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Smart Wearables for Improving Safety in Mines

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***Abstract*— A smart helmet having features such as continuous communication,detection of harsh and unfavourable environmental parameters such as air pressure, temperature,gaseous content.In addition to these features,the proximity of the working personnel and incoming traffic is detected and an alert is issued to the worker to prevent accidents.Bluetooth communication systems helps to communicate between the workers as well as to the monitoring station.A panic switch is issued in the helmet incase of emergencies.**

***Index Terms*— Monitoring, Collision, Communication, panic switch.**

I. INTRODUCTION

The mining business is quite broad and necessitates intricate processes that are carried out in tunnels, below ground, etc. This comprises a number of dangers that have an impact on miners' health. Over 372 miners lost their lives in the Chasnala mining disaster in Dhanbad, Jharkhand, India. It is regarded by many as one of the biggest disasters the mining sector has ever faced. Environmental factors including pressure changes and temperature swings are likely to go unreported by miners. The lives of miners could be at danger if they clash with large things like hard rock or mining equipment. Due to their exposure to hazardous gases, which also affects them, the miners are at risk. In this situation, miners are cut off from the outside world. The smart helmet system becomes an essential and useful instrument in this situation to protect the miners from serious accidents. In order to detect hazardous events, monitor local environmental conditions, update information such as GPS location and sensor data to the central console for simple tracking, and avoid the inhalation of harmful gases, this project aims to create a smart helmet. This protects the lives of miners in the mining industry.

Various pieces of information are acquired through the survey. Mining is the most dangerous business in India, where one person dies at work every third day. The International Labour Organization (ILO) reports that although mining accounts for 8% of all fatal accidents, it only employs about 1% of the worldwide labour force. The largest mining sector in the world, China produces up to three billion tonnes of coal annually. China accounts for 80% of the world's annual mining fatalities despite generating 40% of the world's coal. This study unequivocally shows that more safety precautions must be taken to save the lives of miners. The poll gave us the idea to launch this program.

II. SYSTEM OVERVIEW

Sensors for temperature, pressure, force, infrared, and gas are among the many that are present in the system. Temperature and pressure sensors are used for environmental monitoring. Every time the miners hit with a heavy

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object, force sensors are used. A central console is informed by an IR sensor when a miner removes their helmet. Gas sensors are used to determine whether hazardous gases are present in the environment. GPS is used to track the miners' whereabouts in the event of any abnormalities. The miner can manually turn on the panic switch in the event of a serious emergency to summon help from the central panel. An additional supply of oxygen is provided within the helmet to prevent inhalation of harmful gases brought on by the solenoid valve opening.

III. Existing System

The current method ensures that the miner's head is protected from many injuries by the mining helmet. The current structure makes it challenging to comprehend the state of the ecosystem. Due to their weight and difficulty in wearing them while working, miners frequently remove their helmets. In the case that it is taken away, miners are exposed to risky situations. There is currently no intelligent helmet that can assess the environment and make decisions to maintain worker safety. The miners are not supplied oxygen in the event of a deadly gas leak. The biggest challenge facing mining firms is establishing a communication environment free of barriers.

III. Reasons For Proposal

- To make it easier for underground coal miners to communicate with the outside world.
- Must keep an eye on the conditions in the mines and notify the workers of any emergencies.
- Positioning of miners.
- Detection of harmful substances.
- Indication when a helmet is removed.

IV. Proposed System

We have a helmet in place with the highest level of protection and a tonne of sensors for various types of analysis and detection. To start, hazardous gases are recognised using gas sensors.
When a potentially hazardous gas is identified, the solenoid valve opens to release additional oxygen. The second risky incidence was a miner taking off their protective helmet. An IR sensor may be used to monitor when a miner removes their helmet off their head. The third hazardous event is defined by the use of a force sensor, which is used for detection, as an instance in which miners are struck by anything against their heads with more force than is acceptable. For continuous monitoring, wireless transmitters relay the unexpectedly hazardous conditions to the control station, including temperature and pressure. GPS technology may be used to quickly track the location of miners. The miner may manually take off the helmet in an emergency.In addition a panic switch is issued to enable alerting the control station in case of emergenices.All of these systems combined makes the detection and prevention of accidents easier.

