isrjournals

International Journal of Advanced Research in Computer Science Engineering and Information Technology

Volume: 6, Issue: 3,Special Issue: 1 ,Mar,2021 ,ISSN_NO: 2321-3337

THE WATCH DOG - AN IOT ENABLED DEVICE TO ENSURE FIREFIGHTER'S SAFETY

Charanselvam S, J A Jackswin Lino Sam, T K Vishal

Mr. M Vijay M.E., (Ph.D), Electronics and Communication Engineering, Velammal Institute of Technology, India

ABSTRACT-*The guardian is an IoT based helmet device which is cable of sending and retrieving extracted information about the environment by connecting with nearest Wi-Fi networks. The information encompassing the data of six sensors namely, Temperature and Humidity Sensor, Air Quality Sensor, Atmospheric and Pressure Sensor, and UV Index Sensor. These sensors are governed under a microcontroller of an Arduino framework and works under I2C protocol. The NodeMCU microcontroller sends the data over Wi-Fi to a real-time Google Firebase database where it is classifies the sensors based on their type of data. The retrieved real-time information is displayed on a web app user interface in a timely basis. The web application is build using node.js framework to process the real-time data. For front-end design are built using HTML, CSS and JavaScript.*

Keywords – IoT, NodeMCU, Firebase, Realtime Database

Volume: 6, Issue: 3,Special Issue: 1 ,Mar,2021 ,ISSN_NO: 2321-3337

1. INTRODUCTION

The Watchdog is an IoT enabled device to ensure the safety of firefighter, by sensing his environment using sensors and sending the extracted information to the internet by connecting to nearest Wi-Fi networks. The sensors data collected using sensors namely, Temperature and Humidity sensor, Air Quality sensor, Atmospheric and pressure sensor. These sensors are governed under a microcontroller of an Arduino framework and work under I2C protocol where we use multi-master/multi-slave architecture. The NodeMCU microcontroller sends the data over Wi-Fi to a real-time Google Firebase database, where it classifies the sensors based on their type of data. The retrieved real-time data is displayed on a web app user interface on a timely basis. The web application is built using node.js framework to process the real-time data. The front-end designs are built using ReactJS.

1.1 NEEDED FOR PROJECT:

The number of firefighter injuries has increased by over 28% in the past 30 years. Our team sought to tackle this issue by creating a novel helmet utilizing IOT to improve firefighter safety. We believe that the impact of ideas is the foundation on which we should build our world on. Our team was inspired to take on a challenge that would improve the lives of those around us while remaining true to our roots. Recently fire accident occurred at Kolkata 9 people were dead including 5 fire fighters, the view on lives of our team members were transformed. The effects of the fire left a lasting impression on our views of how technology can be used for good and helped us discover a newfound sense of purpose. We sought to use new and novel technologies to make this a reality.

1.2 OBJECTIVE OF THE PROJECT:

Hazardous gases from fires and various chemicals surround the firefighters in the form of smoke. These gases threaten human health very seriously and cause the deaths and the explosions. In addition, exposure to smoke components has the potential to cause chronic health problems. Frequent exposure to smoke can also cause long-term health problems. Firefighters always face fires and hazardous gases and may have long-term health problems such as cancer, lung disease, and cardiovascular disease, etc. Hence our aim is to monitor volume of total volatile organic compounds, carbon-dioxide concentration, temperature present around the firefighter's environment and intimate them during increase in exposure of these parameters.

1.3 OPERATING ENVIRONMENT:

When responding to an emergency, firefighters are responsible for connecting hoses to hydrants, operating the pumps that power the hoses, climbing ladders, and using other tools to break through debris. Firefighters also enter burning buildings to extinguish fires and rescue individuals. Many firefighters are responsible for providing medical attention. Two out of three calls to firefighters are for medical emergencies, not fires, according to the National Fire Protection Association. When firefighters are not responding to an emergency, they are on call at a fire station. During this time, they regularly inspect equipment and perform practice drills. They also eat and sleep and remain on call, as their shifts usually last 24 hours. Some firefighters may provide public education about fire safety, such as presenting about fire safety at a school. Some firefighters also work in hazardous materials units and are specially trained to control and clean up hazardous materials, such as oil spills and chemical accidents. They work with hazardous materials removal workers in

these cases. Wildland firefighters are specially trained firefighters. They use heavy equipment and water hoses to control forest fires. Wildland firefighters also frequently create fire lines—a swath of cut-down trees and dug-up grass in the path of a fire—to deprive a fire of fuel. They also use prescribed fires to burn potential fire fuel under controlled conditions. Some wildland firefighters, known as smoke jumpers, parachute from airplanes to reach otherwise inaccessible areas.

