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Smart IoT Gloves for Fire Fighter

Prof. Nagaraj Telkar, Prof. Shrikanth Jogar, Akshatha Hatti, Aparna Rati, Chetana Desai, Supriya Guggari
Department of Computer Science and Engineering, SKSVMACET, Laxmeshwar, Karnataka, India

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ABSTRACT

IoT is one of the dominant positions all over the world in technological development. It is another information industry following computer, Internet and mobile communication. In Internet of Things technology, the fire-fighting, fire monitoring and safety management system are an important application. It discusses IoT system framework for fire-fighting, planning, and monitoring. It gives development points for providing research and development of IoT in firefighting, monitoring and safety management field. Intelligent fire monitoring systems need a key of accurate and effective firefighting software design. This project will work on the requirements of user and key main issues of wireless sensor network hardware and software for monitoring fire and fire fighters.

Keywords : RFID Technology, Wireless Technology, Fire Detection, Internet of Things, Web Application and Android Application.

I. INTRODUCTION

Prevention of fire and fire risk level are increasing day by day. Fire-fighting and monitoring situations are very serious today. Public security keeps on insisting in increase of technology in firefighting and monitoring. They give special attention to improve the science and technology in resisting fire disasters. They are concerned about the application of new technology such as IoT and wireless sensor network in fire-fighting and monitoring field. IoT is very suitable for fire-fighting with wide scope along with wireless sensor network (WSN). IoT has high degree of intelligence for maintaining many product categories, quantities, complex fire danger factors and large range of equipment's for fire monitoring and fighting.

IoT has high scalability and high resource sharing capabilities for handling various complex business information. IoT combined with WSN plays an important role in the fire alarm, fire control facility monitoring and fire equipment management. IoT technology is combined with fire fighting for hazard source monitoring, fire monitoring, fire-fighting rescue, fire early warning, prevention and early disposal. It is used effectively to enhance the fire brigade fire fighting and emergency rescue capabilities.

Fire accidents are becoming more serious because of bigger building density and higher urban buildings. Accidental fires caused 6% of all unnatural deaths in India. There are various reasons for fire accidents exploding cooking gas cylinders, Electrical short circuits and so on. Fire accidents kill 54 people daily in India and direct property losses are unknown. In order to protect the people and secure the properties from fire, it is necessary to design good real time high reliable fire monitoring system. In this project, we

will be creating a system that has 3 nodes. The three nodes are fire detection kit, RFID Hand gloves, and mobile and web application. These nodes are connected to each other by using wireless technology. These kits and nodes are highly scalable and reliable.

Firefighters put their own lives in danger to save innocent people trapped inside a building engulfed by fire. The mental state of firefighters during a rescue operation is not completely stable due to loss of visibility, urgent condition of victims and many other environmental factors.

The system is having many advantages and deals with three modules: Fire Detection Kit, RFID Hand Gloves, Android and Web Application. The main objective of the proposed system is to send notification to nearby fire station along with the location. It also includes RFID Tag and RFID Reader which helps the firefighters to get the exact location of the firefighter who will be stuck inside the building and also helps them to find the nearby exit. Android and web application will be having an interface with which we can show the building map and firefighters building internal location on the map.

The firefighter will carry an Android Smartphone and a RFID glove. In the environment, we deploy passive RFID tags (R-tags) on the walls and along the baseboard. The system also includes a server that stores information about the building receives real-time updates about the firefighter location through the phone and computes the directions to the closest exit. The server software also displays the firefighter location on the building map which can be viewed by both the firefighter and the incident commander/fire chief. It is evident that the system will save a significant number of firefighters and victims lives.

II. LITERATURE SURVEY

Rakshit Shah, Pranav Satam, Muzaffar Ali Sayyed, Pratiksha Salvi[2],in the paper "Wireless smoke detector and fire alarm system" stated that A fire or alarm system are often monitored regionally within the premises, or remotely at an overseas place as per demand. Remote alarm provides the owner of the premise with the advantage of observation from distant location associated taking immediate actions once an emergency message is received, unlike a manual system.

Yashi Mishra, Gaganpreet Kaur Marwah and Shekhar Verma [3], in the paper "Arduino based smart RFID security and attendence system" stated that RFID system provides an efficient and simple method for identification. There are other methods for identification like barcode, optical character recognition, biometric and smart card but possible area of use is much larger for RFID system. Like transportation and logistics, security and animal tagging, postal tracking, time and attendance and road toll management.

