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Research paper

Coal Mine Workers Safety Helmet in Li-Fi Data Stored in Cloud

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Abstract

Coal miners are more likely affected by the various threats like gas explosion ,sudden health changes and issues, severe changes of the temperature and the moisture level .In this paper we presented the design of the smart safety helmet for the coal miner using LI-FI, this helmet will be equipped with the network of sensors such as the heartbeat sensor ,humidity sensor, gas sensor and the temperature sensor and the data from these sensors will be transmitted using light fidelity technology ,the alert messages are given to the mobile phones and also through the mail to the authorized person using IOT. Many accidents which occur in the mining industries are due to the slow data transmission or due to the loss of data which has to be transmitted, these issues can be solved by using the light fidelity technology as it is known for the fast data transmission .

Keywords: Alert Messages; fast data transmission; IOT; Light fidelity; Sensors.

1. Introduction

Safety is an important aspect of any industry especially in coal mine industry. Underground miners experience many hazards includes poisoning of gases, sudden health problems due to the temperature and air quality [10]. Presence of hazardous gases will lead to explosion. So quality of air and dangerous event detection are very important to detect in early stages. This paper is about to develop the 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 bare ,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. And 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 LI-FI module for the data transmission , so as soon as the dangerous event occurs the alert message will be sent to the authorized person .light fidelity is known for its fast data transmission .The data is stored in the cloud and Alert message is passed to the Gmail and the mobile phones using IOT.[2]

2. Existing System

In the existing system the helmet is fixed with the gas sensor which could sense the hazardous gases such as the carbon monoxide and methane at the coal miners working environment , In the suspect of the hazardous event the microcontroller sends the alarm to the control room ,here the data transmission is done through the ZigBee[17][10], Which has the low consumption of the power ,affordable price and low maintenance . The main disadvantage of the existing system is scalability , ZigBee tends to transmit the data over the small distance[10]. The low data coverage will leads to the inefficient data transmission ,which in turn leads to the delay of the data transmission at the receiver end .This makes the life of the coal miners unsecured.

3. Proposed System

In this paper we proposed the system as a 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 ardunio 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[15][16],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

Block diagram:

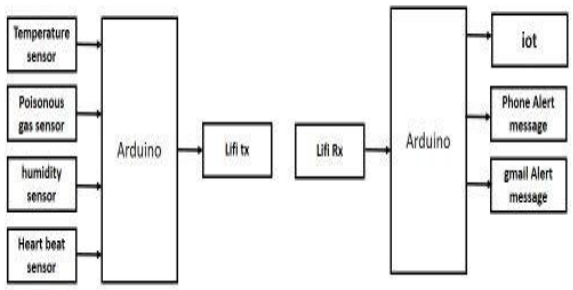

Fig.1: Implementation Model

and loss of the lives .The data are automatically stored in the cloud and the messages are monitored by the authorized person and the alert messages are also send to the authorized person in the form of the electronic mails and the text messages

4. Working principle

The helmet will be equipped with the network of the sensors which consists of the heart beat sensor, humidity sensor, gas sensor and temperature sensor[11][4] these sensors will gather current information or the status of the worker's environment and the data are transmitted through the Ardunio transmitter and LI-FI transmitter and the data are received at the photodiode of the receiver end. In the occurrence of any hazardous event the information will be send to the authorized person through the text message or as a mail, this will be done with the help of the IOT[9] and data are also automatically stored in the cloud.

Hardware Used

4.1 Heart beat sensor

The principle behind this sensor is photo plethysmography .it is an instrument which measures the changes in the volume of blood with the help of the any particular organ. since the

Heartbeat sensor:

blood volume majorly depend on the pulse rate of the heart and by this way it can detected that the h is healthy or not .Light emitting device emits the light which passes through the vascular region something like an earlobe and the detector receives all the signal .The light emitting diode of the heart beat sensor such as the photodiode. light from the source of the light will reflects the light in the case of the a finger tissue and transmits the light in the case of the earlobe , the light detector receives the processed light .The Volume of the blood is depends on the amount of light it absorbed

Fig.2: Heart beat sensor

4.2 Humidity sensor

The water content in the air is measured using a term is known as humidity[4]. The amount of the water content in the air is really an important parameter as it affects the human comforts. Various physical, chemical and biological processes are most likely to depend on the amount of the water content in the atmosphere

