

COAL MINE BASED ON WIRELESS UNDER-GROUND SENSOR NETWORK

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Abstract -- *Wireless underground sensor networks (WUSNs) can enable many important applications such as intelligent agriculture, pipeline fault diagnosis, mine disaster rescue, concealed border patrol, and crude oil exploration. The key challenge to realize WUSNs is wireless communication in underground environments. Many accidents have been done in the coal mine industry with serious casualties and large economic losses. By reducing the accidents in the global mining industry to improve overall mining safety and increase operational efficiency. This paper proposes a WUSN based coal mining safety monitoring. This system also provides an early warning, which will be helpful to all miners present inside the mine to save their lives before any casualty occurs.*

Keywords— *WUSN, Coal mine, accidents, environments, safety.*

I. INTRODUCTION

India is a large country with rich coals. However, the current safe production level of the coal mine is still low, especially in recent years, disasters in coal mine occur frequently, which lead to great loss of possession and life. The safety problems of coal mine have gradually become the focus that the nation and society concern on. The disasters happening in a coal mine are due to the complexity of mine environment and the variety of work condition of a coal mine, so it is very necessary to monitor mine working environment. It plays an important role in coal mine safe production monitoring systems and tends to be wired network systems. With continuous enlarging of exploiting areas and extension of depth in the coal mine, many laneways become blind areas, wherein there are lots of hidden dangers.

In order to solve the problems, we will design a coal mine safety monitoring system based on wireless underground sensor network(WUSN), which can improve the level of monitoring production safety and reduce accident in the coal mines. Wireless sensor networks are composed of a large number of micro-sensor nodes which have small volume and low cost. It possesses self-organized capability by wireless Communication. Underground mines are usually extensive labyrinths, of which the tunnels are generally long and narrow with a few kilometers in length and a few meters in width. Thousands of mining personnel are needed to work under extreme conditions according to the construction requirements, and hundreds of miners die from mining accidents every year. It is now widely approved that underground mining operations are of high risk. However, a monitoring and control system needs to be established as one important infrastructure in order to ensure the mining safety and coordinate various tasks.



Fig. 1 Mining area

It consists of random passages, branch tunnels, and this disorganized structure makes it very difficult to deploy any networking skeleton. In such a case, the utilization of a wireless underground sensor network (WUSN) and other sensing devices may have special advantages for realizing the automation of underground monitoring and control due to the rapid and flexible deployment. In addition, the multi-hop transmitting method can well adapt to the tunnel structure and thus provide enough scalability for the construction of a mining system, and it is very suitable to the comprehensive monitoring and control in coal mines, which can effectively compensate the deficiencies of the existing underground cable monitoring

system. in our society and nation has a more important role for safety issues of coal mines have gradually increased. The occurrence of disasters in coal mines is mainly due to the harsh environment and variability of working conditions. For safety issues, it is very essential for the implementation of mine monitoring systems as shown in Fig. 1.

Wired network systems used to be a trend for traditional coal mines, which have really played a significant role in safe production in coal mines. With the continuous enlargement of exploiting areas and depth expansion, laneways have become blind zones, where numerous unseen dangers are hidden out. So, it is essential to have a wireless sensor network mine monitoring system, which can be disposed of in such mines in order to have a safe production within.

II. LITERATURE SURVEY

Abdul Salam et al. (2017) describes about a novel framework for underground beamforming using adaptive antenna arrays is presented to extend communication distances for practical applications. Based on the analysis of propagation in wireless underground channel, a theoretical model is developed which uses soil moisture information to improve wireless underground communications performance. To this end, the angle, which enhances lateral wave, is shown to be a function of dielectric properties of the soil, soil moisture, and soil texture. Evaluations show that this critical angle varies from 0° to 16° and decreases with soil moisture. Accordingly, a soil moisture adaptive beamforming (SMABF) algorithm is developed for planar array structures and evaluated with different optimization approaches to improve UG communication performance.

Cheng Bo et.al (2012) Due to complex environment of the coal mine, it is necessary to monitor the information of underground environment, device and miner instantly in order to ensure the safety of coal mine production. However, the exiting coal mine cannot meet the requirements of coverage without blind spots as it is developed by the wired network. This paper proposes a RESTful Web services mashup augmented coal mine safety monitoring and control automation using ZigBee wireless sensor network, which can collect the underground temperature, humidity methane values and personal position through sensor nodes in the coal mine, and also collects the personnel position information inside the mine, and then implement a RESTful Application Programming Interface (API) on sensor nodes to provide access to sensors and actuators.