Md. Abdul Aziz, Y.Naveen Kumar, Ch.Pavan Kumar and P. Yaswanth Kumar[4], in the paper "RFID Based Security and Access Control System using ARDUINO" , stated that Radio Frequency Identification (RFID) technology has been attracting considerable attention with the expectation of improved supply chain visibility for both suppliers and retailers. It will also improve the consumer shopping experience by making it more likely that the products they want to purchase are available.

KB Deve, GP Hancke and BJ Silva [5] ,in paper "Design of a smart fire detection system" ,stated that Conventional fire detection systems have a tendency of being triggered by false positives. The proposed system uses smoke and temperature sensors. SMS capability via GSM was implemented so that

occupants can interact with the fire detection system and aid in the detection of false positives. The aim of this work was to design and implement a fire detection system that detects fires effectively and reduces false positives. The results show that the system meets the specifications.

III. PROPOSED METHODOLOGY

In this project, we will be having 3 nodes that are connected wireless. These nodes are:

1. Fire Detection Kit:

The Figure 1 shows the block diagram of Fire detection kit. This mainly consists of a Fire sensor, NodeMCU. Once the fire has been detected by the fire sensor then that data will be sent to NodeMCU. Once the NodeMCU detects any information about fire then it will be uploaded to the server using NodeMCU and a notification will be sent to Android app.

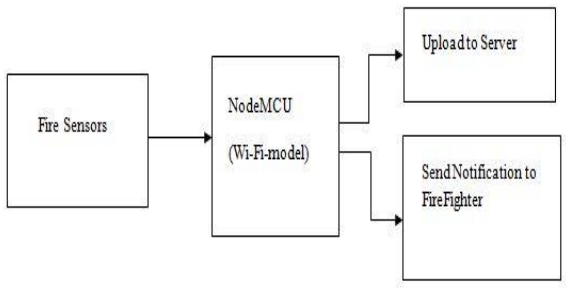

Figure 1: Fire Detection Kit

Once the FireFighter gets a notification to his Android App. He can check the notification and get information about the fire and its location with GPS coordinates. By using this FireFighter team can attend the situation as soon as possible. In this situation, if the building is very big then the firefighters might need internal building navigation or location. By using this system we can help the FireFighter and locate the exact position in the Android app and web application so that each and every other FireFighter can monitor every FireFighter. This internal location can be accessed by using RFID tags. These RFID tags contain a unique number; this unique number is associated with the building's internal location. Once we get this building internal Location we can upload it to the server.

2. RFID Hand Gloves.

Each and every FireFighter will be having RFID hand gloves. The Figure 2 shows the block diagram which is associated with these RFID hand gloves.

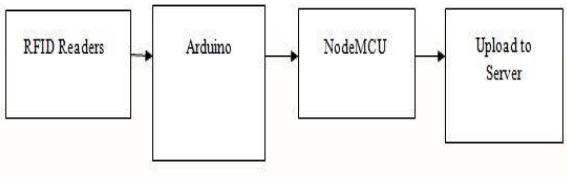

Figure 2 : RFID Hand Gloves

The hand gloves consist of RFID Reader. Once the FireFighter taps on RFID tags present inside the building then that RFID tag unique number can be accessed. Once these hand Gloves get the RFID tag unique number then that will be uploaded to the server. This server will be consisting of unique tags and location information. Once we get this information about location we can update that in the Android and web application so that each and every FireFighter is connected. Hand Gloves will be provided with a special feature called "HELP". There is a push button present on these gloves, by clicking on that button the buzzer will be initiated, by which firefighters can ask for help from other firefighters to rescue him from a bad situation.