1.4 INTENDED USERS AND USES:

Fire fighters are the intended users. It's a helmet gear which encompasses the sensor modules. The condition of the surrounding environment is sensed and segregated based on the types of air parameters. The data of these parameters are sent to a nearby network to monitor by the host (The WatchDog). The host would analyse these data and intimate caution if needed.

1.5 EXISTING METHOD:

Internet of Things-Based Firefighters for Disaster Case Management

In this study, Internet of Things (IoT) based firing zone monitoring and firefighter surveillance system (IoT-FFM) is developed with IEEE 802.15.6 standard and Ad hoc On-Demand Distance Vector (AODV) routing protocol. Fireground coordinates, fire temperature, and gas type in the environment are collected, and also, respiration rate, heart rate, pulse oximeter of the firefighter, and nearest firefighter number are gathered with the proposed IoT-FFM wireless communication system. The gathered data is saved in Influx DB database with Node-RED programming tool and monitored in real-time with Grafana monitoring system at the remote-control centre. End-to-end delay, throughput, and energy consumption parameters are considered for performance evaluation of the IoT-FFM.

1.6 PROPOSED METHOD:

In this method, we encompass the necessary sensors which are used to monitor the air quality parameters like NH3, NOx, alcohol, Benzene, smoke, CO2, etc. These data are conferred to NodeMCU micro-controller where it sends this information based on the type of data to the nearest network. This whole setup is integrated with the firefighter's helmet. When information from the environment is extracted, we are capable of sending this information using Wi-Fi following the IOT protocol to a remote real-time database where it is stored and processed. When this information is retrieved, it is used to create a web user interface that displays the information in a real-time framework to show changes as they happen. This interface allows all subscribers to the web app to monitor the situation different firefighters are and providing assistance when needed. The person who monitors could able to send caution to the fire fighter if necessary. Thereby we could sense any danger and prevent them with ease. The advantage of this method is that the surrounding parameters of the fire fighters can be monitored anywhere in the world.

2. METHODOLOGY

The WatchDog firefighter helmet sends and retrieves information by using six sensors connected to a central microcontroller capable of connecting to nearby Wi-Fi networks. When information from the environment is extracted, we are capable of sending this information using Wi-Fi following the IOT protocol to a remote real-time database where it is stored and processed. When this information is retrieved, it is used to create a web user interface that displays the information in a real-time framework to show changes as they happen. This interface allows all subscribers to the web app to monitor the situation different firefighters are and providing assistance when needed.

Volume: 6, Issue: 3,Special Issue: 1 ,Mar,2021 ,ISSN_NO: 2321-3337

2.1 WHAT IT DOES?

The microcontroller we used for this project is the NodeMCU board which is an Internet of Things enabled board built on top of the Arduino framework. We then attached several sensors to the board (DHT11 Temperature and Humidity Sensor, Air Quality Sensor, BMP180 Atmospheric and Pressure Sensor following the I2C (Inter-Integrated Circuit) protocol where we used a multi-master/multi-slave architecture to allow sensors to publish and receive data to the bus system. When the data is received by the NodeMCU microcontroller, the data is sent over Wi-Fi to a real-time Google Firebase database where it is categorized by sensor and type of data. This information is then retrieved and displayed on a web app user interface updated in real-time. The web app is built using the node.js framework to process the real-time data. Other areas of the web app such as the front-end design are built using the HTML5, CSS3, and JavaScript. Additional features were implemented using React and React-Graphs

2.2 KEY DESIGN COMPONENTS:

Variables/Devices	Quantity	Types
Humidity Sensors	1	DHT11
Gas Sensors	2	MQ 6, MQ 7
Infrared Thermometer	1	MLX90614
Pressure Sensor	1	BMP180
Air Quality Sensor	1	MQ135
Speaker	1	1W, 8Ohm
NodeMCU	1	ESP8266