Weijun Qin et.al (2011) In the field of Cyber Physical Systems and Pervasive Computing, physical resources and web resources can be easily handled and seamlessly integrated into our life. However, due to the heterogeneity of devices and tight coupling of individual information systems, the developers cannot easily create their specific applications by combining with physical and web resources. In this paper, we proposed RestThing which is a restful web service infrastructure based on REST principles in order to hide the heterogeneity of devices and provide a seamless way to integrate embedded devices with existing web applications. Besides, we implemented a prototyping system, which provided the restful accessible way of the wireless sensors, and built a demo application on the smart phone to collect and merge physical and web resources. Finally, we gave the performance evaluation of the prototyping system.

Valdo Henriques et.al (2017) In this paper, we designed wireless sensor networks consisting of temperature, air-flow, humidity, noise, dust, and gas sensors to improve the safety of mines considerably by eliminating the need for human testers inside the mines. Each of these characteristics can be solely or collectively responsible for incurring a risk to a mine worker. The wireless sensor network discussed in this research work considers star and mesh network topologies. We also takes advantage of available wireless technologies, which will not only monitor the conditions inside the mine but also be used to provide a noise mapping feature which will output a noise protection scheme for the workers, and provide ventilation switching to regulate air in the mine. From the experimental results obtained, an accurate mine safety system is achieved by design of various sensors.

III. EXISTING SYSTEM

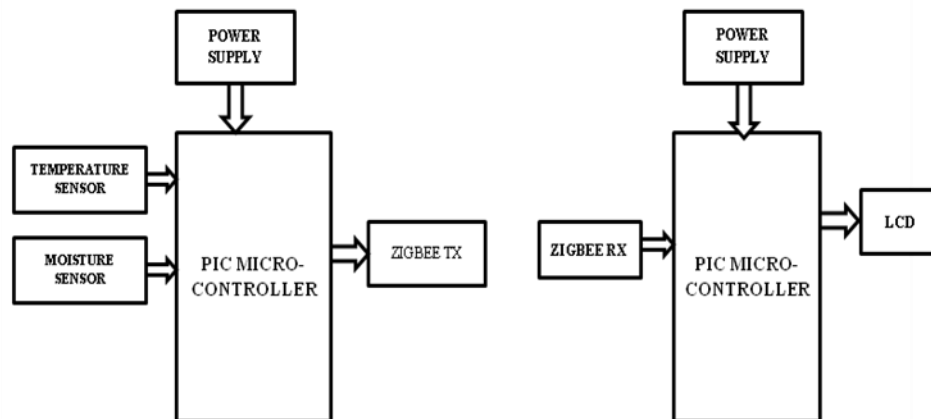


Fig. 2 Block diagram for Existing System by using PIC microcontroller

In an existing system, the Zigbee network has implemented for transferring the measured parameters. In this system, the measures the parameters like a temperature sensor and moisture sensor the measured sensor details are transferred based on the Zigbee network as shown in Fig. 2. The received details are displayed on LCD. In many realistic cases, traditional wireless signal propagation techniques using EM waves can only be applied for very small transmission distances due to a large path loss and vulnerability to changes of soil moisture.

IV. PROPOSED SYSTEM

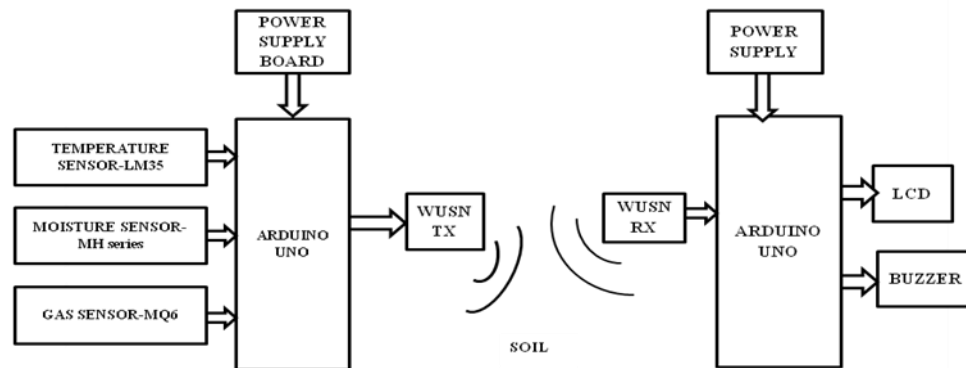


Fig. 3 Block diagram for Proposed System by using ARDUINO UNO

There are Several techniques is adapted to sense the presence of these poisonous gas, among them use of semiconductor type gas sensor is very much effective. These sensors can be mounted in the coal mine area but sometimes these create some problems in mining too. Accidental damage to the sensor device often took place. Another technique is the use of the robot. These robots are effective but the cost of a robot is very high. However, there is another way of getting the effective and low-cost solution of sensor implantation. The key to controlling coal mine accidents the prediction of outburst by implementing sensors and microcontrollers and to generate an alarm system before critical atmospheric level.