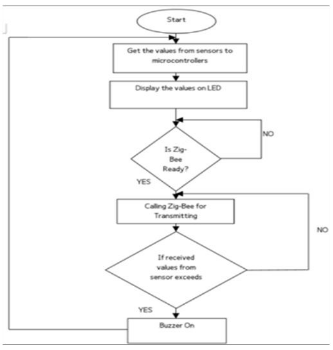

Fig:1 Block diagram of the working of sensors.

V. Working

1. Begin the program and initialize the necessary variables and pins.
2. Set up the gas sensor by connecting it to the appropriate analog input pin on the Arduino board.
3. Set up the temperature sensor by connecting it to the appropriate digital input pin on the Arduino board.
4. Read the gas sensor values using the analogRead() function and store them in a variable.
5. Read the temperature sensor values using the digitalRead() function and store them in a variable.

6. Convert the temperature sensor readings from digital to Celsius using a formula or pre-defined function.
7. Compare the gas sensor readings to a pre-defined threshold value or range to check for any dangerous gas levels.
8. If the gas level is above the threshold value, trigger an alarm or take appropriate action (e.g. turn on a fan to ventilate the area).
9. Display the temperature and gas sensor readings on an LCD screen or serial monitor for real-time monitoring.
10. Repeat the process at regular intervals or continuously, depending on the specific application.
11. End the program or provide an option for the user to reset or terminate the program.

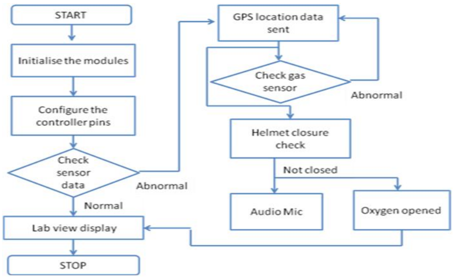

Fig. 2 Flow Chart

VI. HARDWARE DESCRIPTION

A. ARDUINO UNO

The ATmega328P microprocessor serves as the foundation for the open-source Arduino Uno microcontroller board. It is one of the most well-liked boards in the Arduino family and may be used in a variety of robotics and electronics projects. Sensors, actuators, and other electronic components can be connected to the board's numerous input and output pins.

Fig:3 ARDUINO UNO R3

B. LM35 Temperature Sensor

The output voltage of the LM35 series' precise integrated-circuit temperature sensors is linearly proportional to the temperature in Celsius (Centigrade). The LM35 is preferable to linear temperature sensors calibrated in Kelvin because it does not require a considerable constant voltage to be subtracted from the output in order to provide practical Centigrade scaling. The LM35 offers typical accuracy of 14 C at room temperature and 34 C over the entire temperature range of 55 to +150 C without the need for external calibration or trimming.

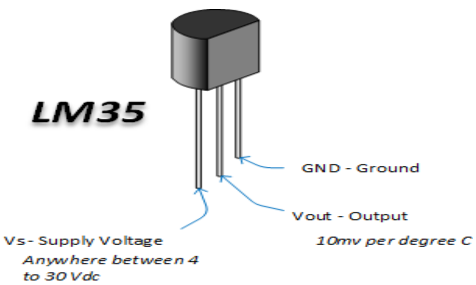

Fig: 4 LM35 Temperature sensor

C. RF Transmitter

The generator of the radiofrequency current that is sent to the transmitting coil is a radiofrequency (RF) transmitter. In the realm of imaging, this generates a signal that is utilised to excite protons. The radiofrequency signal can be sent and received by radiofrequency coils, or they can only act as receivers. A transmit receiver coil, also known as a transceiver coil, is a radiofrequency coil that carries out both of these functions.

Fig:5 RF Module

D. Gas Sensor

A gas sensor is a device that scans an area for gases, usually as part of a safety system. This kind of device can communicate with a control system to initiate an automated process shutdown when it detects a gas leak or other contaminants. Chemical sensors are divided into the category of gas sensors. The quantity of gas present is calculated using a gas sensor. To determine a gas's concentration, a gas sensor interacts with it.

