International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

TrackMan – Tracking & Monitoring System

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Abstract - *The paper discusses about the frequently occurring underground coal mines accident are a big problem for mining industries. The core idea behind the initiative is creating a small wearable device having computing technology to sense human body's vital signs such as accelerometer; which can be used to detect movement of the body, likewise Electrocardiogram (ECG) for heart functionality test and Electromyogram (EMG) for muscular problem. By wearing these devices one can continuously monitor the vital signs of human body. With the increase of coal mine mechanization, it is important to monitor the underground mining activities and miner's physical conditions. Many mines use manual tracking to monitor which miners are underground and their general location. The interactive communication between different types of systems is difficult; the wired equipment interconnection and power supply are more susceptible that it may damage on accidents, hence the entire system becomes vulnerable. Traditional systems are performed with poor flexibility and expansibility. Several electronic tracking technologies that overcome the limitations of manual tracking are currently available. One technique uses a reader-based technique called radiofrequency identification (RFID) technology. Wireless sensor networks have characteristics of self-organization, wireless communication, and simple maintenance. Wireless networks are more flexible and have better perceptive function than wired network. This prototype design of our system is very low in cost and it is easily affordable to everyone. The pulse sensor design is such that, it is easily wearable on hand. Our main aim is to focus on underground coal miners' health and safety.*

Key Words: **RFID=Radio Frequency Identification ECG=Electrocardiogram**

1.INTRODUCTION

Tunnels in underground mines are generally long and narrow, with lengths in kilometers and several meter width. With the increase of coal mine mechanization, it is important to monitor the underground mining activities and miner's physical conditions. Roof fall occurrence is a major problem in Coal Mines. It becomes difficult to track human bodies during such disasters as the mines get dumped with huge pile of rocks and dust. Tracking the workers; dead or alive, is very critical for mining authorities. It causes revenue loss and casualty in underground coal mines; sometimes miners who are alive get trapped by roof fall occurrence and lose their lives due to lack of or delay in rescuing operation. The underground coal mine environment is harsh. It is difficult to work in such conditions and the environment also affects the miners' health. Researches are being carried out to provide technological advancement for the safety and health improvement precautions of underground miners. Many mines use manual tracking to monitor which miners are underground and their general location. When using manual tracking, at the beginning of each shift, the mine foreman provides the dispatcher with a list of names of people and where they are going within the mine. Once in the mine, if a miner needs to go to a different area to work, he notifies the dispatcher using the dial phone in the mine. The dispatcher then updates the list of miners' current locations. Manual tracking has a number of limitations. A miner's location may be given as being within a working section that can be quite large and therefore difficult to pinpoint a miner's exact location. Occasionally a mine worker will forget to notify the dispatcher when moving to another work location. The interactive communication between different types of systems is difficult; the wired equipment interconnection and power supply are more susceptible that it may damage on accidents, hence the entire system becomes vulnerable. Traditional systems are performed with poor flexibility and expansibility.

1.1 Health Monitoring System

Wireless sensor networks have characteristics of self-organization, wireless communication, and simple maintenance. Wireless sensor networks are more flexible and have better perceptive function than wired network, but it is inferior to wired communication in transmission capacity, rate and reliability. A sub branch of Wireless Sensor Networks (WSN), often referred to as Body Area Networks or Body Area Sensor Networks deals with wearable, small devices having computing technology to sense human body's vital signs such as accelerometer can be used to detect movement of the body, likewise Elec-trocardiogram (ECG) for

heart functionality test and Electromyogram (EMG) for muscular problem. By wearing these devices one can continuously monitor the vital signs of human body. Human Tracking System Several electronic tracking technologies that overcome the limitations of manual tracking are currently available. One technique uses a reader-based technique called radio frequency identification (RFID) technology. With the help of tags and readers it is possible to locate the worker's in coal mines effectively and efficiently.

1.2 Human Tracking System

Several electronic tracking technologies that overcome the limitations of manual tracking are currently available. One technique uses a reader-based technique called radio frequency identification (RFID) technology. With the help of tags and readers it is possible to locate the worker's in coal mines effectively and efficiently. [4]

1.3 Wireless Network

For transmitting data from the device to the base station, a wireless network has to be created. With the help of Wi-Fi router, a network can be created wherein information can be transferred from the device to the system. In order to establish a proper wireless connection Ethernet shield will be required.