Humidity sensor:

Fig.3: Humidity sensor

4.3 Temperature sensor

Temperature sensor has three terminals and 5.5 V supply is the maximum voltage for this[11]. The material in the sensor performs the operation which depends on the temperature to make changes in the resistance. The sensor senses the changes in the resistance and the temperature is calculated.[4] The increase in the voltage makes the temperature to increase and this operation is monitored by using diode. Temperature sensors can be connected directly to input of microprocessor and the sensor is also capable of providing the reliable and direct communication with microprocessor. The sensor communication can be done effectively and there is no need of the analogy to digital converter.

Temperature sensor:

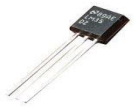

Fig.4: Temperature sensors

4.4 Gas sensor

The gas sensor consists of steel exoskeleton under which a sensing element is placed. The element under exoskeleton will subjected to current with the help of connecting leads .Presence of any gases will ionize the sensing element which causes the changes in the resistance of the sensing element .Gas sensor has high sensitivity and fast response time and the sensitivity of the gas is adjusted by the potentiometer[11].

Smoke sensor:

Fig.5 : Smoke sensor

5. Sensors Ranges

The following table shows the information about the sensors ranges and the ambient data

Tab.1: Sensors Ranges

Sl.No	Sensors	Range	Ambient Data
1	Temperature Sensor	-200oc To +600oc	66 To 70 Degree F
2	Gas Sensor	200 To 10,000 Ppm	Below 1000 Ppm
3	Humidity Sensor	-30oc To 190oc	From 30% To 70% But Ideally Between 50% And 60 %
4	Heart Beat Sensor	140-170 Beats Per Minute (Age 25) 115 And 140 Beats Per Minute (Age 60).	60 To 100 Beats Per Mim.

6. Internet on things

An IOT system is equipped with the sensors, which communicates with the cloud .The data which are gathered by the sensor are stored in the cloud , the stored data are processed ,based on the processed data the desirable action is performed.The user can make action on the other side without any physical contact with it and the changes is done through the system which is on the user interface[9]. The network of the sensors ,data processing and a user interface are the some important parameters of the iot system.

7. LI-FI

Light fidelity technology is known for the high data speed and the data are transmitted electromagnetically and runs on visible light. It uses the common light emitting diodes which is at the sender side and photo detector is placed at the receiver end, the The analog signals which are detected by the various sensors are given to the LI-FI transmitter, here the analog signals are converted into the digital signals and the these digital data are received by the photodetector or the LI_FI receiver , the received data can be converted into any forms such as video and audio application or the web enabled services and the main advantages of LI-FI are high speed, data density, security, device to device connectivity.

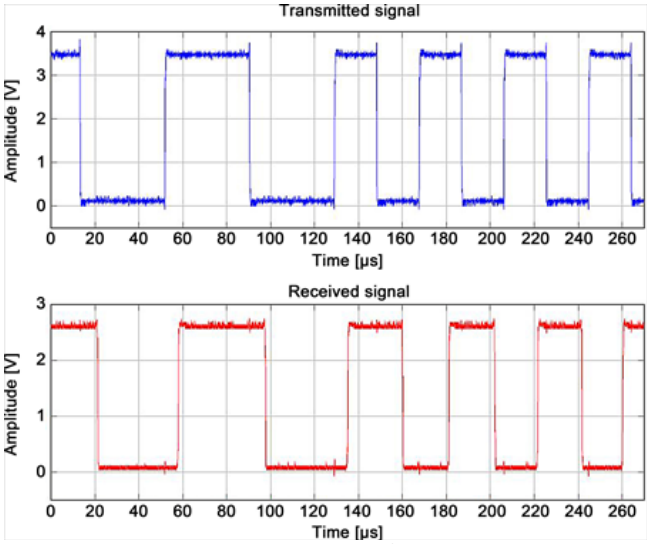

Fig.6 : Data Signal Of Li-Fi

The analog signals which are detected by the various sensors are given to the LIFI transmitter, here the analog signals are converted into the digital signals and the these digital data are received by the photodetector or the LI_FI receiver , the received data can be converted into any forms such as video and audio application or the web enabled services and the main advantages of LI-FI are high speed, data density, security, device to device connectivity.

