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SCADA System for Workers Safety of Explosive Atmosphere in Coal Mines using Wireless Sensor Network

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ABSTRACT

Today safety of miners is a major challenge. Miner's health and life is vulnerable to several critical issues, which includes not only the working environment, but also the after effect of it. Mining activities release harmful and toxic gases in turn exposing the associated workers into the danger of survival.This paper presents a wireless detection of explosive atmosphere in underground coal mines that can be implementation of safety jacket for coal mine workers, this jacket is equipped with methane gas, fire, smoke, temperature, and heart beat sensor and emergency key. The all sensors are interfaced with ARM7, it sense the data and which is transmitted to master node through zigbee. The WSN sensor is connected at both end for transmission and reception of data. The all sensed data will be shown on VB screen and threshold value is set at master end, if sensor value reaches beyond the threshold level, the master will trigger on the buzzer and keep the coal mines workers safe from upcoming accident.

Keywords- WSN, ZIGBEE, smart jacket, PC, VB Software.

1. INTRODUCTION

Underground mining operations prove to be a risky venture as far as the safety and health of workers are concerned. These risks are due to different techniques used for extracting different minerals. The deeper the mine, the greater is the risk. These safety issues are of grave concern especially in case of coal industries. Thus, safety of workers should always be of major consideration in any form of mining, whether it is coal or any other minerals.

Demand of coal as energy sources is always important and significant. But thousands of workers have lost their lives in mining accidents. The main reason is these accidents occur due to the presence of methane gas and carbon monoxide gas in these mines. These gases are colorless, odorless and undetectable by human sensor. A continuous monitoring is necessary which is done by implementing microcontroller and sensors to alert workers before critical atmospheric level. To enhance both production and safety in mines, an authentic communication is established between fixed base station and workers. But the wired communication is difficult n coal mines so recently WSN technology evolved and provides better solution for data acquisition with a secured monitoring. A cost efficient Zigbee is supported by wireless monitoring system with sensor and PC.

Wireless Sensor networks (WSNs) is an emerging technology that is used in many applications include in environment monitoring, home and building automation, lighting control, medical and military applications. A wireless Sensor network consists through joining of several sensor nodes which have included communication and sensing capabilities. In this project we are designing a low power, cost-effective, and Zigbee protocol based wireless sensor network that provides an intelligent surveillance and safety system for underground coal mines. Here each packet is authenticated using a security algorithm hence increasing the overall security of system.

II. CONTRIBUTION BY THE PREVIOUS RESEARCHERS

Here different papers are studied and analyzed based on the approaches used by the different researchers and modifications are made to provide more reliability in the proposed system.

"SCADA System for Detection of Explosive Atmospheres in Underground Coal Mines Through Wireless Sensor Network" A. Romero, A. Marín and J. A. Jiménez IEEE LATIN

AMERICA TRANSACTIONS, VOL. 12, NO. 8, DECEMBER 2014

A. Romero, A. Marín and J. A. Jiménez"SCADA System for Detection of Explosive Atmospheres in Underground Coal Mines through Wireless Sensor Network"IEEE LATIN AMERICA TRANSACTIONS, VOL. 12, NO. 8, DECEMBER 2014.The system is wireless system for detection of explosive atmosphere in coal mines using triangle Coward and diagram Bureau of Mines. The solution for this problem that exist in coal mine are mathematical analysis using WSN and LABVIEW.

PranjalHazarika, Implementation of Smart Safety Helmet for Coal Mine Workers ,1st IEEE International Conference on Power Electronics. Intelligent Control and Energy Systems (ICPEICES-2016). This paper presents implementation of safety helmet for coal mine workers. This helmet is equipped with methane and carbon monoxide gas sensor and data is observed on X-CTU software(Graphical Network View).

The system is wireless system for detection of explosive atmosphere in coal mines using triangle Coward and diagram Bureau of Mines. The solution for this problem that exist in coal mine are mathematical analysis using WSN and LABVIEW.

