

Safety Monitoring System for Mining Applications Using Raspberry Pi

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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 display the data in PC.

I. INTRODUCTION

We all remember the quote that “Time and tide never comes back”. This quote well suits for human being life. Because “Life once lost can never be regained. “It is discussed here because daily several lives are being lost in the coalmine due to several regular hazardous events that occur unfortunately in the coalmine. Years are being passed with so much research on how to provide safety to the people who work in the coalmine. But unfortunately the research is not yet reached to high end because of several failures. Generally the hazardous events that occur are releasing of poisonous gases, falling of hard objects on the miners. Apart from this hazardous event other hazardous events are like presence of higher water moisture level in the soil. Sometimes the miners remove the helmet from their head to have comfort for a while. This also leads to hazardous event because if any hard obstacle falls on the head when the helmet is off the head then it may lead to death of coal miner.

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. 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. 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. 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.

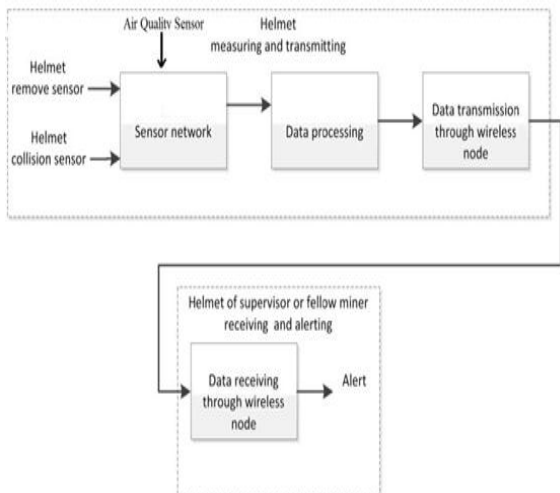


Fig 1: Existing system Block Diagram to provide safety to the worker

In the past they have used electro chemical sensor which identifies poisonous gases like CO, SO₂ and NO₂ using SGX sensors. 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 did not yield good results.

III. PROPOSED SYSTEM

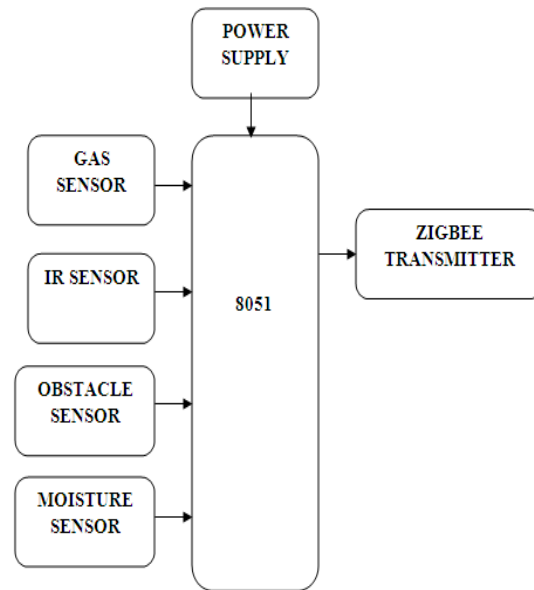


Fig 2: Transmitter block diagram

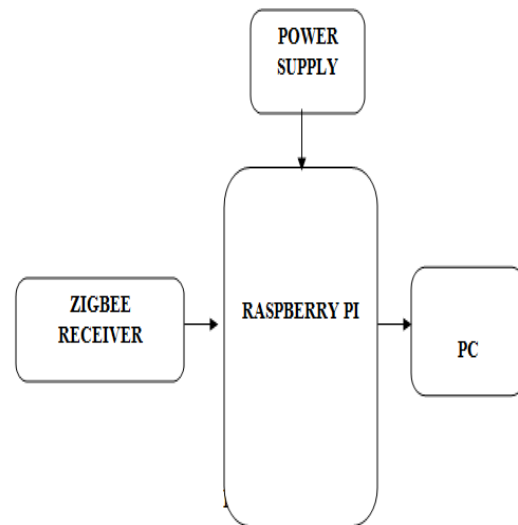


Fig 3: Receiver Block Diagram

IV. FLOWCHART

The flowchart shown below gives the exact view of the proposed system with the number of hardware devices involved in this proposed system. In this chapter the flow chart of the project, working of the project and hardware implementation of the project is explained clearly.