Table 2.1 Design Components

2.3 BLOCK DIAGRAM:

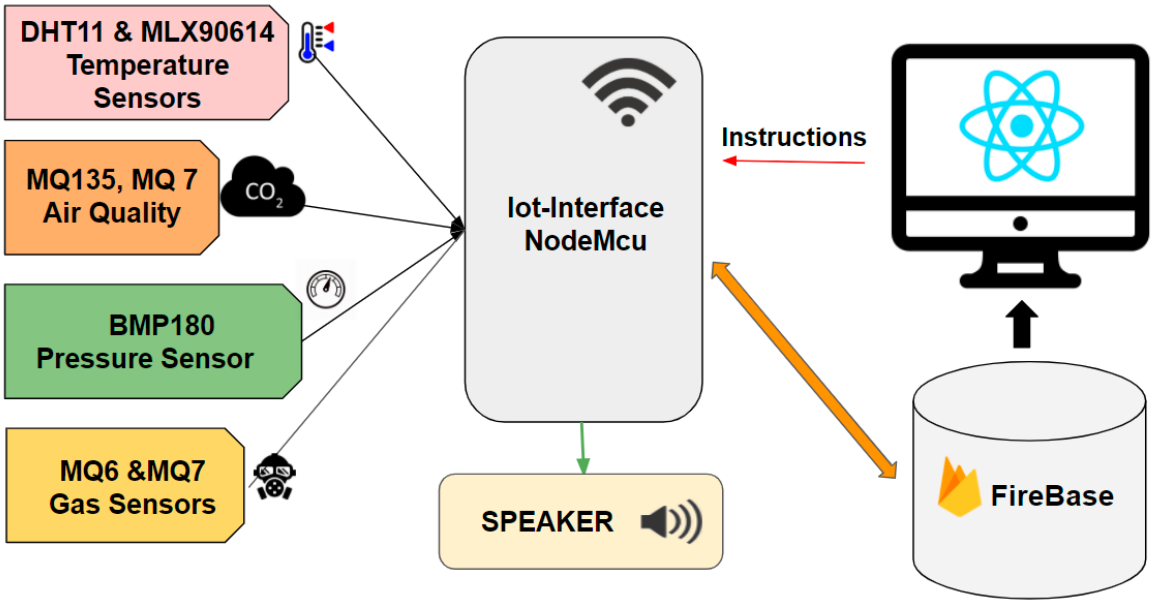

Figure 2.1 Block Diagram of The Working Prototype

3. SOFTWARE IMPLEMENTATION

3.1 REAL-TIME VISUALIZATION:

The data that are retrieved from sensors are sent to the Firebase through NodeMCU connected to the nearest Wi-Fi, the dataset from firebase is gathered to perform alert analysis with the help of Node.js and ReactJS framework. The data are displayed in the form of graphs in a dashboard, which is monitored by a remote person. The person in turn communicates with the Firefighter if the environment is not suitable for the Firefighter to survey. Figure 8 shows the monitoring dashboard at the receiver side.

Figure 3.1 Monitoring dashboard - Mockup

3.2 PACKAGES - BACKEND

In order to configure the backend and interface the above sensors, we must install all the necessary library packages. The necessary packages are listed below.

- DHT-Library sensor
- Gas Sensor library
  - MQ-7 library
  - MQ-135 library
- MLX90416-library
- BMP180 library
- PCM library
- Arduino-Json library

Volume: 6, Issue: 3,Special Issue: 1 ,Mar,2021 ,ISSN_NO: 2321-3337

4. PROTOTYPE IMPLEMENTATION

A minimum viable result of the final implementation has been made and observed. It has been made sure that the prototype would do all the essential functionalities. The prototype is built based on a modular principle, making sure adding or removing a sensing equipment is both easier and quicker. For example, adding or removing a sensor would require removing/adding one line of code in both the frontend and backend.

In short, we should have very least/minimum tech-debt while updating or downgrading the project. The initial prototype is built with that scope of modularity in mind. Here are some pictures of the prototype.

