ENHANCED FIRM PROTECTION FROM FIRE HAZARDS USING IoT

A Project Report Submitted to

the APJ Abdul Kalam Technological University

in Partial Fulfillment of the Requirements for the Award of the Degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

BY

Mr. ARSHAG RABEE TK
Reg.No. VVT15CS011

Under the Guidance of

Mohammed Riyas KV

(Assistant Professor, Dept. of CSE)

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Mr. ADARSH K   **VVT15CS002**

Mr. ARSHAG RABEE TK   **VVT15CS011**

Mr. SABARI NATH P   **VVT15CS023**

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CERTIFICATE

This is to certify that the report entitled **"Enhanced Firm Protection From Fire Hazards Using IoT"** submitted by **"ARSHAG RABEE TK"** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering is a bonafide record of the project work carried out by them under my/our guidance and supervision.. This report in any form has not been submitted to any other University or Institute for any purpose.

Internal Supervisor(s)   External Supervisor(s)

PG Coordinator   HEAD OF THE DEPT

DECLARATION

I undersigned hereby declare that the project report "Enhanced Firm Protection From Fire Hazards Using IoT " , submitted for partial fulfillment of the requirements for the award of degree of Bachelor of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Mohammed Riyas KV. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

Place : KARAD

Date : 14/06/2019   Signature

                                                                         ARSHAG RABEE TK

ACKNOWLEDGEMENTS

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CHAPTER 1

INTRODUCTION

Fire hazards are a big problem that human society were facing from years ago. The unscientific constructions of the building and it's complexities is increasing chances of fire hazards. The major reason for fire hazards in industrial building is due to the short circuit, It may came because of the careless and unscientific construction of buildings. The losses due to fire hazards are un affordable. Losses may occur in the form of asset loss or in the form of human loss. The asset loss can be compensate using from policy protections, But a human life is much valuable than everything else. During the fire incidents the people were unable to reach out of the buildings due to lack of knowledge about the building structure, In these cases the people will stuck inside the building and this will lead to their death by breathing the toxic gases produced by the fire. Both these losses can be reduced by monitoring the fire incidents in a firm and reporting this to the concerned authorities. So in order to avoid these losses we need to implement a new technique, which will effectively meet all requirements mentioned above. So by using the IoT we are implementing a system to monitor fire in the building and then inform it in to the concerned authorities. Also it will provide a safest path for peoples inside the building to reach out and fire officers for the evacuation. It will work by meeting all the real time constraints, So it initiate a quick response against the fire. It doesn't need a human interaction for the working, Hence it is very useful for monitoring the fire in the off time of the firm.

1.1 IoT(Internet of Things)

The "Internet of Things" (IoT) is a familiar technology in current scenario. It is a fairly simple concept to understand and simple to use. IoT is the ability for things that contain embedded technologies to sense, communicate, interact, and collaborate with other things, thus creating a network of physical objects. In this environment physical objects are provided with the ability to transfer data over a network eliminating human-to-human or human-to-computer interaction. IOT refers to a network of comprehensively linking things through sensors and communication equipment, including linking among things and linking between people and things. Internet of Things applications is a essential part of modern industries, It can be found in every industry with a diversity of application for smart homes, smart buildings, travel and transportation, health and personal care, retail, agriculture, construction etc.

1.2 Fire Hazards in Firms

Nowadays, due to the enormous growth in industrialization, big industries are growing up gradually. Most of the cases, industries are not following the standard rules for constructing high rise building that lead to occurrence of different kinds of accidents including fire accidents. Fire accident is now such an alarming issue and a common

occurrence that it is really difficult for fire brigade service and police to keep up with the situation. Presently, automatic fire alarm, smoke detectors or water sprinklers are being used by many industries. Earlier research found that, in most of the cases victims die of smoke inhalation and suffocation. Not being able to find the exit leads them to stay longer time inside the affected area and thus they die due to inhalation of poisonous gases like carbon-dioxide and carbon-monoxide. Therefore, there is no doubt regarding the fact that, a planned and guided evacuation is very important in order to reduce the damage of fire accidents.

1.3 Existing Fire Extinguishing Process and its Drawbacks

The existing fire extinguishing process is not a effective mechanism. If fire sensors in the firm detects fire, Then it will trigger a alarm and inform the employees. Also it will open the water sprinkler to extinguish the fire. After that some people will inform it in to the fire safety officers. But if it happens in the off time of the firm or in the night time, there is no effective mechanisms to inform this incident to the concerned authorities. The fire will spread till the morning or the opening of the firm. So the absence of these fire information from fire officers will lead in to many losses. Also in case of people trapped inside the fire building and unable to communicate with outside world will lead to human losses. And in some cases the fire department will receive information about the fire incidents and they didn't know the exact spot of building, This will also lead to delay in evacuation process.

1.4 Android Application

This android application provides a user interface. New users will register their details through this application. By entering the details in to the application, Two type of users are served using this app, User official and user normal. The admin will accept their registration request and grant them to login in to their account by entering the username and password. By checking the user type They will directed in to their home page, The homepage of user official contains a drawer with two options. One for Notification and another for Building maps. The notification option will save all the incoming notification in to the application for a period. The building maps will provide google maps of all the registered buildings. The home page of user normal also contains a drawer with two options. One notification option for storing the incoming notification and another Building status option. This will provide the current Status of all floor in the user's building. At the time of fire occupant the web server safest path for the exit in the form of notification. Only the user in the floor of the fire occupied building will receive the notification. The safety officers always receive the fire alert in their android application regardless the building.

1.4.1 Google Firebase Cloud Messaging

Firebase Cloud Messaging (FCM), formerly known as Google Cloud Messaging (GCM), is a cross-platform cloud solution for messages and notifications for Android, iOS, and web applications, which currently can be used at no cost.

The service is provided by Firebase, a subsidiary of Google. On October 21, 2014, Firebase announced it had been acquired by Google for an undisclosed amount. The official Google Cloud Messaging website points to Firebase Cloud Messaging (FCM) as the new version of GCM.

1.5 Hardware Components

The hardware part is consist of a Arduino board, GSM module and a flame sensor. The Arduino board is a printed circuit board which is used as a basic board with a firmware to attach different devices and capabilities to it, The flame sensor is used for detect the fire inside a building and is attached to the Arduino board. By detecting the fire the flame sensor trigger a input in to GSM module attached to Arduino board. The GSM module will initiate call and SMS alert in to concerned authorities as guided by the firmware. The call duration is about 30 seconds and it's a blank call, it is used as a alert in to fire officers. After that the SMS will be send. The SMS contains information such us building name, building address and a link to google map to identify the building location.

1.6 Need for Study

The fire accidents in the large and small industries were a threat for ongoing businesses. It will bring too many risk in to business, Also the losses due to the fire impacts are unpredictable. The losses may occur in the form of money, other assents and human lose. We can only prevent the fire accidents in to a small extends. It may occur due to many reasons and when it happens it grows faster. So the effective mechanism to reduce the losses due to fire is to extinguish it as soon as possible by the fire officers or by any other measures. Also need to take out the people inside the building as soon as possible. Through proposing a effective mechanism to address this all problem we can reduce the losses due to fire in to a extend.

1.7 Scope of Study

- We can reduce the impact of fire accidents by informing it in to the concerned authority as soon as possible.
- It will reduce the workload of fire officers by giving them the exact location of the occupant building.

- It provides a evacuation path for officers and users to reach out of building.

1.8 Summary

This chapter has given an overview about firm protection from fire hazards using IoT and its need and scope in this new technological era. As the industry growing day by day, the chances for occurring the fire accidents are also increasing. Because of this reason enhanced firm protection from fire hazards are proposed in this work.

Further chapters discuss the related work, existing system with its drawbacks, proposed system and conclusion.

CHAPTER 2

LITERATURE SURVEY

There is extensive literature related to the Fire protection of firms using IoT. Many researchers have proposed various system to monitor and control the fire hazards. By the growth of industries the complexity for handling the fire hazards also increased. The recent technologies are bringing various solutions to address this complexities. This growth in technology bringing optimal solution for fire problems ith minimal cost and maximum efficiency.

2.1 IOT BASED EMERGENCY EVACUATION SYSTEM

In the year 2016, Keerthi Mohan, Aishwarya Mahesh, Atul Vasudevan, Krupa Panchagnula of Dayananda Sagar Academy of Technology and Management, Bangalore have jointly proposed a IoT Based Emergency Evacuation System with some new methodologies against the fire hazards using IoT. Primarily they have a hardware part and software part. The hardware part is used for detect the fire and other harmful incident's that may occur in the firms. They used a Arduino Mega board as a microcontroller board. Sensors like DHT 11 (sensor for detecting humidity and temperature), MQ2 flying fish (gas sensor) and ADXL335(vibration sensor) are used for detection of fire, detection of gas and detection of earthquake respectively. Also it uses a GSM module for sending SMS alert to predefined numbers. The android application is used for give a effective guidance to the people to easily get out of the building.

2.1.1 Advantages

- Fire alert by alarms when fire is detected.
- SMS Alerts about the fire incident in to the predefined number.
- Guidance to get out of the building in time of fire incident's.
- It efficient for natural calamities like earthquake.
- Useful for detection of gas accidents in industries.

2.1.2 Limitations

- No location based services like maps to guide the fire officers in to the fire occupant building.
- It is not providing any safest path for the users as well as for the fire officers to reach out of the building.
- The components were much more costly when compares to the latest components and technologies.
- Also the working of the system is sometimes fails to meet the real time constraints.

2.2 IoT BASED FIRE ALARM AND MONITORING SYSTEM

In the year 2017,Saumya Tiwari, Shuvabrata Bandopadhaya of BML Munjal University have jointly proposed IoT Based Fire Alarm and Monitoring System, which a based on the hardware than that of the software. It enabled different kinds of hardware components to monitor and extinguish the fire. It is done through IoT platform through GSM network. This system consist of two sub-system: transmit (Tx) subsystem and receive (Rx) subsystem; each subsystem having their own processing unit. The Tx process unit consist of Intel Galileo Gen 2 board. The sensor set are installed at different zones. Each set consist of a LM35V and MQ02 to sense temperature and smoke respectively. When the fire is detected in the building, first it will enable a fire alarm with a heavy sound, Then it cuts the power supplies in to the building and automatically enables the water sprinkler.

2.2.1 Advantages

- Enable fire alarms when fire is detected in the firm.
- The power supply in to the firm will be automatically cut off when fire is detected.
- Enables the water sprinkler's when the fire is detected.
- It is a integrated system of all possible fire extinguishing methods.

2.2.2 Limitations
- No location based services like maps to guide the fire officers in to the fire occupant building.
- It is not providing any safest path for the users as well as for the fire officers to reach out of the building.
- The components like Intel Galileo Gen 2 board, LM35V and MQ02 were costly.

2.3 SMART APPARATUS FOR FIRE EVACUATION - AN IoT BASED FIRE EMERGENCY MONITORING AND EVACUATION SYSTEM

In the year 2017, Swarnadeep Majumder, Sean O'NeilSmart, Ryan Kennedy of Worcester Polytechnic Institute(WPI) have jointly proposed Smart Apparatus for Fire Evacuation - An IoT based fire emergency monitoring and evacuation system with use of a mesh network of smart fire alarm and path planning algorithms. The goal of this system is inform the occupants and emergency services of the location of the fire and provide a real-time path for evacuation. Their vision was to implement a server work station that will receive all the sensor data from various node. Based on the received input it will find the location of the fire and provides immediate services.

2.3.1 Advantages

- SMS alert to the fire officers including information regard the fire occupants.
- It provided a Evacuation path for both users and fireofficers.
- It is based on real time constraints.

2.3.2 Limitations

- Slower path processing algorithms.
- Components used are costly
- Complex structure and methods.

