



03-134142-022 FAAIZ KAMRAN

03-134142-062 HAMZA AMEER

03-134142-064 M.KHALID

## **Home Automation**

In partial fulfilment of the requirements for the degree of

**Bachelor of Science in Computer Science**

Supervisor: Mr. Tahir Iqbal

Department of Computer Sciences

Bahria University, Lahore Campus

June 2018



# Certificate



We accept the work contained in the report titled  
“HOME AUTOMATION”,

written by

FAAIZ KAMRAN

HAMZA AMEER

M.KHALID

as a confirmation to the required standard for the partial fulfilment of the degree of  
Bachelor of Science in Computer Science.

Approved by:

Supervisor: Mr. Tahir Iqbal

---

June 4<sup>th</sup>, 2018



**DECLARATION**

We hereby declare that this project report is based on our original work except for citations and quotations which have been duly acknowledged. We also declare that it has not been previously and concurrently submitted for any other degree or award at Bahria University or other institutions.

Enrolment	Name	Signature
03-134142-022	FAAIZ KAMRAN	
03-134142-062	HAMZA AMEER	
03-134142-064	M.KHALID	

Date : \_\_\_\_\_



Specially dedicated to  
my beloved mother and father  
(Faaiz Kamran)  
my beloved mother and father  
(Hamza Ameer)  
my beloved mother and father  
(M.Khaild)





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In addition, we would also like to express my gratitude to our loving parent and friends who had helped and given us encouragement.

Faaiz Kamran

Hamza Ameer

M.Khalid



## **HOME AUTOMATION**

### **ABSTRACT**

This document presents a design and prototype implementation of new home automation system that uses Wi-Fi technology as a network infrastructure connecting its parts. The proposed system consists of two main components; the first part is the server (RESPBERRY PIE), which presents system core that manages, controls, and monitors users' home. Users and system administrator can locally (LAN) or remotely (internet) manage and control system code. Second part is hardware interface module, which provides appropriate interface to sensors and actuator of home automation system. Unlike most of available home automation system in the market the proposed system is scalable that one server can manage many hardware interface modules as long as it exists on Wi-Fi network coverage. System supports a wide range of home automation devices like power management components, and security components. The proposed system is better from the scalability and flexibility point of view than the commercially available home automation systems.



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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

The “Home Automation” concept has existed for many years. The terms “Smart Home”, “Intelligent Home” followed and has been used to introduce the concept of networking appliances and devices in the house. Home automation Systems (HASs) represents a great research opportunity in creating new fields in engineering, and Computing. HASs includes centralized control of lighting, appliances, security locks of gates and doors and other systems, to provide improved comfort, energy efficiency and security. HASs becoming popular nowadays and entered quickly in this emerging market. However, end users, especially the disabled and elderly due to their complexity and cost, do not always accept these systems.

Due to the advancement of wireless technology, there are several different connections introduced such as GSM, WIFI, and Bluetooth. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in HAS project, WIFI is being chosen with its suitable capability. The capabilities of WIFI are more than enough to be implemented in the design. Also, most of the current laptop/notebook or Smartphone come with built-in WIFI adapter. It will indirectly reduce the cost of this system.



## **1.2 Scope of Project**

### **Indoor**

1. Electrical outlets of any room in home can be turned on and off through smartphone.
2. Status of electrical outlets of all rooms in home can be checked through application.
3. Temperature of each room will be showed in the application.
4. Electrical outlets are turned off using timer.

### **Outdoor**

1. Door will automatically lock.
2. If a person didn't have his cell phone he can also use thumb scanner to unlock the door.
3. Live streaming of surveillance camera on the main door can be viewed on application.
4. Capturing image of every person entering and leaving home stored in database.
5. Unlock main door through application.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Product perspective

This system will consist of two parts: indoor and outdoor. The mobile application will be used to interact with the system and view information about the home appliances status. The mobile application will need to communicate with a system through Wi-Fi within the mobile phone, which in turn communicates with a module.

Since this is a data-centric product it will need somewhere to store the data. For that, a database will be used. The mobile application will only use the database to get data, all of the database communication will go over the Wi-Fi. The mobile application has some restrictions about the resource allocation. To avoid problems with overloading the operating system the application is only allowed to use 20 megabytes of memory while running the application. The maximum amount of hard drive space is also 20 megabytes.

