IoT BASED SMART HELMET FOR INDUSTRIAL WORKERS

A

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CANDIDATE'S DECLARATION

I hereby declare that the Dissertation entitled "IoT BASED SMART HELMET FOR INDUSTRIAL WORKERS" is my own work conducted under the supervision of Dr. ANIRBAN BHOWMICK, Assistant Professor, SEEE - SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING at VIT University, Bhopal.

I further declare that to the best of my knowledge this report does not contain any part of work that has been submitted for the award of any degree either in this university or in other university / Deemed University without proper citation.

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CERTIFICATE

This is to certify that the work embodied in this Project Exhibition -2 report entitled **"**IOT BASED SMART HELMET FOR INDUSTRIAL WORKERS**"** has been satisfactorily completed by **Ms. Sukanya (21BAC10022), Mr. Divyansh Pandey (21BAC10029), Ms. Laxmi Parmar (21BAC10033),** and **Mr. Yash Kuchiya (21BAC10041)** in the School of Electrical & Electronics Engineering at VIT University, Bhopal. This work is a bonafide piece of work, carried out under my guidance in the School of Electrical & Electronics Engineering for the partial fulfilment of the degree of Bachelor of Technology.

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Executive Summary

Mining is indispensable to the creation of goods, infrastructure and services which enhance the quality of their lives. As a society we're blessed to enjoy the many advantages that industry manufactured products provide us by processing these raw materials. But working in the earth presents many different security and health dangers. The mines that are deeper, the more dangerous it could be to be running jobs. Safety is very important in every workplace, but very often we hear about accidents in factories industries causing loss of life. The labours and workers working in any factory, industries, construction site or mine is vulnerable to accidents. There's oxygen leak that is restricted, and there are challenges related to leaving a mine if a crisis happen. And therefore they should be with safety guards properly. In most of the accidents, number of deaths or severe injuries is maximized because the labours and worker are not wearing safety equipment or wearing low grade safety equipment. Working environment hazards include radiation leakage, fall due to suffocation, poisoning gas leakage and gas explosion. Hence air quality and hazardous event detection is very important factor in industry. In order to achieve those safety measures, the proposed system provides wireless sensors network for monitoring real time situation of working environment from monitoring station. IoT based smart helmet is the idea that has been developed for the social responsibility towards the society. This system will assists in reducing major number of accidents. So here we propose a mining tracking as well as safety system for the mining industry using microcontroller based circuit on the worker helmet. The working of this project is based on sensing the environment condition and sending it to monitoring station. Whenever the smoke or temperature value cross the threshold level, the buzzer will be on. The system makes use of Atmega microcontroller to receive the data transmitted by worker helmet nodes. Thus the system ensures mining worker safety using IOT.

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List of Symbols & Abbreviations

1.	IoT	Internet of Things
2.	AI	Artificial Intelligence

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

An IoT (Internet of Things) based smart helmet is a specialized headwear that incorporates various sensors, communication devices, and other electronics to enhance the safety and functionality of the wearer. These smart helmet is integrated with temperature sensor, humidity sensor, and gas sensor, so it is a specialized headwear that combines advanced electronic with environmental sensing capabilities. These smart helmets are designed to provide real-time information and support to the wearer, such as alerts for potential hazards, navigation assistance, and communication with others, with a focus on environmental awareness and safety. This type of smart helmet is ideal for a range of applications, including hazardous material handling, and industrial work, where monitoring the environment is critical to the safety of the wearer. By integrating temperature, humidity, and gas sensors, the smart helmet provides real-time information about the environment and enhances the safety and functionality of the wearer.

1.2 MOTIVATION OF THE WORK

"Life is a precious gift by god, this is for living not for loosing". The life of anyone is incredibly important and valuable. Every person has inherent and dignity, and every life has the potential to make a positive impact on the world. The motivation behind the development of lot based smart helmets stems from the desire to improve safety and efficiency in various industries and activities that require the use of protective headwear. With the advent of IoT technology, the opportunity arose to integrate a range of sensors, communication devices, and other electronics into protective headwear, resulting in the creation of smart helmets. Overall, the motivation behind the development of IoT based smart helmets is to create a safer, more functional, and more efficient protective headwear solution for a range of industries and activities.