2. PROPOSED MODEL/SOLUTION

2.1 Model/Solution – I

Researches are being carried out to provide technological advancement for the safety and health improvement precautions of underground miners. We will be designing a prototype of such device cum system which can continuously monitor the heart rate pulse of an underground coal miner. We get to know through this device during the accidents that how many miners are alive under the mine. Our aim is to design a low-cost, wearable wireless device which can continuously monitor the human heart rate pulse and send the information to the receiver/base station, either directly from sensor node or through intermediate nodes. Sensor node is integrated with a pulse sensor while intermediate node is just a kind of repeater. We present the major requirements to develop. A small device that can operate on a tiny event-driven operating system, and also it provides support for efficient monitoring and intensive operation.

2.2 Model/Solution – II

Radio Frequency Identification (RFID) is an upcoming technology which has recently attracted the interest of the research community because of the extraordinary benefits it offers over the other existing identification and data capturing technologies. This is formatted to review the existing RFID literature and explore the issues in the present RFID systems since the technology is still in its acceptance phase. Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects.

The tags contain electronically stored information. Some tags are powered by electromagnetic induction from magnetic fields produced near the reader. Some types collect energy from the interrogating radio waves and act as a passive transponder. Other types have a local power source such as a battery and may operate at hundreds of meters from the reader.

Unlike a barcode, the tag does not necessarily need to be within line of sight of the reader and may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture. There is a boom in the industry to use RFID technology in the recent years.

Research and development in this field has made this technology to be used in supply chain management, attendance management, library management, automated toll collection etc. There are multiple RFID standards being used in the industry. The existence of these multiple standards helps the users of this technology to choose between various standards and choose the approach which best suits them and then implement it for communication between an interrogator (RFID reader) and the RFID tag.

3. DESIGN IMPLEMENTATION

3.1 System Design

The basic device is Arduino Uno. Arduino is connected with the RFID reader at pins 9, 8. The Arduino is programmed such that it can read the RFID tags. The Ethernet shield is placed over Arduino kit to so as to connect the device with LAN cable. The pulse sensor is connected to the Arduino pins A0, 5V, GND. With the help of LAN cable, Wi-Fi router is connected to the Ethernet shield.

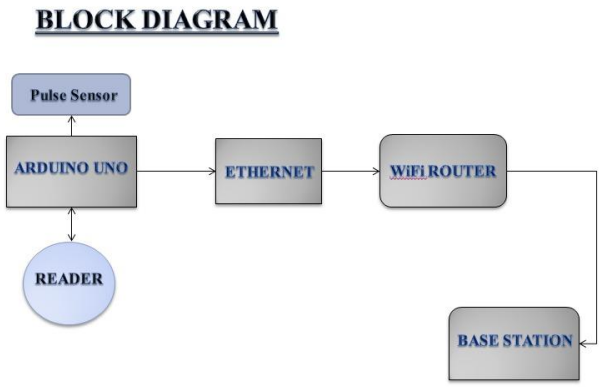

Fig – 1: Block diagram of the System

3.2 Web Page

The data which is transmitted from the Wi-Fi router is displayed on the web page. The web page will be displaying information like location of the mine worker in the lane and pulse rate of the worker.

3.3 Working of RFID

RFID readers are used to interrogate data stored in tags. It contains a radio frequency module, a control unit and an antenna to interrogate electronic tags via radio signals. The antenna inside the reader generates electromagnetic field. When a tag passes through the field, the information stored on the chip in the tag is interpreted by the reader and sent to the server, which, in turn, stores the information about the location of the mine worker. [2]

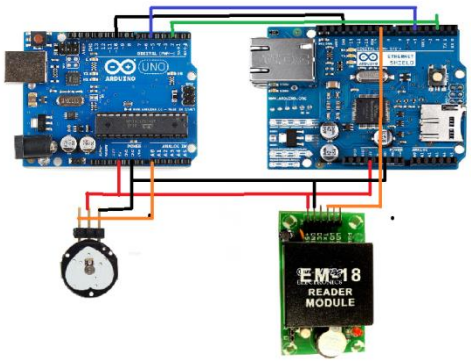

Fig – 2: Circuit diagram of the System

3.4 Working of the Pulse Sensor

Figure depicts the behaviour of IR light towards the human blood. This figure shows the IR sensor module of our design for the detection of human pulse. The IR LED is used to transmit IR light which is then reflected by the radial artery of the human finger and the reflected IR light will be detected by photo-transistor. The figure is showing the pulse-oximetry phenomenon. Here the IR light absorption and reflection is pictured for the oxygenated and deoxygenated human blood. It is human blood characteristics that it absorbs more IR light when oxygenated while less when it is de-oxygenated. Such technique is also called the Pulse-oximetry. [2]