#### 2.2 Product functions

With the mobile application, the users will be able to interact with the electric appliances and will also be able to view its status whether its switch is off or on. The administrator of the system will allow who can use the application and will also can add or remove the family member information into the system.

Electrical outlets of any room in home can be turned on and off through smartphone. Fan Speed can be controlled manually by user as well as according to the room temperature. Electrical outlets will be switched off when no one is in the room using sensor detection. Status of electrical outlets of all rooms in home can be checked through application. Temperature of each room will be showed in the application. Electrical outlets are controlled using timer for any specific event. Notification in case of short circuit will be send to the application.

When a Person came near to door with his (app install and activated) cell phone door unlock automatically. If a person didn't have his cell phone he can also use thumb scanner to unlock the door. Live streaming of surveillance camera on the main door can be viewed on application. Capturing image of every person entering and leaving home stored in database. Unlock main door using through application in case of guest. Notify if a person is on the door. Lock main door according to set timer.

### **2.3 User characteristics**

There are two types of users that interact with the system: users of the mobile application and administrators. Each of these users has different use of the system so each of them has their own requirements.

The mobile application users can only use the application to control switches and see live video feedback while the administrator can use application, see live video stream, add members of family into the system, can view snapshots, add user thumb print, set fan speed and timer on lights.

### **2.4 Constraints**

The mobile application only runs on android cell phone as our project is only in its prototype. The Wi-Fi connection is also a constraint for the application. Since the application fetches data from the database over the Wi-Fi, it is crucial that there is a Wi-Fi connection for the application to function.

## **2.5 Assumption and dependencies**

One assumption about the product is that it will always be used on mobile phones that have enough performance. If the phone does not have enough hardware resources available for the application, for example the users might have allocated them with other applications, there may be scenarios where the application does not work as intended or even at all.

Another assumption is that the Wi-Fi components in all phones work in the same way. If the phones have different interfaces to the Wi-Fi, the application need to be specifically adjusted to each interface and that would mean the integration with the Wi-Fi would have different requirements than what is stated in this specification.

## **2.6 Hardware interface**

The major hardware required for this project are Raspberry Pi Relay Module, Transistor, Wi-Fi Sensor, Android phone with minimum android version 4.2 Jellybean to run the home automation application, Camera, Finger Print module, Wi-Fi Router. Raspberry Pi, camera module, router, android phone and the power strip circuit. Raspberry pi is the central part of the whole system and pretty much acts at the core processing and control system. The camera module is used to capture video and stream it online. Likewise, router is used to create a LAN, which connects pi and the android phone to a common network. Similarly, android phone is necessary to run the android app and finally power strip connects the electrical appliances to the electronic control logic of the system.

The power strip is designed on a PCB and it contains various electronic elements like capacitors, resistors, LEDs and relays. One end of the power strip is connected to the electronic logic part of the raspberry pi while next end to the electrical home appliances. So, basically it controls the home appliances based on the logic of pins of pi.

## **2.7 Software interface**

There are two major pieces of software in this project. First one is the android application, which is front end and next is the server side software running on the raspberry pi at the backend.

Android app is capable of nicely presenting the current status of the home appliances and also control them by simply pushing certain buttons. Also, app streams the live video from the site of pi. Android app sends the data about status of appliances to the SQL lite database and receives in the same way with the help of python socket. Raspberry pi hosts the SQL lite database and a Python script which control the pins of the pi based on the data send over by the android app. Similarly, live streaming is done with the help of the video encoder named which streams the video captured using inbuilt python camera library.

The software and other utility tools required/used for the development of software aspect of this project is discussed in the further part of this section.

### **2.7.1 Android Studio**

Android Studio is the comprehensive IDE for the android application development by Google. We developed our android app entirely in android studio.

### **2.7.2 Python IDLE and C++**

IDLE is the IDE for the python language. We coded the server side script which runs on the pi using python. This script is responsible for controlling the status of the home appliances.

### **2.7.3 SQL lite**

Server was setup on the pi to host the SQL lite database and python server socket which make the communication between the android app and database possible. SQL lite hosts a database which has table that stores the status of the devices connected to the pi. These status are updated based on the data obtained from the android app to reflect the status of the home appliances.

## 2.8 Functional Requirements

### **ID: FR1**

TITLE: Download mobile application

DESC: A user should be able to download the mobile application through either an application store or similar service on the mobile phone. The application should be free to download.

### **ID: FR2**

TITLE: Administrator registration - Mobile application

DESC: Given that a user has downloaded the mobile application, then the Admin should be able to register through the mobile application. The administrator must provide user-name, ip address, password and email address. The user can choose to provide a regularly used phone number.

