IoT BASED MINE SAFETY SYSTEM USING WIRELESS SENSOR NETWORK

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ABSTRACT

Activities developed under hazardous conditions, such has mining, require an active investment from the industry to avoid serious injuries and even loss of lives. Mine Detection Robot can be substituted or partial substituted for emergency workers to enter the mine shaft disaster site and detect hazardous gas do some environmental exploration and surveying task .Safety measures taken to address this problems is to implement current sensor technologies and IoT based wireless communication system which uses cloud computing for transmission and storage of parameters obtained from wireless module with zigbee interface. Wireless sensor technology used in recently developed mine safety monitoring system is highlighted and compared with traditional wired monitoring system.

Keyword :- *IoT, Zigbee Wireless technology, Sensors.*

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1. INTRODUCTION

Mining as defined by the Oxford Dictionary is the process or industry of obtaining coal or other minerals from a mine. The activities carried out in order to obtain these minerals have a dangerous elements to them. The average mine workers is exposed to the harsh underground environment which can sometimes incur an injury or cause loss of life. A portion of these injuries/fatalities can be attributed to human error.

However, these are circumstances that are dictated by the ambient conditions underground which can be blamed for these accidents. These conditions are difficulty to monitor without placing someone's life at risk. The older methods of mine monitoring involves using a person to go down and report back. This methods is however dangerous as the person who is monitoring a specific hazard could be harmed by that same hazard. This type of first hand monitoring is invasive.

Fig-1: Mining area

There is an existence of specific system or schemes which are put into place for these hazardous environments in order to protect the worker from harm. The higher level terms for these systems/schemes is the Occupational Health and Safety. This standard aims to reduce the liability of occupational injuries and diseases not only to

benefit the workers but also the economy upon which this work builds. These accidents can lead to losses due to early retirements and insurance premium for the mine. The cooperation of this standard is crucial and is observed by the certification to a majority of the major mining companies in South Africa. This standard can be reinforced through the implementation of modern technology alongside policies to obtain the best possible result.

2. LITERATURE SURVEY

Building a safety system to monitor the ambient characteristics of the mining environment [1]. Remote monitoring of the health conditions of miners can better aid search-and-rescue efforts after accidents [2].To develop a secure sensor network by interconnecting attestation between surrounding sensor nodes [3]. In this paper, the hazard theory, system security and risk analysis theory have been used to screen the evaluation indexes. Analytic hierarchy process and mean square error method were applied to determine the weight of each index and establish a comprehensive evaluation system [4]. Providing low data rate for short coverage and long battery life using Zigbee module [5]. Monitoring data in coal mine is essentially data stream with the change of environment, coal mine monitoring data stream implied concept drifts. Coal mine safety evaluation can be seen as concept drifting data streams classification [6]. Large lead–acid batteries are predominantly used throughout the mining industry to power haulage, utility and personnel-carrier vehicles. Without proper operation and maintenance, the use of these batteries can introduce mechanical and electrical hazards, particularly in the confined, and potentially dangerous, environment of an underground coal mine [8]. The utility of sensors is apparent in applications where the characteristic measurement is required in real-time [9]. The practice of mining can be dangerous [10] and unsafe. The proposed system designed examines and implements certain functionality that solves the abovementioned short comings or limitations in real-time mining environment monitoring [11]. This is the sensor which is used to measure the ambient humidity inside the mine. This sensor has a typical current draw of 200 µA [12] which makes it ideal for a battery operated system. Detects natural gas and methane between concentrations of 300-10000ppm [12] [13]. Detects gases by observing their absorption spectrum in infrared region [15].

3. PROBLEM STATEMENT

According to current estimation.100 million landmines, mostly antipersonnel mines laid in over 60 countries, kill over 20,000 persons a year, many organizations and universities in different countries have increasingly recognized the significant of low cost and sustainable technologies for mine detection and extraction. The current solution for removing landmines from civilian areas is the use of trained technicians who manually search for buried objects using a metal detector. A human operator, on the other hand, sweeps a mine detector from side to side while moving forward to cover ground; this process is rather slow (20-50 square meters per hour).The operator can follow the ground profile with the detector head close to the ground without hitting the ground or any objects on it. The operator can vary the width of sweep to suit a particular situation, and is usually not limited by terrain. However, the manual method is slow, hazardous, manpower-intensive and stressful. As a result, the operators can perform this task only for short periods. In addition, the task is monotonous and at times errors result due to operator inattentiveness.

4. PROPOSED SYSTEM

To reduce the Human Death Ratio in the Mine explosion and Accidents we are implementing wireless sensor network for parameters measurement accuracy and safety can be achieved with the help of sensor network. Each of the mine workers were provided with personal care taking unit in order to detect the hazardous conditions. If explosion takes place, quick transmission of information to emergency care centre to intimate the status of the mine workers. To provide maximum assistance before explosion take place.

Fig-2 Mining Robot

Fig-3 Helmet

A. System Overview

In this system we are going to use wireless sensor network technology for high speed data transmission in the mining area and we are making use of Robot to check the environmental conditions and to inform the mine workers if any hazardous conditions are going to happen in mining area. Each of the mine workers will be provided with personal care taking unit i,e helmet, the helmet is fixed with some sensors in order to inform about variation in parameter values.

B. System Architecture

4.1 Robotic section

Robotic section will be fixed with some sensors that are temperature sensor, gas sensor, tilt sensor, humidity sensor, obstacle sensor all these sensors are interfaced with ARM LPC2148 microcontroller and intern ARM controller connected to LCD display to display the parameter values. ARM controller is connected to transmitter Zigbee module in order to transmit the information if any parameter variation in the mining area to receiver Zigbee module located in ground PC.