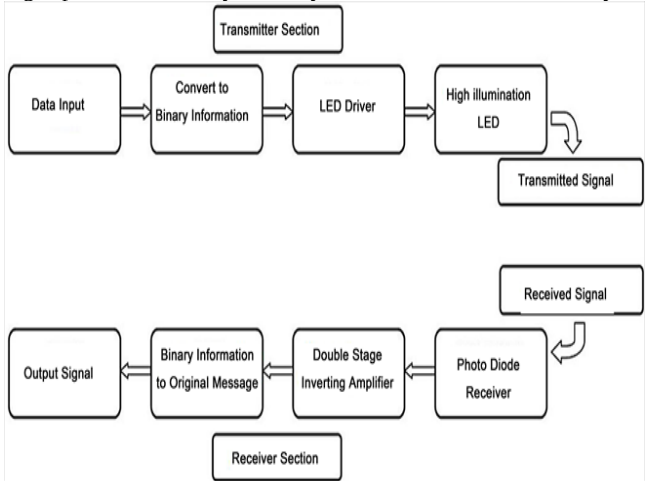

Fig.7: Data Flow for Experimental

8. Experimental Setup

In the experimental setup one student asked to wear the helmet which is equipped with the all the sensors with LI-FI transmitter and the receiver end is connected to the system or to the laptop, In this setup the receiver .module is connected to the

laptop and the data under normal the normal environment are taken in the account of the result. The data are also stored in the cloud and the authorized person will get the data.

Fig.8 : Transmitter Photodiode

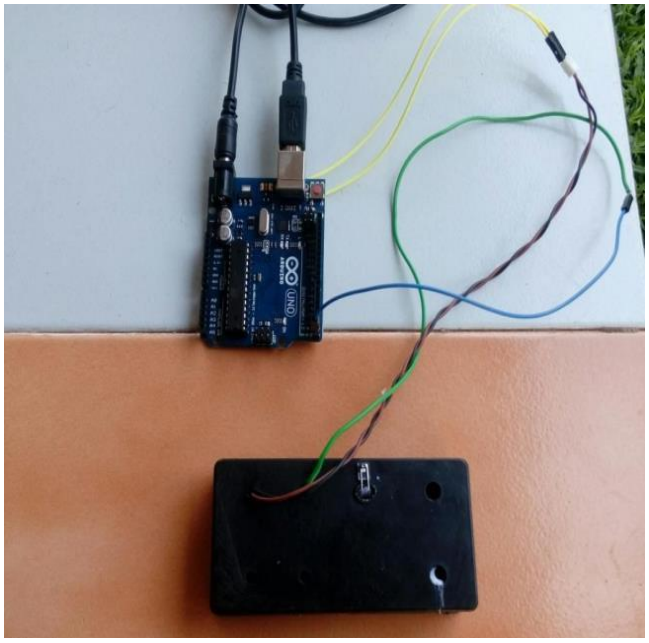

Fig.9 : Receiver Connected With Photodiode

Here the heartbeat sensor is fixed in the ear lobe of the person who uses the helmet. The data storage in the form of the of graphical method and also in the tabular method and they are as follows

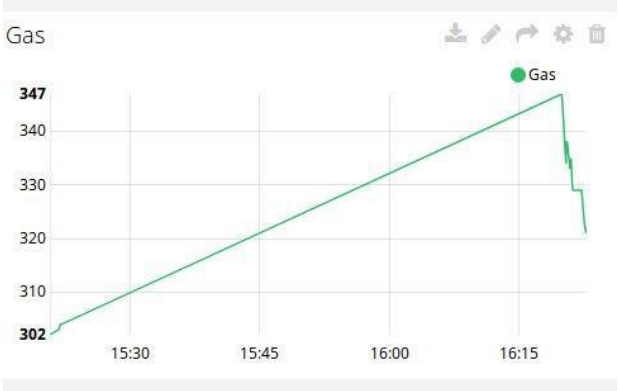

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Fig.10: Output of Gas Sensor

Graphical representation of the occurrence of the dangerous gases are plotted in the above graph, where the x-axis denotes the occurrence time and the y-axis denotes the ranges of the gas[1].