III. SYSTEM OVERVIEW

Wireless Sensor networks (WSNs) is an emerging technology that is used in many applications include in environment monitoring, home and building automation, lighting control, medical and military applications. A wireless Sensor network consists through joining of several sensor nodes which have included communication and sensing capabilities. In this project we are designing a low power, cost-effective, and Zigbee protocol based wireless sensor network that provides an intelligent surveillance and safety system for underground coal mines. Here each packet is authenticated using a security algorithm hence increasing the overall security of system.

The sensor node is placed on the Miner itself. These nodes are interfaced with sensor such as temperature, Pulse, fire and methane gas. This node will continuously sense and send the data to master.

A. slave

This node is used for sensing data, packet handling, data buffering, Data authentication, link quality indication and packet timing information. The slave consists of ARM7, sensors and emergency switch, The sensor sense data and transmit through zigbee to master node. In the coal mines have hazards gases for worker health which are colourless and undetectable. But it can be detect by using sensors. The slave gives information to master of each event after every two seconds.

B. Master

By using VB software at base station observer can visualize all situations. This can be done by ARM7 and XBEE the values are sending to the monitoring unit.When temp level exceeds the saturation level, the command gets produced in the underground unit as "Emergency Temperature abnormal''.This Node consists of a PC on which we can see all the data in real time with help of Tables and graphs. For this we can use Visual basic / MATLAB s/w / LAB VIEW software.

Fig.1. Overall system

V. RESULT AND SIMULATION

In bellow Figure shows the Graph of Temperature Sensor Values at Master node which is placed at Control Room, if the sensor value reaches beyond the Threshold Value then Buzzer will Trigger ON, which is helpful for workers to avoid upcoming accident.

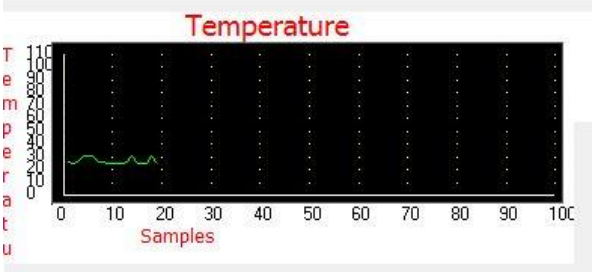

Fig.2. Graphof Temperature Sensor

In bellow Figure shows the Graph Of Gas Sensor Values at Master node which is placed at Control

Room, If the sensor value reaches beyond the Threshold Value then Buzzer will Trigger ON, which is helpful for workers to avoid upcoming accident.

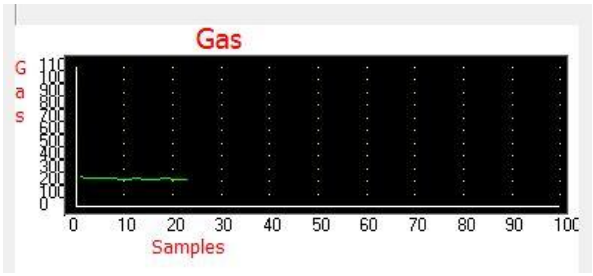

Fig.3. Graph of Gas Sensor

In bellow Figure shows the output Table of VB software, #2 it indicates the immediate data of slave two similarly for slave first is #1. After that bit it shows temperature, gas, smoke, heart beat and emergency respectively and this data is linked with VB screen.

Fig.4. Visual basic output code

In bellow Figure shows Sensor Values at Master node which is placed at Control Room.

Fig.5. PC screen image

VI. CONCLUSIONS AND FUTURE WORK

The work proposal is to identify hazards at various locations in coal mines. The advanced gas detection techniques hasbeen used in saving many lives.In the field of monitoring and sensing innovative application can be developed by WSN technology.The zigbee module monitors the underground parameters, not only parameters but also can be automatically generating and gives alert message to workers.

1. Using additional sensors all possible safety issues could be monitored such as gases, dust, vibrations, fire etc.
2. Zigbee can also be used for the surveillance of mining operations such as subsidence, water leakage etc.
3. The other important data can be communicated through this system making it feasible where wired communication is a hindrance.
4. The control can be governed from the surface itself as the system provides easy access.

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