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Safety of Underground Coal Mine Using Artificial Intelligence and Wireless Sensor Network

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Abstract

Mining process plays the vital role in the modern era for the development of nation as well as the world wide. By using the mining only we can now a day's having so many essential goods what we are using everywhere[2]. If we take the case of coal, then it is the most important product through which all the byproduct we are getting like fuel, wax, plastic, peat etc. In this paper purpose was to provide an implementable design scenario for underground coal mines using Artificial intelligence technique along with wireless sensor networks (WSNs)[1]. The main reason being that given the intricacies in the physical structure of a coal mine, only low power WSN nodes can produce accurate surveillance and accident detection data[4,6]. Because of the rapid growth of accident in mines area like roof fall, explosion, etc, the development of intelligent sensors, microcontrollers, and network technology, became essential; so as to make a reliable condition for our automatic real-time monitoring of coal mine[2]. The underground system collects temperature, humidity and methane values of coal mine through these intelligent sensor nodes in the mine, and provide the necessary safety prerequisite to avoid accidents.

Keywords- Coal mine, Artificial Intelligence, Wireless Sensor Network, Embedded Board, safety.

I. INTRODUCTION

As we know the existing monitoring systems underground of coal mine mostly use cable network which may get damaged in span of time due to temperature, loose contact and mostly moisture. In the underground mine explosion is also sometimes takes place due to short circuit[7]. And very often of them (mines) use wireless sensor networks but can't provide the details of the number of personnel in the mines due to lake of intelligence in the sensor. When an accident happened, especially explosion, the sensors and cables usually were damaged fatally, and couldn't provide information for rescue search and detection events[5].In this application, Wireless sensor network and the AI (Artificial Intelligence) can used to solve the key issues of communication bandwidth, mobile data transmission, staff orientation, working surface real-time monitoring, synchronization monitoring and so on[6]. They make the sensor so smart so that even in failure it is self detected where the fault occur and suggest taking some necessary algorithm.

II. AIM OF PROJECT

1. To check the presence of methane gas inside the mine, which is a prime cause of explosion?
2. To check the water level of nearby river continuously, these causes the soak in the tunnel and create the moisture which may damage the sensor or sensor circuit.
3. To save the life of worker who may die by numerous explosion taking place inside the mine, and
4. To provide whole interconnection, wirelessly using different topology in a smart manner.

III. DESIGN AND PROPOSAL OF PROJECT

A. UNDER GROUND SECTION:

In the underground section, the parameters temperature, humidity and gas are measured by means of respective sensors in a smart way so that the operational voltage is also not effected in due course of time[6].
The number of people inside the coalmine is monitored by the help of IR sensor. During a hazard this information will be useful to know whether there are any people remained inside the coal mine[8]. Information regarding the safety measures like wearing oxygen helmets etc., will be already given to the workers so that they can save their life[7]. If any of the received parameters are beyond the ultra limit, then a Buzzer will

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be ON, giving warning to the people. The parameters are displayed on the LCD screen and as well as transmitted to the Ground Section through the Zigbee Transceiver which is a application of AI[3]. The schematic diagram is as below.

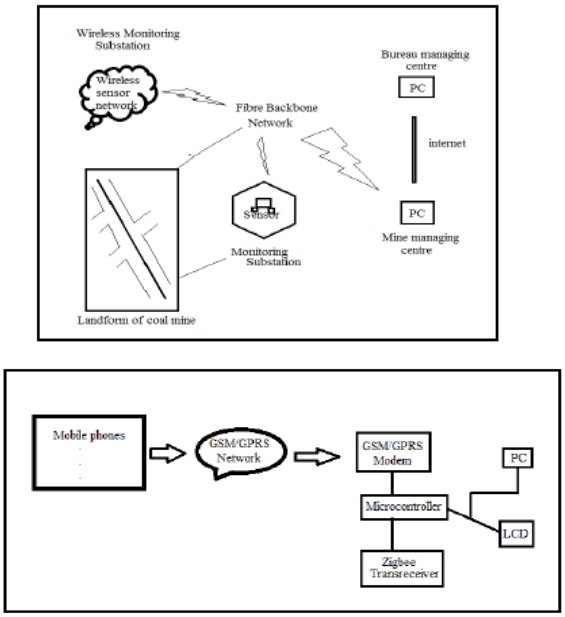
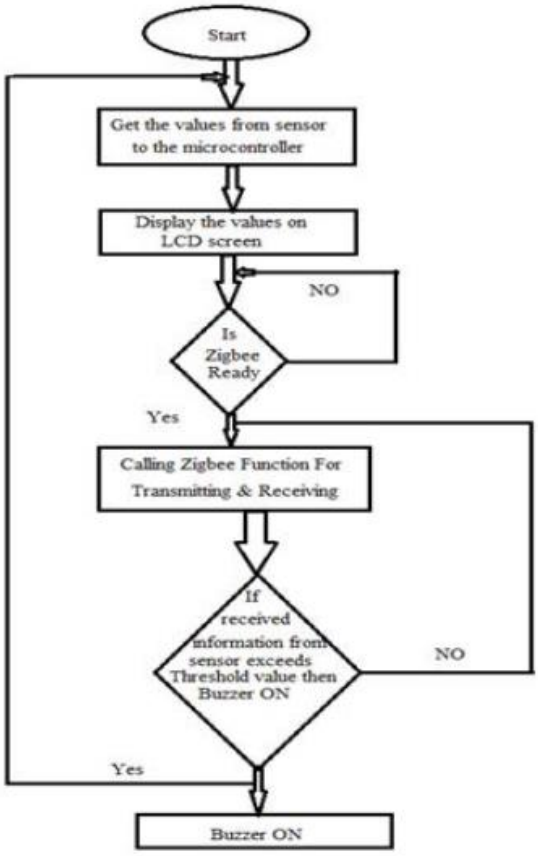