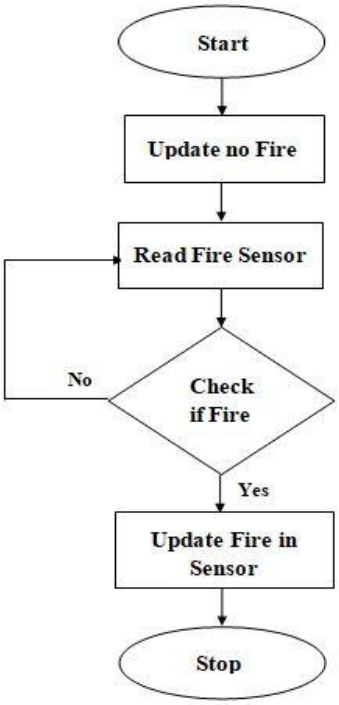

Figure 3: Flow chart of Fire Detection Kit

The Figure 3 shows the flow diagram of Fire Detection Kit. The fire detection kit will be connected to both wifi and server. Initially the output will be low (i.e., 0) which indicates there is no fire catch. The main function of the fire sensor is to read the output value (i.e., low or high) and update it to the server. If fire is detected then the output value will be high (i.e., 1) and it will updated to the server. Immediately the notification will be sent to the nearby fire station with the location of the fire caught building.

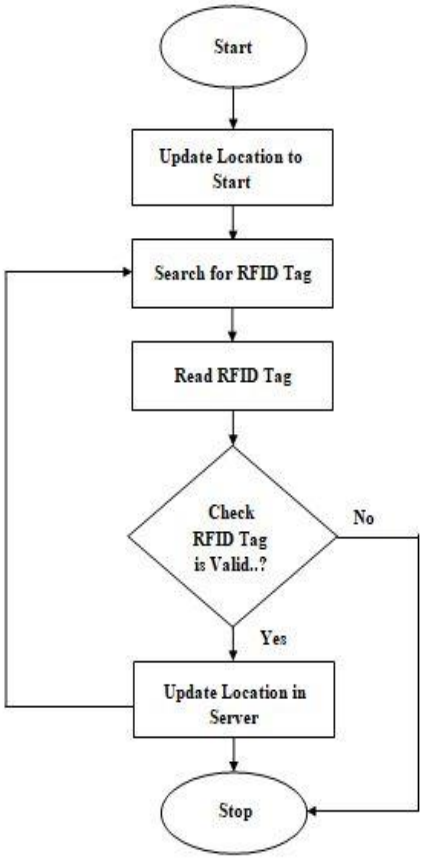

Figure 4: Flow chart of RFID Hand Gloves

The Figure 4 shows the flow chart of RFID Hand gloves. Once the fire fighter arrives to the fire caught location he will be provided with the RFID hand gloves which consist of RFID reader, and RFID tag will be already mounted inside the building.

The fire fighter will be provided with internal building map through the android application whenever he is stuck inside and couldn't find the way out to the exit he can search for the RFID tags which will be mounted inside the buildings wall once he finds can tap on the RFID tags using RFID reader. Each RFID tag will be having its own unique code which will be assigned to location in the server. The RFID tag will read the unique code of the tag and checks whether it is valid or not, if valid the current location of the firefighter will be displayed in both android and web application.

IV. REQUIREMENT ANALYSIS

A. HARDWARE REQUIREMENTS

The section of hardware configuration is an important task related to the software development insufficient random access memory may affect adversely on the speed and efficiency of the entire system. The process should be powerful to handle the entire operation. The hard disk should have capacity to store the file and application.

- Arduino
- NodeMCU
- Fire sensor
- RFID tag and reader

B. SOFTWARE REQUIREMENTS

A major element in building a system is the section of compatible software since the software is the market is experiencing in geometric progression .selected software should be acceptable by the firm and one user as well as it should be feasible for the system. This document gives a detailed description of the software requirement specification. The study of requirement specification is focused specially on the functioning of the system.

- Arduino IDE 1.8.13
- Java JDK 15.0.2
- Android Studio 4.1
- Python 3.9.0, Flask 1.1.2

V. EXPERIMENTAL RESULTS

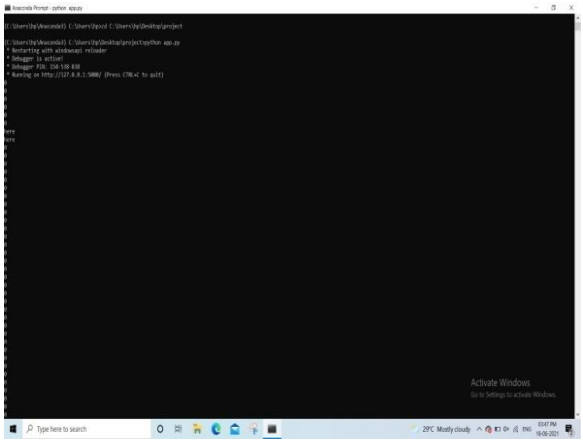

Figure 5: Connection to Server

The Figure 5 shows that code for connecting to server. The hardware components should be connected to the wifi and the server will be initiated. As soon as the server gets connected an IP address is generated from which we can access the Web Application.