DEP: FR1

### **ID: FR3**

TITLE: Administrator log-in - Mobile application

DESC: Given that an admin has registered, then the admin should be able to log in to the mobile application. The log-in information will be stored on the phone and in the future the user should be logged in automatically.

DEP: FR1, FR3

### **ID: FR4**

TITLE: User registration - Mobile application

DESC: Given that a user has downloaded the mobile application, then the user should be able to register through the mobile application. The user must provide user-name, IP address, password and e-mail address. The user must provide this information to administrator before registering to the application. The user can choose to provide a regularly used phone number.

DEP: FR1 FR2

### **ID: FR5**

**TITLE:** User log-in - Mobile application

**DESC:** Given that a user has registered, then the user should be able to log in to the mobile application. The log-in information will be stored on the phone and in the future the user should be logged in automatically.

**DEP:** FR1, FR3, FR4

**ID: FR6**

**TITLE:** Change password

**DESC:** Given that a user has registered, then the user should be able to change his/her password by application.

**DEP:** FR1, FR4

**ID: FR7**

**TITLE:** Mobile application - Options

**DESC:** Given that a user is logged in to the mobile application, then the first page that is shown should be the option page. The user should be able to select one of the options, according to several options. The search options are status (of electrical appliances), switches, temperature and surveillance.

**DEP:** FR4, FR5.

**ID: FR8**

**TITLE:** Mobile application – option status

**DESC:** once a user selected this option, the user should be able to view status of all electric appliances including status of main door whether it's closed or not.

**DEP:** FR4, FR5, FR7

**ID: FR9**

**TITLE:** Mobile application – option switches:

**DESCP:** through this option the user will select which electric appliance should turn on and off, it could be either fan or light or common switch in a home.

**DEP:** FR7

**ID: FR10**

**TITLE:** Mobile application – option temperature

**DESC:** A user should be able to select and view temperature of the room they desire in current time. **RAT:** To view temperature of a room restaurant. **DEP:** FR7

**ID: FR11**

**TITLE:** Mobile application – option surveillance.

**DESC:** A user should be able to view the live feed of camera directly on his or her mobile through application.

**DEP:** FR7

**ID: FR12**

**TITLE:** Mobile application – door unlocking registration

**DESC:** A user thumb print will have to be registered by admin for the purpose of unlocking door. The door should also unlock when a user with application come near to the main door, for this purpose user cell phone mac address should also be registered by admin.

**DEP:** FR5, FR7

**ID: FR13**

**TITLE:** Mobile application – unlocking door

**DESC:** A user mobile should be registered to use this feature of a system, user thumbprint can unlock door after being registered and also through application, but only when the application is on and working.

**DEP:** FR5, FR12





## CHAPTER 3

### DESIGN AND METHODOLOGY

#### 3.1 Use case Description

**Unique Identifier:** U1

**Name** Login

**Objective** A user of the System logs in to the System.

**Actor(s)** Registered Users

##### **Basic Flow**

This use case starts when a system user is not logged in to the system and goes to the Login page.

1. The System prompts the user for an IP address and password or signup new account
2. The user enters his/her IP address and password.
3. The system validates the entered contact no. and password by calling an API via Internet connection, making sure that the entered contact no. is a valid contact no. in the System, and that the required password is entered for the entered contact no.
4. When the user taps on the login button the system sends data to the API for Authentication.
5. The user is signed in and returned to the home page as a Logged in User.
6. The use case ends.

**Alternate Flows****Title** User Fails Authentication**Description** If the User entered an invalid contact no. and/or password, the following occurs:

1. The system describes the reasons why the User failed authentication.
2. The system presents the User with suggestions for changes necessary to allow the User to pass authentication.
3. The system prompts the User to re-enter the valid information.
4. The Flow continues where the User enters new information.

**Pre-Conditions****Title** Registered**Description**

User must have an account.

**Post-Conditions****Title** Success**Description**

The User is authenticated and the system displays a home page based on the user type.

**Failure** User is unable to log in for one or more reasons.**Unique Identifier:** U2**Name** Signup**Brief Description** A user of the System creates an account**Actor(s)** Android User**Basic Flow**

This use case starts when a system user has no account and goes to the Signup page.

1. The System prompts user for registration information, IP address, username, and password.
2. The user enters in their information.
3. System verifies information and creates account.

