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IOT Based Smart Helmet for Construction Workers

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Abstract—*Industrial safety is one of the main aspects of 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. It provides real time monitoring of harmful gases like CO, CH4 and LPG and also temperature and humidity. To overcome those hazardous situation, this system provides emergency alert to the monitoring station . Some workers are not aware of safety and they did not wear helmet properly. For this purpose, a limit switch was used to successfully determine whether the workers had worn their helmet properly or not. The system uses Wi-Fi technology for transmission of data from working environment to the monitoring station. There is an alert switch at working environment for emergency purpose.*

Keywords*—Safety, NodeMCU, Sensors, IoT, Cloud Computing*

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I. INTRODUCTION

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifier and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. IoT has evolved from the convergence of wireless technologies, microelectromechanical systems(MEMS), microservices and the internet. The convergence has helped tear down the silo walls between operational technology and information technology, allowing unstructured machine-generated data to be analyzed for insights that will drive improvements. In earlier days, LED helmets were deployed in Industries to inform the workers about the hazardous events. Later sensors were deployed to detect the events and the alert can be sent to the remote monitoring unit to avoid losses. several wireless sensor network has been used to detect and transfer datas. The most commonly used technology for wireless transfer is zigbee .One of the main disadvantage in using zigbee as a medium of transfer is the coverage area.The coverage area of zigbee is usually 10– 100 meters line-of-sight, depending on power output and

environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. The proposed system uses Wi-Fi technology to transfer data from the working environment to the remote monitoring unit. The merit in using Wi-Fi as a medium of transfer is that it covers wider area and it is the latest modern technology that has been emerging worldwide for transferring data. In this system the transferred data is collected ,stored and analyzed using Thingspeak application. Thingspeak is one of the recently developed application in the field of IoT for analysing data transferred by wireless sensor networks. 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. Working in the earth presents many different security and health dangers. Frequently the underground environment is shaky or unpleasant. The mines that are deeper, the more dangerous it could be to be running jobs. There's oxygen leak that is restricted, and there are challenges related to leaving a mine if a crisis happen. So here we propose a mining tracking as well as safety system for the mining industry using microcontroller based circuit on the worker helmet. We use rf based circuitry to detect workers moving through the entire mining site. The helmet is integrated with an rf based tracking system which in coordination with the tracker rf systems help provide data over IOT. The system makes use of atmega microcontroller based rf tracker circuitry to receive the data transmitted by worker helmet nodes. This helps map the current location of workers through the entire mining site. Moreover each worker helmet circuit is integrated with a panic/emergency button. This button when pressed shows an emergency sign over the IOT web interface about the worker emergency. This can be used for any emergencies like – toxic gas inhalation, cave ins, physical injury etc. Thus the system ensures mining worker safety using IOT.

II. LITERATURE SURVEY

The purpose of this literature review is to investigate the topic of "IoT Based Bike Analyzer: Delivery Boys Safety Mechanism". Following section explores different references that discuss about various topic related to our project.

"Implementation Of Smart Helmet" Deekshitha K J and Pushpalatha S, 2017 In this paper an IoT product called "Smart Helmet" is proposed, which comprises of two units, motor unit and helmet unit. It consists of different sensors and a transmitter circuitry. The transmitter side microcontroller contains three sensors which are alcohol sensor, vibrate sensor and IR sensor. The receiver side microcontroller comprises of a LCD, GSM module, RF recipient, Receive antenna, DC motor, drive L293D and GPS module[1].

"Accidental Identification and Navigation System In Helmet" A.Ajay, G.Vishnu, V.Kishoreswaminathan, V.Vishwanth, K.Srinivasan and S. Jeevanantham, 2017 A system for intelligent helmet has been proposed. This system detects the occurrence of an accident and makes provisions to sound an alert through the use of a GPS and GSM system. This system aims in providing a low cost intelligent system mainly focusing on the importance of human life[2].

