Smart Safety Helmet for Coal Mine Workers In Lifi

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ABSTRACT

Mining is the first step in the dirty life cycle of coal. When coal mines move in, whole communities are forced off their land by expanding mines, coal fires, subsidence, and overused and contaminated water supplies. Mines are quick to dig up and destroy forests and soils. But once the coal is gone, the problems they leave behind, like acid mine drainage, can persist for decades. Around the world, Greenpeace campaigns to help communities stop coal mines, and speed up the shift to 100 percent clean, safe renewable energy. In this paper we are going to safe the coal mine workers by implementing the smart safety helmet. In this we are going to use Arduino (atmega328p), temperature sensor, humidity sensor, and heartbeat sensor and smoke sensor. The temperature at the workspace, humidity level in air, detection of any gasses, heartbeat level of the workers are the parameters to be considered during their work. These parameters are sensed by those respective sensors and the information is collected by the Arduino and they are monitored at the base station. The medium between the transmitter and receiver is light. The light is modulated in such a way that they can deliver the values from sensor at transmitter side and deliver them to the receiver end.

Keyword: - *Light Fidelity, Embedded, Wireless optical networks, Arduino*

1. INTRODUCTION

Safety is an important aspect of any industry especially in coal mine industry. Underground miner's experience many hazards includes poisoning of gases, sudden health problems due to the temperature and air quality. Presence of hazardous gases will lead to explosion. So quality of air and dangerous event detection are very important to detect in early stages. To get rid of those critical circumstances by developing a smart helmet which will equipped with the sensors like temperature sensor, humidity sensor, heart beat sensor and smoke sensor.

The temperature sensor sense the temperature of the coal miner's working environment which helps in cases of the very high temperature and the very low temperature which the human body could not bear, the humidity sensor senses the moisture level of the underground as the human body could not sustain the low humidity surroundings which leads to the fainting of the coal mine workers, heart beat sensor checks whether the coal miner is free from the health risk, If there is no risks are identified it clears that the blood circulation is normal.

Gas sensor senses the present of the hazardous gases which could threaten the life of the coal mine worker. These sensors will collect information about the current situation of the miner and send the information to the authenticated person. These sensors are connected to the microcontroller arduino, the arduino transmitter transmits the information from the sensors and these data are received by the arduino at the receiver end. Delaying in information sharing also one of the main reason for the miner's death. To avoid the delay in data transmission the system uses the LiFi module for the data transmission so, as soon as the dangerous event occurs the alert will be sent to the authorized person. Light fidelity is known for its fast data transmission which uses the visible light as a medium of communication.

2. PROPOSED SYSTEM

The helmet which is equipped with the network of sensors such as the heart beat sensor which will be fixed to the coal mine worker which will constantly checks the blood volume which is directly related with heart functions and monitors the workers' health, temperature sensor collects the workplace temperature data, humidity sensor gets the information of the moisture content of the work place and gas sensor gets the data of the various gas in the coal mine and these sensors are connected to the Arduino microcontroller transmitter which transmits data using light fidelity technology and data will be received by the another end by the receiver. In the existing system data are transmitted with the help of the zigbee technology where the data transmission is not much efficient, its transmission rate is very low which is around 30 meters it may leads to the less data coverage or sometimes to the loss of the data and it may leads to the late alerts and loss of the lives. Since, lifi is a fastest mode of transmission the data are transmitted without any delay or loss in data. Thus the workers can work in an eco-friendly environment where occurrence of radiations is less.

2.1 Block diagram of proposed system

The block diagram of the system to use Lifi mode of communication has two major components, transmitter and receiver. The transmitter side consist of two power supplies 5V and 12V which are splitted using a voltage driver circuit. The 5V supply is to give the source power supply for all the analog sensors and the arduino for its operation. The 12V supply is to give driving voltage for the LED light from which the data is to be transmitted. The brief diagram of the proposed system is shown in the figure 3.3 which interfaces various sensors and a transmitter module.

