IoT Based Smart Helmet for Site Worker's Safety

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Abstract: *The death rate of the construction workers at the construction site is increasing day by day. But still there are no such chances to reduce this fatality rate. So for providing continuous observing of the labors and to prevent them from any health hazards during working, this system proposes a smart flexible helmet for the construction workers to provide security and rescue measures in case of any panic situations. The proposed system describes a smart low-cost helmet for the construction workers. Specially, safety becomes a main issue when you consider construction and manufacturing business. The project aims to provide a secure and safer working environment for labors thus to reducing the number of deaths happening in construction sites. The helmet includes different sensors such as temperature Sensor, gas Sensor, light Sensor etc. & IoT devices such as Arduino Uno which is a microchip controller and ESP8266 to send signals over the Wi-Fi. The aim of this project report is to describe a prototype system and integrating some different IoT technologies and some safety levels for the industry construction site.*

Keywords: Smart Helmet, Internet of Things (IoT), Arduino Uno, Sensors, Gas sensor, Temperature sensor, light sensor, LDR, ESP8266 Wi-Fi module, Buzzer, ThingSpeak.

I. INTRODUCTION

The Internet of things describes physical objects that are embedded with sensors, processing ability, software, and other technologies that connect and interchange data with other devices and systems over the Internet or other communications networks. The Sensors are used to sense the activity, orientation, movement of the workers on the construction site. The death rate of the construction workers at the site has been increasing every year. If the worker working 5th or 10th floor of the large building gets severe heart attack, it takes some amount of time to reach that floor and recover him. Within that time, he may be expected to death. In India, Approximately 38 construction workers die on construction sites every year. For example in 2017, there were 67 deaths, 2016 saw 55 deaths, 2015 saw 62 deaths and 2014 saw 69 deaths, etc. In order to provide continuous observing of the labours and to prevent them from any health hazards during working, this system proposes a smart flexible helmet for the construction workers to provide safety and rescue measures in case of any panic situation.

The construction and Mine industries are some of the most important industries fir the economy of India. But these industries are always preoccupied by the fact that the people that work there is always in the danger of accidents like fire bursts or gas leakages. The labours face lot of struggles and difficulties in the workplace due to the unsuitable balance between work and their safety. Besides affecting them physically, they are affected emotionally as well. Among all the other industries the building industry stands as the leading provider of fatalities. Day by day the death rate of the construction labours at the construction site is growing. But still there are no such medications to reduce this fatality rate. This project is based on using IoT technology to work as a remedy by detecting these accidents. Thus this reduces the response time of the people working there as can take the necessary steps once they identify that an accident has taken place. The number of fatal deaths happening in the construction sites is growing up every year. The safety and health of people is not guaranteed in construction sites. The workers face a lot of struggles and difficulties in the workplace due to the unsuitable balance between work and their safety. Besides affecting them physically, they are affected emotionally as well.

II. LITERATURE REVIEW

There are some related works carried out on IoT Based Smart Helmet as follows:

Fan zihhong [1] proposed the "Quality and safety management of construction" projects are contradictory and consistent. To ensure the safety, the construction engineering safety management system should first be strengthened. Therefore, we introduced IoT technology to construction safety management and carried out in-depth research on practice and promote safety management of construction projects.

V.Jayshree, M. Nivetha Kumari [2] proposed the "IoT Based Smart Helmet for Construction Workers", To provide continuous monitoring of the workers and to prevent them from any health hazards during working, this system proposes a smart flexible helmet for the construction workers to provide security and rescue measures in case of any emergency conditions. The proposed system describes a smart inexpensive helmet for the construction workers made up of sensor.

Mangala Nandhini. V, Padma Priya G.V, Nandhini. S, Mr. K.Dinesh [3] proposed the,"IoT based Smart Helmet for Ensuring Safety in Industries", To provide Industrial safety is to industry. Working environment hazards include suffocation, gas poisoning 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 a wireless sensor network for monitoring real time situation of working environment from monitoring station.

Leo Louis [4] proposed the, "Working principle of Arduino and using it as a tool for study and research" This paper explores the working principle and applications of an Arduino board. This also explores on how it can be used as a tool for study and research works. Arduino board can provide a quick tool in development of VLSI test bench especially of sensors. Main advantages are fast processing and easy interface.

K.M. Mehta, S.K.Shankar, Karthikeyan N, Nandhinee K, Robin Hedwig P [5] proposed the "IoT Based Safety and Health workers". Safety is a major problem in construction works. There is no proper solution to solve the problem. People's safety is not ensured in the construction works. In most of the cases, the problem occurs due to work stress or poor health conditions. Some of the accidents occur where people fall down from heights and left unnoticed which leads to death due to lack of medical attention.