Fig.11: Output of Humidity Sensor

The humidity sensor collects the relative humidity of the worker's environment and the graphical representation of the heartbeat checking and the temperature values as follows

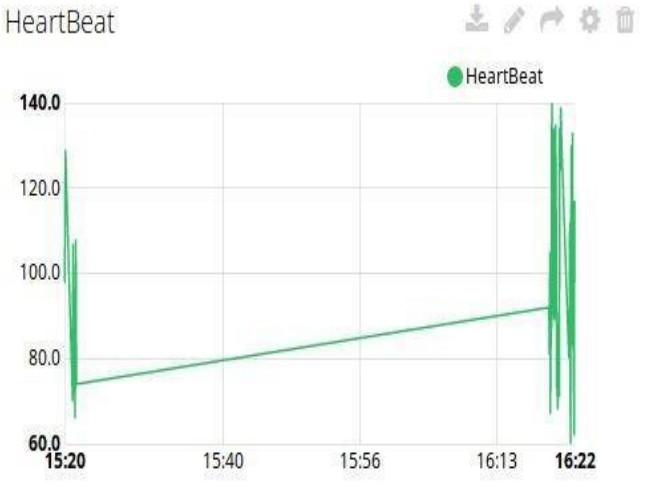

Fig.12 : Output of Heartbeat Sensor

Fig.13: Output of Temperature Sensor.

The gmail alert will be generated in the abnormal cases

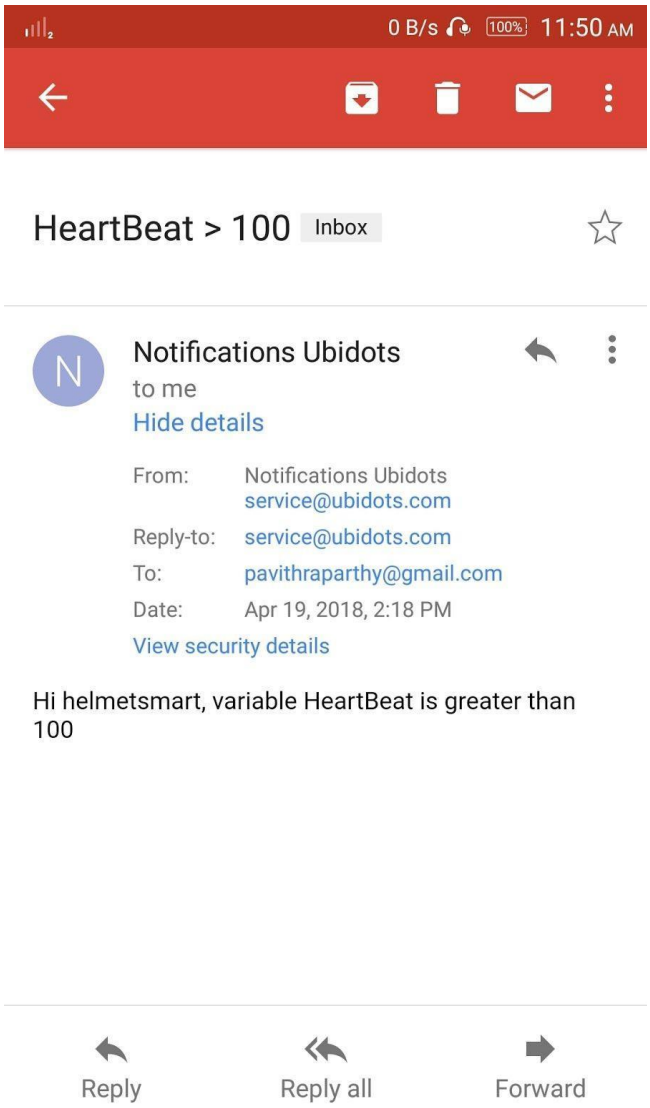

Fig.14: Email Alert

9. Conclusion and Future Work

Safeties of worker are very important in many industries and also in coal mine industry. This paper will proposed to reduce life risk of the coal miners at the various situation by efficient monitoring and fast data transmission which is achieved by the light fidelity technology. In future the works like automatic message to the nearby hospitals and the call alerts to the authorized person will be done.

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