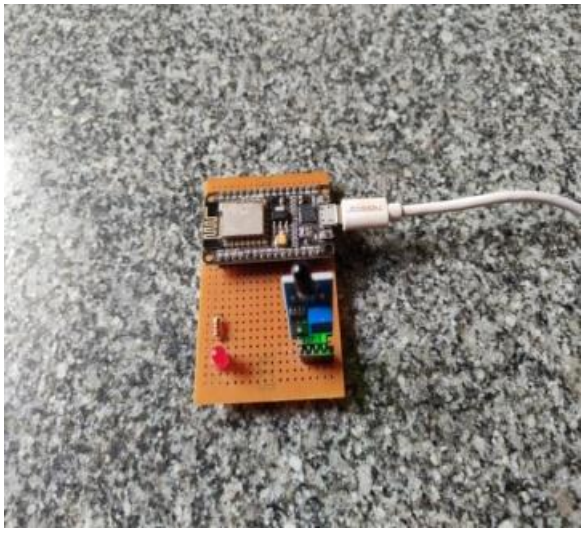

Figure 6: Fire Detection Kit

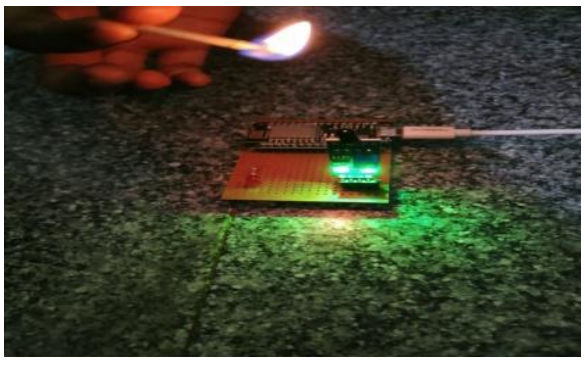

Figure 7: Detection of Fire

The Figure 6 shows the Fire Detection Kit and Figure 7 shows the Detection of Fire. When the fire is caught the Fire Detection Kit will sense the fire and update it to the server.

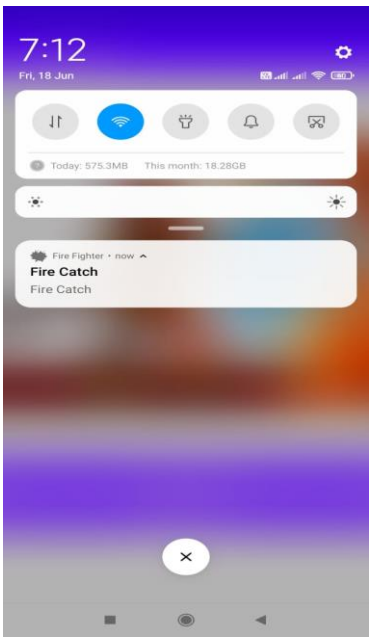

Figure 8: Notification in App

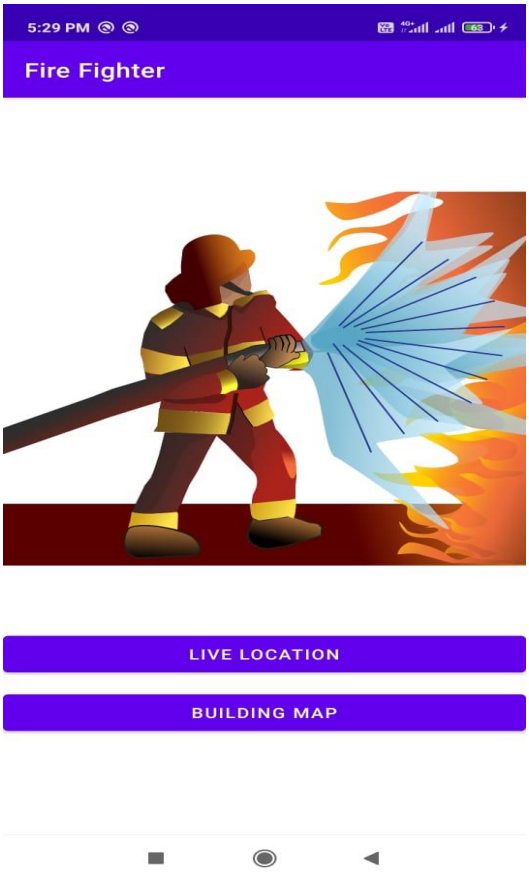

Figure 9: Dashboard of App

The Figure 8 shows the notification sent to the android app when the fire caught and the Figure 9 shows the Dashboard of the android app.