III. ANALYSIS OF PROBLEM

Occurrences of accidents in the construction and mining sites are usually a part of the news. In this era of science, construction provides home to many people and mining is of great economical importance. These include the fire breaking out, harmful gases spreading, etc. These incidents are fatal, not to be taken easy. Nowadays, it has become mandatory to wear protective helmets at such sites. But these helmets can prevent the head from crashing against objects, but are helpless against fire and similar accidents. In this context, there is a grave danger to the lives of people working in those sites. Most of the contractors and workers take proper care in working at these places. But still there are such incidents where the human lives are in danger. This is a question that wants to be answered.

In this age of advanced technology, we need a breakthrough where technology is used to help people be safe at these sites. A technology that can detect fire, that can detect gaseous leak that can be used to inform people about an accident if it happens, without any extra efforts. This technology would save lives, reduce accidents at sites by detecting them before they occur. Thus detecting fire or a leaking harmful gas before it spreads is an important step in saving the lives of the workers who work there to make a living. This is an instance where technology is being used for saving lives, a very important application of technology.

IV. PROPOSED WORK

We have proposed a system which will detect a fire or a gas leak and make it easy to take efforts before it spreads. The system mainly consists of a Helmet enhanced with IoT. The helmet consists of sensors and IoT modules that will detect any accidental fire break or gas leak as soon as it is encountered in its small form.

The Temperature sensor and the Gas sensor will sense the surroundings for extreme heat and gaseous leak. If there is a high temperature in the surroundings the Red LED will glow, and if there is a gas detected, then the Blue LED will glow. In both the cases the buzzer will start buzzing and the worker will become aware of the danger. The ESP module will send the same information to the manager or the contractor to take necessary action.
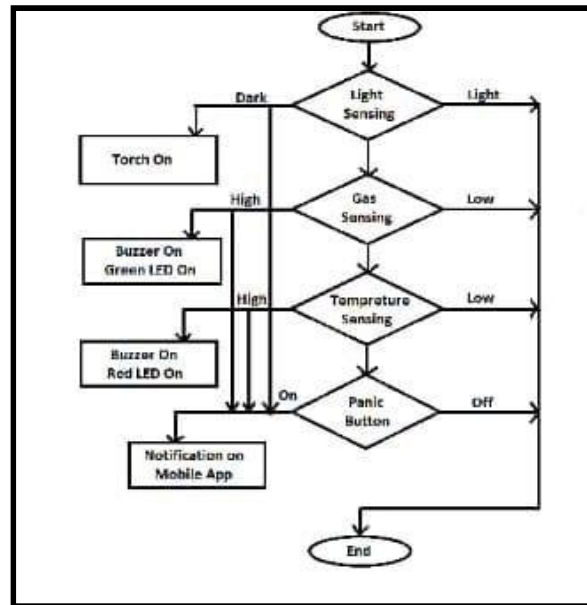
Figure: Flowchart of system

V. OBJECTIVE

The main objective to this system is to design a helmet that provides safety to the construction and mine workers before any accident happens at the working site. It mainly helps them protect themselves from fire outbreaks or harmful gases in their surroundings. Also it notifies the superior authorities about any threats that present themselves during the work period. This can prove a great help in saving human lives at work.

VI. SYSTEM ANALYSIS

The complete operation of the IoT Based Smart Helmet for Site Worker's Safety depends on the Arduino Uno. This project is divided into two stages namely as :

1. Hardware development and
2. Software development.

6.1 Hardware Development

In hardware development, the breadboard is used for circuit connections, LED's are useful for showing some output, here we use Buzzer for beeping the audio signals and some jumper's wires for making proper connection between the circuits.

6.2 Software Development

In Software development phase, the code was constructed by using C programming language and was targeted to the Arduino UNO. The Arduino UNO plays and important role in this phase. It is an open source computing platform that is used for construct and programming electronic devices. The Arduino is responsible for all logical calculations part that are require for our system. Here we are also going to use the ThingSpeak.com application for transmitting and receiving to of data. Mobile application for getting the notification signals.

A. Arduino Uno

Arduino is an open source microcontroller which can be simply programmed, erased and reprogrammed at any Instant of time. It based on simple microcontroller boards, it is an open source computing platform that is used for constructing and programming electronic devices. It is designed with 14 digital input/output pins and 6 analog input pins and this pins are mostly used for output connections like LED,LCD etc. This kit is embedded inside the smart helmet during the manufacturing process and it controls all the activities of all modules. Arduino Uno is to It simply connects to the Computer

with the USB cable and power it With AC to DC Adapter or battery to get started. In our project the working of Arduino Uno in Smart Helmet is to read values from gas sensor, temperature sensor and light sensor. It has three important abilities If the worker is approaching to a dangerous gas, the helmet will inform him with a alert sound from the buzzer.

