint yield good results [9].

III. PROPOSED SYSTEM

The information from different sensors sent to the raspberry pi. At whatever point the sensor information surpasses the predetermined limit (preset) esteem, the wi-fi module at remote observing site transmits ready flag to nearby site by blowing signal ceaselessly. Alarming excavators in a mine can be a troublesome procedure remembering the ordinary working conditions that are experienced in a mine. Underground mines are extremely dull spots and in this way the diggers utilize wellbeing caps with worked in or connectable mining lights.

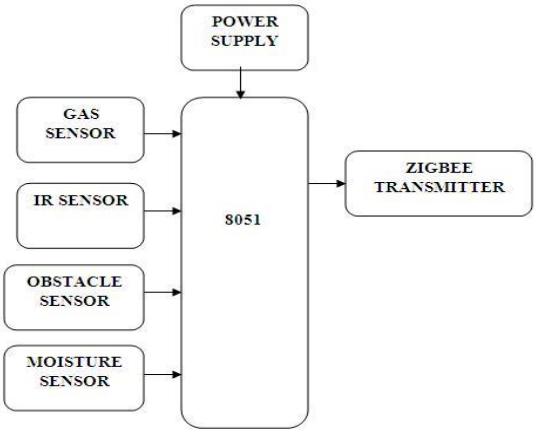

Fig.2: Transmitter block diagram

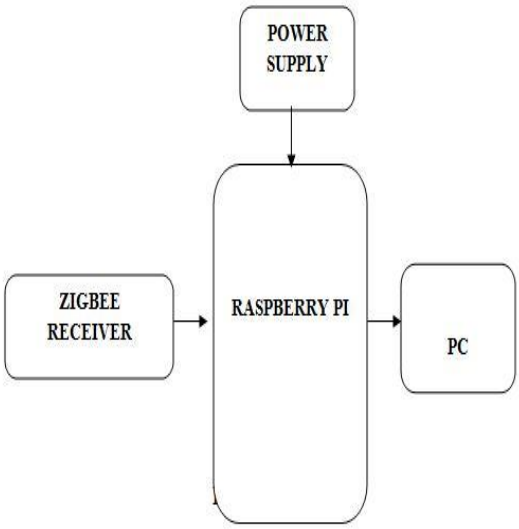

Fig.3: Receiver Block Diagram

The flowchart shown below gives the exact view of the proposed system with the number of hardware devices involved in this proposed system.

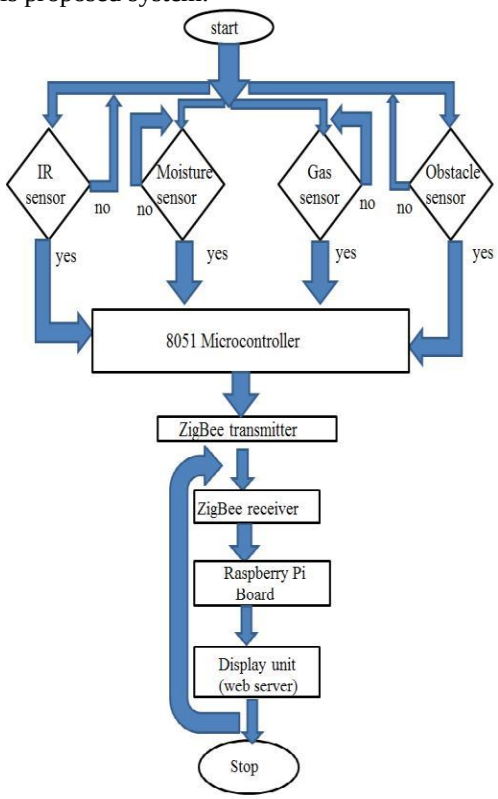

Fig.4: Flowchart of the proposed system

IV. WORKING PRINCIPLE

Initially the gas sensor, moisture sensor, IR sensor and obstacle detection sensor are mounted properly on the miner head along with proper interfacing with the 8051 microcontroller. When the miner enters into the coalmine all the sensors get into activated mode .The gas sensor senses different gases like CO, SO_2, NO_2.if this concentration levels of the gases are higher than 6ppm for CO, likewise other concentration levels for other gases, they will harm to the miners health. Hence these gases are detected using the gas sensor and its concentration levels will indicate to the 8051 microcontroller.

The moisture sensor is placed with preferred orientation in the soil in the coalmine .this moisture sensor checks and identifies the water content level in the soil if the water moisture levels are more than the threshold level than immediately it passes that data to the 8051 micro controller for further process.

Helmet is major protection for each miner who works in the coalmine. Sometimes there may be situation like, worker feeling uneasy and he may remove the helmet for a while, which is very danger, because if any hard substance bumps him on the head then he may lose his life. Hence to warn the workers to put the helmet all the time on the head, in this project we use an

advanced and efficient IR sensor which measures up to a distance of 10cm, to give indication to the raspberry pi control system about the status of the helmet through wireless communication. This process warns miner to keep his helmet on the head all the time if he removes it.IR sensor continuously checks the helmet interface .If the helmet is removed from the head then the IR sensor loses its contact with the head. Then immediately it passes low signal to the 8051 microcontroller which intimates it to central control raspberry Pi system.

