

# MSP430 Based Mine Monitoring and Control Using Wireless Sensor Networks

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**Abstract-**This paper puts forward monitoring and control of mine environment using wireless sensor network and MSP430. Data transmission is done in wireless manner. There is no any electric wiring. Monitoring and control system controls different environmental parameters like temperature, humidity, gas, fire etc. This system requires less power. This system uses MSP430 MCU with very low energy consumption and network transmitting chip nRF24L01 with low energy consumption to reduce system consumption as much as possible. This system is used for On-line monitoring of different mines like Coal, Tungsten safety with simple structure, low cost, low power consumption, which will improve the level of monitoring, production safety and reduce accident in the various mines. Also it helps to increase life of mine workers.

**Key Words:** WSN, MSP430, Nodes, Environment Monitoring, Mine.

## 1. INTRODUCTION

Production level of mines is still low, especially in recent years, disasters of mine occur frequently, which leads to great loss of possession and life. Safety is the major problem of mine which has gradually becomes the focused issue of the nation and society concern on. The disasters of coal happening are due to the complexity of mine environment and the variety of work condition of mine, so it is very necessary to monitor mine working environment.[1]

The environment inside any mine is dangerous. To monitor and collect information on the various nodes is a difficult for mine enterprise. The design of monitoring system for mine safety constructed by MSP430 and wireless sensors and network can be used to overcome these problems.. An inexpensive, flexible, continuous monitoring system of underground mine workers protection and security becomes an important task.[3]

A microcontroller based system is used for collecting and storing data and making decision accordingly, based on

which the mine worker is informed through different alarm tone as well as voice system. The voice system with both microphone and speaker, converted into digital signal and successfully communicate wirelessly with the ground control centre computer system. The communication system is reliable based on ZigBee, IEEE 802.15.4 standard. This is used for transmission between the hardware circuit fitted with the mine workers and the ground control centre computer system through some routers.[4]

Traditional mine monitoring systems tend to be wired network systems, which play an important role in mine safe production. Due to continuous enlarging of exploiting areas and extension of depth in mine, it is necessary to monitor blind areas, where lots of hidden dangers are present. Moreover, it is inconvenient to lay cables which are expensive and consume time.[2]

In order to solve above problems, the proposed mine safety monitoring system based on wireless sensor network can improve the level of monitoring production safety and reduce accident in the mine.

## 2.SYSTEM CONCEPT

Proposed system provides solutions to issues observed in traditional mine monitoring system like bulky wired system, interference noise due to cables, etc using WSN and MSP430 which will have following features:

1. Wireless data transmission
2. Low cost and low power consumption
3. Automatic decision making system

Wireless sensor networks is composed of a large number of micro-sensor nodes which have small volume and low cost. It possesses self-organized capability by wireless communication. In recent years, it is widely used in the fields of our lives, scientific research, military, intelligent traffic, environmental monitoring, intelligent weapon, and so on. Compared to the traditional mine monitoring, the proposed system uses wireless sensor networks in mine safety monitoring.

Wireless sensor network based proposed system can be formed inside mine in following manner:

1. Sensor nodes will be installed such a way that can cover all area inside the mine.
2. Group of sensor nodes will be connected to the respective cluster head nodes.
3. All cluster head nodes will be connected gateway node
4. Gateway node is responsible to communicate with ground monitoring center.

Information collected at ground monitoring center will be used for analyze the mine environment and to make decision as per the situation.

The implementation of our proposed system can be achieved in three stages.

### 2.1 Design of wireless sensor nodes

This stage contains design of sensor nodes which are responsible for the collection of environmental parameters, and sending the collected data. Testing the output of different sensors will be carried by considering gas sensors, temperature and humidity sensors, etc. The hardware structure of the wireless sensor network node is as shown in fig.1. MSP430 is placed in between Sensors and Wireless communication module. The data acquisition module (MSP430) is used for sensing, collecting information and converting to digital signals. The wireless communication module is mainly responsible for communicating with other nodes.

