Development of Smart Helmet for Mining workers using Internet of Things

[1] Sahil Kamble, [2] Yash Watkar, [3] Vaibhav Chaple, [4] Sneha Motghare, [5] Sushmita Taiwade

[1] Research Student, [2] Research Student, [3] Research Student, [4] Research Student, [5] Research Student
Computer Science and Engineering,
SBJIT, Nagpur, India

Abstract – The mining industry is very dangerous industry where workers work deep in mine. This paper shows the information of the Smart Helmet Iot based system which is useful for the safety of mining workers working in the mining Industry.

Index Terms - LoRa, Temperature Sensor, Gas Sensor, Vibration Sensor, Buzzer, ESP8266

I. INTRODUCTION

We're developing smart helmet for mining worker using LoRaand various sensors. The life of worker is veritably importantin this last seen of worker is visible, air quality in mining, temperature and moisture. Discovery of various hazardous gases present in mine. Alert system for the smart helmet which tells worker is fallen or have some problem related to mining. Buzzer is used in this system so that worker and administrator who's working will be alert for accidental condition. In mine there's problem of internet connectivity sowe're using LoRa in design so that problem will be answered.

II. LITERATURE SURVEY

Jingjiang Song, Yingli Zhu et al. Proposed automatic monitoring system for coal mine safety grounded on wireless detector network. This system design monitoring for coal mine safety constructed by MSP430F and nRF2401. The detector groups of the system intensely cover temperature, moisture and other parameters in the underground mine, parameters measured are transferred to wireless communication module by the micro-controller. The collected information is transferred to long- distance monitoring center by string. The problem of this perpetration is that tackle is placed inside the coal mines, when a natural disaster or a roof fall passed, the system is damage. So, the trust ability and long life of conventional communication system is poor. Due to the harsh terrain inside the mine, the installation and conservation of the system is veritably delicate. Another problem is that the working condition of coal mine is veritably noisy and if thedistance of miner and system is long, miner not get propercommunication.

Pranjal Hazarika et al. presents perpetration of safety helmet for coal mine workers. This helmet is equipped withmethane and carbon monoxide gas detector. This detector senses the gas and the data is transmitted to the control room wirelessly, through a wireless module called Zigbee connected with the helmet. When the methane or carbon monoxide gas attention is beyond the critical position, regulator in the control room triggers an alarm and keeps the factory and the workers safe by precluding a forthcoming accident. This system doesn't detect fall downof the person and whether the miner's wear and tear the helmet or not.

Guo Feng and Yongping Wu et al. These experimenters developed a device that's veritably useful for threat mitigation in areas where there's mineral disquisition exertion, similar as coal, gold, etc. This system is stylish for chancing the exact position of the coal worker. With this device, shadowing is easy, and any help in an exigencycan be delivered veritably snappily. The primary debit of the system is that Bluetooth is a short space wireless technology, and the operation of cabling is tough.

D Kock et all. formulated robotization for the coal miningassiduity in South Africa considering that of productivity, health and safety They jointly delved the coal interface discovery (CID), to do this they used two well- known wayssimilar as vibration analysis and natural gamma radiation. Communication channels they also considered infrared, power line carrier radio and optic fiber communication channels for transmission of data in the coal mines. ChengQiang etal. have proposed an intelligent helmet for coal mines grounded on Zigbee wireless communication, their main idea is to descry the moisture position, methane attention and the temperature of the mining area. These tasted data will be transmitted to the ground station wirelessly through Zigbee.

Shishir et have proposed a safety helmet for miners grounded on ZigBee wireless technology; then they are monitoring gas attention, moisture and temperature of the girding. The tasted data is transmitted wirelessly through Zigbee to control center. When the tasted data is out of normal values the alert is transferred through Zigbee by lighting up different LED's and blowing up alarm.

J. Behr, A. Kumar and G.P. Hancke et al A smart mining helmet was developed that's suitable to descry three typesof dangerous events similar as peril position of dangerousfeasts, miner helmet removing, and collision or impact (miners are struck by an object). The dangerous events wereclassified as a miner removing the mining helmet off their head. An off the- shelf IR detector was also used to successfully determine when the helmet is on the miner's head.