The key to controlling mining accidents the prediction of outburst by implementing sensors and microcontrollers and to generate an alarm system before critical atmospheric level. Continuous monitoring is necessary which again requires some effective and accurate sensing system. The proposed system consists of the temperature sensor, Moisture sensor and gas sensor for monitoring the parameter like temperature, Moisture condition, and gas. The measured parameters are transferred WUSN. In this approach, magnetic induction based transmission is proposed. At the receiver side, it receives the measured parameters display on LCD and Buzzer is used for the purpose of emergency indication as shown in Fig. 3.

V.

CIRCUIT DIAGRAM

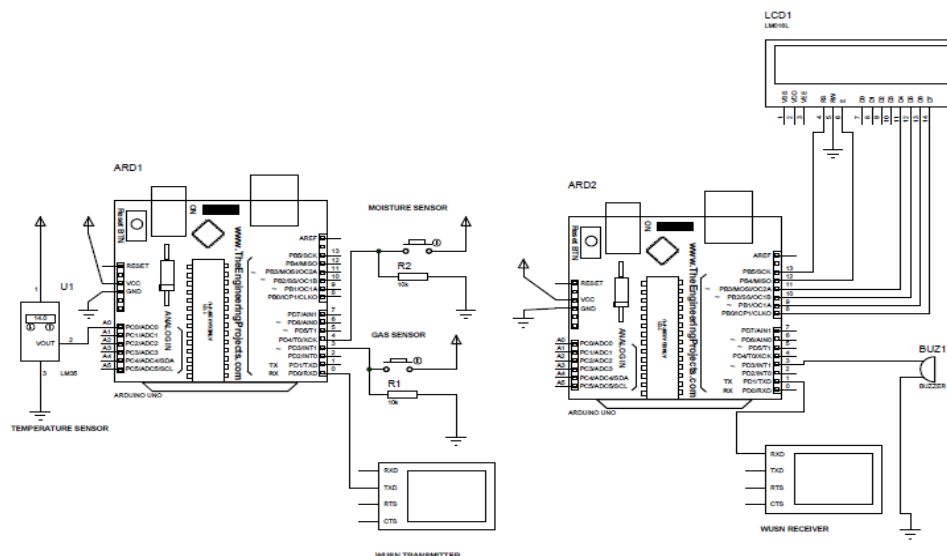


Fig. 4 Circuit diagram of proposed System

In this circuit, at WUSN transmitter side temperature sensor (LM35) Vout pin is connected to the Arduino UNO A0, similarly, moisture sensor Vout and gas sensor Vout connected to 3 and 4 of Arduino UNO. The measured sensor details pick up by the Arduino UNO controller then this measured signal transferred with the help of WUSN transmitter module. At the receiver side, WUSN receiver module receives measured details. LCD display (RS,EN,D4,D5,D6,D7) connected to Arduino UNO (13,12,11,10,9,8). A buzzer is connected to 3 pins of Arduino. When the Arduino controller receives abnormal condition then the buzzer pin goes high for indication purpose as shown in Fig. 4.

VI.SIMULATION CIRCUIT DESIGN

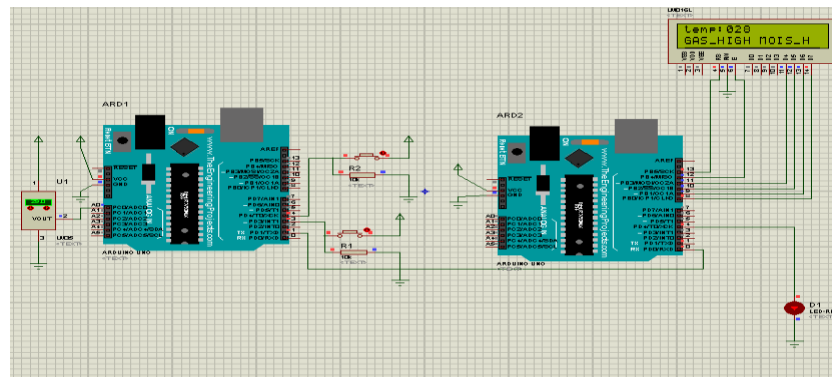


Fig. 5 Simulation circuit for transmitter and receiver

In wusn transmitter side temperature sensor, moisture sensor and gas sensor are interfaced with the Arduino UNO microcontroller. It picks up the measured sensor details. This measured sensor details transmitted using WUSN transmitter module based on magnetic induction approach. At the receiver side, the WUSN receiver module receives the information and is displayed on the LCD. If the measured sensor details go high means buzzer is used to indicate as shown in Fig. 5. Simulation for this project implemented using Proteus software. Here temperature sensor connected to A0 of Arduino and moisture sensor and gas sensor is connected to 3 and 4 pins of Arduino. The sensor measured details are transferred serially to the receiver. In this simulation not able to show how transmitted in the soil. So instead of that, we use serial transmission.

