COAL MINES MONITORING AND SECURITY SYSTEM

SNEHA KHANAPURE, SAYYADAJJ D.
1PG Scholar, Department of Electronics and Communication Engineering, MIT, Aurangabad, Maharashtra, India
2Head of the Department of Electronics and Communication Engineering, MIT, Aurangabad, Maharashtra, India
Email: sneha.khanapure@gmail.com, sayyad_ajij@yahoo.com

Abstract: Based on continuous revolution of coal mining technology, this paper puts forward a project about safety monitoring system of coal mine using Zigbee technology and RS485 interface. A system is designed using group of sensors which monitors the different environmental condition in underground mines and if value exceeds from threshold value, then the Miners are informed through Alarm. Another module is wireless sensor network software, which is developed to trace and locate underground miners by sending the alert message to control stations. The paper shows that the system is flexible in the architecture of software and hardware, and can easily extended to other mine safety production fields.

Keywords: Tracking and monitoring, intelligent sensor network, Zigbee device, Visual basics 6.

I. INTRODUCTION

Safety of the human life is most important concern in any type of industry. In mining industries specifically in coal mines, due to the environmental condition, there are chances of disasters of constantly lives are lost and many countless miners are injured. To avoid any type of unwanted phenomenon all the mining industry should follow the basic precautionary measures. To avoid any loses to the production and damaging of human health, reliable and continuous communication system is required. The present monitoring system of the coal mines mostly use cable networks in many places which are still incapable of saving lives of those workers which are working in this professional. Another disadvantage of wired communication is if it is damaged due to land slide or explosion, it is very difficult and expensive to reinstall it again.

Our proposed system is based on wired as well as wireless communication which are developed for fast and reliable communication without any interruption. Not only monitoring of wireless and cable network can complement each other, implementing safety monitoring but also it can solve key issue of communication bandwidth, data transmission, staff orientation, synchronised monitoring is possible.

II. WIRELESS SENSOR NETWORK

Wireless Sensor Networks (WSNs) consist of small nodes with sensing, computation, and wireless communications capabilities. A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, gas, humidity, light etc. A sensor network is as being composed of a large number of nodes which are deployed densely in close proximity to the phenomenon to be monitored. Each of these nodes collects data and its purpose is to route this information back to a sink. Today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

III. SYSTEM DESIGN STRUCTURE

This system is developed using two wireless sensor nodes, one is a fixed node and another is mobile data acquisition sensor node. These nodes are used to monitor the different environmental parameters inside the underground coal mine. The structure diagram of this system is shown in following figure 1 and figure 2.
The data acquisition through fixed sensor node uses two types of communication technology, wired and wireless [3]. Here four different sensors are used in this node they are temperature, light, gas, humidity. These Parameters are monitor by the sensors continuously and then data is sent to base station. When it is found that the parameter received at base station have exceed the set limit, then the miners are informed through the alarm buzzer to ring in time for safety measures.

Another mobile sensor node (moving node) will be attached with the body of miner. This node has a sensors module which is mainly battery-powered [4]. In particular mine excavation area, this module is placed to the worker that not only facilitates the data collection, but also it can trace the location of miner from the base station using our system software.

IV. TECHNOLOGY OF ZIGBEE

A wireless network used for home, building and industrial control. It conforms to the IEEE 802.15.4 wireless standard for low data rate networks. With a maximum speed of 250 Kbps at 2.4 GHz, ZigBee is slower than Wi-Fi and Bluetooth, but is designed for low power so that batteries can last for months and years[5]. The typical ZigBee transmission range is roughly few 100’s of meters, but that can vary greatly depending on temperature, humidity and air quality. It can communicate up to 254 controlled network nodes at a time.

Although ZigBee networks can be configured in star, peer-to-peer and mesh topologies, it is the mesh network from which ZigBee was named. A ZigBee mesh provides multiple pathways from device to device (like the Internet) and eliminates a single point of failure. If nodes go down or are removed, ZigBee devices can “zig” and “zag” through the network to their destination like a bumblebee[5]. ZigBee uses two types of devices. Reduced-function devices (RFDs) are sensors that communicate with full-function devices (FFDs). FFDs are complex nodes that conform to the full 802.15.4 standard and can serve as routers. It currently operates in 868MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40kbps in USA, and the 2.4GHz ISM bands in India at a data-rate of 250Kbps. Table shows a comparison of different transmission media [5].

<p>| TABLE I. Comparison of Different Transmission Media |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Bluetooth</th>
<th>RF Module</th>
<th>Zigbee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption</td>
<td>Medium</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Units</td>
<td>7</td>
<td>1</td>
<td>254</td>
</tr>
<tr>
<td>Distance</td>
<td>10m</td>
<td>50m</td>
<td>Few 100m</td>
</tr>
<tr>
<td>Transfer Rate</td>
<td>1Mbps</td>
<td>4.8Kbps</td>
<td>256Kbps</td>
</tr>
</tbody>
</table>

V. SYSTEM SOFTWARE DESIGN

The system software is developed using visual Basic 6 under Windows OS® as front end tool which is an object oriented based software package. A software developed here is to Display different environmental parameter inside the coal mine and systematic miner movement path is plotted.

The module allows design of Fail Safe communication technique to make sure that the slave can send the data to master even if one of the transmission technique fails. The paper mainly completes the software design of system with wired and wireless parts as we are using two transmission technique, one Zigbee trans-receiver (wireless) & other RS-485 (wired). Initially the slave will send their data via Zigbee. And if Zigbee fails due to any reason’s the slave will automatically switch to wired RS-485 communication. In this way data collection is done without any interruption.

VI. FLOWCHART

The flowchart of our system design is show below. Here at first the parameter are monitored via zigbee technology, and under certain circumstances Zigbee get damaged and fails to transmit the data. AS soon as the system recognizes that zigbee is failed to communicate then it check for RS485 communication whether it is ready, when it get ready then data will be transmitted via RS485 communication in this way continuous monitoring of parameters will be possible without any interruption.

![Fig 3.Systematic flowchart]
CONCLUSION

In this application monitoring of the underground coal mine system based on wired as well as wireless network so the key issue of communication bandwidth, continuous monitoring & safety has been solved before the hazards happens [7]. In case of disaster, the system will help to locate the miner’s which are trapped inside underground coal mine. This will solve the time taken for rescue work since it is automated increase life safety of rescuers and coal mine workers.

REFERENCES