**Alternate Flows****Title** Invalid Information Entered**Description**

If user entered invalid information following occurs:

1. User clicks submit after entering information system asked for.
2. System displays information with appropriate message to correct invalid information.
3. User re-enters information.
4. The Flow continues where the User enters new information.

#### **Pre-Conditions**

**Title** Account

#### **Description**

User must not be a registered user.

#### **Post-Conditions**

**Title** Success

#### **Description**

The user entered successful information and is returned to the home page as a Logged in User.

#### **Failure**

User is unable to sign up for one or more reasons and is returned to the login/signup selection page.

**Unique Identifier:** U3

**Name** View Menu

**Brief Description** The user will able to view menu

**Actor(s)** Registered Android User

#### **Basic Flow**

This use case starts when the user successfully log in

1. The System displays the list of options.
2. Use Case ends.

#### **Alternate Flows**

**Title** Menu list Error

#### **Description**

1. Prompt message of network not available, try again later.
2. User will refresh the application.

3. The Flow continues.

**Pre-Conditions**

**Title**

Permissions

**Description**

User must be logged in.

**Post-Conditions**

**Title** Success

**Description** Successfully views the menu.

**Unique Identifier:** U4

**Name** Home Control

**Brief Description** User can select home control option from the menu

**Actor(s)** Logged in Android User

**Basic Flow**

This use case starts when the user selects the home control option from menu.

1. The application will show list of rooms to be selected.
2. The user will select the desired room.
3. The selected room switches with their name (lights, fans etc.) will be showed whether switched on or off.
4. Then the user can switch on and off the desired appliances of that selected room.
5. Use Case ends

**Pre-Conditions**

**Title** Home control

**Description**

Home control option must be selected by the user.

**Permission** User must be logged in and have selected home control option from within the menu.

**Alternate Flows**

**Title** Other options

**Description**

1. The user must go back to the menu screen.

2. User must select home control option.
3. The Basic Flow continues

#### **Post-Conditions**

**Title** switch

**Success** Switch of desired room can be turn on or off

**Failure** System prompts, switch cannot be turned on/off

**Unique Identifier:** U5

**Name** CCTV

**Brief Description** User can view live feed of the main door

**Actor(s)** Logged in Android User

#### **Basic Flow**

This use case starts when the user selects the CCTV option from menu.

1. The System shows the live feed to the user.
2. The user (if admin) will show option of live feed and saved footage.
3. The user (admin) will select saved footage.
4. The saved footage will be viewed.
5. Use Case ends.

#### **Alternate Flows**

**Title** Camera Error

#### **Description**

1. The system prompts the dialogue camera feed unavailable.  
Check camera.
2. The Basic Flow continues

#### **Pre-Conditions**

**Title** CCTV

**Description** User must be logged in.

**Permission** CCTV option must be selected from within the menu.

#### **Post-Conditions**

**Title** Success

#### **Description**

Live video feed will be showed

**Failure** Video Feed won't be viewed

**Unique Identifier:** U6

**Name** Main Door

**Brief Description** Main Gate door will be locked and unlocked through application

**Actor(s)** Logged In User

**Basic Flow**

This use case starts when a user selects the Main Door option from the menu.

1. The system show status of main door whether already locked or unlocked
2. The system will show option of unlock and lock
3. The user will select lock option to lock door
4. The user will select unlock option to unlock door

**Pre-Conditions**

**Title** Door lock/unlock

**Description**

Door must be locked in order to unlock and vice versa

**Permission** Lock/unlock option must be selected

**Post-Conditions**

**Title** Success

**Description**

Door will successfully unlock/lock

**Unique Identifier:** U7

**Name** Editing user

**Brief Description** Admin will give access, remove or add user

**Actor(s)** Logged In User (Admin)

**Basic Flow**

This use case starts when an Admin logs in and select option users.

1. The System will get all users information

2. The system will show list of users registered
3. The admin will select the user to edit
4. Use Case end

**Pre-Conditions**

**Title** Admin

**Description**

Admin must be logged in

**Users** One or more users should be registered to edit

**Permission** Users option must be selected by admin

**Post-Conditions**

**Title** Success

**Description** Admin successfully edits, add or remove user from the system

**Unique Identifier:** U8

**Name** Temperature view

**Brief Description** User can view temperature of a room

**Actor(s)** Logged In User

**Basic Flow**

This use case starts when a temperature option is selected from the menu.