2.4 INTERNET OF THINGS TECHNOLOGY FOR FIRE MONITORING SYSTEM

In the year 2017, S.R.Vijayalakshmi, S.Muruganand of Bharathiar University have jointly proposed Internet of things technology for fire monitoring system for hazard source monitoring, fire monitoring, fire-fighting rescue, fire early warning, prevention and early disposal. It is working with the use of wireless sensor network. Sensors detects the fire condition and transfers the data to the system. The basic components are sensor for data collection, data base server building for data storage, human-computer interface for data exchange and micro controller for data processing.

2.4.1 Advantages

- Early detection of fire in firms using sensors.
- Real time and historical data building using data base server.

2.4.2 Limitations

- No location based services like maps to guide the fire officers in to the fire occupant building.
- It is not providing any safest path for the users as well as for the fire officers to reach out of the building.
- Small surveillance capacity, poor reliable in detection.

2.5 IoT BASED SMART FIRE EMERGENCY RESPONSE SYSTEM

In the year 2018, Noorbasha Johnsaida, Lakkisetty V.Rahul, Tadi Shalini of Vasireddy Venkatadri Institute of Technology have jointly proposed IoT Based Smart Fire Emergency Response System. The flame sensor detect the fire and it activates the GPS which finds the current location of fire accident area. The location is stored in the cloud and activating message is send to the destination point by the GSM module. A flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. It is using a raspberry pi instead of Arduino. It uses twilio for

cloud communication platform as a web server. Initially it will detect the fire using the flame sensor and give signal to the Arduino board, The Arduino will initiate a message in to users as a alert and also provides a location based service for the fire officers to reach the location.

2.5.1 Advantages

- Alert to users and Fire officers regarding the fire information.
- It sends a location coordinate to the fire officers to reach the destination.
- It also suspends the fuel lines engaged to the buildings.
- It activates a fire suppression system.

2.5.2 Limitations

- It is not providing any safest path for the users as well as for the fire officers to reach out of the building.
- Cost of raspberry pi is more than that of a Arduino board. But both of them functions similar.
- The twilio is a paid server.

2.6 AN IoT BASED INTELLIGENT FIRE EVACUATION SYSTEM

In the year 2018, Afsana Khan, Afrida Anzum Aesha, Juthi Sarker Aka, S. M. Faisal Rahman, Md. Jamil-Ur Rahman of Military Institute of Science and Technology and Rajshahi University of Engineering and Technology have jointly proposed An IoT Based Intelligent Fire Evacuation System comprises of two parts i.e, the software module and the hardware module. Data from the sensors of hardware module is passed onto the software module through the server. The software module performs the necessary calculation and sends the result to the hardware module. In this A* algorithm is used to find the evacuation path. It is using a Grid based floor plan to generate the evacuation path. The hardware module consist of a Arduino mega board, Passive infrared Sensor (PIR), Smoke Sensor (MQ-2) , Heat Sensor (LM35), ESP Module 8266 (Wi-Fi Module), LED lights and a 5V Buzzer. When the Sensor detects fire it will trigger a input in to the Arduino board, the Arduino board will initiate a alert to people and process the evacuation path based on the received inputs.

2.6.1 Advantages

- It provides a Alert in to users through a SMS when the fire is detected.
- It also sends the location of the occupant building in to the fire officers.
- It provides a evacuation path using A* algorithm.

2.6.2 Limitations

- A* algorithms is a slower path finding algorithm. So we can't use it effectively.
- The overall system is a little complex

2.7 IoT BASED FIRE DEDUCTION AND SAFETY NAVIGATION SYSTEM

In the year 2018, G.Ajith, J.Sudarsaun, S.Dhilipan Arvind , Dr.R.Sugumar of Velammal Institute of Technology have jointly proposed An IoT Based Fire Deduction and Safety Navigation System. It provides early extinguishing of a fire disaster, large number of detectors which periodically measure smoke concentration or temperature are deployed in buildings and help the workers to get out of the building using the navigation system. This system provides a confirmation of the fire suspecting system to avoid any false alarm. The system will immediately send a message along with the image of the effected spot and Arduino's location using GSM.

2.7.1 Advantages

- Confirmations of the fire suspecting system.
- SMS alert to users and officers
- Continous monitoring of temperature using web server.

2.7.2 Limitations

- No location based services like maps to guide the fire officers in to the fire occupant building.
- It is not providing any safest path for the users as well as for the fire officers to reach out of the building.
- Complex hardware system.

2.8 SUMMARY

The major contribution of this chapter is the study and comparison of related papers. Most of the related papers focus on the Fire alert mechanism. Referring this papers provides the knowledge of how the current measures for the fire evacuation are working and what are their advantages and disadvantages. It helps to understand what the solution we need to bring to address all the problems related to the fire incidents.

CHAPTER 3
IoT BASED FIRE SAFETY MEASURES

3.1 INTRODUCTION

Several measures for monitoring the fire and controlling them are available in this era. But still losses due to fire accidents are remaining as un controllable. Also we are hearing such kind of news daily. So this shows that still there is no effective mechanism for handling the fire hazards. Many of the systems proposed for the fire monitoring and controlling is well fitted for current scenario, but it failing for meet the real time constraints. And we know that the efficiency of a system for fire controlling is based on its response towards the fire in the real time. Let us look what are the current safety measures for controlling the fire accidents on current scenario.

3.2 FIRE MONITORING AND ALARM

The fire monitoring system is a conventional mechanism to detect the fire in the surrounding. Now a days it is a standard safety feature in all buildings. Various sensors like flame sensor, smoke detector etc.. are used for the detection of the fire in the surroundings. This devices were embedded with a microcontroller and the this microcontroller examines the values read by the sensors. When the fire is detected, the sensor will pass a signal in to the microcontroller and the microcontroller will initiate the alarm. The alarm is a buzzer with high volume, this will inform the employees in the building about the fire incident and it will help them to reach out of the building.

3.3 HARDWARE CAPABILITIES FOR FIRE EXTINGUISHING

With the advancement of technologies, various technologies are proposed for self fire extinguishing process. This doesn't need a external interaction for start the activity. When the fire is detected then it will start the extinguishing process itself. Different hardware capabilities for the fire extinguishing includes water sprinkler, power supply cut off etc. this hardware capabilities were deployed based on the nature of the firm. For example, if the firm having a highly inflammable fuel line, then the hardware is deployed to cut the flow of fuel through the pipe and isolate it from the fire. the water sprinkler and power cutoff is a standard measures in all the building. In this system the hardware part is consist of a microcontroller and sensor. When the sensor detects fire the microcontroller direct the water sprinkler installed in the building to spread water. This will help to prevent the spreading of fire and extinguish it in the early stage. Simultaneously it will cut the power supplies in to the building, this will help to reduce the spreading of the fire.

3.4 FIRE ALERT

The impacts of fire accidents can be reduced by detecting it in the early stage and taking appropriate measures to extinguish it. If there is presence of human in the building during fire accident then early detection and taking appropriate measure for distinguish the fire is possible. But if there is no human presence in there then it is impossible to identify the fire and it will lead in to a huge fire accident. For example, if the fire accident happened in the off time of the firm, then there is no measures to detect it and inform to people. The another scenario is that there is people inside the building and they are unable to communicate with outside. So to handle this situation an automatic system is needed to monitor the fire incidents and inform it in to concerned authorities at the early stage. For this a Arduino board and GSM module is used. The sensor will detect the fire and sends signal in to the Arduino board. The Arduino board will initiate a SMS alert in to fire officers. This will help them to reach in the destination as soon as possible.

3.5 EVACUATION PATHS

Evacuation paths are used for two purposes, one is to guide the people inside the fire building to reach out of the building safely. The next is to provide a evacuation path for the fire officers for the rescue operation. When a fire hazard is occur the people will contact the fire officers for the rescue operation. But the fire officers didn't have any knowledge about the building. They even don't know how to enter the building and were the people is stucked etc. so if provide them with a evacuation map of the building, it will help them to start the rescue operation immediately. Also many death rate due to the fire hazard are because of the people remaining inside the building. The people were not know about the path to outside due to smoke and fire. so the evacuation path will also help them to reach out of building with out the help of the fire officers. There are several path finding algorithms are available such as A* algorithm, Grid based safest path etc.

3.6 PROBLEM IDENTIFICATION

The existing system for fire controlling have many features. But the major problem is that there is not a integrated system of this. Some of the system may consist of fire alarm and monitoring and some consist of evacuation maps. So we need a integrated system by combining this all specification. The another major problem of the existing system is that the time taking to respond against the fire incident. Some systems are not well time constrained and some path finding algorithms are slower in processing.

3.7 SUMMARY

In this chapter, an overview of the existing diary systems has been discussed. The concept of intellectual diary has been proposed and the problem identified in this system is elaborated.

CHAPTER 4

ENHANCED FIRM PROTECTION FROM FIRE HAZARDS USING IoT

4.1 INTRODUCTION

The proposed system, Enhanced Firm Protection From Fire Hazards Using IoT can be explained according to its system architecture. This system is mainly focuses to an integrated fire protection system with less complexities. The main problem with existing system is that the lack of integration and complexity. The system is capable of informing the fire incidents to its users with in a few time when the fire is detected. Here the proposed system provides an android application to the end users for receiving information about the fire incidents. It also uses a website for admin to add details of device installed buildings. Then it uses a local webserver to hold the data from user as well as data from the hardware.

4.2 OBJECTIVES

- Provides a complete integrated system for fire evacuation.
- Monitoring of fire in a fire
- Alert to fire officers when the fire has occurs.
- Providing shortest safest path based evacuation map.
- Location service to the fire officers with in the SMS.

the developed system can be explained according to the architecture shown below.
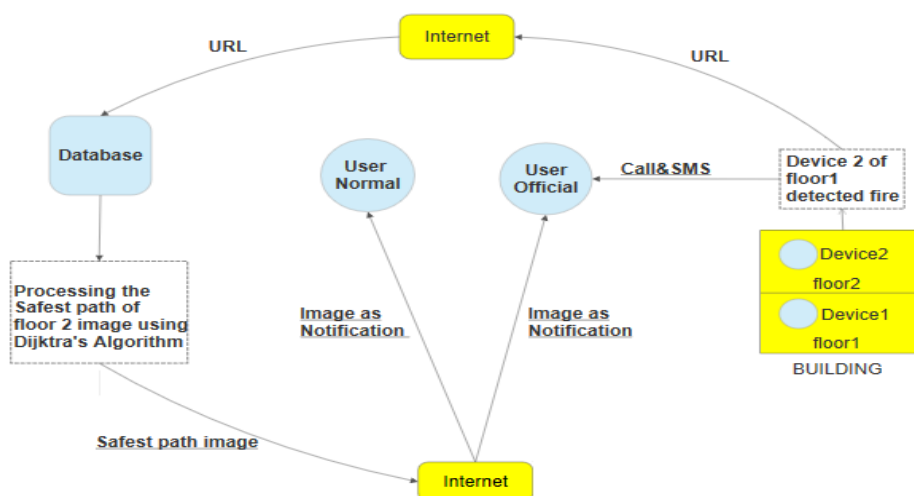
4.3 SYSTEM ARCHITECTURE

Fig 4.1 System Architecture

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The hardware device is installed on the building and the following information are collected. The building name, building location, floor number in which device installed, the coordinates of the device according to the building, the image of floor etc. this data are stored in to the database by the admin. The device is consist of Arduino board, GSM module and a flame sensor. If the flame sensor detects fire in building, initially the Arduino make a call in to fire officers using the GSM module after that it will send a SMS alert to them including the information about the building address and Google map location. After that it makes a http request in to our server via internet. The server will process the request and check for the device id in the database. Using the values of the device in the database it will process the evacuation path. The evacuation path algorithm is stored on the server. By retrieving the values of the responded device it will find the safest shortest path. after finding the path, the path is plotted on the floor image using drawing algorithm. After completing the drawing this image is send to end users via the internet. the users will receive this image as a notification in their android application.