1.3 PROBLEM STATEMENT

Saving life of mine worker is an important responsibilities. This project is to address the need for improved safety and efficiency in industries and activities that require protective headwear. There are many specific challenges and issued during working in mine. Many industries and activities, such as construction, and hazardous material handling, expose workers to dangerous conditions that can result in injury or death. Conventional protective headwear does not always provide adequate protection in these environments. In many hazardous environments, workers must make decisions based on information about the temperature, humidity, and gas levels in their surroundings. However, conventional protective headwear does not provide real-time information about the environment. Conventional protective headwear provides limited functionality.

1.4 OBJECTIVE OF WORK

- To create a state-of-the-art protective headwear solution for mine worker.
- To provide improved protection in hazardous environments.
- To record the real time environmental condition of surroundings.
- To provide real-time environmental awareness during any hazardous condition.

CHAPTER 2

LITERATURE REVIEW

2.1 IOT BASED SMART HELMET FOR INDUSTRIAL WORKERS

A mining helmet has been developed which detect different types of hazardous events such as, humidity, temperature, concentration of combustible gases and many more parameters. The helmet sends the readings of the parameters to the base station PC through cloud which is being inspected continuously. If any reading exceed its limit the helmet sends information through IoT to the base station and alert the miner through buzzer. As the system requirement and the required components can be easily made available and this project can be implemented easily. It will provide safety to worker and change the way of their working, as well as system controlling the various environmental changes in mines. It is reliable system with quick response and easy installation. And the helmet has a flexible design where different sensor can be added or removed according to different industrial use.

Reference from: Dadhania, Kishan, Niket Narayan,

and Bhagyashree Somavanshi.

"IoT based Smart Helmet for Industrial Workers."

Key findings:

●Mining helmet will detect the different types of hazardous events.

●Helmet will send the reading data to base station via cloud which is being inspected.

●In case of exceed the reading, information will be send through IoT.

●This helmet will provide safety to the worker and it will be very helpful for them.

2.2 SMART HELMET 5.0 FOR INDUSTRIAL INTERNET OF THINGS USING ARTIFICIAL INTELLIGENCE

The objective of the proposed device is to improve occupational health and safety (OHS); increasing employee performance by reducing the probability of illness, injury, absence or death. Another objective is to contribute to the third wave, as proposed by Niu et al., through the implementation of intelligent systems for early risk detection in the working environment. AI allows to maximize decision making in simple or very complex situations. The AI boom that has taken place in the last decades has led to the development of countless AI applications in numerous areas. At present, increasingly better solutions are available to protect the lives of workers when they are exposed to high-risk conditions. That is why, in industry, AI is combined with security measures in order to create an environment that offers better conditions for industrial development.

Reference from: Campero-Jurado, I., Márquez-Sánchez, S., Quintanar-Gómez, J., Rodríguez, S. and Corchado, J.M., 2020. Smart helmet 5.0 for industrial internet of things using artificial intelligence. *Sensors*, *20*(21), p.6241.

Key findings:

●To increase employee performance by reducing the probability of illness, injury, or death.

●Using AI (Artificial Intelligence), we can improve the early risk detection in the working environment.

●In nowadays, AI is a better solution to protect the lives of workers when they are exposed to high-risk conditions.

●AI is being combined with security measures for better conditions for industrial development.

2.3 IOT BASED SMART HELMET FOR UNDERGROUND MINES

The proper supervision and proper communication is very important requirement of mining industries. The smart helmet provides a real time monitoring of harmful gases, proper light intensity for work, humidity and miner is wearing the helmet or not. The harmful gases like carbon monoxide, LPG, Methane and also temperature are monitor using this system. The wired communication network is not so effective because when natural calamity or a roof fall occurred, wired network is damages, so it is very difficult and costly to reinstall the entire system. The effective solution for communication from base station to underground mine is IOT based wireless network. The smart helmet for mining industry consists of various sensors which are fixed on the helmet. The sensors used are Gas Sensor, Temperature Sensor, Humidity Sensor, LDR for light intensity, and IR sensor to detect weather the miner wearing helmet or not. By using IOT module the mine information like environmental parameters in mine or wearing helmet or not can be seen anywhere anytime by using internet. So the proper action can take within time to rescue the miner.

Reference from: Borkar, S.P. and Baru, V.B., 2018.

IoT based smart helmet for underground mines.