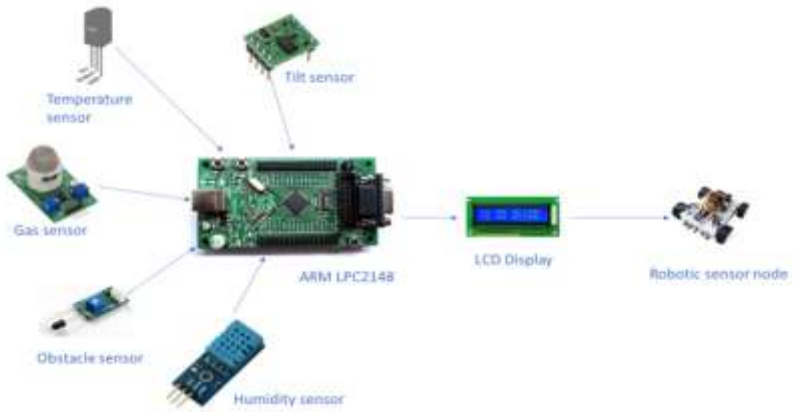

Fig-4 : Robotic Section

4.2 Helmet Section

Helmet is the personnel care taking unit provided to the mine workers. The helmet section fixed with some sensors that are temperature sensor, heart rate sensor and obstacle sensor to detect variation in parameter values if it goes beyond the threshold level and is fixed with APR to give voice intimation to mine workers if any hazardous conditions are going to happen in mining area. This section also connected to ground PC through wireless Zigbee module.

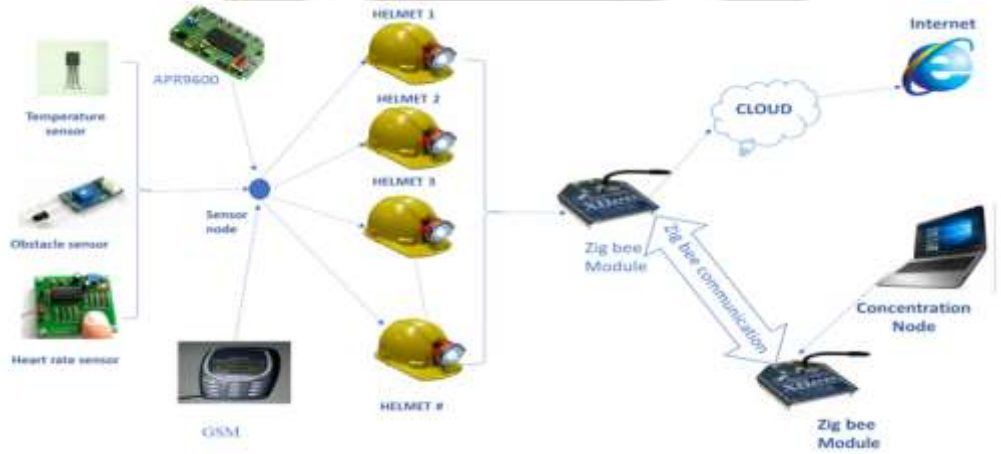

Fig-4 : Helmet Section

4.3 Concentration Node

The concentration node consists of ground PC which is wirelessly connected to the receiver Zigbee module in order to collect the information stored in the cloud through IoT and provide safety measures for the mine workers when hazardous conditions occurs in the mining area. This section will give information to the near by hospitals in order to save the life of mine workers when hazardous conditions occurs in mining area.

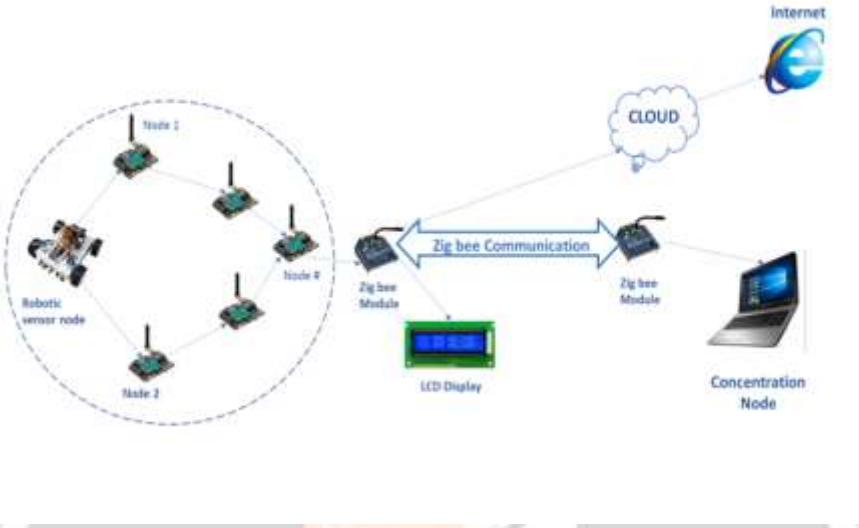

Fig-5 :Concentration Node

5. CONCLUSION

The application of wireless sensor network will improve the safety of coal mine. The wireless are more flexible and can avoid of rewiring and also it will greatly improve the performance and efficiency of data transmission of the coal mine safety system. In this application, as we are storing the values of the parameters in the PC, the stored values can be used to detect the hazards before they happen. As we are giving the information to the personnel regarding the measures to be taken in case of a hazard, it will be useful for them to save their life before any one comes and help them to come out of the mine.

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