4.4 RAW DATA COLLECTION

The main data are collected from the hardware side. The flame sensor in the hardware module detects the fire. initially the pin of this to the Arduino is set to high. If it detects the fire then the pin is turned in low. Using this input the Arduino will send a web request in to the web server. In this request it includes the device id. The webserver will validate the request and finds the device id. Then it retrieves all the information about the device from the database such as floor number, vertex names , edges , possible paths etc. using this information the safest shortest path is generated.

4.5 INSTALLING THE HARDWARE MODULE

Hardware module is consist of 3 parts. A Arduino board, GSM module and Flame sensor. This 3 components are connected together and formed a fully working device. The power supply is given in to the Arduino board. The Arduino board is programmed using Arduino programming tool. It is a C programming and the program code is burned in to the Arduino memory. This act as the firmware. The device is installed on the users building as per their need. One device is capable of monitoring fire in 2 meter radius. On the time of installation we will collect the total information of the building especially the floor images and coordinates of the device installed on the floor.

4.6 WEBSITE

The website is handled by the admin to enroll the information in to it. Initially there will be a login page for the admin in to website. The username and password were given default. Then the next window shows the options to store the data about the building and its related information. It will add the following information.

- Building name
- Floor details
- Company details
- Device details
- Vertex details
- Edge details

This data were directly stored in to a local database using MySQL Server 5.0

4.7 WEB SERVER AND DATABASE

The web server is implemented using Net Beans IDE 8.0.2, it will process the incoming request in to the web server. The request usually contains the device id. So by receiving this request the server will check for the device id and it founds it, then all the data related about the device is retrieved and passed in to the Safest Shortest path algorithm to generate the evacuation path. After generating the path the path is plotted on the floor image using the java drawing class. Then it is send to end users using the notification service by Google Firebase. MySQL Server 5.0 as is used to create a local databse. It uses the local systems storage space as the server. The user registration details and the information given by the admin is stored in there. There is a total of 12 tables in the database and they are : Building table, company details table, device location settings table, edge table, floor table, path table**,** login table, official registration details table, user registration table, user type table and vertex table, the values in to this table were entered by users and admin. additional to this the program uses a table to store generated tocken and this table is known as tocken table.

4.8 SAFEST SHORTEST PATH ALGORITHM

By receiving the inputs from the server this algorithm starts to execute. Initially it identifies the device which detected the fire. then it will process the safest path as of follows.

- A preliminary criteria is applied to the Algorithm to avoid the risky paths. Initially we set the value as 1 meter radius.
- It avoids all the paths near this 1 meter radius. So the rest of the path are created.

So after obtaining all the possible safest path it will apply Dijktra's algorithm to find the shortest path. It will process on the following manner.

- The distance of the all possible shortest path are calculated.
- The path with minimum distance is placed on the top of list and check the rest of path.
- If a path with minimum distance is found, then it is placed on the top, else placed under the first element in the list.
- Repeat the process through all the safest path.

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After obtaining this path, the path is send to a algorithm in java class to plot the path on the floor image. After drawing this image the image will sends to the users.

4.9 SUMMARY

In this chapter, an overview of developed Fire protection system has been discussed. It deals with deals with different modules used in this research work. The proposed methodology focuses to perform a fully functioning integrated fire protection system.

CHAPTER 5

IMPLEMENTATION ENVIRONMENT

This chapter gives the description on how the project is implemented, the implementation of software and hardware requirements. Also describes about the android operating system used by the smartphone, the android and java features that has been used for the completion of the work.

5.1 REQUIREMENTS

5.1.1 Developer Requirements

- ➢ **Hardware Development Tools**

- • Arduino Board

- • GSM Module

- • Flame sensor

- ➢ **Software Development Tools**

- • Operating System   : Windows 7

- • IDE for Application   : Android Studio with Android SDK()

- • Cloud communication: Google Firebase

- • Website Design   : Xhtml

- • IDE for server   : Net Beans IDE 8.0.2

- • Database   : MySQL Server 5.0 (Local database)

5.1.2 Installation Requirements

- ➢ Smart Phone with Android Operating System

- ➢ Android version   : 4.4 and above (i.e., kitkat and above)

- ➢ Hardware Support   : Arduino board, GSM module, Flame sensor

5.2 FRAME WORK WITH ANDROID JAVA

5.2.1 Android Operating System

Android is an open source and Linux based operating system for mobile devices such as Smartphone and tablet computers. Android was developed by the open handset Alliance, led by Google, and other companies. Google wanted Android to be open and free; hence most of the Android code was released under the open source Apache license, which means that anyone who wants to use Android can do so by downloading the full Android source code. vendors (i.e. hardware manufactures) can add their own proprietary extensions to Android and customize Android to differentiate their product from others.

The main advantage of adopting Android is that it offers a unified approach to application development. developer need only develop for Android, and their application should be able to run numerous different devices as long as these devices are powered using android. Application is the most important part of success chain in the world of Android.

a)Features of Android

Android is open source and freely available to manufacturers for customization therefore there are no fixed hardware or software configurations. However Android itself support the following features;

➢ Storage – Uses MySQL for data storage

➢ Connectivity - Support GSM/EDGE, IDEN, CDMA, EV-DO, UMTS, Bluetooth(includes A2DP and AVRCP), Wi-Fi, LTE and WiMAX

➢ Messaging - Supports both SMS and MMS

➢ Web browser - Based on open source web kit together with chrome's Vs. JavaScript engine

➢ Media Support- Includes support for the following media: H.263, H.264 (in 3GP 3GP or MP4 container), MPEG-4 SP, AMR-WB(in 3GP container), AAC, HE-AAC(in MP4 or 3GP container), MP3, MIDI, WAV, JPEG, PNG, GIF and BMP

➢ Hardware Support - Accelerometer sensor, Camera, Digital Compass, Proximity sensor and GPS

➢ Multi-touch - Supports multi-touch screens

➢ Multi-tasking - Support multi-tasking applications

➢ Flash Support - Android 2.3 supports flash 10.1

➢ Tethering - supports sharing of internet connection as a wired/wireless Hotspot

The main Android devices in the market include Smartphone, Tablet, E-reader devices, netbooks, MP4 players, internet TVs and so on

5.2.2 Android versions

Table 5.1 : Android Versions

Android Versions	Release Date	Code Name
1.1	9th February 2009	
1.5	30th April 2009	Cupcake
1.6	15th September 2009	Donut
2.0/2.1	26th October 2009	Éclair
2.2	20th May 2010	Froyo
2.3	6th December 2010	Gingerbread
3.0/3.1/3.2	22nd February 2011	Honeycomb
4.0/4.0.4	19th October 2011	Ice Cream Sandwich
4.1-4.3.1	9th July 2014	Jelly Bean
4.4-4.44,4.4W-4.4W.2	31st October 2013	Kitkat
5.0	12th November 2014	Lollipop
M(Developer Preview 2)		

Each version of the Android OS is identified by an API level number. for e.g., Android 2.3.3 is level 10(API 10), while Android 3.0 is level 11 (API11) and so on.

5.2.3 Required tools for Android development
➤ Android development can be done with a Mac, Windows or a Linux machine.

➤ All tools needed for Android development are free and can be downloaded from the web

➤ JAVA JDK- The android SDK makes use of the Java SE Development Kit(JDK). JDK comes with collection of tool that are used for developing and running Java programs. They include:

- applet viewer (for viewing Java applets)
- javac (Java compiler)
- java (Java interpreter)
- javap (Java disassembler)
- javah (for C header files)
- javadoc (for creating HTML documents)
- jdb (Java debugger)

➤ Android SDK – This is the most important piece of software needed to download. Android SDK contain a debugger, libraries, an emulator, documentation, sample code and tutorials. This SDK should be installed properly and SDK manager need to be configured.

5.2.4 Java and Java Features

Java is a general-purpose programming language that is class-based, and designed to have as few implementation dependencies as possible. It is intended to let application developers write once, run anywhere (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture. The syntax of Java is similar to C and C++, but it has fewer low-level facilities than either of them. Java programming language was originally developed by Sun Microsystems which was initiated by James Gosling and released in 1995 as a core component of Sun Microsystems' java platform(java 1.0[J2SE]). As of December 2008 the latest release of the java standard edition is 6(J2SE). with the advancement of java and its widespread popularity, multiple configuration were built to suite various types of platform. The Sun Microsystems has renamed the new J2 versions as java SE, java EE and java ME, respectively.

Java is:

- Simplicity : Java is a very simple language as it is derived from C++ and C. So a user who has learned the C and C++ programming can easily do it by learning basic Java syntax.

- Object-Oriented : Java is an Object-oriented language as it modelled around 'objects' rather than on the 'process'

- Platform Independence : Java is a platform independent language, that it is independent of whatever software environment is available.

- Security Java is known to be such a secure language because it has the following features, they are

    - ✓ Java has no explicit pointer.
    - ✓ Programs are run in a virtual machine sandbox.
    - ✓ Java adds a class loader which separates the classes for a package of the local file system from imported ones from a network.
    - ✓ It has a bytecode verifier which checks the code fragments for any illegal code that violate the access right.
    - ✓ It as a security manager that defines the access for Java classes.

- Robustness : Java is a robust language i.e. a strong language. It uses a strong memory management, the lack of pointers helps in security issues, an automatic garbage collection, exception handling and also type checking mechanism which in all makes it a very strong language.

- Neutral Java Architecture : In Java, codes are compiled and thus bytecodes are generated. These bytecodes can run on any computer architecture thus making Java architecture neutral.

- Portability : Java is a highly portable language as the bytecodes can be carried to any platforms.

- High performance : Java offers high performance due to its bytecodes, it is faster than any interpreted language. Java architecture is designed to reduce overheads during runtime.

- Distributed Applications : Java can create distributed applications using RMI and EJB. This feature of Java facilitates the user to call any file by calling any method on any computer.

- Multi-Threading : A thread in any language is a different program that runs concurrently, this feature helps Java to handle multiple tasks simultaneously. Threads don't occupy memory, it works on memory sharing.

- Dynamics : Java is a dynamic language which means it can link new Java class libraries, Java objects, and Java methods dynamically. It also supports functions from its native languages such as C and C++.

Java is a general purpose object oriented programming language. Java program can be developed as Stand-alone applications and Web applets. Stand- alone java program execution involves two steps:
1) Compiling Source code in to byte code using java c compilers.
2) Executing the byte code program using java interpreter.

5.2.5 Differences between JDK, JRE and JVM

Understanding between JDK, JRE and JVM is important in java.