International Journal of Research in Engineering

Science and Management (IJRESM), *1*, pp.52-56.

Key findings:

●In mining industries, proper supervision and proper communication is important.

●Smart helmet provides a real time monitoring of harmful gases, proper light, intensity of work, humidity.

●The better way to install communication system between base-station to underground mine is IoT based wireless network.

●Using IoT module, we can detect environmental parameters in mine or wearing helmet or not.

CHAPTER 3

PROBLEM FORMULATION AND PROPOSED METHODOLOGY

3.1 PROBLEM FORMULATION:

Data tabled in the “Lok Sabha” earlier this month revealed that 377 workers involved in mining of coal, minerals and oil were killed in accidents between 2015 and 2017. Of the 377 deaths, 129 occurred in 2017 alone. As many as 145 died in 2016, while the figure was 103 in 2015. Coal mines have accounted for the highest number of casualties due to accidents in mines. Of the 377, more than half, 210, were killed in coal mines. These figures were provided by the Labour and Employment Ministry on December 31, 2018. This is because we don’t give much care on this type of problems in country. And also the conventional protective headwear used in hazardous environments, such as construction, firefighting, and hazardous material handling, often does not provide adequate protection and does not integrate with modern technology to enhance safety, efficiency, and communication.

3.2 HOW CAN WE DECREASE THE INDUSTRIAL ACCIDENTS?

We need a system integrated with IoT technology to gather real-time data about the environment, to monitor performance and alert maintenance teams to potential issues. This information can be used to coordinate emergency response and to ensure that workers receive prompt medical attention in the case of any accident. And this information will be combined with impact sensors to create a smart helmet that provides enhanced safety, efficiency, and communication. The final deliverable will be a functional and effective smart helmet that meets the needs of workers in hazardous environments and provides a safer and more efficient solution compared to conventional protective headwear. The helmet will also include a user-friendly interface and data analysis tools to provide real-time information and insights about the environment and the wearer's safety. Using technology we can save many life of industrial worker and reduce the number of such type of accidents.

3.3 PROPOSED METHODOLOGY

3.3.1 Introduction

The goal of this project is to make a system which can observe the real time environmental condition and it will give alert in the case of any odd situation. This system will work with the help of Arduino which is connected to all the sensor. Arduino is the core component of this model. Arduino will detect the reading of all sensor and whenever the recorded value cross the threshold value, the buzzer connected to the system will start alerting to worker. A wifi-module is connected to the system, it will help to transfer the recorded data. In addition, for operating this system, we have used Arduino operating system with C++ programming language. The used components details are as follow:

Arduino UNO Atmega328p: The Arduino Uno is an open-source microcontroller board based on the microchip ATmega328p microcontroller. The board is equipped with sets of digital and analog input/output (I/O) pins. The board has 14 digital I/O pins, 6 analog I/O pins.

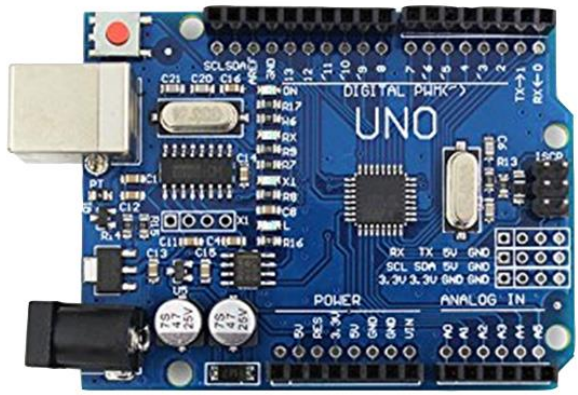

FIG. 3.1 Arduino UNO Atmega328p

LM-35 Temperature Sensor: The LM35 is a low-power, low-cost, high-precision temperature sensor. This IC provides a voltage output that is linearly proportional to the change in temperature.

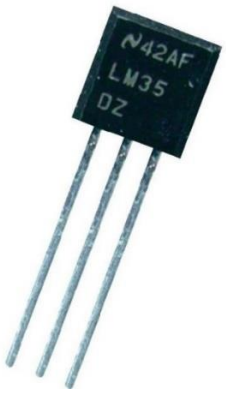

FIG. 3.2 LM-35 Temperature Sensor

MQ135 Gas Sensor: An MQ135 air quality sensor is one type of MQ gas sensor used to detect, measure, and monitor a wide range of gases present in air like ammonia, alcohol, benzene, smoke, carbon dioxide, etc. Preheating of 20 seconds is required before the operation, to obtain the accurate output.