While working in the coalmine which is generally under the earth several times several hard substances fall on the miner and this several times lead to lose of their precious life's which would really leave a bad dream in the lives of their families. So in this project we are using a obstacle detection sensor which quickly to this hazardous event .when any hard substance falls on the miner and the obstacle sensor measures the pressure with which it has hit the miner and now both the pressure levels are compared in the 8051 microcontroller and if its hitting pressure is greater than the reference pressure level which is preloaded in the micro control, then immediately the information is sent to the central control system using wireless communication method.

The total process is and data of all sensors is gathered and loaded at central control system and the status of each worker is clearly seen in the computer display unit using the web server technology and necessary precaution actions are taken to provide safety to the miner.

V. RESULTS

The application is implemented and tested in the hardware setup and following are the outcomes which are described below.

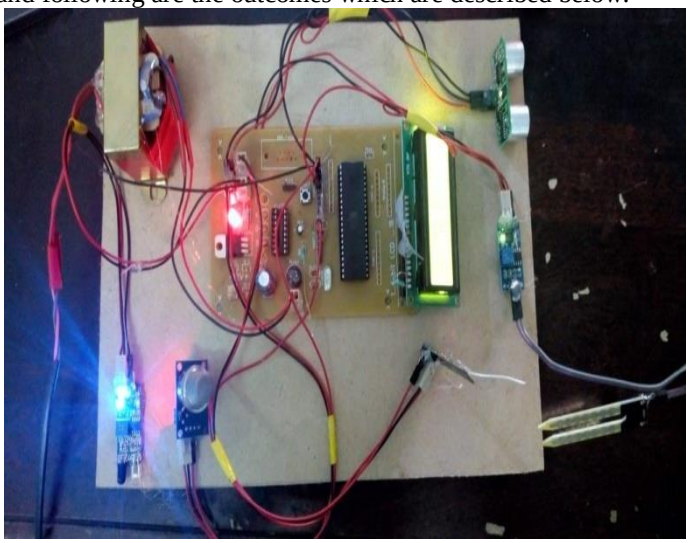

Fig.5: Typical hardware setup at the transmitter end (Helmet)

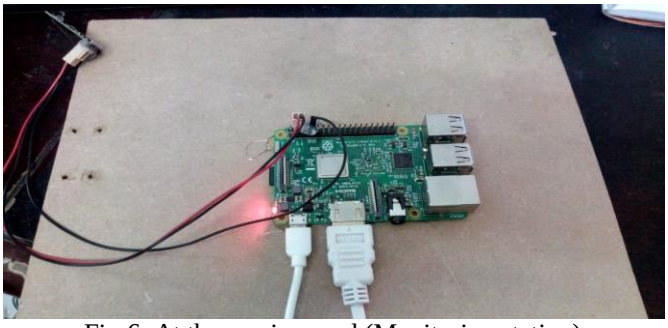

Fig.6: At the receiver end (Monitoring station)

Fig.7: Displaying Sensors status

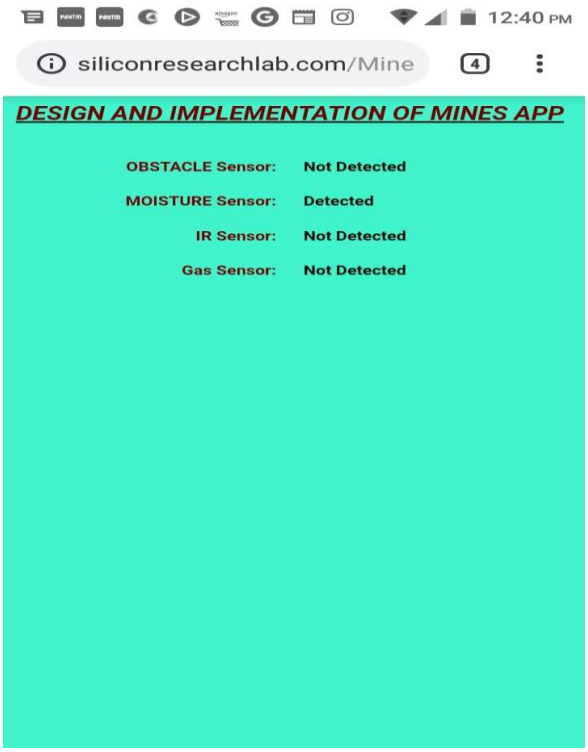

Fig.8: Web server page

VI. CONCLUSION

This paper gives a framework identified with wellbeing and security of underground mines. The framework is dependable, reliable, continuous, practical and easy to use. A bigger range and more profundity inside risky underground mines are currently can be secured and mishaps can be controlled viably. The framework consolidated the low power, minimal effort WiFi based high recurrence remote information transmission innovation. The sensor and Wi-Fi module can be ideally introduced in mines (routers). Proper checking and correspondence is conceivable between the representatives and the observing site which can take proper activities all the more quickly and shrewdly. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

VII. REFERENCES

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