"An IoT based Smart Helmet for Accident Detection and Notification" Prem Kumar M, Rajesh Bagrecha , 2017 The objective of this project is to develop a smart helmet is to provide a means and apparatus for detecting and reporting accidents. Sensors, Wi-Fi enabled processor, and cloud computing infrastructures are utilised for building the system. The accident detection system communicates the accelerometer values to the processor which continuously monitors for erratic variations. When an accident occurs, the related details are sent to the emergency contacts by utilizing a cloud based service. The vehicle location is obtained by making use of the global positioning system[3].

"IoT BASED SMART HELMET SYSTEM USING RASPBERRY Pi-3" Vinith.G and Dr. K.thangarajan, 2017 Shrewd System for Helmet Detection utilizing Raspberry Pi guarantees cap ownership by a motorcyclist consistently by catching a depiction of the rider's head protector utilizing Pi Camera and affirming object location by cascading technique. The primary thought behind the venture is to diminish street fatalities among motorcyclists. An intelligent LED will caution the rider if the protective cap is not recognized after which the rider needs to guarantee the ownership of a cap or else the System will show a notice message which will win the rider a strike in the event that it is overlooked. An automated e-mail alert generation system is also developed in a reporting module of proposed system[4].

"Faaz Smart Helmet" Faizan Manzoor, Shah Asif Bashir, Aaqib Manzoor, Zain Ashraf Wani, Shahid Mohi Ud Din, 2017 The smart helmet includes the integrated electronic system which uses some of the basic components in the world of electronics. The microcontroller coordinates with the GPS, GSM, WIFI and the sensors. The vibration sensor, pressure sensor and the accelerometer sensor triggers after a certain value which can cause damage to the motorcycle rider. Once the sensors are triggered above the certain value, the GPS coordinates along with time will send a message to the family members and the server via WIFI component and GSM[5].

"IMPLEMENTATION AND ANALYSIS OF SMART HELMET" Rashmi Vashisth, Sanchit Gupta, Aditya Jain, Sarthak Gupta, Sahil, Prashant Rana, 2017 In this project radio frequency module is responsible for

the wireless communication between the helmet and the bike circuit. The Piezo electric buzzer is used to detect speeding and this feature is extended by limiting the speed of the user. The ALCHO-LOCK function is used to prevent drink and drive scenarios Accelerometer detects accidents, and a fog sensor for increasing visibility in case of fog or smog are also used. Another feature known as E-HELMET allows for automatic deduction of the required amount from the users virtual wallet wirelessly preventing the rider to stop and pay for it[6].

"Intelligent Transportation System For Accident Prevention And Detection" Dr.D.Selvathi, P.Pavithra, T.Preethi, 2017 This paper provides an intelligent system for two wheelers accident prevention and detection for human life safety. The prevention part involves, "Smart Helmet", which automatically checks whether the person is wearing the helmet and has non- alcoholic breath while driving. The relay does not ON the engine if these two conditions are not satisfied. The microcontroller controls the function of relay and thus the ignition. The system also enables detection of an accident at any place and reports about the accident to predefined numbers with GSM module. The Microcontroller continuously records all the parameters of automobile for prevention and detection of accident[7].

"Mission On! Innovations in Bike Systems to Provide a Safe Ride Based on IOT" Archana.D, Boomija.G, Manisha.J, Kalaiselvi.V.K.G, 2017 Our system aims in providing a safe bike ride by the use of the sensor that helps the rider know the approaching vehicles and generate vibrations in the bike's handlebar. When a person starts to ride the bike , the person has to plug in the bike key and the bike's coordinate system starts. It is operated through a wireless control system. Most of the time people never mind to wear helmet. Therefore the helmet is fixed with sensors to detect if the person is wearing the helmet or not. After the person has worn it , the helmet will automatically lock and the bike's engine starts[8].