III. PROPOSED WORK

This project includes various sensors which would detect various risks for workers working in a mine. The project uses LoRa for long range reliable communication. The project uses an MQ-135 for hazardous gases leveldetection. It uses an IR sensor for detecting falling rocks. The device uses Gas sensors for detecting level of toxic gases inside the mine. It also uses an Atmospheric Pressuresensor for detecting increase or decrease in atmospheric pressure which can result in risks for the mine worker. Temperature and humidity sensors are also used. LoRa boards are used at both end – Mine worker's helmet as wellas Supervising Unit. Alerts at both ends are given using buzzer and LED indications.

SYSTEM ARCHITECTURE

This is the system architecture of our project. In thisbattery is connected, alert system/buzzer isconnected. In this we have used various sensor such as DHT11, LM-35, Vibration sensor, MQ-135 Air quality sensor. Microcontroller Node-MCU which is connected with all sensor. The working of Node - MCU it is Wi-fi-Module and data transformed by using this module. We have connected based Lora tocontroller which will give store data in cloud and then information is displayed in Website and androidapplication. In this project, we have gas sensor and temperature sensor. When the temperature is high, the sensor sends immediate notification to the main communication area. This work has to be by the Internet of Things. Similarly, the temperature has to notify the changes in the temperature and it will sendalert messages to the user.

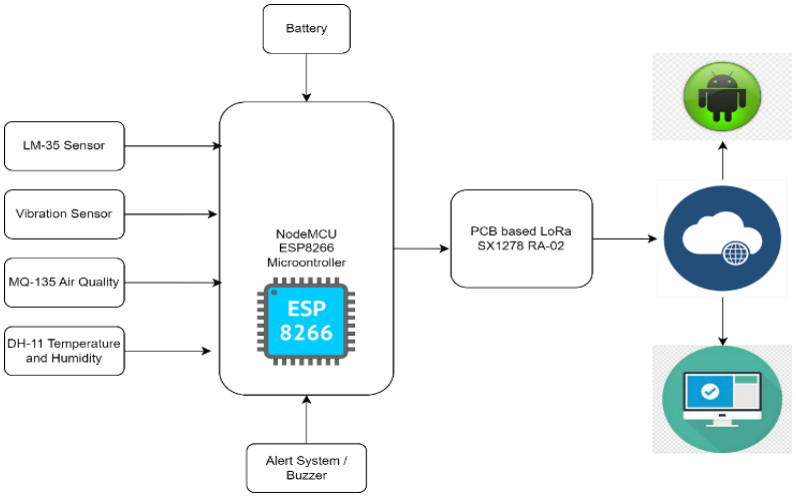

Fig: 3.1 System Architecture

FLOWCHART

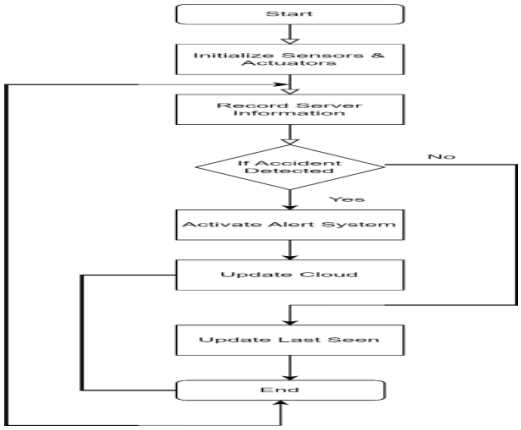

Fig: 3.2 Flowchart

Above we have shown the flow of our project. First, we willstart initialize sensor and actuator after that record server information. If any accident is detected activate alert system update cloud update last seen end. If no accident detected update last seen of worker and end the operation.