FIG. 3.3 MQ135 Gas Sensor

DHT11 Humidity Sensor: A humidity sensor is an electronic device that measure the humidity in its environment and converts its findings into a corresponding electrical signal. DHT11 is a digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any micro-controller such as Arduino, Raspberry Pi etc... to measure humidity and temperature instantaneously.

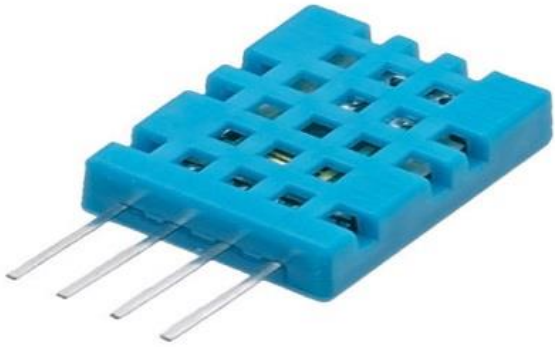

FIG. 3.4 DHT11 Humidity Sensor

ESP8266ESP-01: The ESP-01 ESP8266 Serial WIFI Wireless Transceiver Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, one can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers.

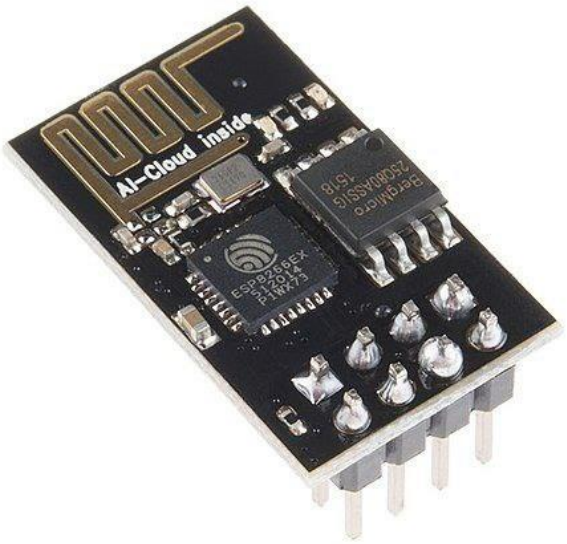

FIG. 3.5 ESP8266ESP-01

Buzzer Module: An Active Buzzer Alarm Module for Arduino is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. It is 3.3V-5V DC Electronic Part Active Buzzer Module. Using top quality material, it is durable in use. An active buzzer rings out as long as it is electrified. Compared with a passive buzzer, it is a bit expensive but easier to control. Typical uses of buzzers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke

FIG. 3.6 Buzzer Module

Jumper Wires: A jumper wire is an electric wire that connects remote electric circuits used for printed circuit boards. By attaching a jumper wire on the circuit, it can be short-circuited and short-cut (jump) to the electric circuit.

FIG. 3.7 Jumper Wires

Breadboard: A GL-12 840 Points solderless Breadboard is an invaluable tool for experimenting with circuit designs whether in the R&D or university lab. A breadboard is used to make up temporary circuits for testing or to try out an idea. No soldering is required so it is easy to change connections and replace components.

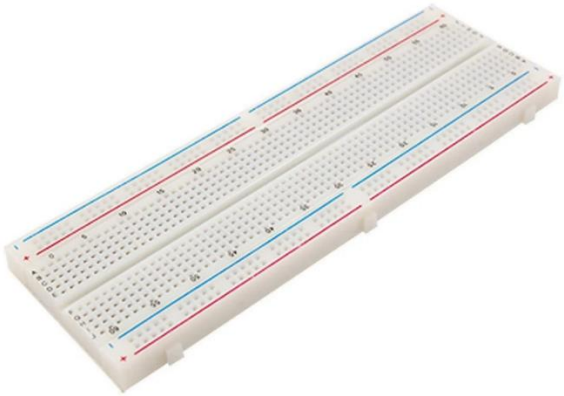

FIG. 3.8 Breadboard

3.3.2 Analyse and design the system

●The working of this electronic model is simple. We can understood this with the help of Arduino.