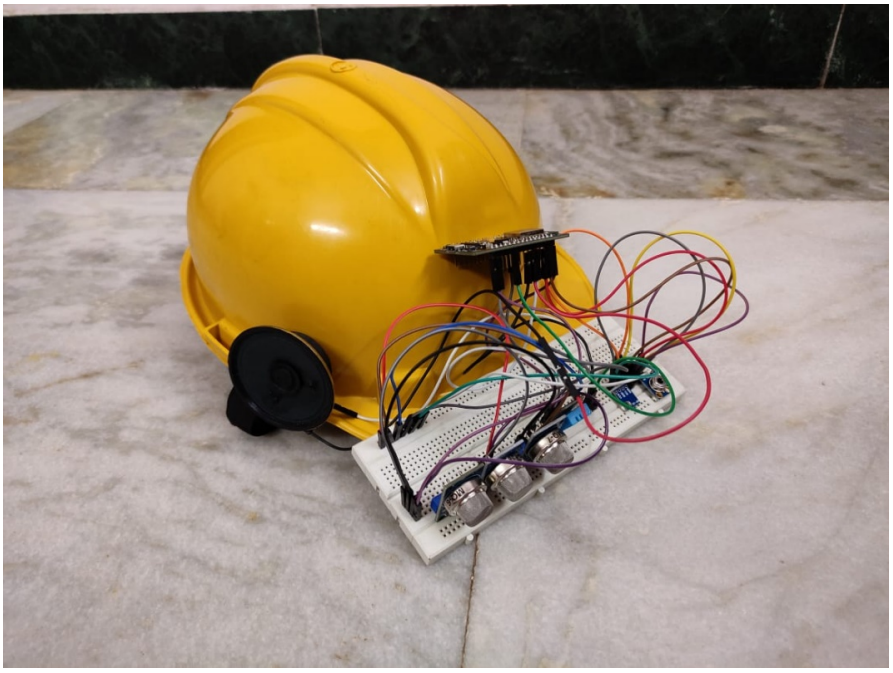

Figure 4.1 Prototype of The WatchDog

Volume: 6, Issue: 3,Special Issue: 1 ,Mar,2021 ,ISSN_NO: 2321-3337

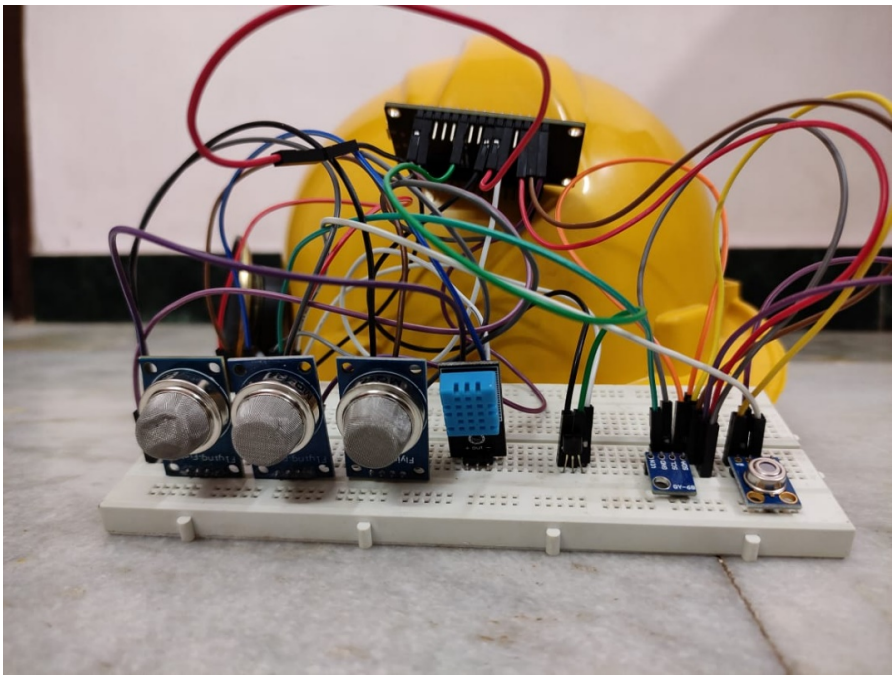

Figure 4.2 Closeup shot showing all the sensors

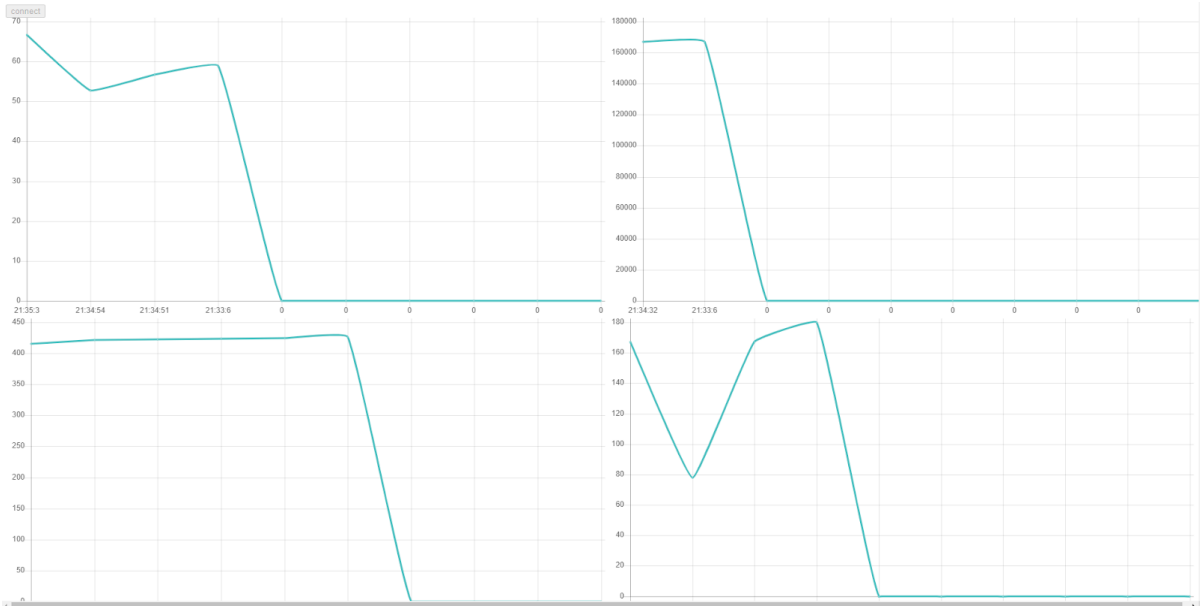

Figure 4.3 Initial Prototype of the dashboard working real-time

During the initial dashboard building phase, we focused mainly on the speed of data arriving from sensors to the dashboard. We tried to reduce the latency as much as possible by removing extra bloat and unnecessary code in the process.

5. CONCLUSION AND FUTUREWORK

IoT technology can help the people and the stuff in danger with the smart mechanism. In this study, we aim to use the IoT advantages for the Firefighters and the firegrounds. It helps us monitor each individual firefighter's surrounding environment and caution them whenever it is needed. There by we could prevent any crisis. In the future, we plan on implementing a full master-slave protocol between the web app and the microcontroller. Currently, the microcontroller is capable of sending information to Google Firebase and the web app is