- JVM (Java Virtual Machine)
  JVM (Java Virtual Machine) is an abstract machine. It is a specification that provides run time environment in which java bytecode can be executed. JVMs are available for many hardware and software platforms. JVM , JRE and JDK are platform dependent because configuration of each OS differs. But, java is platform independent. The JVM perform following main tasks:

  - Loads code
  - Verifies code
  - Execute code
  - Provide runtime environment

- JRE (Java Runtime Environment)
  JRE is an acronym for Java Runtime Environment. It is used to provide runtime environment. It is the implementation of JVM. It physically exists. It contains set of libraries + other files that JVM uses at runtime. Implementations of JVMs are also actively released by other companies besides Sun Micro Systems.
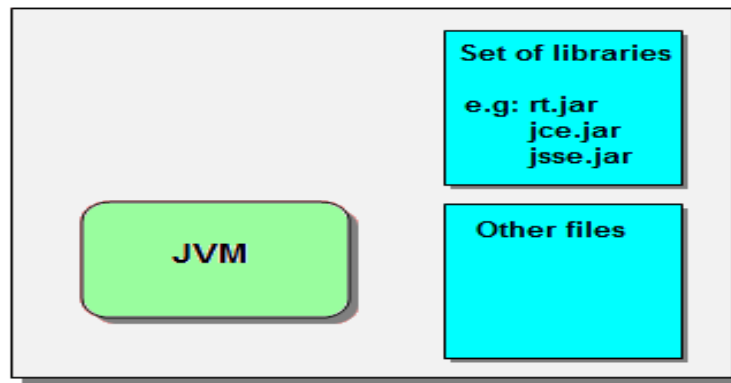
Fig 5.1 : JRE

➢ JDK (Java Development Kit)
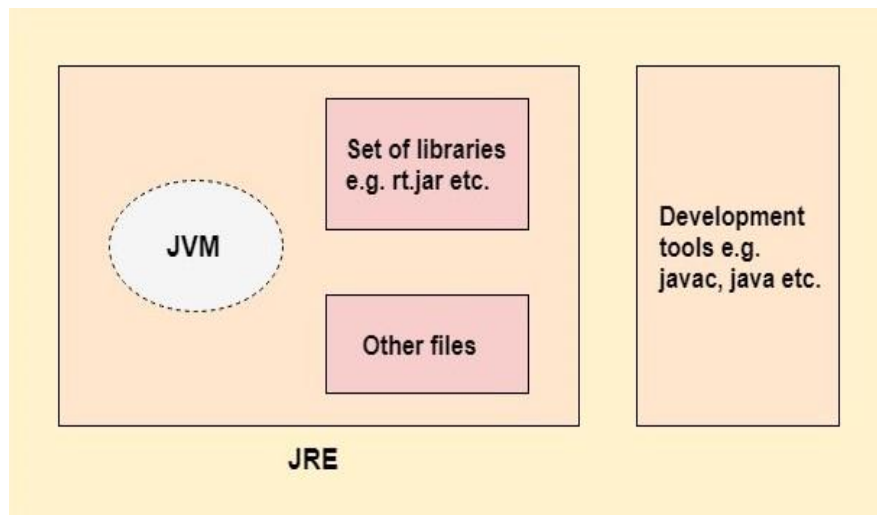JDK is an acronym for java development kit. It physically exists. It contains JRE + development tools.

Fig 5.2 : JDK

While considering a java program it can be defined as a collection of object that communicate via invoking each others methods.

- Object – objects have states and behaviors.
- Class – A class can be defined as a template or blue print that describes the behaviors or states that object of its type support.
- Methods – A method is basically a behavior. A class can contain many methods. It is methods where the logics are written, data is manipulated and all the actions are executed.
- Instance variables – each object has its unique set of instance variables. And objects state is created by the values assigned to these variables

The inventors of java wanted to design a language which could offer solutions to some of the problems encountered in modern programming. They wanted the language to be not

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only reliable, portable and distributed also simple, compact and interactive. Sun Microsystems officially describe java with the following attributes:

- Compiled and interpreted
- Platform interdependent and portable
- Object oriented
- Robust and secure
- Distributed
- Familiar, simple and small
- Multithreaded and interactive
- High performance
- Dynamic and extensible
- Ease of development
- Scalability and performance
- Monitoring and manageability
- Desktop client
- Core XML support

5.2.6 Android Studio IDE

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems. It is a replacement for the Eclipse Android Development Tools (ADT) as the primary IDE for native Android application development.

Android Studio was announced on May 16, 2013 at the Google I/O conference. It was in early access preview stage starting from version 0.1 in May 2013, then entered beta stage starting from version 0.8 which was released in June 2014 The first stable build was released in December 2014, starting from version 1.0.

Since 7 May 2019, Kotlin is Google's preferred language for Android app development. Still, other languages are supported, including by Android Studio.

The following features are provided in the current stable version:

- Gradle-based build support

- Android-specific refactoring and quick fixes
- Lint tools to catch performance, usability, version compatibility and other problems
- ProGuard integration and app-signing capabilities
- Template-based wizards to create common Android designs and components
- A rich layout editor that allows users to drag-and-drop UI components, option to preview layouts on multiple screen configurations[
- Support for building Android Wear apps
- Built-in support for Google Cloud Platform, enabling integration with Firebase Cloud Messaging (Earlier 'Google Cloud Messaging') and Google App Engine
- Android Virtual Device (Emulator) to run and debug apps in the Android studio.

Android Studio supports all the same programming languages of IntelliJ (and C Lion) e.g. Java, C++, and more with extensions, such as Go and Android Studio 3.0 or later supports Kotlin and all Java 7 language features and a subset of Java 8 language features that vary by platform version. External projects backport some Java 9 features. While IntelliJ that Android Studio is built on supports all released Java versions, and Java 12, it's not clear to what level Android Studio supports Java versions up to Java 12 (the documentation mentions partial Java 8 support). At least some new language features up to Java 12 are usable in Android.

5.2.7 Net Beans IDE

NetBeans is an open-source integrated development environment (IDE) for developing with Java, PHP, C++, and other programming languages. NetBeans is also referred to as a platform of modular components used for developing Java desktop applications.

NetBeans is coded in Java and runs on most operating systems with a Java Virtual Machine(JVM),including Solaris, Mac OS, and Linux.

NetBeans manages the following platform features and components:

- User settings
- Windows (placement, appearance, etc.)
- NetBeans Visual Library
- Storage
- Integrated development tools
- Framework wizard

NetBeans uses components, also known as modules, to enable software development. NetBeans dynamically installs modules and allows users to download updated features and digitally authenticated upgrades.

NetBeans IDE modules include NetBeans Profiler, a Graphical User Interface (GUI) design tool, and NetBeans JavaScript Editor.Net Beans framework reusability simplifies Java Swing desktop application development, which provides platform extension capabilities to third-party developers.

5.3 HARDWARE DEVELOPMENT

The major hardware components used are:
- Arduino Board
- GSM Module
- Flame Sensor

5.3.1 Arduino Board

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models,

which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

5.3.2 Flame Sensor

A flame detector is a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system. When used in applications such as industrial furnaces, their role is to provide confirmation that the furnace is working properly; in these cases they take no direct action beyond notifying the operator or control system. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.

5.3.3 GSM Module

GSM module is used to establish communication between a computer and a GSM system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. GSM module consists of a GSM modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc..) for computer. GSM MODEM is a class of wireless MODEM devices that are designed for communication of a computer with the GSM network. It requires a SIM (Subscriber Identity Module) card just like mobile phones to activate communication with the network. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make, Receive, or reject a voice call.

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The MODEM sends back a result after it receives a command. Different AT commands supported by the MODEM can be sent by the processor/controller/computer to interact with the GSM cellular network.

5.4 Data Flow Diagram

A data-flow diagram (DFD) is a way of representing a flow of a data of a process or a system (usually an information system). The DFD also provides information about the outputs and inputs of each entity and the process itself. A data-flow diagram has no

control flow, there are no decision rules and no loops. Specific operations based on the data can be represented by a flowchart.

There are several notations for displaying data-flow diagrams. The notation presented above was described in 1979 by Tom DeMarco as part of Structured Analysis.

For each data flow, at least one of the endpoints (source and / or destination) must exist in a process. The refined representation of a process can be done in another data-flow diagram, which subdivides this process into sub-processes.

The data-flow diagram is part of the structured-analysis modelling tools. When using UML, the activity diagram typically takes over the role of the data-flow diagram
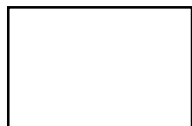
5.4.1 Components of Data Flow Diagram

There are only four different symbols that are normally used on a DFD. The elements represented are:
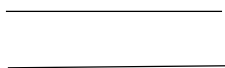
- External entities
- Processes
- Data stores
- Data flows
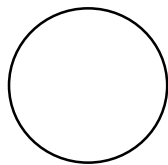
Function

Input/output

Database

Data flow

5.4.2 Context Level DFD

Context-level data flow diagram first, which shows the interaction between the system and external agents which acts as data sources and data sinks. The context diagram helps to define the system boundary to show what is included in, and what is excluded from the system. The diagrams consist of a rectangle representing the system boundary, the external entities interacting with the system and the data which flows into and out of the system. The context level DFD is also known as level 0 DFD. This context-level DFD is next exploded, to produce a Level 1 DFD that shows some of the details of the system being modeled.

According to the proposed architecture for the enhanced firm protection from fire hazards the following data flow diagram provides the overall structure of the application.

The Level 0 in here representing the overall structure of the system. Both the hardware and software part. There is two kinds of users in this system. User official (user type1) and user normal (user type 2).   Initially both users interacts with the android application for completing their registration process and login. The hardware which detects fire will directly interact with the user type 1 and the server of the system. Then this server provides essential details to the users through the android application.
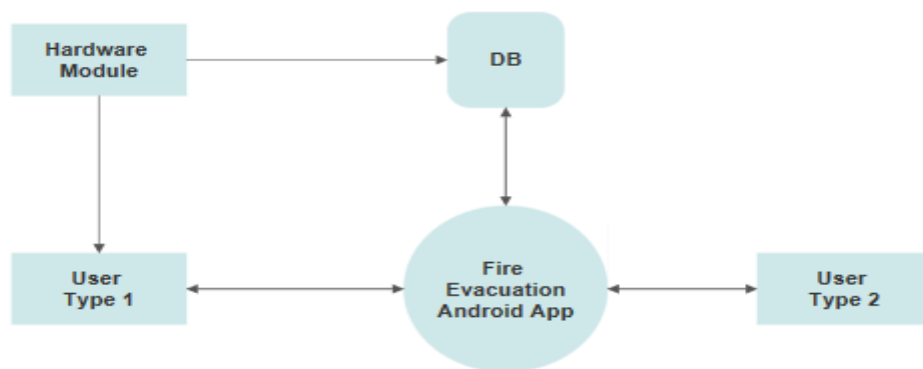
Fig 5.3 :Context Level DFD

5.4.3 Level 1 DFD

The context level DFD is used to produce a Level 1 DFD that shows some of the details of the system being modeled. In this Level 1 DFD we have 3 subparts, User official side, User normal side and a admin side.

(i)Level 1 User Official

First the official users will register their details in to the application using an interface. This details stored on the database of the server. The admin will decide to approve their

request. If the admin approves, then they can login in to the application using their username and password. By checking the user type, the application will direct them in to the home page. The homepage is consist of a drawer with some options. The important among them are Notifications (to store the incoming notification about the fire incidents), Building Maps(location of the all registered building).
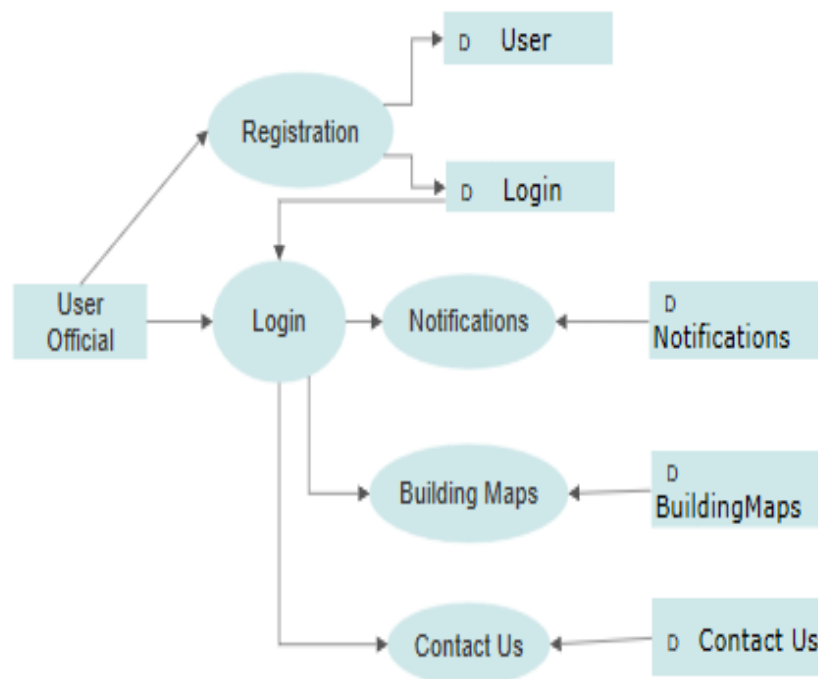
Fig 5.4 : Level 1 User Official DFD