Working of The Project

As shown in below block illustration, helmet unit correspond of microcontroller (ESP8266), LoRacommunication module, temperature sensor (LM35), Humidity sensor (DHT11), gas sensor (MQ135), power force (appendage 12v). Three detectors (temperature, moisture, gas) which are connected to microcontroller ESP8266. These three sensors are connected to the adc harbors of microcontroller to convert the analog values intodigital form. The sensors available in the helmet collect thetemperature, humidity and gas information and shoot this information to the remote monitoring unit. Long range LoRa is used for data transmission. A temperature sensor (LM35) shows the present temperature every 10 min it plotsthe graph with respect the values in monitor. also, remaining sensors sense separate values and post controlling area. All values show in the form graph representation.

RESULT

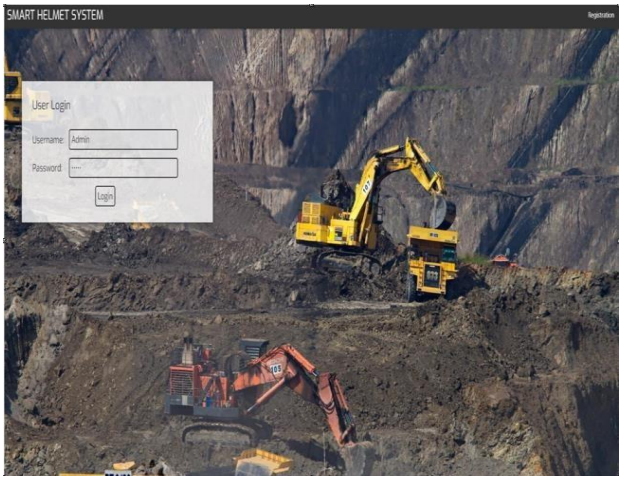

Fig: 3.3 Login Page

In above fig you can see user login page of our website. TheLoRa technology is used for data transmission from the working environment to the base station. The transmitter unit consists of air quality sensor, helmet removal sensor, temperature and humidity sensor. All real time data are received from helmet to the monitoring station through LoRa and can be visualized on the website or application. At the receiver side buzzer is used for abnormal condition.The data transmitted from transmitter unit is received by receiver unit. The data received by receiver unit then will upload to the cloud and then it from it will show our websiteor application. And this the login page which have been built for the website in which supervises form the mining industries can login to check the status of the worker working in the working environment.

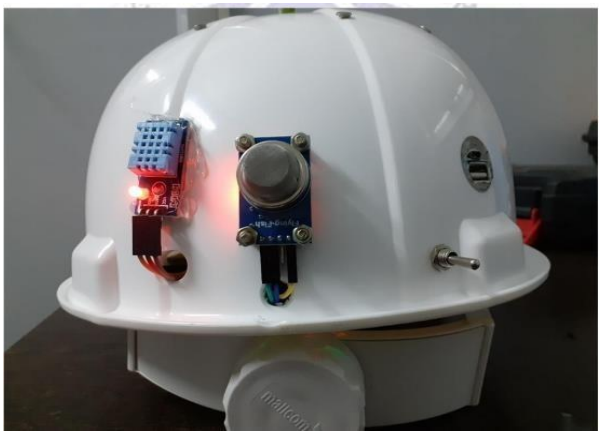

Fig: 3.4 Transmitter Unit

This is a front side of the helmet. We are using DHT-11 temperature and humidity sensor. MQ-135 which detect thegases in the surrounding area in coal mine where the workeris working. As we can see in above figure the sensors like DHT11 MQ-135 are placed above the helmet with toggle switch and power controller. In the coal mine there are various harmful gases present so this sensor senses the data about harmful gases and air quality in the mine. As well measure the parameters like temperature and humidity with the help of DHT11 sensor. Toggle switch is used to turn on the helmet ifthe toggle switch is of then helmet won't work if anddata will not transfer from helmet to monitoring station. At last you can see charging port which willbe used to charge the helmet so that helmet can be used with upmost fluency. All the components are inorganized manner.