capable or retrieving it, however, the opposite is not possible. Having the web app alert firefighters of unstable or dangerous conditions is crucial in the safety for all parties involved, as a result, in the future we will want to implement the ability for the web app to publish to Google Firebase as well and allow the microcontroller to retrieve this data and provide feedback to the user.

REFERENCES

#1. Web Based Environment Monitoring System Using IOT - 2019 (Pooja Ghule, Mansi Kambli)

#2. An IoT Based Environment Monitoring System - 2020 (Mosfiqun Nahid Hassan, Mohammed Rezwanul Islam, Fahad Faisal)

#3. Wireless Sensor Networks for Effective Environmental Tracking System Using IoT and Sensors - 2018 (D. Punniamoorthy, Vikram S. Kamadal, B. Srujana Yadav, V.Sriram Reddy)

#4. Environment Monitoring System through Internet of Things(IOT) - 2018 (Vijay R.Shinde, Pankaj P. Tasgaonkar, R. D. Garg)

Volume: 6, Issue: 3,Special Issue: 1 ,Mar,2021 ,ISSN_NO: 2321-3337

#5. An Autonomous Wireless Body Area Network Implementation Towards IoT Connected Healthcare Applications - 2017 (Taiyang Wu, Fan Wu, Jean-Michel Redouté, Mehmet Rasit Yuce)