"Smart Helmet & Intelligent Bike System" Prof. Chitte P.P, Mr. Salunke Akshay S, Mr. Thorat Aniruddha N and Mr. Bhosale Nilesh T, 2016 The "Smart Helmet" is a type of protective headgear used by the rider which makes bike driving safer than before. The distinctive utility of project is fall detection, if the bike rider fall from bike it will send message automatically. Here each unit has used a separate microcontroller, for bike unit we use Arduino Lilypad and for helmet unit we use ARM7 lpc2148. Signal transmission between the helmet unit and bike unit is using a RF concept. The advantage of using this project is the detection of accident in remote area can be easily detected and medical services provided in short time[9].

"Intelligent Helmet" Jennifer William, Kaustubh Padwal, Nexon Samuel, Akshay Bawkar, SmitaRukhande, 2016 The proposed system is to develop an intelligent helmet. A module affixed in the helmet will sync with the module affixed on bike. The microcontroller is the actual decision making unit of the entire circuit and the programs will be fed into it. According to the data it will receive from the module on bike it will control the output of remaining components. Based on the output of both the accelerometers on bike and helmet, it will send message to nearest police station in case of an accident using GSM module and based on the outputs of alcohol sensor and IR sensor, it will send a relay output to the engine [10].

III. PROBLEM STATEMENT

To design and implement the system using Internet of Things to provide the safety is a major problem in construction works. This project aims to develop smart wearable devices such as helmet using various sensors that will help in monitoring the health and safety of workers.Hybrid approach to integrate fixed and mobile IoT sensors to measure and monitoring the enviroment in which the workers are working. Collect the air quality around people, by combining fixed and mobile sensors and alert the managers if any crisis occurred.

IV. MACHINE LEARNING ALGORITHMS

1. KNN Algorithm

K-Nearest Neighbour is one of the simplest Machine Learning algorithms based on Supervised Learning technique. K-NN algorithm assumes the similarity between the new case/data and available cases and put the new case into the category that is most similar to the available categories. K-NN algorithm stores all the available data and classifies a new data point based on the similarity. This means when new data appears then it can be easily classified into a well suite category by using K- NN algorithm. K-NN algorithm can be used for Regression as well as for Classification but mostly it is used for the Classification problems. K-NN is a non-parametric algorithm, which means it does not make any assumption on underlying data. It is also called a lazy learner algorithm because it does not learn from the training set immediately instead it stores the dataset and at the time of classification, it performs an action on the dataset. KNN algorithm at the training phase just stores the dataset and when it gets new data, then it classifies that data into a category that is much similar to the new data. Example: Suppose, we have an image of a creature that looks similar to cat and dog, but we want to know either it is a cat or dog. So for this identification, we can use the KNN algorithm, as it works on a similarity measure. Our KNN model will find the similar features of the new data set to the cats and dogs images and based on the most similar features it will put it in either cat or dog category. The K-NN working can be explained on the basis of the below algorithm: • Step-1: Select the number K of the neighbors • Step-2:

Calculate the Euclidean distance of K number of neighbors • Step-3: Take the K nearest neighbors as per the calculated Euclidean distance. • Step-4: Among these k neighbors, count the number of the data points in each category. • Step-5: Assign the new data points to that category for which the number of the neighbor is maximum. • Step-6: Our model is ready.

V. PROPOSED SYSTEM

he system provides real time monitoring of industries from the monitoring station. The transmitter unit is placed on helmet of worker and receiver unit placed on the monitoring station. The Wi-Fi wireless technology is used for data transmission from the working environment to the base station. The Wi- Fi communication network provide way to monitor the working environment through thingspeak application from the monitoring 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, Carbon monoxide.