Fig :6 Gas sensor

E. IR Sensor

Fig: 7 HC 05 module

The HC-05 module creates a wireless connection between devices by utilizing Bluetooth technology. It supports the Bluetooth 2.0+EDR (Enhanced Data Rate) protocol and works in the 2.4GHz band. With a range of up to 10 meters, the module can function as either a master or a slave device.

VII. SOFTWARE IMPLEMENTATION

A. Arduino Programming

Written in the Arduino Integrated Development Environment (IDE), Arduino code is a program that is uploaded to an Arduino microcontroller board. The microcontroller executes the code, which was developed in a language like C/C++, in order to operate various devices or complete particular tasks.

B. Tinkercad

An integrated development environment called Lab VIEW was created especially for engineers and scientists. A graphical programming language that is native to lab VIEW and uses a data flow model rather than sequential lines of text code allows us to develop functional code using a visual layout that mirrors our cognitive process. .

VIII. Simulation Results

Thus, the suggested system was effectively built as illustrated in fig. 9, and it aids in warning the central console in the event of emergency situations. When there are anomalies in the sensor data, ARDUINO assists in tracking the miners' location.

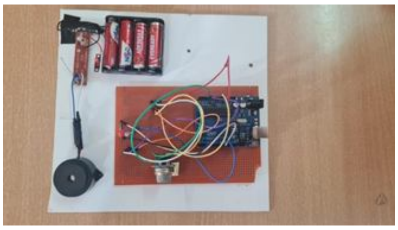

Fig:8 Hardware setup

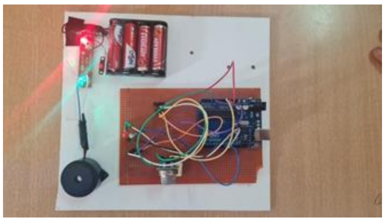

Fig:9 Working

The helmet device that tracks temperature, pressure, force, and hazardous gases is intended to alert the control room in the event of an abnormal condition. A voice communication system has been installed so the miners can be contacted directly in an emergency. The visualization is produced at the main console using lab view software. The information is transmitted wirelessly to the central console.

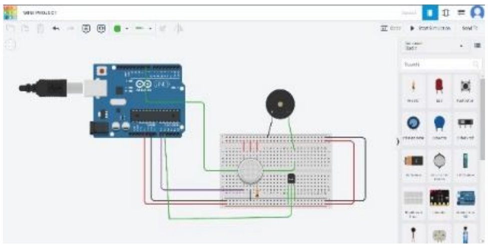

Fig: 10 Simulation

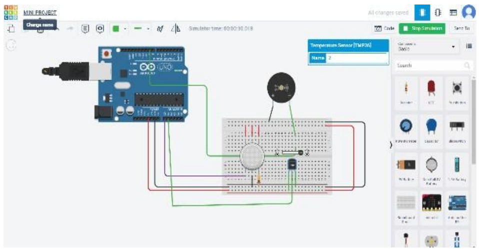

Fig:11 Temperature output

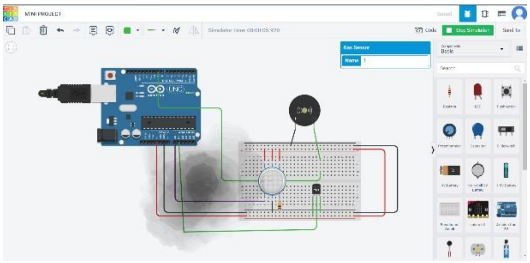

Fig12: Gas Sensor Output

IX. Conclusion And Future Scope

As a result, a smart helmet is created for hazardous event detection, environmental condition monitoring, information updating such as GPS location and sensor data to the central console for convenient tracking, and delivering oxygen supplements to prevent the intake of harmful gases. With the use of the Internet of Things, the system can also be improved (IOT). It is possible to build a database that continuously monitors the sensor modules. This module can be very helpful in preventing accidents and also to alert the control stations in time. All of these collected data can also be fed to a machine learning algorithm to provide more optimal solutions .The awareness of the working personnel can also be increased and all of these quality of life improvements leads to a safe working environment.

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