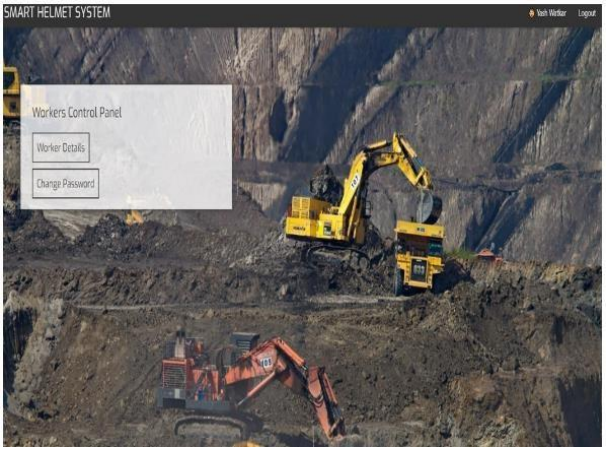

Fig: 3.5 Home Page (Worker Control Panel)

After registration you can come back to login page and enter the information as you can see in the abovefigure such as user name and password with which you have done your registration. After putting info and pressing login button you will go the main home page of the website. As you can see in above fig. aftergoing through login page you reach to the home pageof the website were you get two option such as Worker Details and Change password. In first optionyou get Worker Details button upon clicking that button you will reach to the dashboard of the websitewhere you get all the info about a worker working inthe working environment. The LoRa technology is used for data transmission from the working environment to the base station. The transmitter unitconsistsof air quality sensor, helmet removal sensor,temperature and humidity sensor. The air quality sensors monitor the level of harmful gases like LPG,Methane, and Carbon monoxide.

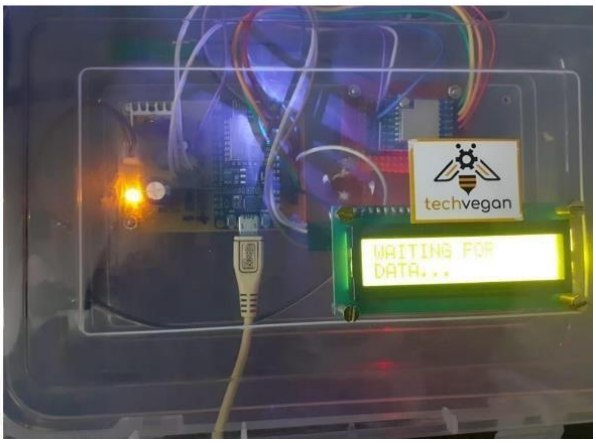

Fig: 3.6 Receiver Unit

In the above figure you can see a box with lots of components. It is a receiver unit contains pcb board,LoRa, connecting wires and LCD screen which will show the data which is transmitted from transmitter unit through LoRa technology. The transmitter unit is placed on helmet of worker and receiver unit placed on themonitoring station. The LoRa technology is used for data transmission from the working environment to the base station. The transmitter unit consists of air quality sensor, helmet removal sensor, temperature and humidity sensor. The air quality sensors monitor the level of harmful gases like LPG, Methane, and Carbon monoxide.

All Worker Status

Sr. No.	Worker ID	Name	Temperature	Humidity	Air Quality	Last Seen	Delete
1	WR12345	Sahil Kamble	27 °C	32 %	1 ppm	11:11 am - 19/11/2022	
2	WR12345	Sahil Kamble	27 °C	32 %	1 ppm	11:10 am - 19/11/2022	
3	WR12345	Sahil Kamble	27 °C	32 %	1 ppm	11:10 am - 19/11/2022	
4	WR12345	Sahil Kamble	27 °C	32 %	1 ppm	11:10 am - 19/11/2022	
5	WR12345	Sahil Kamble	0 °C	0 %	0 ppm	11:09 am - 19/11/2022	
6	WR12345	Sahil Kamble	0 °C	0 %	0 ppm	11:09 am - 19/11/2022	
7	WR12345	Sahil Kamble	27 °C	34 %	1 ppm	11:08 am - 19/11/2022	
8	WR12345	Sahil Kamble	27 °C	33 %	1 ppm	11:08 am - 19/11/2022	
9	WR12345	Sahil Kamble	27 °C	33 %	1 ppm	11:08 am - 19/11/2022	
10	WR12345	Sahil Kamble	27 °C	31 %	1 ppm	11:07 am - 19/11/2022	