VII. RESULTS

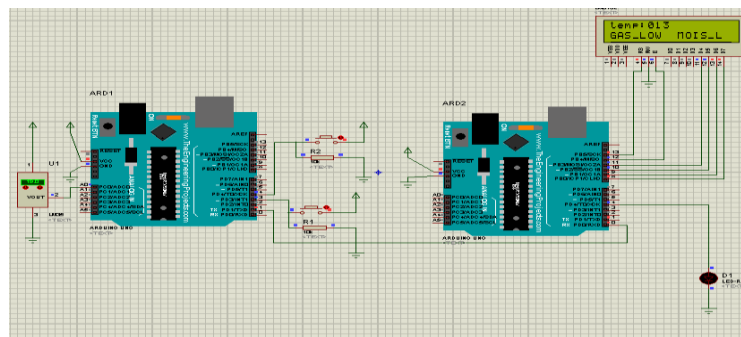


Fig. 6 Buzzer is indicating when gas is low is shown in LCD display

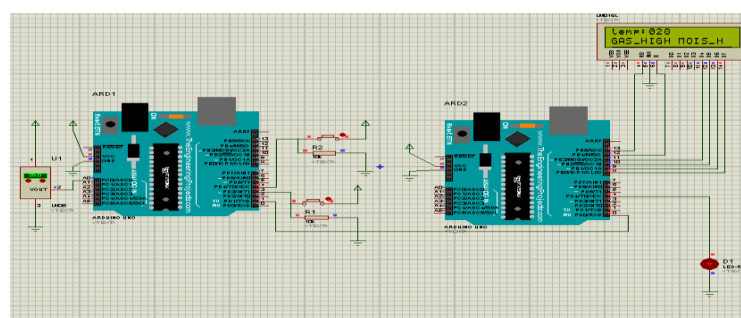


Fig. 7 Buzzer is indicating when gas is high is shown in LCD display

VIII. HARDWARE IMPLEMENTATION

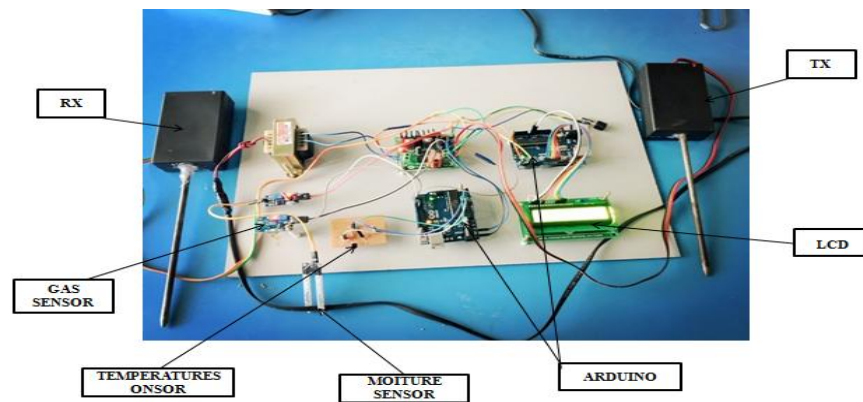


Fig. 8 Hardware setup

As shown in Fig. 8 hardware setup has some of the components has been introduced transmitter, receiver, gas sensor, temperature sensor, a moisture sensor, an Arduino UNO board is used. By using this hardware setup we have tested the gas sensor by agarbatti, and a temperature sensor is tested by using the sample water, and finally, the moisture sensor is tested by some water content of sand.

IX. CONCLUSIONS

Thus the coal mine safety monitoring system is implemented using wireless underground sensor network (WUSN). Based on magnetic induction approach the advances are related to various aspects of wireless communication and networking. Moisture, Gas and temperature level is always sensed and if changes in those values from the threshold level then it monitored by the monitoring center. From this proposed we can able to give immediate treatment for workers in case of an emergency situation. This System will further be developed by introducing additional sensors for determining fire and obstacles. And also voice-based communication will be introduced in the future.

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