1. System will get the temperature from temperature sensor
2. System will then show that temperature to the user
3. User can view temperature in the application
4. Use Case End

**Alternate Flows**

**Title** Temperature sensor

**Description**

1. The system prompts the error to not possible may be damaged.
2. The Basic Flow continues.

**Pre-Conditions**

**Title** Sensor

**Description**

Sensor must be working properly



**Post-Conditions****Title** Success**Description**

System will successfully show the temperature of a room

**3.2 Use case diagram**

Figure 1. Use case diagram

### 3.3 Sequence diagram

A sequence diagram is an interaction diagram that shows how objects operate with one another and in what order. It is a construct of a message sequence chart. A sequence diagram shows object interactions arranged in time sequence.

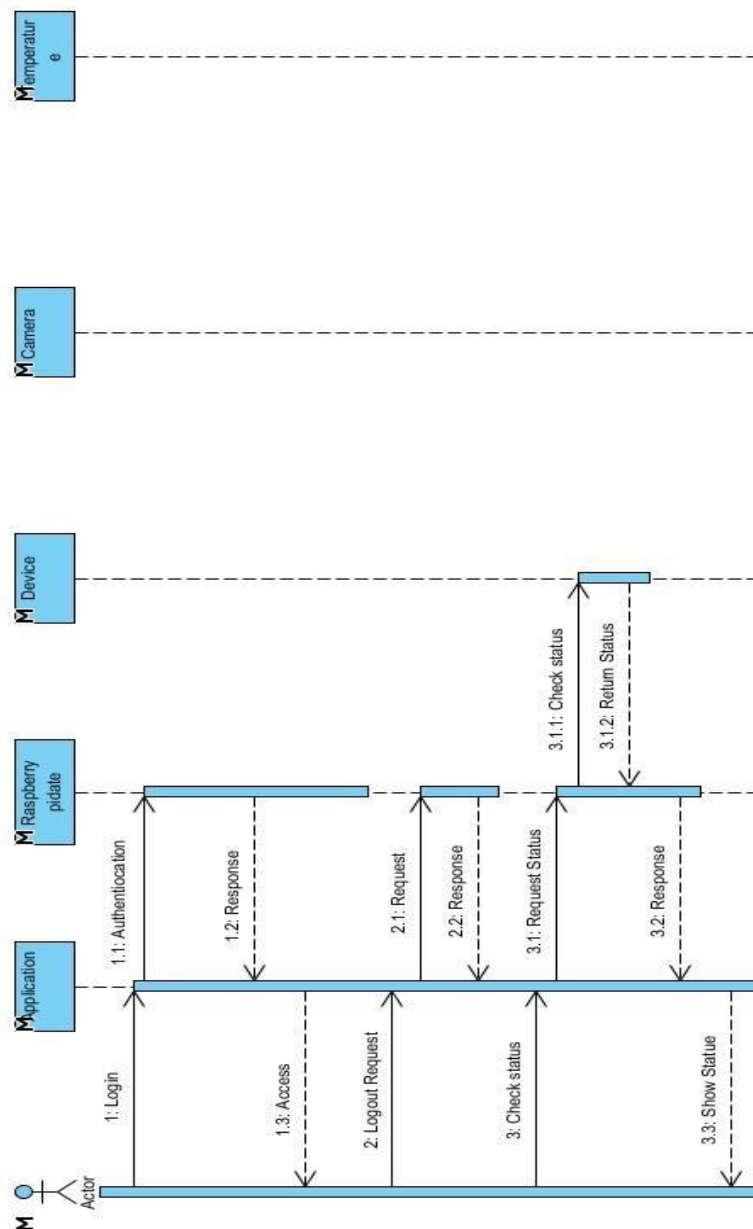


Figure 2. Sequence diagram

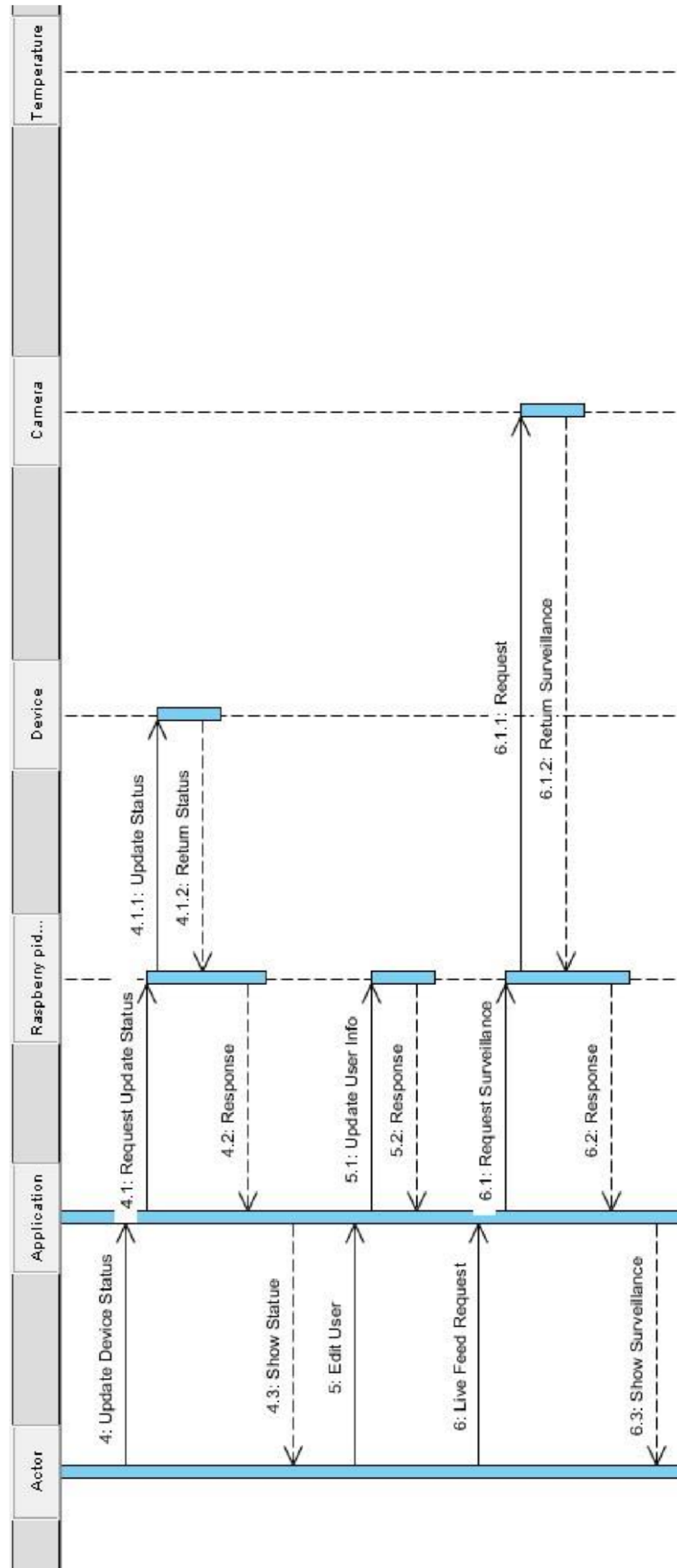


Figure 3. Sequence diagram 2

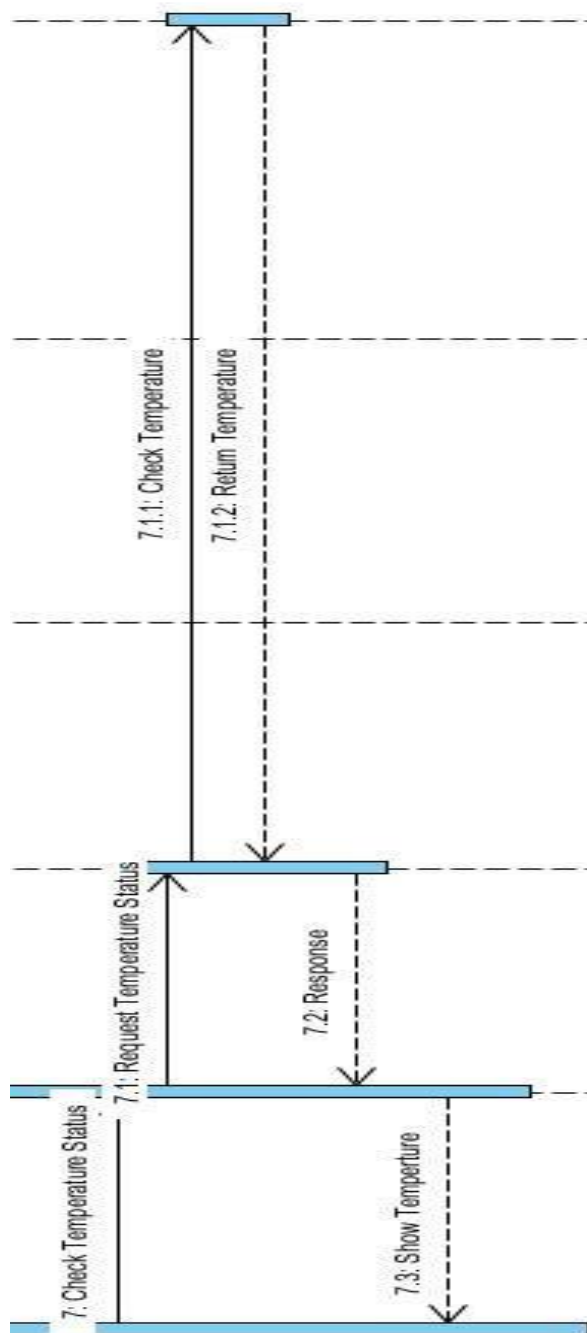


Figure 4. Sequence diagram 3

### 3.4 Collaboration Diagram

A collaboration diagram, also called a communication diagram or interaction diagram, is an illustration of the relationships and interactions among software objects in the Unified Modelling Language (UML). Along with sequence diagrams, collaborations are used by designers to define and clarify the roles of the objects that perform a flow of events of a use case.