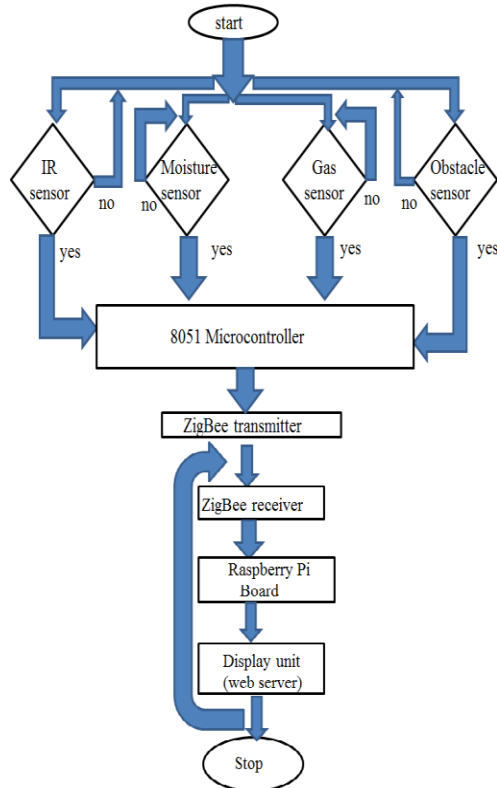


Fig 4: Flowchart of the proposed system

V. 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, SO₂, NO₂. 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.

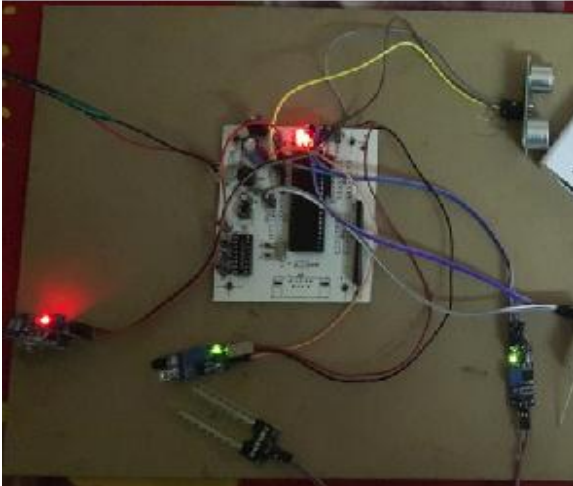


Fig 5:Proposed system hardware set up

VI. RESULTS

As discussed the below figure shows the initial state of the web page .

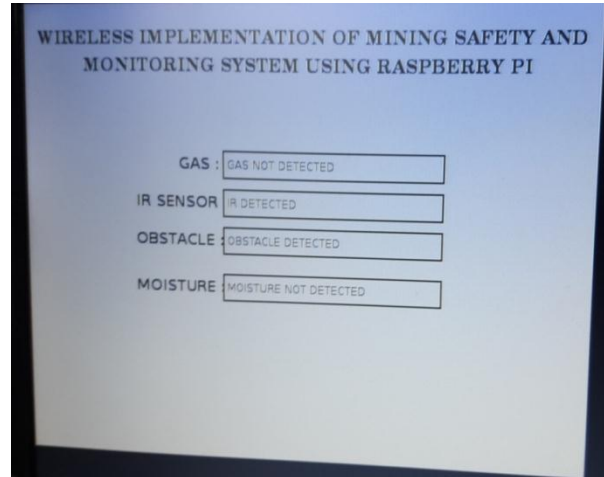
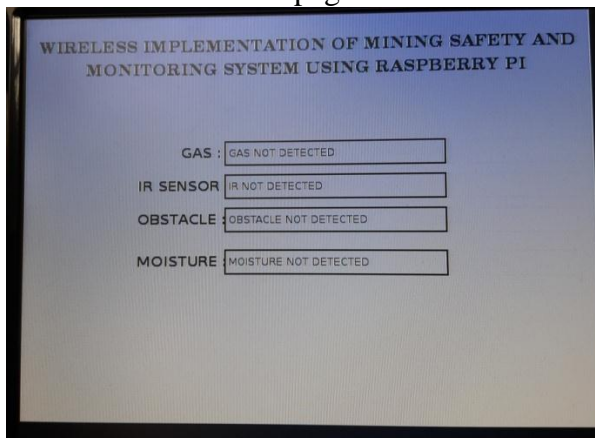