In our case, we will be connecting the pulse sensor to the ear lobe for taking accurate pulse. Also it is comfortable for the workers to wear it on ear lobe instead of hand or finger as they work rigorously with their hands. The major functionality of this module is dependent on the IR sensor module. Output from the photo-detector diode is given to the op-amp through tantalum capacitor.

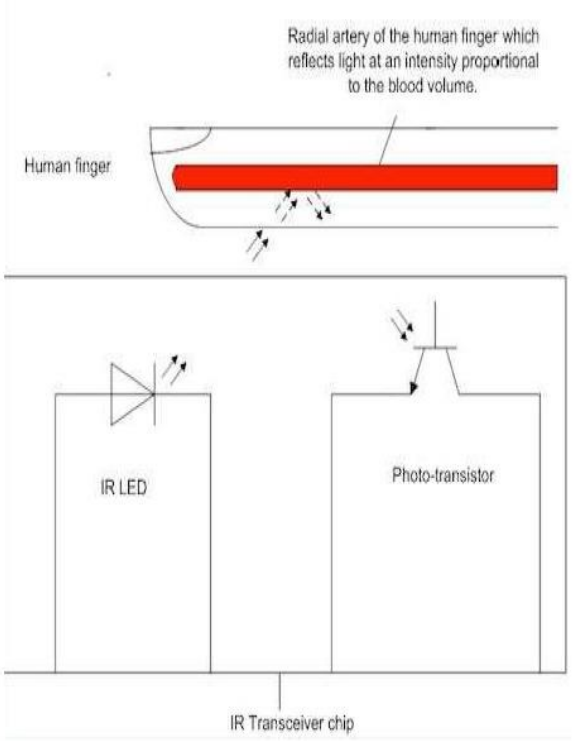

Fig – 3: Working of Pulse Sensor

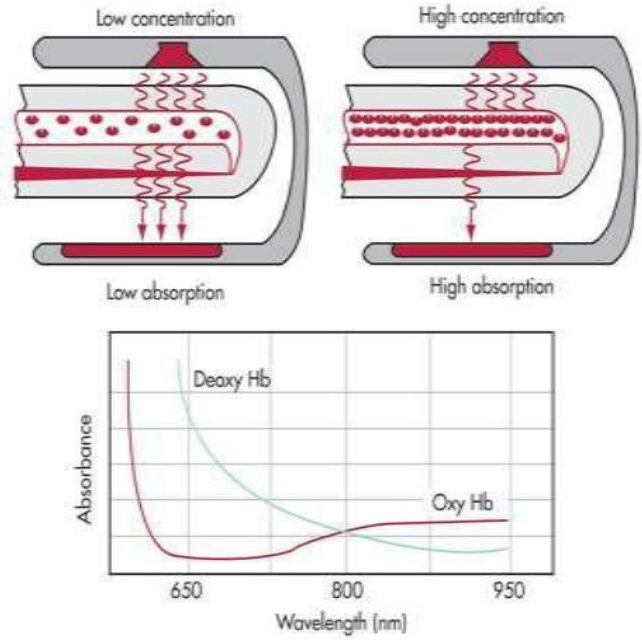

Fig – 4: Effect of Blood on Light Sensor

4. CONCLUSION

For tracking the exact location of the coal mine workers, an RFID tracking system is designed. For monitoring the health of the mine worker a pulse sensor is used. The complete information is transferred on a wireless network using Wi-Fi module. [2]

5. FUTURE SCOPE

The system can be further advanced by adding some more features to it. Features like giving an alert in case of medical emergency can be implemented. Also some other additional health monitoring devices other than pulse rate can be used for detailed health analysis of a mine worker. A gas sensor system which will alert the worker in case of increase in the amount of poisonous gases can also be designed. A system for sending alert on mobile phone or a smart phone operated system can also be made. [2]

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