In above you figure you can see all worker status. After login into the website and clicking on first option on the home page that is Worker Details you will get to the dashboard where you get all workers status working in theworking environment. The sensed data from the sensors canbe seen in this dashboard. You can see the information suchas air quality in ppm temperature degree Celsius humidity in percentage and last seen of worker you can also see the worker ID and Name. From this we can able to find if the worker is fine through his last seen status and the working environment humidity temperature and also air quality. Hence the task of supervisor becomes easy to keep supervision on the worker so that worker can be safe at all cost.

IV. CONCLUSIONS

We have **designed** a website and completed its partial development. Our website will give the solution for the safety of workers working in the mining environment. We have applied **engineering knowledge** to **analyse** the **societal problem** regarding the dangerous situation in the mining site and provide a modern engineering solution for the safety of the workers. Then we have designed this system in two modules. We have **investigated** the availablesystems to find out the new solutions and updates. We haveused **modern tool LoRa** for the implementation of the system. During this project tenure we have applied **professional ethics** and understood the importance of **teamwork** and **communication** while presenting project in various competitions and conferences for **project management**. This solution can be developed at generalized level for multiple sectors for **life-long learning**.

V. REFERENCES

1. Gyu and Myoung Lee, 2014. INTERNET OF THINGS. International Journal of Innovations & Advancement in Computer Science, 3(5).
2. Nagaraja and Jagadeesh, 2017. IoT based Smart Helmet for unsafe event detection for mining industry. International Research Journal of Engineering and Technology (IRJET), Volume: 04 Issue: 01.
3. Abdulla R, Abdillahi A, Abbas MK, "Electronic Toll Collection System based on Radio Frequency Identification System,". International Journal of Electrical & Computer Engineering (2088-8708), 1;8(3), 2018.
4. Huang, H. C., & Lee, Y. D. (2017). A Study of Indigenous Measuring Factors for Employer Brand Attractiveness in Taiwan: Comparative Analysis of Academy and Industry Experts. IMPACT: International Journal of Research in Business Management (IMPACT: IJRBM),
5(11), 11-20. 5. Hazarika Pranjal, 2016. Implementation of Smart Safety Helmet for Coal Mine Workers. In IEEE International Conference on Power Electronics. Intelligent Control and Energy Systems. Jorhat, India, ICPEICES.
6. Vargas Hernández, J. G., & Plascencia, M. D. L. R. (2017). Application of the IndustryBased Theory the Case of Mexican Company Cemex. Management & Administration (IMPACT: JMDGMA), 1(2), 31-44.
7. Sanchit Gupta and Rashmi Vashisth, 2017. IMPLEMENTATION AND ANALYSIS OF SMART HELMET. In IEEE International Conference on Signal Processing, Computing and Control (ISPCC 2k17). Solan, India, Sep21-23, 2017, IEEE.
8. Chang, W. Y., & Chang, P. C. (2018). Application of Radial Basis Function Neural Network, to Estimate the State of Health for LFP Battery. International Journal of Electrical and Electronics Engineering (IJEEE), 7(1), 1-6.
9. Praveen Kulkrani and Sangam, "Smart System for Hazardous Event Detection and Evaluation in Mining Industries,". International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, 5th Vol 3rd Issue, 2017.
10. SHARMA, S., & KUMAR, G. (2016). A dual Wideband Stair Shape Microstrip Patch Antenna for C & X Band. International Journal of Electronics and Communication Engineering (IJECE), 5(4), 1-8.
11. Dhanalakshmi and Lathapriya, "A SMART HELMET FOR IMPROVING SAFETY IN MINING INDUSTRY,". International Journal of Innovative Science and Research Technology, 2nd Vol 3rd Issue, 2017.
12. Rayan Mohamed, 2015. International Journal of Science and Research (IJSR)- Microcontroller Based Master Slave Communication for Electrical Stepper Motor, 23197064.