(ii)Level 1 User Normal
Initially the normal users will register their details in to the application using an interface. This details stored on the database of the server. The admin will decide to approve their request. If the admin approves, then they can login in to the application using their username and password. By checking the user type, the application will direct them in to the home page. The homepage is consist of a drawer with some options. The important

among them are Notifications (to store the incoming notification about the fire incidents in their building), Building Status(current status of the building, whether it is safe or not).
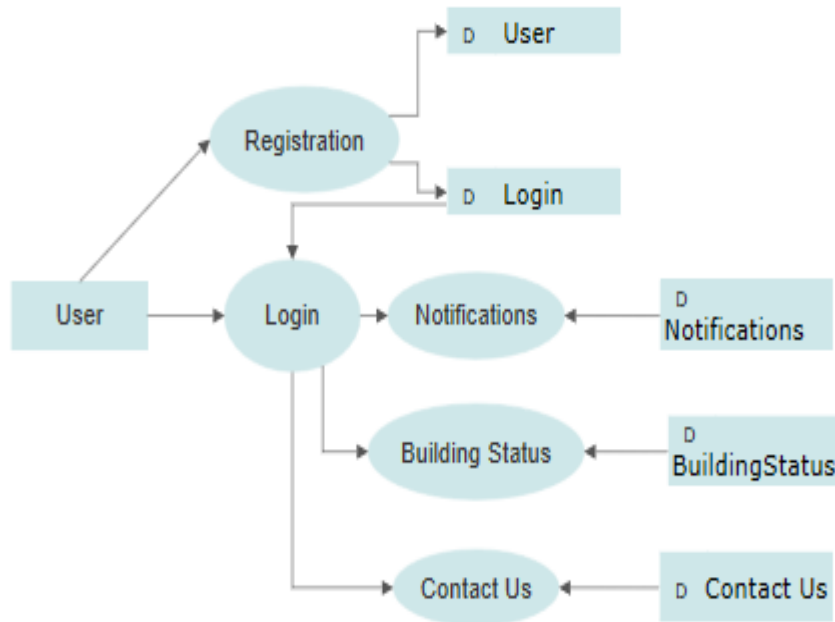

Fig 5.5 Level 1 User Normal DFD

(iii)Level 1 Admin

Admin is controlling the overall system. Admin is provided with a username and password. By the login he will directed in to a new webpage.it includes options to add details about Building, floor, company, device location, vertex and edge. This all informations were collected by admin during the installation of the hardware module in a firm. The building details includes building name and location details. Floor information contains how many floors are there in the building. Company details collects the informations about the company. vertex and edge informations are the location of thr device in the building, this information are used to find the shortest safest path. Additionally the admin manages the incoming users registration details.the admin can approve the request as well as he can reject it. The all information above is surveyed by the admin and manually entered to the database.
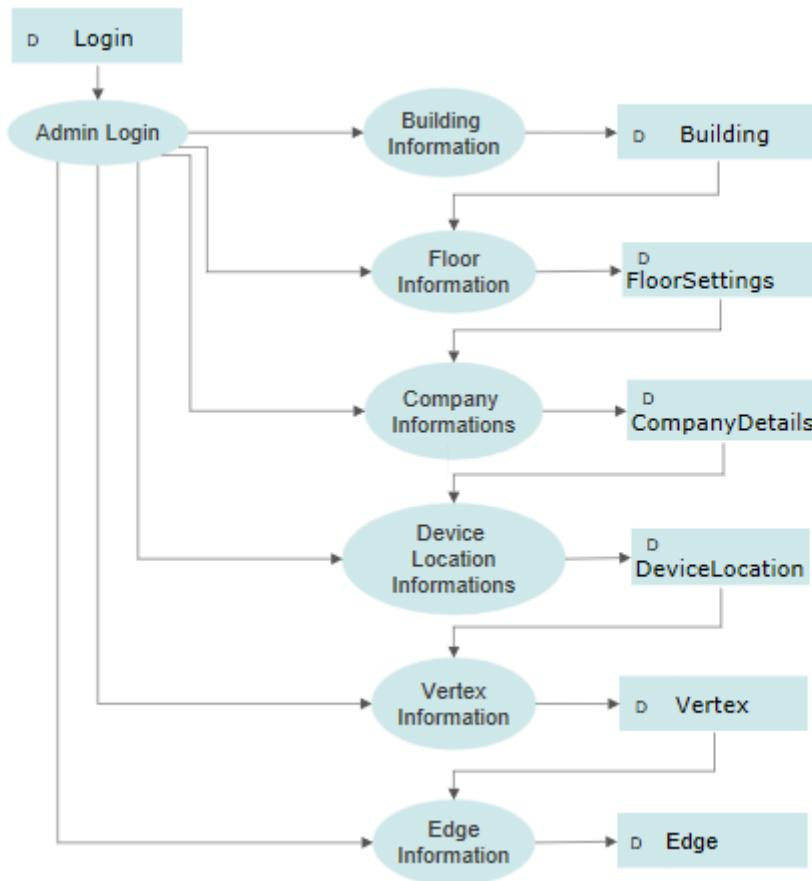
fig 5.6 : Level 1 Admin DFD

Advantages of data flow diagram:

- A simple graphical technique which is easy to understand.
- It helps in defining the boundaries of the system\.
- It is useful for communicating current knowledge to the users.
- It is used as the part of system documentation file.
- It explains the logic behind the data flow within the system.

5.5 IMPLEMENTATION OF ENHANCED FIRM PROTECTION USING IoT

The enhanced firm protection using IoT is depending on different services. Basically it has two parts. One software side and one hardware side. The hardware side is consist of a Arduino board, GSM module and a Flame sensor. The flame sensor is used for detecting fire in the surrounding. The pin of sensor is initially set in to high, when it detects fire it changes in to low. When the pin is low then the Arduino understood there is a fire hazard around the device. So it will initiate a call in to predefined number using GSM, after that it will send a SMS to them regarding the location and address of the building. The Arduino is programmed using Arduino 1.8.9 is a programming language used to program the micro controllers. We can call it as firmware. This firmware will direct the operation specified

for the hardware. This hardware is installed in a fixed location on the building and the coordinates are recorded.

The next part is a android application. The user have to install it on a android device like other android applications. After installation by opening the application the user will see a menu with several options. Initially for login using their username and password, then there is another two option for signing up as a official or as a normal user. If the user is already registered then he can login. If not, then they have to provide sufficient information about them in to the application. The approval of users is decided on the web side by the admin. The approved users can login to the application. By checking the user type the application direct them in to two separate homepages. Basically both the home page same contents, one notification option to see the recent notifications about the fire incidents, one contact us option to contact the application developer in case of a dilemma. Then a logout button to logout the application. Another two options are, in official homepage they will have a building map option to get all the locations of the buildings enrolled in this system. And in normal user homepage they will have a building status option to know the status of all floors in that building, it will display the status of building as danger condition or safe condition. The android application is developed using Android Studio and their SDK, it uses Google Firebase Cloud communication to receive notifications from the server.

The next part is a web side for the admin to add the details of building and related information in to the database for different purposes. The collected during the installation of hardware is manually entered by the admin in to the database using this web side, the web side have a login page for admin login, then the next directing page shows different options to add details such as building information, floor information, company information, device information, vertex and edge information. Using these values the safest shortest path is calculated. Additionally it has two options to approve officer and user registration request. The web part is implemented using Net Beans IDE 8.0.2. it also keeps the algorithms for finding shortest path as a java class.

The final part is the database side to store various information. It is implemented using the MySQL server 5.0, which is connected with Net Beans IDE and operations are cooperated. The data are saved in to database via Net Beans using java.

The server side have tables to store data. There is 12 tables on the server side.

5.5.1 Tables

There are 12 tables on the server side. They are Building table, company details table, device location settings table, edge table, floor table, login table, official registration details table, path table, tocken table, user registration table, user type table and vertex table. The Building table is used to store information related to the building installed the device. Which include building name, building id and building location. the company details table used for store the information about the companies inside the building. Which includes company name, company id, building id, floor number etc. The device location settings table stores data about the location of device installed. It contains device name, x coordinate value, y coordinate value etc. The edge table stores the edges between the vertex. The floor table stores information about the floor such as floor id, floor number etc. login table stores the login information of user and used for their type checking. official registration details table used for storing official registration details such as name,

office, phone number etc. Path table used for storing all possible paths inside a building. Tocken table used for storing the tockens generated by the Fire Base. User registration table used for storing normal users registration details such as name, phone number, building etc. User type table used for checking the user type. Vertex table used for storing vertex information such us vertex name, x value, y value etc.

Table 5.2 : Building Table

Bid	name	b_urll
Int (100)	Varchar (25)	Varchar (500)

Table 5.3 : Company Table

companyname	companyaddress	CId	BId	FId
Varchar (100)	Varchar (100)	Int (10)	Int (10)	Int (10)

Table 5.4 :Floor Table

id	floorno	image	BId
Int (10)	Varchar (100)	Varchar (100)	Int (10)

5.6 PERFORMANCE METRICES

The system can be well evaluated on the basis of meeting the real time constraint and less processing time. This matrices are evaluated after the implementation to ensure that the developed application and hardware can be installed and used easily and safely without any issues.

5.7 SUMMARY

This chapter dealt with requirements and software descriptions, hardware descriptions and implementation of the proposed methodology is also discussed. The data flow diagram is explained diagrammatically to understand how the developed application is working.

CHAPTER 6

RESULT ANALYSIS AND DISCUSSION

This section describes the analysis done on the developed application in accordance with its performance and operational power.

Since when technologies are growing faster and its contributing so many good things for the welfare of human beings. As the growth of industrialization and the growth in field of construction bringing enormous security problems to the society. Fire hazard is one among them. So we must address this problem effectively to reduce the losses due to it. Hence by using these advancement in technologies we are providing a integrated system for fire monitoring and extinguishing. This system succeeded to execute all the requirement with in the defined time constraint. It will took about the total of 31 seconds to complete all the process while detects a fire. the table following showing the total time taken by the system to complete the over all tasks.

6.1 TABLE OF TOTAL TIME TAKEN BY SYSTEM

Table 6.1 : Time Table

process	Time taken
Fire detection by flame sensor	Less than 1 second
Duration of Call to the fire officers	30 second
SMS and Web service request	Less than 1 second
Processing of evacuation path	Less than 1 second
Notification to users after path calcultion	Less than 1 second

6.2 SUMMARY

This chapter by the result analysis showed the efficient working of the proposed system by meeting all the requirements with the time constraint. This work will help to reduce the impact of the fire by detecting it in the early stage and by informing it in to the concerned authorities.

CHAPTER 7

CONCLUSION AND FUTURE WORK

Prevention of fire accidents have significant role in human's life. The fire accidents will bring un affordable losses to human society. The fire accidents are occurs accidently, so we can't predict when it happens and how it happens. So the total removal of the fire incidents form the society is impossible. As the first we need to take more care about the fire in home, industries etc. the next step is to took appropriate measure to extinguish the fire when it is detected. The impact of fire accidents can be reduced when it is detected at the earliest stage. In that time the extinguishing process is simpler and we can isolate the fire from effecting the surroundings. Also the efficient work of fire officers at the early stage of fire incident can also reduce the impact of it. Enhanced firm protection using IoT system is a user friendly system to detect and inform the fire incident's at the earliest stage. This will guide the safety officers in to the incident location and also simplify the evacuation with the use of a safest shortest path. It also help the people inside the building to reach outside using this safest shortest path.

The current hardware setup of our system consist of a simple GSM module and fire sensor. In future we can add features like Water sprinkler, Automatic power supply cut, Automatic Fuel line Cut and fire alarm to our Hardware. Which will develop a fully functioning fire preventing system.