●The circuit diagram consist all above mentioned components.

●In this, we are using different types of sensor which will record the real time environmental condition.

●All the sensor are connected to Arduino which will send the input data to Arduino what they have recorded.

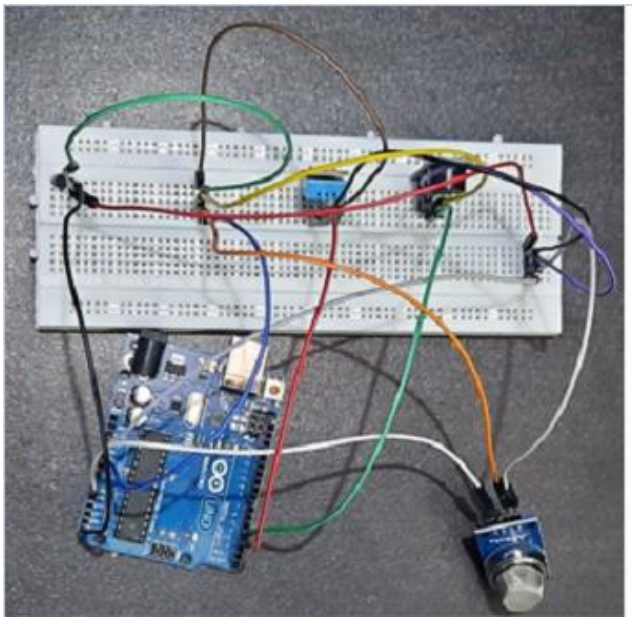

FIG. 3.9 Circuit Diagram

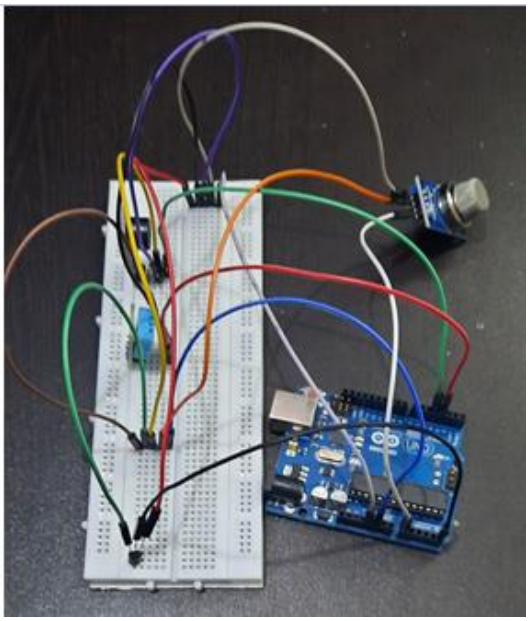

FIG. 3.10 Circuit Diagram

●Here, we have set a threshold value for temperature, humidity, and gas. When recorded value will cross the threshold value, the buzzer will give us a sound for alert.

●In the case of any emergency, buzzer will sound and we will find out that there is something wrong.