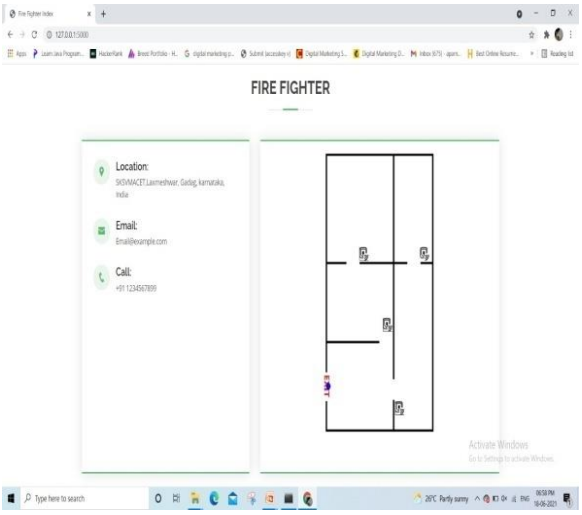

Figure 10: Blueprint of the Building in Web Application

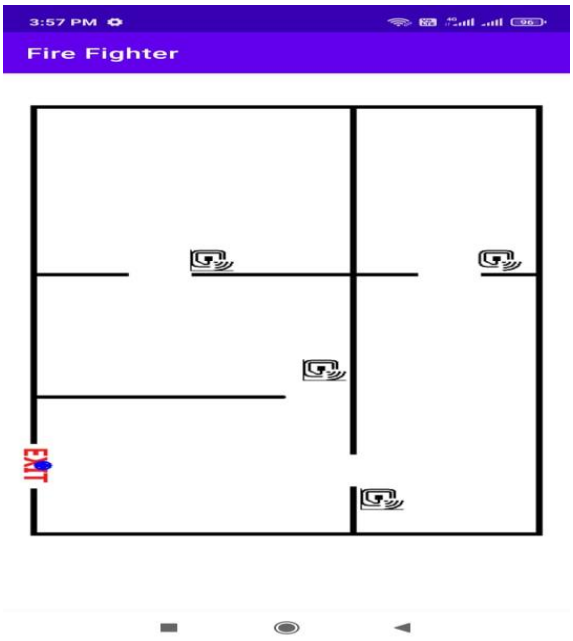

Figure 11: Blueprint of Building in App

The Figure 10 and Figure 11 shows the Blueprint of the building which is available both in Web and Android Applications. It points the exit which indicates that the fighter has not entered the building.

Figure 12: Buzzer on the RFID Hand Gloves

Figure 13: RFID Reader

The Figure 12 show the buzzer that is mounted on the RFID Hand Gloves and the Figure 13 shows the RFID Reader on the Hand Gloves

Figure 14: RFID Tags

Figure 15: Tapping on RFID Tag

The Figure 14 shows the RFID Tags and the Figure 15 shows how the RFID tag are tapped using RFID Reader. The RFID Tag should be mounted on the wall and RFID Reader is present on the hand gloves.