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APPENDIX- A

SAMPLE SOURCE CODE

- **Android Studio Java Code for Home Page of Officials**

```java
package com.example.divya.firebaseexample;

import android.content.Intent;
import android.os.Bundle;
import android.support.design.widget.FloatingActionButton;
import android.support.design.widget.NavigationView;
import android.support.design.widget.Snackbar;
import android.support.v4.view.GravityCompat;
import android.support.v4.widget.DrawerLayout;
import android.support.v7.app.ActionBarDrawerToggle;
import android.support.v7.app.AppCompatActivity;
import android.support.v7.widget.Toolbar;
import android.util.Log;
import android.view.Menu;
import android.view.MenuItem;
import android.view.View;
import android.widget.TextView;
import android.widget.Toast;

import com.google.firebase.iid.FirebaseInstanceId;

public class HomeOfficial extends AppCompatActivity
        implements NavigationView.OnNavigationItemSelectedListener {

    String passFname,passLname,passEmail;
    TextView textViewFname,textViewemail;

    PrefManager prefManager=null;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_home_official);

        prefManager=new PrefManager(getApplicationContext());


        Toolbar toolbar = (Toolbar) findViewById(R.id.toolbar);
        setSupportActionBar(toolbar);

       /* FloatingActionButton fab = (FloatingActionButton) findViewById(R.id.fab);
        fab.setOnClickListener(new View.OnClickListener() {
```

```java
 @Override

 public void onClick(View view) {
         Snackbar.make(view, "Replace with your own action",
Snackbar.LENGTH_LONG)
             .setAction("Action", null).show();
     }
   });*/

   DrawerLayout drawer = (DrawerLayout) findViewById(R.id.drawer_layout);
   ActionBarDrawerToggle toggle = new ActionBarDrawerToggle(
       this, drawer, toolbar, R.string.navigation_drawer_open,
R.string.navigation_drawer_close);
   drawer.addDrawerListener(toggle);
   toggle.syncState();

   NavigationView navigationView = (NavigationView)
findViewById(R.id.nav_view);

   View navHeader =navigationView.getHeaderView(0);

   textViewFname =
(TextView)navHeader.findViewById(R.id.tv_officialheadername);
   textViewemail =
(TextView)navHeader.findViewById(R.id.tv_officialheaderemail);

   navigationView.setNavigationItemSelectedListener(this);

   Intent i=getIntent();

   passFname = i.getStringExtra("pass_fname");
   passLname = i.getStringExtra("pass_lname");
   passEmail = i.getStringExtra("pass_email");


   textViewFname.setText(passFname+" "+passLname);
   textViewemail.setText(passEmail);
 }

 @Override
 public void onBackPressed(){
   DrawerLayout drawer = (DrawerLayout) findViewById(R.id.drawer_layout);
   if (drawer.isDrawerOpen(GravityCompat.START)) {
     drawer.closeDrawer(GravityCompat.START);
   } else {

     if(!prefManager.getUsername().isEmpty()){
     }else{
```

```java
            super.onBackPressed();
        }

    }
}

    @Override
    public boolean onCreateOptionsMenu(Menu menu) {
        // Inflate the menu; this adds items to the action bar if it is present.
        getMenuInflater().inflate(R.menu.home_official, menu);
        return true;
    }

    @Override
    public boolean onOptionsItemSelected(MenuItem item) {
        // Handle action bar item clicks here. The action bar will
        // automatically handle clicks on the Home/Up button, so long
        // as you specify a parent activity in AndroidManifest.xml.
        int id = item.getItemId();

        //noinspection SimplifiableIfStatement
        if (id == R.id.action_settings) {
            String tkn = FirebaseInstanceId.getInstance().getToken();
            Log.d("Msg", "Token Official ="+tkn);
            Toast.makeText(getApplicationContext(),"Token
Official="+tkn,Toast.LENGTH_LONG).show();

        }

        return super.onOptionsItemSelected(item);
    }

    @SuppressWarnings("StatementWithEmptyBody")
    @Override
    public boolean onNavigationItemSelected(MenuItem item) {
        // Handle navigation view item clicks here.
        int id = item.getItemId();

        if (id == R.id.nav_officialnotifications) {
            PrefManager pref=new PrefManager(getApplicationContext());
            String msgBody=pref.getNotification();

            Log.d("Msg", "msgBody ="+msgBody);
            if(msgBody.contains("Image:"))
            {
                if(msgBody.contains("Building")){
                    String floorNo=msgBody.substring(0,msgBody.indexOf("Building"));
                    String
buildingName=msgBody.substring(msgBody.indexOf("Building"),msgBody.lastInd
exOf(": Image"));
```

```java
                String img=msgBody.substring(msgBody.indexOf("Image:")+6);

                Log.d("Msg", "floorNo ="+floorNo);
                Log.d("Msg", "buildingName ="+buildingName);
                Log.d("Msg", "img ="+img);

                // Create Notification
                Intent intent = new Intent(this, DisplayImageActivity.class);
                // intent.putExtra("" + "",remoteMessage.getNotification().getBody());
                intent.putExtra("imgName",img);
                intent.putExtra("floorNo",floorNo);
                intent.putExtra("buildingName",buildingName);

                startActivity(intent);

            }else{
                Toast.makeText(getApplicationContext(),"No active
Notifications",Toast.LENGTH_LONG).show();
            }
        }else{
            Toast.makeText(getApplicationContext(),"No active
Notifications",Toast.LENGTH_LONG).show();
        }
        // Handle the camera action
    } else if (id == R.id.nav_officialbuildingmap) {

        Intent intent=new
Intent(getApplicationContext(),BuildingMapActivity.class);
        intent.addFlags(Intent.FLAG_ACTIVITY_NO_HISTORY);
        startActivity(intent);

    } else if (id == R.id.nav_contactus) {
        Intent intent=new Intent(getApplicationContext(),ContactUs.class);
        intent.addFlags(Intent.FLAG_ACTIVITY_NO_HISTORY);
        startActivity(intent);

    } else if (id == R.id.nav_logout) {

    prefManager.signOut();
        Intent intent=new Intent(getApplicationContext(),LoginPage.class);
        intent.addFlags(Intent.FLAG_ACTIVITY_NO_HISTORY);
        startActivity(intent);
    }

    DrawerLayout drawer = (DrawerLayout) findViewById(R.id.drawer_layout);
    drawer.closeDrawer(GravityCompat.START);
    return true;
  }
}
```

- **Android Xml Code for Home Page of Officials**

```xml
<?xml version="1.0" encoding="utf-8"?>

<android.support.v4.widget.DrawerLayout
xmlns:android="http://schemas.android.com/apk/res/android"

    xmlns:app="http://schemas.android.com/apk/res-auto"

    xmlns:tools="http://schemas.android.com/tools"

    android:id="@+id/drawer_layout"

    android:layout_width="match_parent"

    android:layout_height="match_parent"

    android:fitsSystemWindows="true"

    tools:openDrawer="start">

    <include
        layout="@layout/app_bar_home_official"

        android:layout_width="match_parent"

        android:layout_height="match_parent" />

    <android.support.design.widget.NavigationView

        android:id="@+id/nav_view"

        android:layout_width="wrap_content"

        android:layout_height="match_parent"

        android:layout_gravity="start"

        android:fitsSystemWindows="true"

        app:headerLayout="@layout/nav_header_home_official"

        app:menu="@menu/activity_home_official_drawer" />

</android.support.v4.widget.DrawerLayout>
```

- **Java Code for Admin Login on Net Beans IDE 8.0.2**

```java
/*
 * To change this license header, choose License Headers in Project Properties.
 * To change this template file, choose Tools | Templates
 * and open the template in the editor.
 */
package com.bean;

import javax.faces.bean.ManagedBean;
import javax.faces.bean.RequestScoped;

/**
 *
 * @author ADARSHKAKKAT
 */
@ManagedBean
@RequestScoped
public class LoginBean {

private String username;

private String password;

/**
 * Get the value of password
 *
 * @return the value of password
 */
public String getPassword() {

return password;
}

/**
 * Set the value of password
 *
 * @param password new value of password
 */
public void setPassword(String password) {
this.password = password;
}
```

```java
/**
* Get the value of username
*
* @return the value of username
*/
public String getUsername() {
return username;
}

/**
* Set the value of username
*
* @param username new value of username
*/
public void setUsername(String username) {
this.username = username;
}

/**

* Creates a new instance of LoginBean
*/
public LoginBean() {
}

public String doLogin() {

String username = getUsername();
String password = getPassword();

String sql = "SELECT * FROM  fireevq.login where username='" + username + "'  and
password ='" + password + "'";

System.out.println(sql);
DBConnecion db = new DBConnecion();

String level = db.doLogin(sql);

if (level.isEmpty()) {
System.out.println("Invalid Login");
} else {
if (level.trim().equals("admin")) {
```

```
return "AdminHome.xhtml";
}
}
System.out.println("Username =" + username + "Password =" + password);
return "";
}
}
```

- **Xhtml Code for Admin Login on Website**

```
<?xml version='1.0' encoding='UTF-8' ?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
xmlns:h="http://xmlns.jcp.org/jsf/html">
<h:head>
<title>Facelet Title</title>
</h:head>
<head>
<title>SocialNet</title>
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
<link href="style.css" rel="stylesheet" type="text/css" />
<script type="text/javascript" src="js/jquery-1.3.2.min.js"></script>
<script type="text/javascript" src="js/script.js"></script>
<script type="text/javascript" src="js/cufon-yui.js"></script>
<script type="text/javascript" src="js/arial.js"></script>
<script type="text/javascript" src="js/cuf_run.js"></script>
</head>
<h:body>
<div class="main">
<div class="main_resize">
<div class="header">
<div class="logo">
<h1><a href="#"><span><b>Fire Evacuation</b></span></a></h1>
</div>
<div class="clr"></div>
<div class="hbg"><img src="images/header_images.jpg" width="923" height="291"
alt="" /></div>
</div>

<div class="content">
<div class="content_bg" align="center">
<div style="height: 50px" ></div>
```

```
<h:form>
<h:panelGrid columns="2">
<h:outputLabel value="Username"></h:outputLabel>
<h:inputText value="#{loginBean.username}"></h:inputText>
<h:outputLabel value="Password"></h:outputLabel>
<h:inputSecret value="#{loginBean.password}"></h:inputSecret>
<h:outputLabel></h:outputLabel>
<h:commandButtonvalue="LogIn"
action="#{loginBean.doLogin()}"></h:commandButton>
</h:panelGrid>
</h:form>
<div style="height: 50px"></div>
<div class="clr"></div>
</div>
</div>
</div>
<div class="fbg">
<div class="fbg_resize">
<div class="clr"></div>
</div>
</div>
</div>
<div class="footer">
<div class="footer_resize">
<p class="lf"> <a href="#"></a>.</p>
<p class="rf"> <a href="http://www.rocketwebsitetemplates.com/"></a></p>
<div class="clr"></div>
</div>
</div>

</div>
<div align="center"> <a href='http://all-free-download.com/free-website-
templates/'></a></div></h:body>
</html>
```
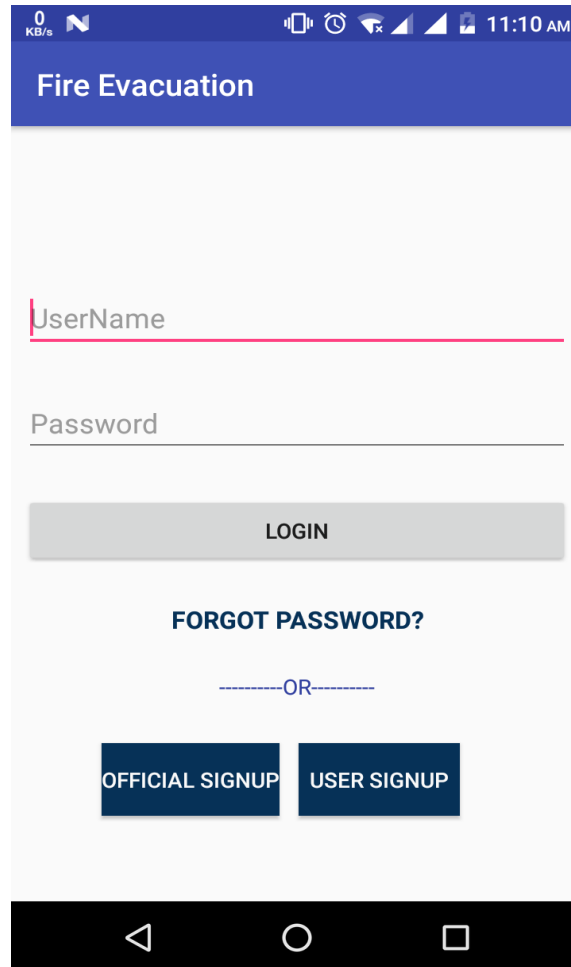
APPENDIX – B

SCREENSHOTS

Fig B.1 : First Page of Application

This is the front page while opening the application where the user has the provision for login and registration.