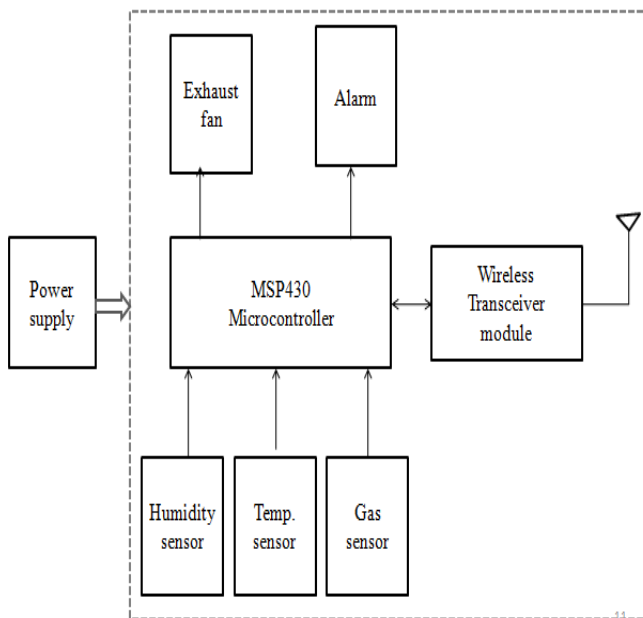


Fig -1: Wireless Sensor Node

### 2.2 Design of wireless sensor networks

In the wireless part of the underground, according to nodes function and level, nodes are divided into sensor nodes, cluster head nodes and gateway node. Sensor nodes are responsible for the collection of environmental

parameters, and sending the collected data. Cluster head nodes are mainly designed by the special environment of mine. Generally mine is not a straight line and exists corners and branches. In order to ensure the data transmission effectively while the shortest distance is sent to the gateway node, cluster head nodes are arranged at the corner of the mine tunnel and wellhead. The main function of cluster head nodes is to send and receive data without the data collection so as to save resources at the same time to extend the life of the network nodes.

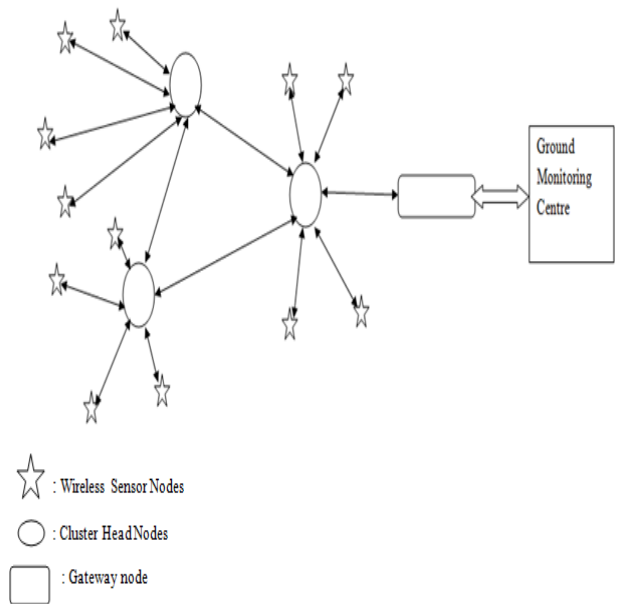


Fig -2: Wireless Sensor Network

### 2.3 Monitoring and controlling environmental parameters

Gateway node will communicate with PC through serial communication. Gateway node is a special node in sensor network, which is responsible for the communication between computer and sensor network. It is situated near ground monitoring centre.

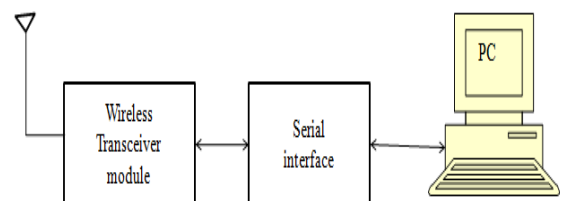


Fig -3: Ground Monitoring Centre

The gateway node plays a central role in wireless sensor networks. It is responsible for wireless sensor networks and computer communications, on one hand it receives the data from the wireless sensor networks, on the other hand it is connected with the Ethernet and sends data to the monitoring center. The various safety indicators within the mine could be sent by cluster head nodes to the gateway node directly or indirectly. Then via the internet the gateway node uploads the data to the ground monitoring centre.

### 3. Results:

Wireless sensor network will look like as shown in figure below:

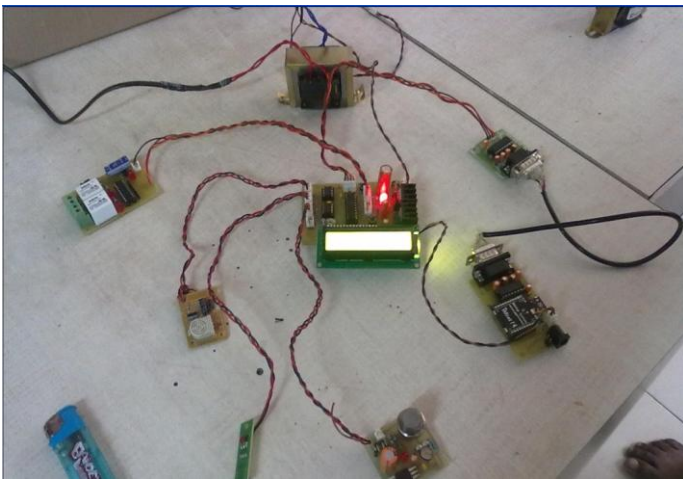


Fig -4: Hardware implementation of WSN

Sensor output for normal and extreme condition is shown below:

Output of sensors:

#### 3.1 GAS Sensor (MQ6):

Table -1:Output Gas Sensor

Operating voltage	Condition	Output of sensor
5v	Normal	0.1V
5v	Extreme	1.8V

#### 3.2LM 35 temperature Sensor:

Linearity: 10mV/°c

Table -1:Output of Temperature Sensor

Operating voltage	Condition	Output of sensor
5v	Normal	27°C
5v	Extreme	45°C

#### 3.3Humidity Sensor (SYSH220):

Linearity: 0.33mV/%RH

Table -1:Output of Humidity Sensor

Operating voltage	Condition	Output of sensor
5v	Normal	60%RH
5v	Extreme	80%RH

#### 3.4 Smoke detector:

Table -1: Output of Smoke detector

Operating voltage	Condition	Output of sensor
12v	Normal	3.2V
12v	Extreme	1.7V

GUI is designed in Labview as shown below:

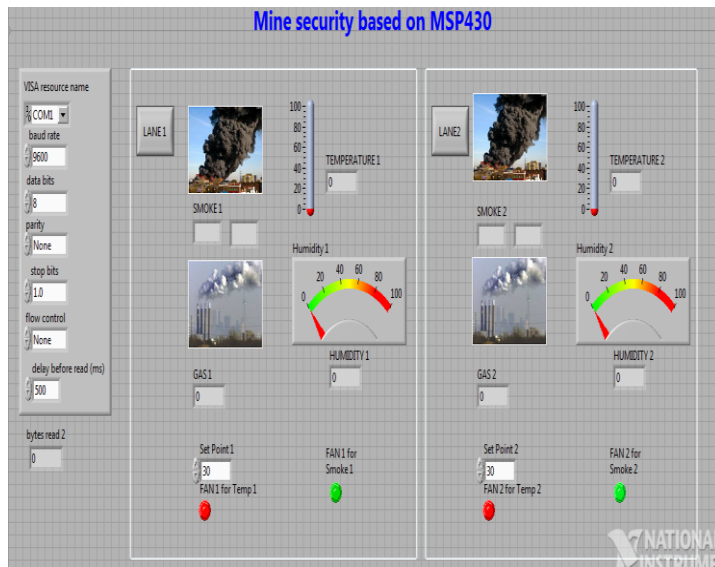


Fig -5: GUI Design

#### 4. CONCLUSIONS

With the help of proposed system we can reduce the accidents and hazards which occurs in different types of mines. Environmental parameters like temperature, humidity, gas can be monitored and controlled with the help of wireless sensor networks and MSP430 This system is less bulky and more accurate which can replace traditional wired system. It is more flexible than traditional one.

#### REFERENCES

[1] He Xuewen, Wang Yun, "The Design of Tungsten Mine Environment Monitoring System based on Wireless Sensor Networks," **Second International Conference on Intelligent System design and Engineering Application**, 2012, pp. 1319-1322.

[2] Yingli Zhu , Wanghui Zeng, "Design of Monitoring System for Coal Mine Safety Based on MSP430 and nRF905," **International Conference on Intelligence Science and information engineering**, 2011, pp. 98-101.

[3] Yang Zhou, Qiaodi Zhou, "Wireless temperature & humidity monitor and control System," 2012, pp. 2246-2250.

[4] Zhang Yanbing, "Design of Low-power Wireless Communication System Based on MSP430 and nRF2401," **International Conference on Measuring Technology and Mechatronics automation**, 2010, pp. 1008-1010.

[5] Lihua Chen, Xiaowen Liu, Ji Dai, Duan Zhao, "Design of Coal Mine Temperature Measuring and Controlling System Based on Wireless Sensor Networks," **Instrument technique and Sensor**, 2008(12):87-89.

[6] IAR Systems, "MSP430 IAR Embedded Workbench™ IDE User Guide for Texas Instruments' MSP430 Microcontroller Family", IAR Systems, 2004.

#### BIOGRAPHIES



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