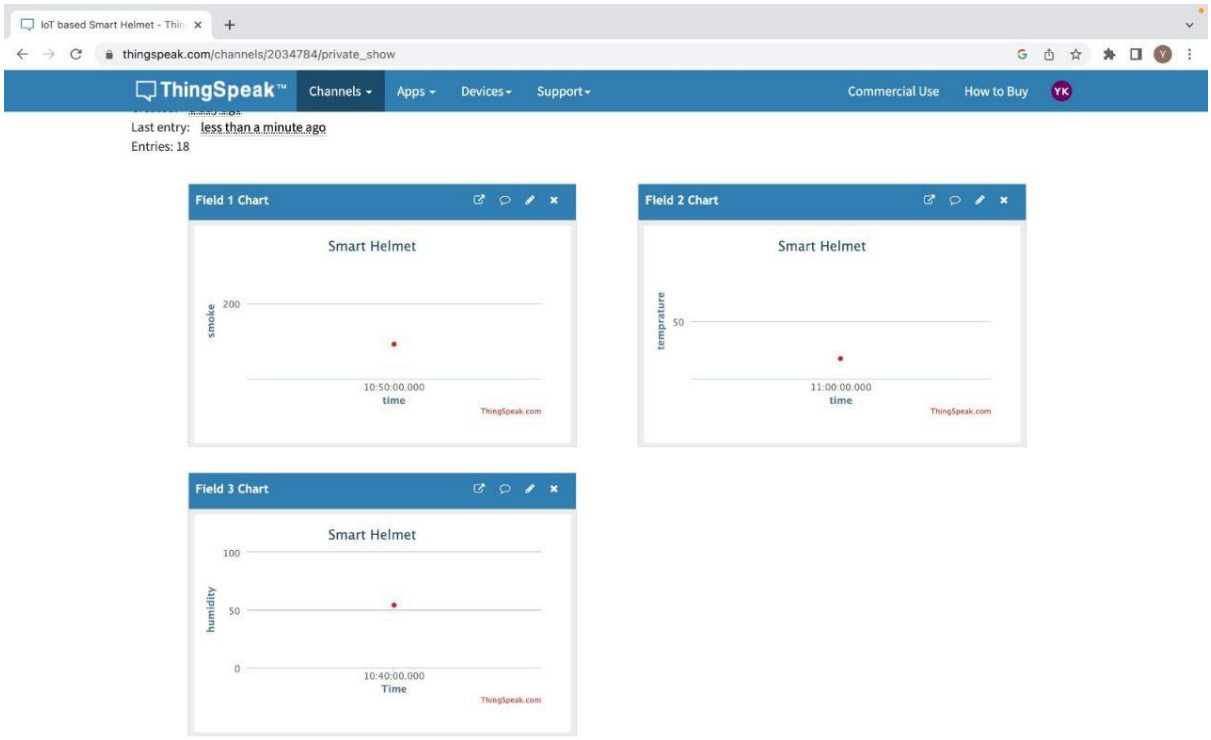

FIG. 3.11 RESULT

FIG. 3.12 SMART HELMET

FIG. 3.12 SMART HELMET

CHAPTER 4

RESULTS AND DISCUSSION

4.1 RESULTS

●The main objective of the project, 'to record the real time environmental condition of surroundings', have been done successfully.

●This IoT based electronic device is giving alert about the high temperature, high humidity, and hazardous gas.

●The function of IoT based smart helmet is actually smart. It will help to save the precious life of industrial worker.

●The implementation of smart helmet have been done successfully.

4.2 DISCUSSION

●At last, we discussed about the all work we have done to complete this model and found that it is working perfectly. It is fully prepared to work as a smart helmet for industrial worker.

●During working on this project, we learned many things related to electronic components, their function and how they work.

●In future, we will try to modify this smart helmet so that it can save lives of many industrial worker with more smart function.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 LIMITATION/CONSTRAINTS OF PROPOSED SYSTEMS

●During the implementation of this model, we have to be very careful when we are choosing the sensor. It should function more accurately so that we can record exact data of environment

●This smart helmet may have some technical limitation. As we can make it more advance using some others electronic devices.

●This smart helmet will cost more than the conventional helmet.

●The sensors and other components of the smart helmet will require regular maintenance to ensure that they are working properly and recording the accurate data.

5.2 FUTURE SCOPE

●In future, it will be a very beneficial electronic device because it will help to save the life.

●Only doing some changes, this smart helmet can be used in many field.

●This smart helmet system can be integrated with machine learning, and other technologies and can be very effective business model as it is working as a life-saving system.

5.3 CONCLUSION

●The equipment within this system are very basic components of electronic. Circuit design only consist some sensors, microcontroller and buzzer.

●The system is integrated with buzzer which will alert about environmental condition.

●It is an industrial based headwear which can be of great where security is a matter of concern.

●This cost more than conventional but not more because it is matter of life.

●This smart helmet can be used in many fields where temperature, humidity, and gas is a sign of danger.

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● Dadhania, Kishan, Niket Narayan, and Bhagyashree Somavanshi. "IoT based Smart Helmet for Industrial Workers.“

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● Borkar, Shruti P., and V. B. Baru. "IoT based smart helmet for underground mines." *International Journal of Research in Engineering Science and Management (IJRESM)* 1 (2018): 52-56.

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● Campero-Jurado, I., Márquez-Sánchez, S., Quintanar-Gómez, J., Rodríguez, S. and Corchado, J.M., 2020. Smart helmet 5.0 for industrial internet of things using artificial intelligence. *Sensors*, *20*(21), p.6241.