Fig 1: Mine Safety System using Wired and Wireless Monitoring using smart sensor.

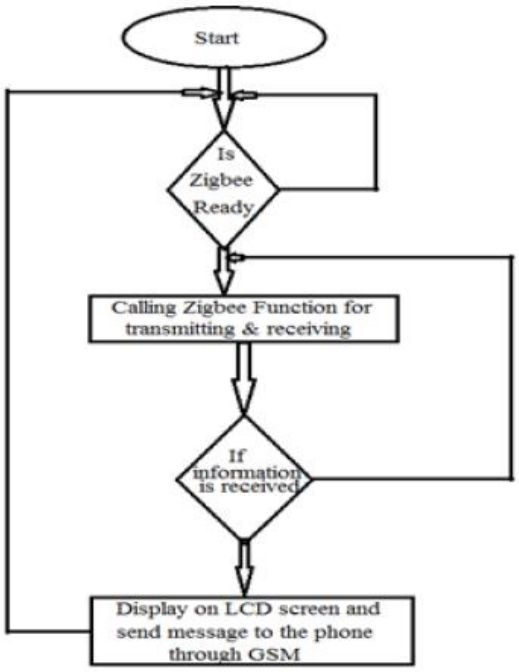
B. GROUND SECTION:

In the Ground Section, the Transceiver receives the information and sends to the controller which control the entire operation and is connected with LCD which displays the information in the Ground Section[4]. The controller is connected to the GSM modem through RS232.A number of mobile phones to which the data has to be sent is connected to the modem through GSM network. In addition the controller is connected to PC; the measured values are continuously displayed and stored in
the PC for future use.

A I. FLOW CHART FOR UNDER GROUND SECTION:



B.I. FLOW CHART GROUND SECTION:



IV. SENSOR NODE ARCHITECTURE

The basic block diagram of a wireless sensor node is presented in figure below.

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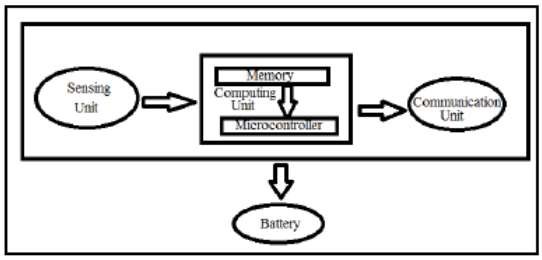

1. Sensing Unit:

It is the most important unit of the sensor which is used to sense the data and accordingly it generates the signal. It collects data at the ground level. This data is the physical raw data which is sampled and converted to the analog domains and then into the digital form which is then converted into digital forms[7], which is then sent to the processing unit. There exists a variety of sensors that measure environmental parameters such as temperature, light intensity,
sound, magnetic fields, image, etc.

2. Processing Unit:

The processing unit mainly provides intelligence to the sensor node. It process the digital data so obtained from the sensing node and then process it in the sequence[2]. The processing unit consists of a microprocessor, which is responsible for control of the sensors, execution of communication protocols and signal processing algorithms on the gathered sensor data.

3. Transmission Unit:

Similar to microcontrollers, transceivers can operate in Transmit, Receive, Idle and Sleep modes. An important observation in the case of most radios is that, operating in Idle mode results in significantly high power consumption, almost equal to the power consumed in the Receive mode[2]. Thus, it is important to completely shut down the radio rather than set it in the idle mode when it is not transmitting or receiving due to the high power consumed.

4. Battery

It is another important unit in the system which supplies power to the complete sensor node. It plays a vital role in determining sensor node lifetime. In the mine area if the voltage get fluctuate then it may cause the damage of sensor[5]. Also if the power supply is not accurate then sensed data may get erroneous and result will be wrong. The amount of power drawn from a battery should be carefully monitored. Sensor nodes are generally small, light and cheap, the size of the battery is limited[5]. Furthermore, sensors must have a lifetime of months to years, since battery replacement is not an option for networks with thousands of physically embedded nodes. This causes energy consumption to be the most important factor in determining sensor node lifetime.

V. CONCLUSION

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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2. Er. Ravi Ranjan Kumar, Er. Vijay Kumar, and Er.Vipin Gautam are the research scholar at Gandhi Engineering College, Bhubaneswar, Odisha.

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