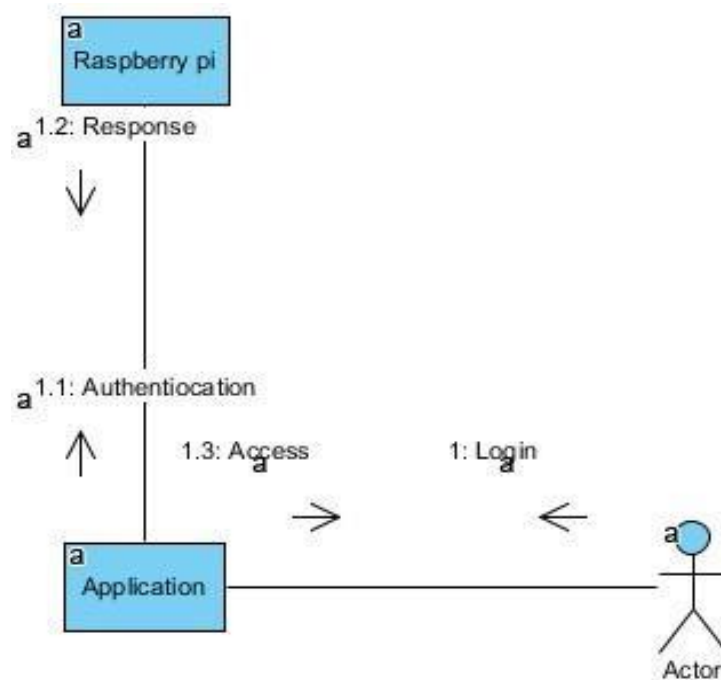


Figure 5. User login

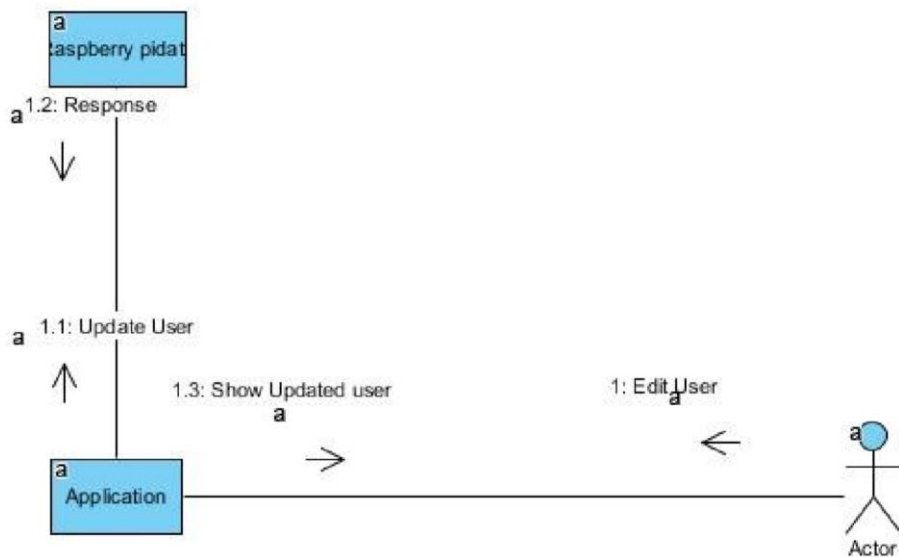


Figure 6. Edit user