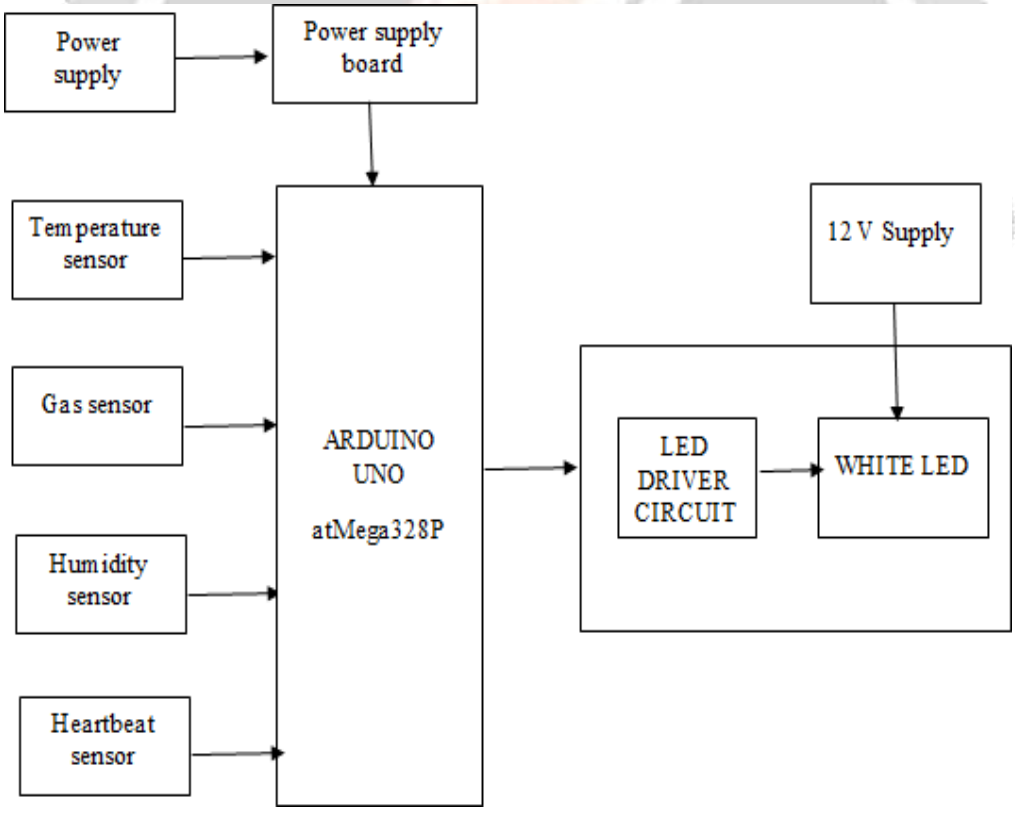

Fig -1: Block diagram of the transmitter

The receiver side consists of a photo detector which detects the light waves which are directly falling over it. The detected data is observed in light form, it should be converted into electrical form for doing further process. A transducer converts the received light rays into a digital form. These signals are then processed by an arduino and monitored at the base station. The block diagram of the proposed system is shown in the figure 3.3 which interfaces various sensors and a transmitter module.

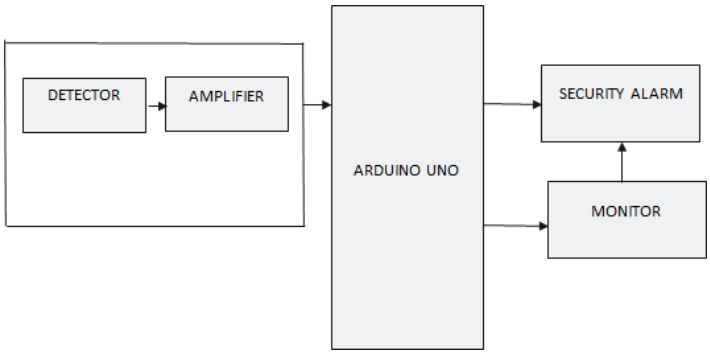

Fig -2: Block diagram of Receiver

The Lifi communication used for transmission and reception of data is embedded with a microcontroller named Arduino UNO atmega 328p uses serial transmission in UART of the microcontroller which is connected with transmitter module sends the data through the white light of wavelength 700nm to 400nm. White light is actually made up of all of the colors of rainbow because it consists of all wavelengths, and it is described as polychromic light.

3. EXPERIMENTAL SETUP

The sensor values obtained by interfacing various sensors are to be sent to a receiver by means of light. A light transmitter module using a data line is used for this communication. The data line of the lifi transmitter module is connected to the serial transmit pin of the arduino board, so that the data is modulated along the light in a serial communication path. The experimental setup of the lifi transmitter and receiver connected to various sensors is shown in figure 3 and figure 4.

Fig -3: Transmitter setup

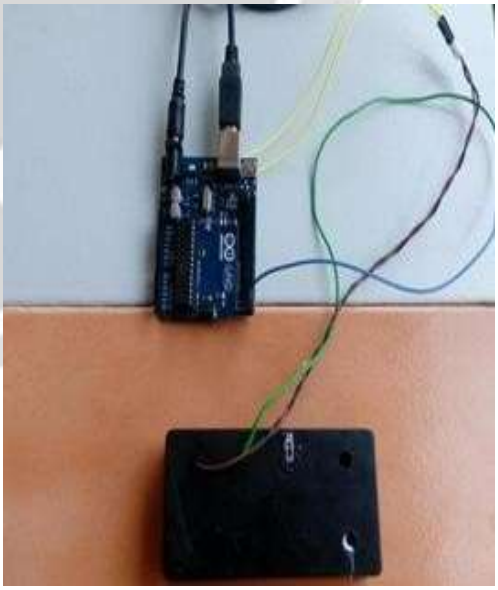

Fig -4: Receiver setup

4. RESULTS AND DISCUSSSION

Light Fidelity or Li-Fi is a Visible Light Communications (VLC) system running wireless communications travelling at very high speeds. Li-Fi uses common household LED (light emitting diodes) light bulbs to enable data transfer, boasting speeds of up to 224 gigabits per second. It is a form of Visible Light Communication and a subset of optical wireless communication (OWC).