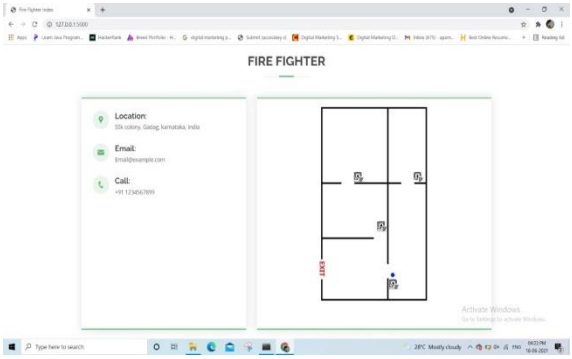

Figure 16: Location of FireFighter in Web Application

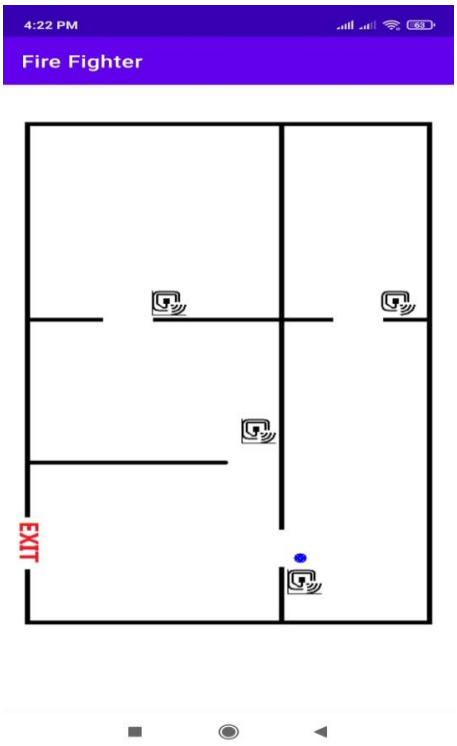

Figure 17: Location of FireFighter in App

The Figure 16 and Figure 17 shows the current location of the FireFighter in Web and Android Application respectively.

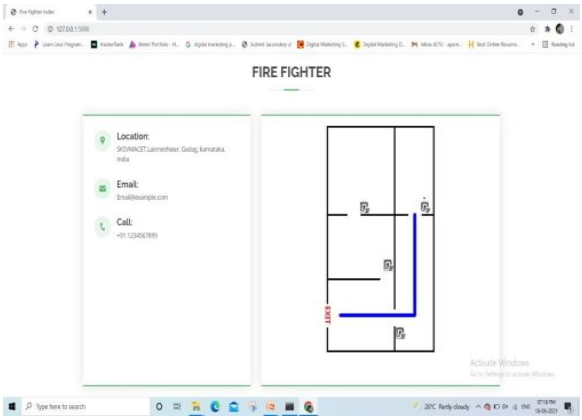

Figure 18: Path to Nearest Exit in Web Application

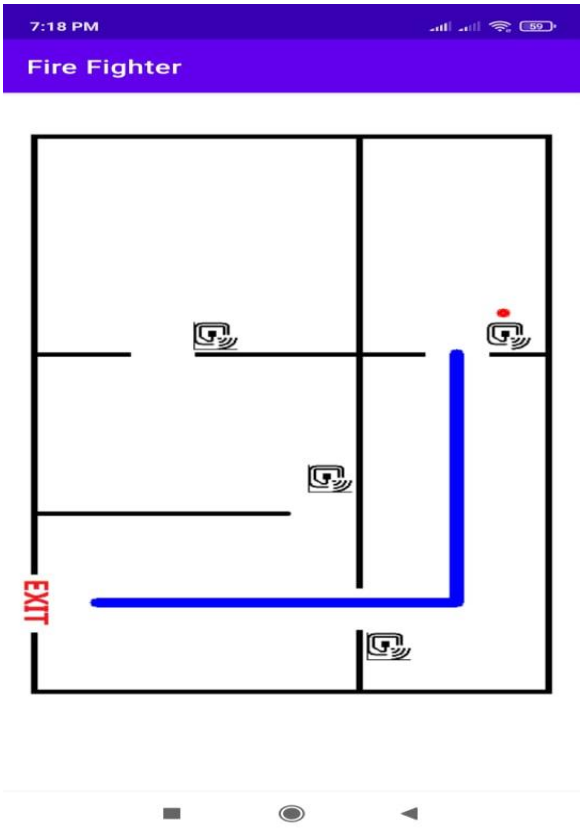

Figure 19: Path to Nearest Exit in App

The Figure 18 and Figure 19 shows the nearest path to the exit in Web and Android Application respectively. Whenever Firefighter taps on both buzzer and RFID reader.

VI. CONCLUSION

We introduced three modules Fire Detector Kit, RFID Hand Gloves, Android and Web Application. The Fire Detector Kit module will detect the fire through sensor and send notification along with GPS coordinates to nearby Fire stations. The RFID Hand Gloves use RFID technology to know the exact location of the FireFighter present inside the building. This system assist the FireFighter to navigate inside a building and find the nearest exit.

Android and Web Application is provided to view the blueprint of the building for both firefighters who are inside and outside of the building. The Android application will have a special feature called "HELP", by clicking on that button firefighters can ask for help from other firefighters to rescue him from a bad situation.

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