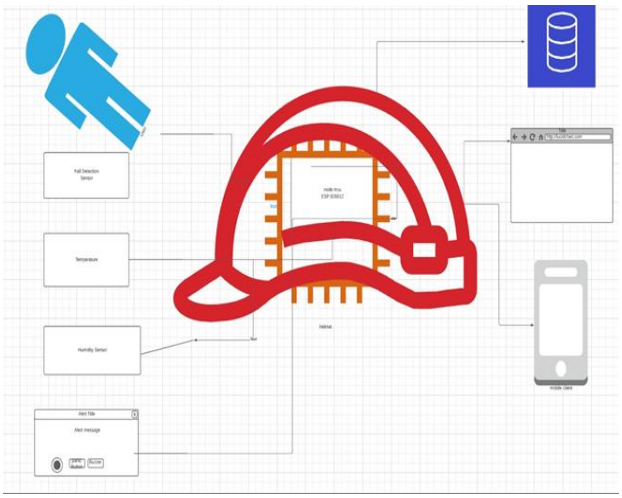

Fig. System Architecture

VI. SYSTEM MODULES

Hardware Modules:

1. **IR Sensor** This IR reflective sensor Module used TCRT5000 IR Sensor to detect colour and distance. This sensor module consists on an IR transmitter an IR receiver. IR Transmitter continuously emits IR signal which is then reflected by an obstacle and is then detected by the IR receiver. TCRT5000 Infrared Reflective Sensor Module is often used in line following robots, object sorting Robot because this module can sense if a surface is white or black. The measuring distance range from 1mm to 8mm, and the central point is about 2.5mm. There is also an on-board potentiometer to adjust the sensitivity. The infrared diode will emitting the infrared continually when the module is powered ON, when the emitted infrared light has not been reflected or the strength is not big enough, the receiver diode will in the off state and output pin i.e. DO will be LOW.
2. **NodeMCU** :- NodeMCU is an IoT Module based on ESP8266 Wi-Fi Module. NodeMCU uses Lua Scripting language and is an open source Internet of Things (IoT) platform. This modules has CH340g USB to TTL IC. Features of Node-MCU IoT Module 1.Open source IoT Platform 2.Easily Programmable 3.Low cost & Simple to Implement 4.WI-FI enabled
3. **Pressure Sensor** The BMP180 is the new digital barometric pressure sensor of Bosch Sensor Tec, with a very high performance, which enables applications in advanced mobile devices, such as smart phones, tablet PCs and sports devices. It follows the BMP085 and brings many improvements, like the smaller size and the expansion of digital interfaces. The ultra-low power consumption down to 3 A makes the BMP180 the leader in power saving for your mobile devices. BMP180 is also distinguished by its very stable behavior (performance) with regard to the independency of the supply voltage. BMP180 is the best lowcost sensing solution for measuring barometric pressure and temperature. Because pressure changes with altitude you can also use it as an altimeter! The sensor is soldered onto a PCB with a 3.3V regulator, I2C level shifter and pull-up resistors on the I2C pins. The BMP180 is the next-generation of sensors from Bosch, and replaces the BMP085. The good news is that it is completely identical to the BMP085 in terms of firmware/software/interfacing.
4. **DHT11 sensor** The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use but requires careful timing to grab data. The only

real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

5. **Push button** It is going to use as a panic button at that movement when the rider faces the accident condition. If the rider is that much okay to push the button by himself or someone nearby to him can press that button to help the rider.

6. Graphical User Interface For GUI we are developing website and android application using PHP, CSS, HTML. All the data collected by the sensor are going to be stored on a cloud and will be shown on website and android application. The message will be sent in form of email as well as text message on the patients parents and friends.

VII. CONCLUSION

We explored a new way to protect the construction workers and other people working in the industries, by combining various sensors and use of Internt of Things. This proposed system is implemented to ensure the complete safety of the workers at the construction site. Through this smart helmet, the contractor can continuously monitor the entire workers involved in construction process and can also get notification about the workers' physical condition and can immediately save the workers from any serious issues in case of emergency. Hence we can reduce the death rate of the construction workers and provides increased security to them.

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