This OWC technology uses light from light emitting diodes (LEDs) as a medium to deliver networked, mobile, high-speed communication in a similar manner to WiFi. Visible Light Communication (VLC) works by switching the current to the LEDs off and on at a very high rate too quick to be noticed by the human eye.

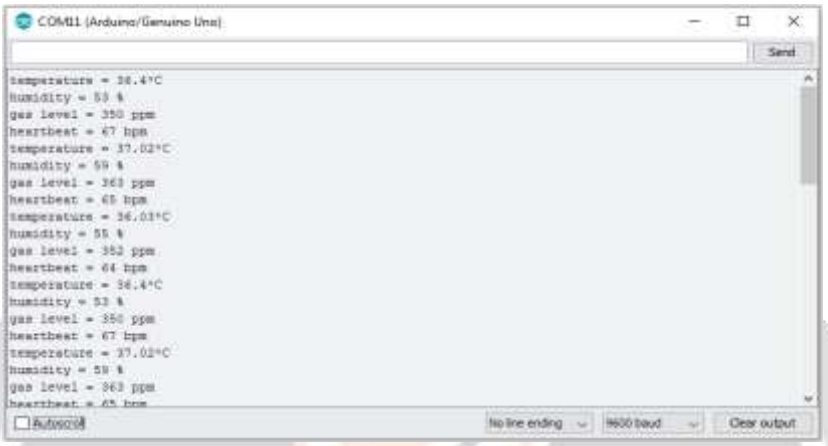

Fig -4: Serial monitor reading of Lifi transmitter

The transmitted may reach the receiver without any delay since light is too fast and the occurrence of noise is less as compared to other means of communication. The transmitter side and receiver side of the data monitored with serial monitor and the screenshots are attached in figure 4 and figure 5 respectively. In figure 5 the serial communication sends the data of all the four sensors to the receiver using light. A delay of 5 seconds is used between every iteration of the loop of the program. Here COM port 11 is connected to the transmitter arduino board. The COM port 11 is used for uploading program into the arduino board and with the same port we can view the serial monitor readings of the transmitter data. The data are continuously transmitted to the receiver using light with a delay of 5 seconds. This 5 seconds is utilized by the sensors to determine the various values at various instances of time. Thus the serial transmission of data takes place with light.

Fig -5: Serial monitor reading of Lifi receiver

The receiver side will receive the data from the light transmitted by the transmitter using photo detectors. These photo detectors senses the data which are coming along with the light into the serial receiver pin of the arduino board. The receiver side arduino board is connected to COM port 12. The readings in the COM port 12 is shown in figure 5.

The white led is used for the transmission and reception of data since the white led has its wavelength from 400 nm to 700 nm in the spectrum of visible light region. This wavelength range corresponds to the entire visible light region with all the colors from violet to red. Thus the data can travel along the light without much noises and reaches the receiver.

The data are continuously monitored. If any sensor reading exceeds the threshold value then the arduino microcontroller at the receiver end triggers an alarm with the buzzer connected at the receive end.

5. CONCLUSION AND FUTURE SCOPE

A smart mining helmet was developed that is able to detect four types of hazardous events such as danger level of hazardous gases, over heat, water storms and critical health issues. The layout of the visualization software was completed with an arduino microcontroller board. PCB's that were designed and made included a breakout board and a prototype board. A whole software implementation was done based on Arduino IDE software in order to do the measure the sensors and alert the miners and of calculations done with the measured values.

The system was extensively tested in order to determine whether or not the system works to the requirements. It was observed that the readings are transmitted to the base station which are connected with a photo detector module in the mining cave. The distance might still want to be limited as it would be impractical to warn miners that are too far away to find the miner who is experiencing a hazardous event. Node hopping can be implemented to allow transmissions to the supervisor or even a central control station. This can be done by adding stationary nodes that are programmed to only bounce any signal that is received. The system was improved by adding more measuring devices to check the miner's blood pressure and heart rate. Gas concentrations can be measured as well. In future, it could also be considered if such modules can also be used for secondary services, such as localization of workers relative to each other. This module can also be used in toll gate registration system of vehicles utilizing the headlights to transmit data.

6. REFERNCES

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