Fig 6: Initial state

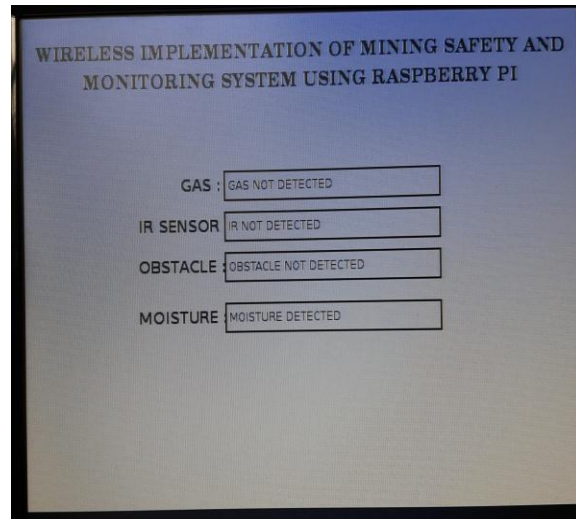


Fig 7: Moisture Detected

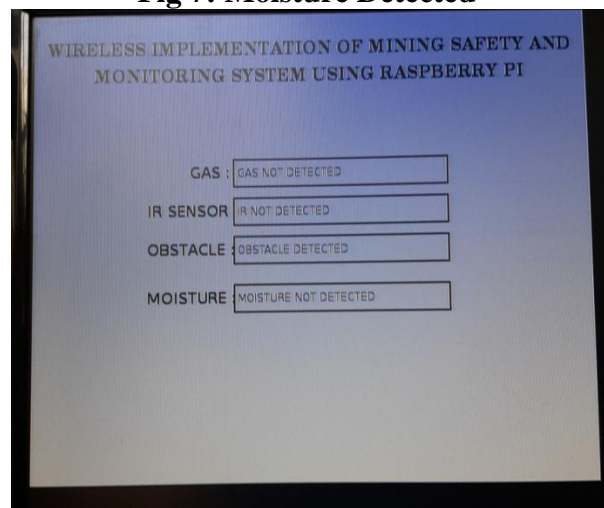


Fig 8: Obstacle Detected

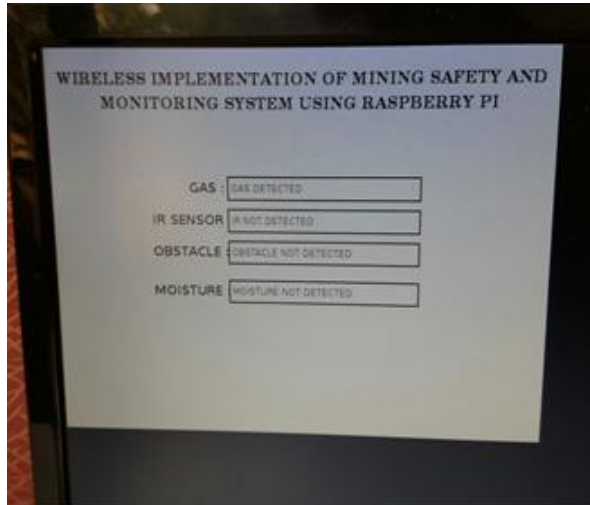


Fig 9: Gas detected

In figure 7 the image shows the status of the web page when the moisture is detected, it is indicated with the message displayed as Moisture Detected. In figure 8 the image shows the status of the web page when the obstacle is found. In figure 4 the image shows the status of the web page when the helmet is on the head. In figure 9 the image shows the status of the web page when the hazardous gas is detected.

VII. CONCLUSION

The project “A Smart Helmet for Air Quality and Hazardous Event Detection in Mining Industry” has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC’s and with the help of growing technology the project has been successfully implemented.

Future Scope

This principle and techniques followed in this project has lot of future scope in developing several applications in association with sensors which will provide the safety majorly to the coalmine employee’s. Using the raspberry Pi controller several real time applications can be developed which will be

useful in the field of different industries and places.

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