Figure 2: Arduino Uno

B. LM35 - Temperature Sensor

A temperature sensor is a device that is designed to measure the degree of hotness or coolness in an entity. The working of a temperature meter depending upon the voltage across the diode. The temperature modification is directly proportional to the diode's resistance. Temperature sensors are broadly available as both digital and analog sensors. If suddenly fire situation is occur around the worker then temperature goes above the threshold value which is set on Arduino Uno then the red light is glow and beep of buzzer. That is for local alert system. Again in this situation Wi-Fi Module send the notification for manager they will help the worker. In this way temp. Sensor will work.

Figure 3: LM35 - Temperature Sensor

C. MQ2-Gas Sensor

MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, hydrogen, smoke. MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance varying when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas. In our system the gas sensor will sense a environment if it is gas or even smoke is detect above a threshold value then beep of buzzer is heard and also green will led glow. That is for local alert. Again in this situation Wi-Fi Module send the notification to a manager to know about situation. And they will help the worker and in this way the gas sensor will work in our project.

Figure 4: MQ2-Gas Sensor

D. Light Sensor

Light sensor Light sensor will sense the brightness of the area around the workers where the worker are working If it is dark then the torch-light will be on and then notification comes on mobile application.

Figure 5: Light Sensor

VII. IMPLEMENTATION

Implementation is the stage of the project when the theoretical design is turned out into a working system. Thus, it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective. The implementation stage involves careful planning, investigation of the existing system and its constraints on implementation, designing of methods to achieve changeover and evaluation of changeover methods. In our project firstly we design the circuit development then we connect ESP8266 Wi-Fi module with ThingSpeak after that we create an mobile application and it fetch the data from ThingSpeak..Com

Firstly, we have embedded three sensor, like buzzer,ESP8266 wife module, panic button for any emergency situation on Arduino Uno, those sensors are temperature sensor, gas sensor, and light dependant register. Now we have setup this system on helmet as shown in the following figure.


Fig. 5 Outer side Helmet
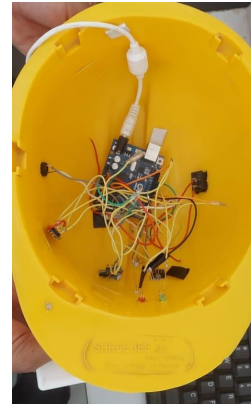
Fig.6 Inner side Helmet

We have also developed an mobile application which will be used to display current readings of all the sensors. For that we need to connect Wi-Fi i.e. ESP8266 Wi-Fi module with hotspots of mobile in which our application is installed. In this application we are able to see details of workers whose data is being fetch for example employee id, name of person, blood group and current date. And we are also monitor current environment near the worker, which includes readings of Light, temperature, gas, and panic button as shown in following figure.
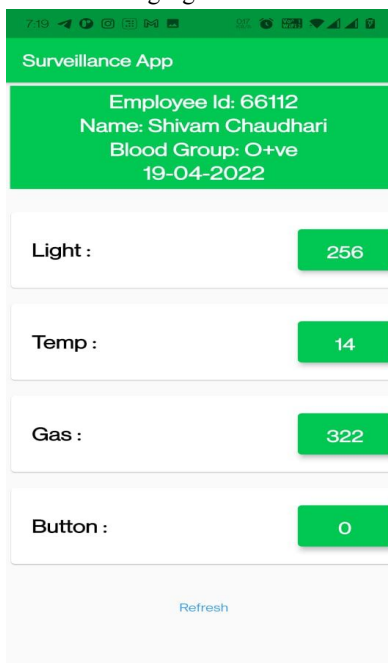
Figure 7: Mobile Application

Supposed we take a situation where Shivam is a worker who is working on a construction site, by wearing our smart helmet. Suddenly due to some reason gas is leaked, so the gas sensor will detect this and send data to ThingSpeak through the ESP8266 Wi-Fi. Here ThingSpeak is a cloud services that displays the data fetched from the ESP8266 Wi-Fi module in a form of graphs. Further this data is transferred to the mobile application in the form of numbers. Now Manager will monitor this data regularly whether the readings are normal or not. As per our example the value of gas sensor will be high depending on the leakage of the gas at site if it is more than the threshold value then green LED will glow and manager would know about that.

Now the manager will take approximate action according to the situation and try to avoid accidents. As this was of gas sensor similarly temperature and the light sensors will work accordingly.

VIII. CONCLUSION

Through this study, we developed a smart helmet which was designed to help workers to get rid of hazardous events in industries. The design and implementation of a system which can provide security for construction Site and miner workers and take the appropriate action are required. The proposed method is used for beneficial of security purpose and industrial purpose. Hence the system is reliable with simple and easily available components, making it light weight and portable. This product can be enhanced by adding additional features in the near future.

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