Fig B.2 : Home Page Of Officials

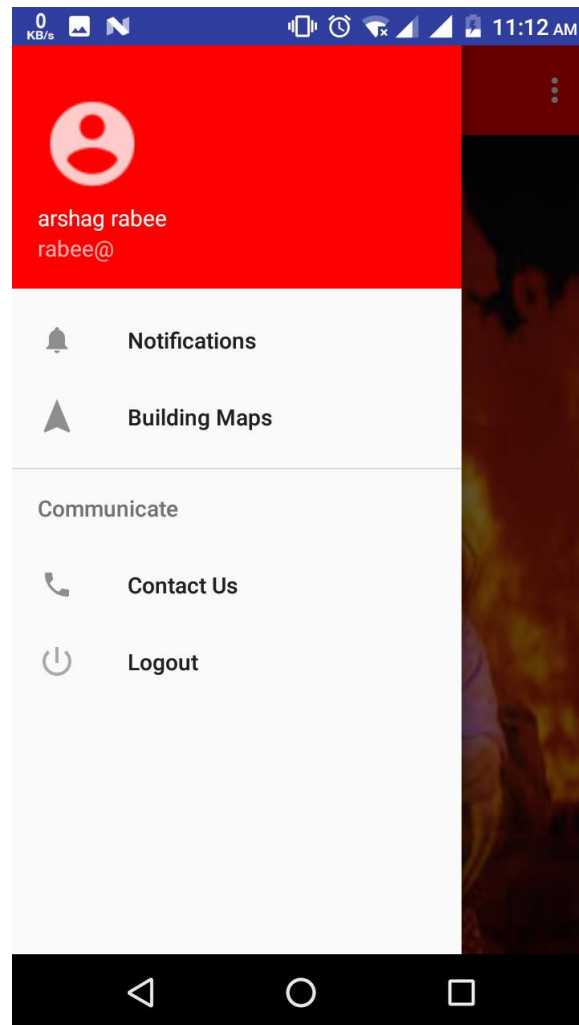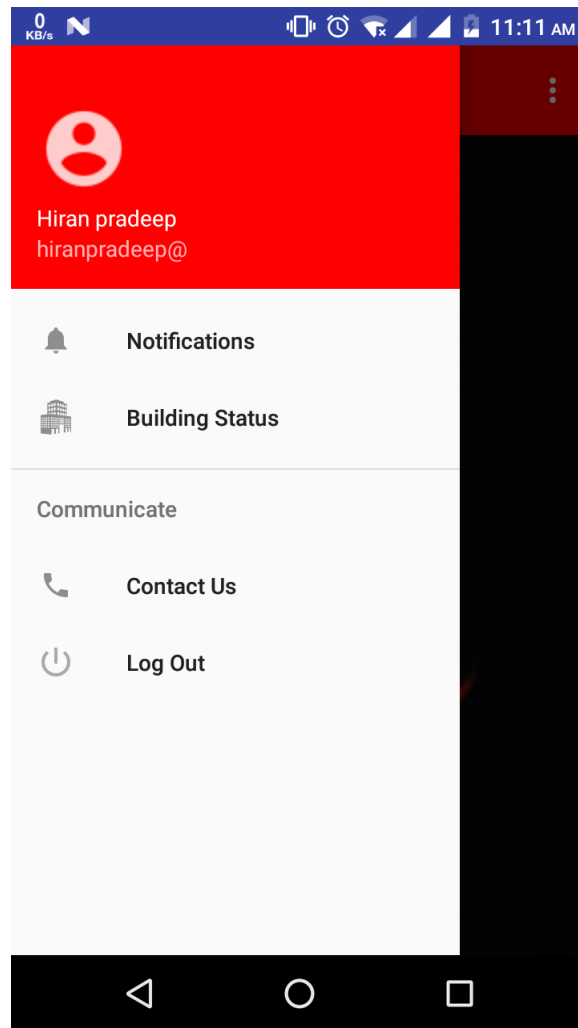By the login, the official users will direct in to this page.

Fig B.3 Drawer in Officials Home Page

The drawer is located in the left portion of the officials home page. The top of drawer shows the information of the login user. Then there is 4 options for different functions they are, Notifications, Building Maps, Contact Us, Logout.

Fig B.4 :Home Page of Normal Users

After the login the normal users will directed in to this page.

Fig B.5 : Drawer in Normal Users Home Page

The drawer is located in the left portion of the officials home page. The top of drawer shows the information of the login user. Then there is 4 options for different functions they are, Notifications, Building Status, Contact Us, Logout.
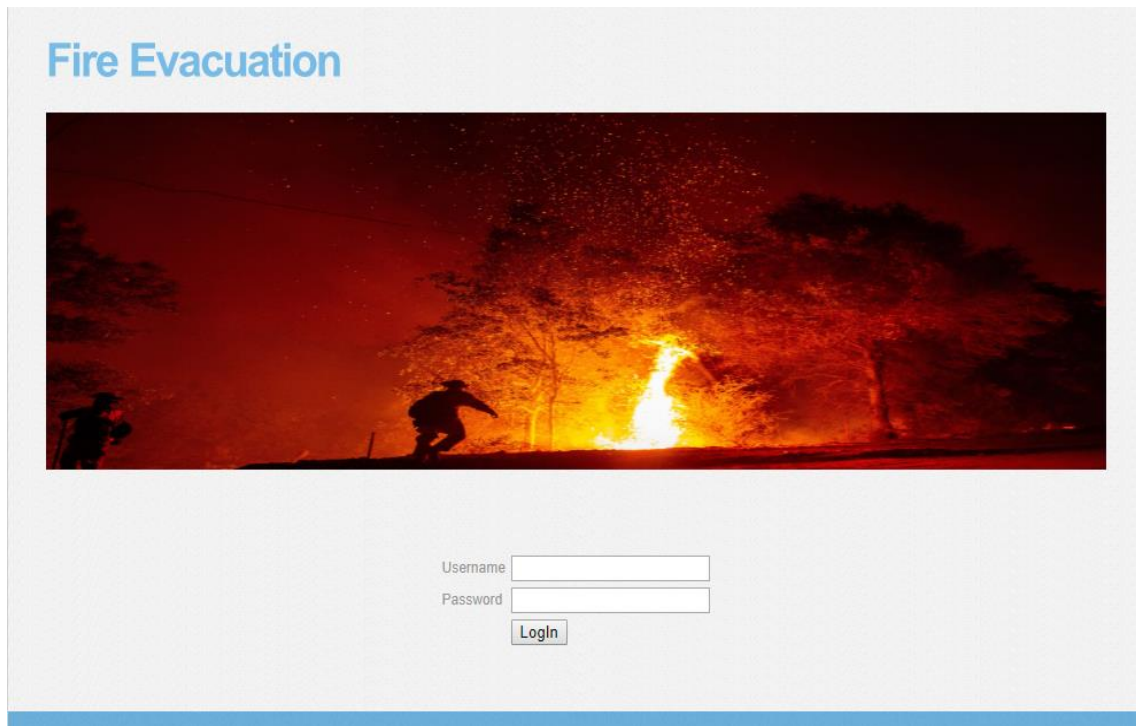
Fig B.6 : Website Page for Admin Login

Admin login in to the server using this website. The password and username is set on the database.

Fire Evacuation

Building Settings

Floor Settings

Company Details

Device Location Settings

Floor Vertex

Floor Edge

User Approval status

Official Approval status
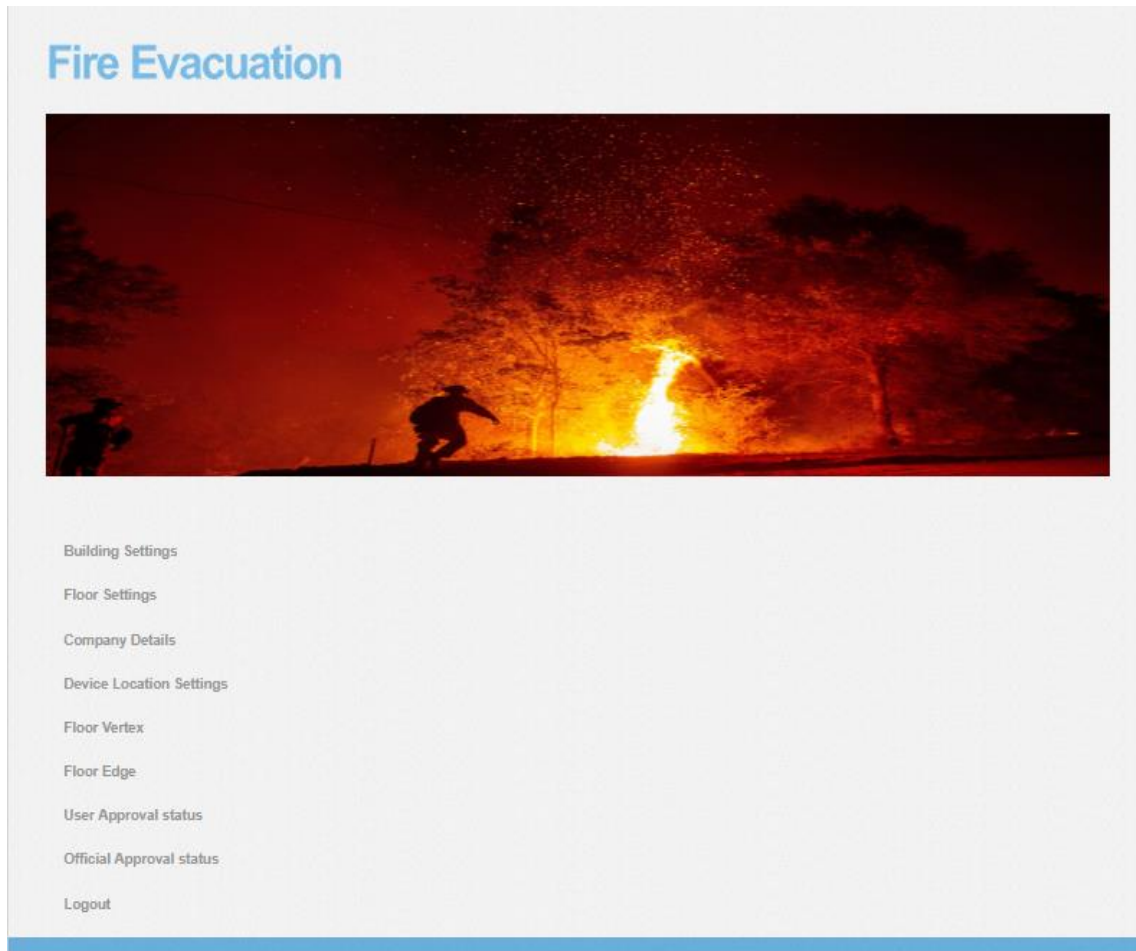
Logout

Fig B.7 :Admin Home Page in Website

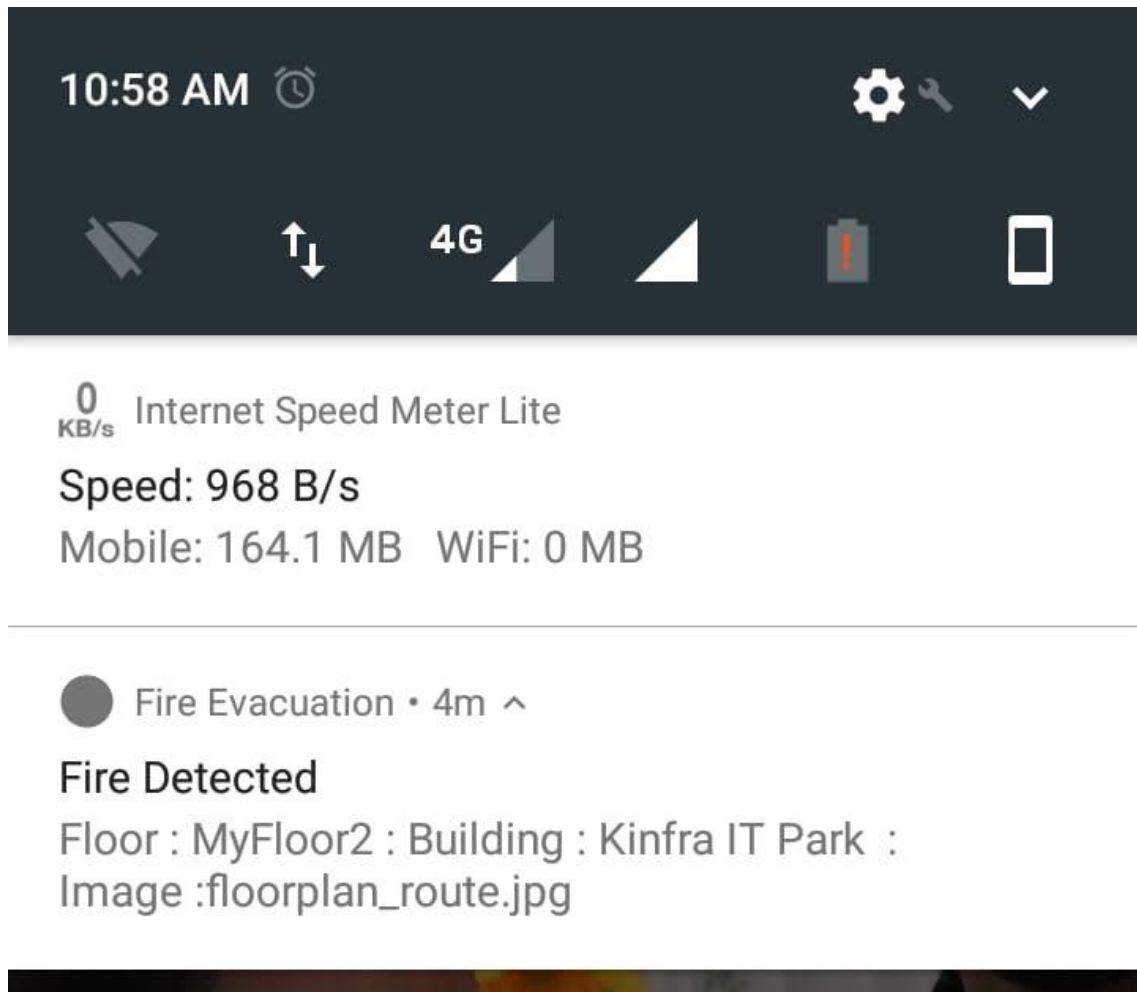By the login the admin is directed in to this page. It has several options including the log out section too. On each click they will directed in to another page.

Fig B.8 : Notification Received by the User

At the time of fire accident, the users will receive notification in this format. Which includes floor name, building name and a path for evacuation.
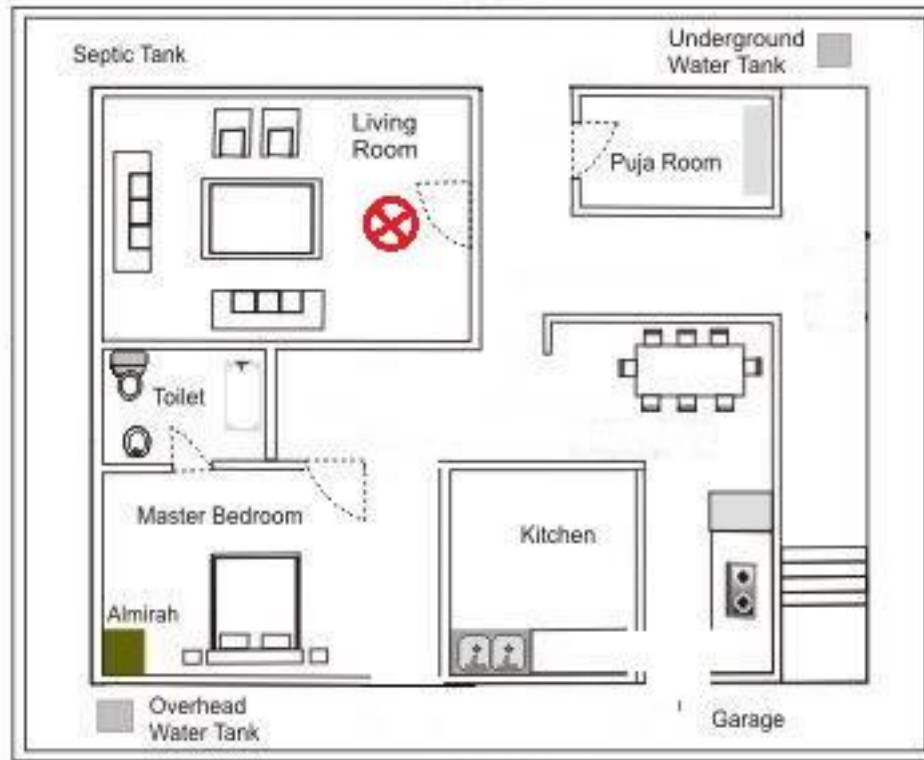
Fig B.9 Sample Image of a floor

This image is used as the model in our system. The red mark denotes the position of device.
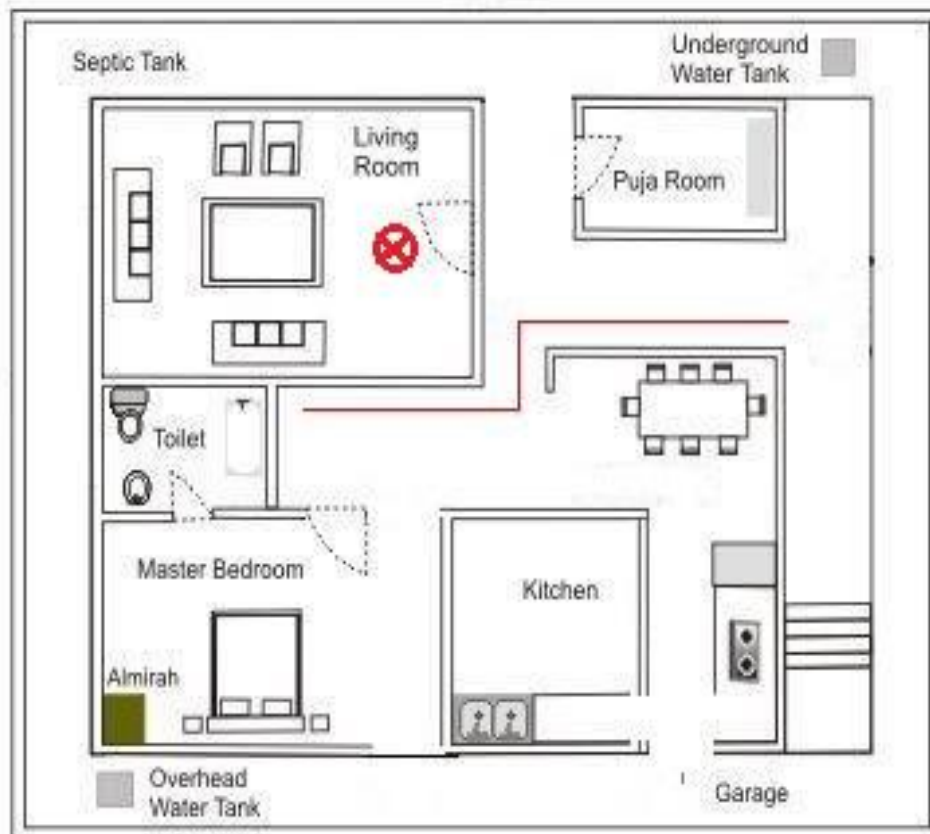
Fig B.10 : Evacuation path

Evacuation path generated by the algorithm using the sample plan. The red mark denoting the position of device. This device is detected the fire. the red lines indicating the safest shortest path to reach out of building.
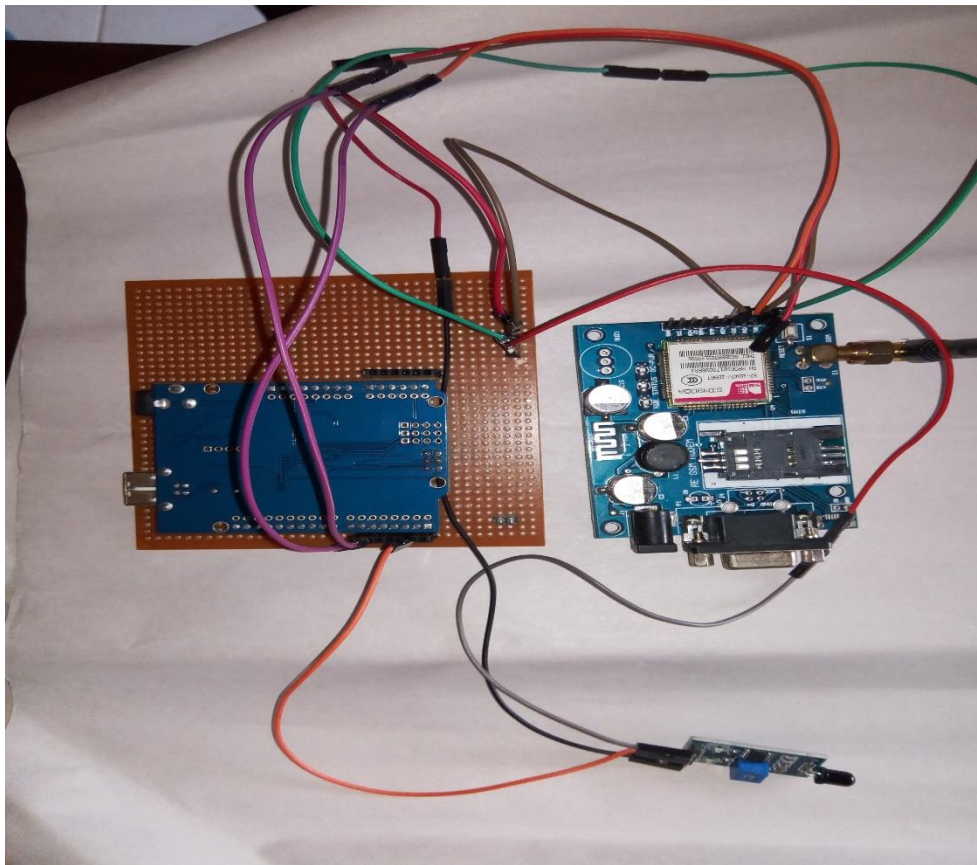
Fig B.11 : Hardware module

The hardware module is consist of a Arduino board, GSM module and a Flame sensor.

APPENDIX – C

SUMMARY TERMS

Arduino Board

A microcontroller board with several functions. Several sensors are attached on it.

Flame sensor

It is a sensor used to detect the fire in surrounding

Google Firebase

It is a cloud communication service by Google with out any cost

GSM Module

A hardware part used to make a call, receive a call and SMS purposes.

IoT

Internet of Things is a technology with enable interaction between machines and human via a internet in any where any time.