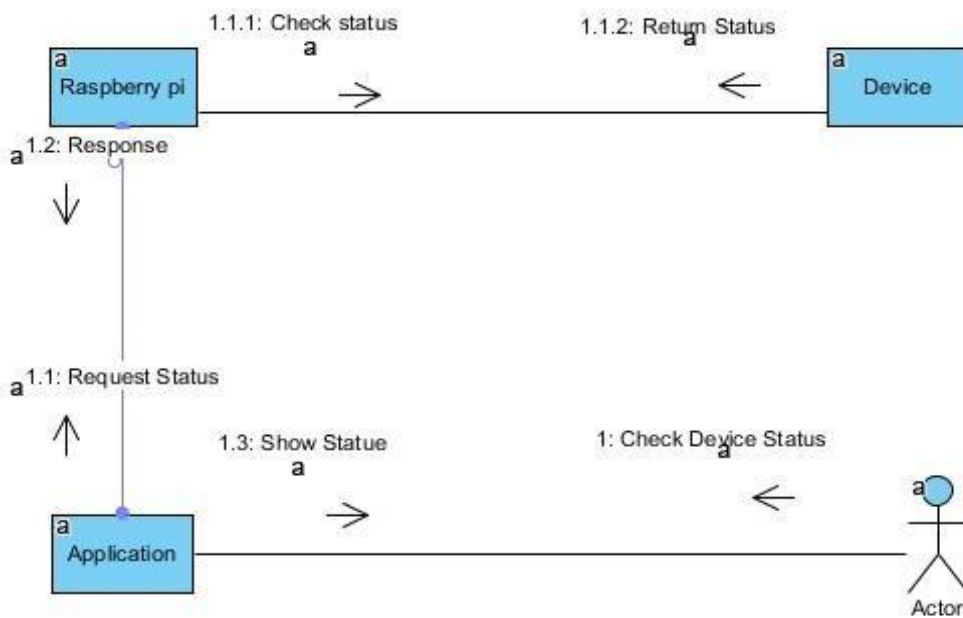


Figure 7. Check device status

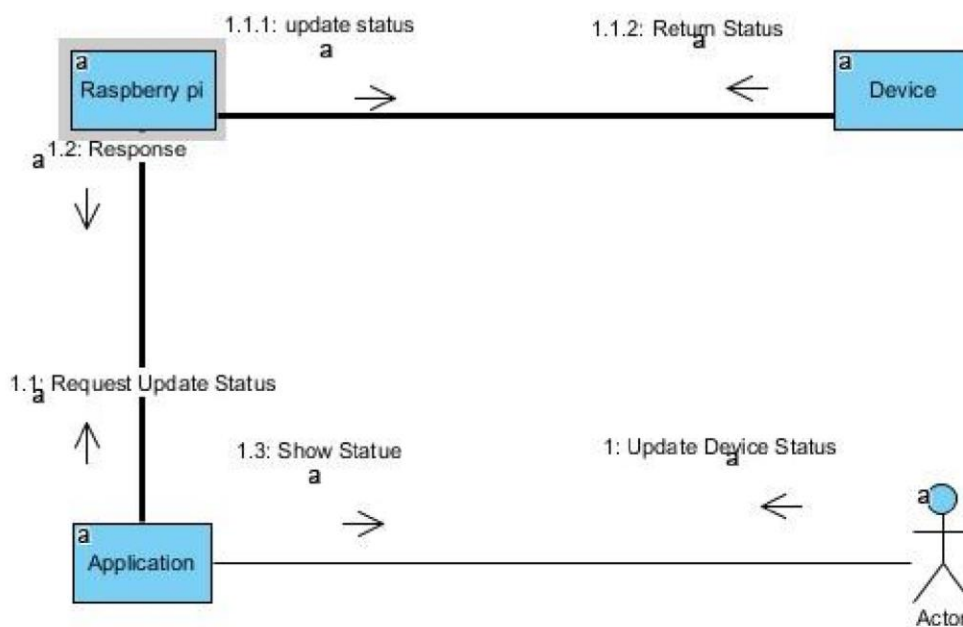


Figure 8. Check device status

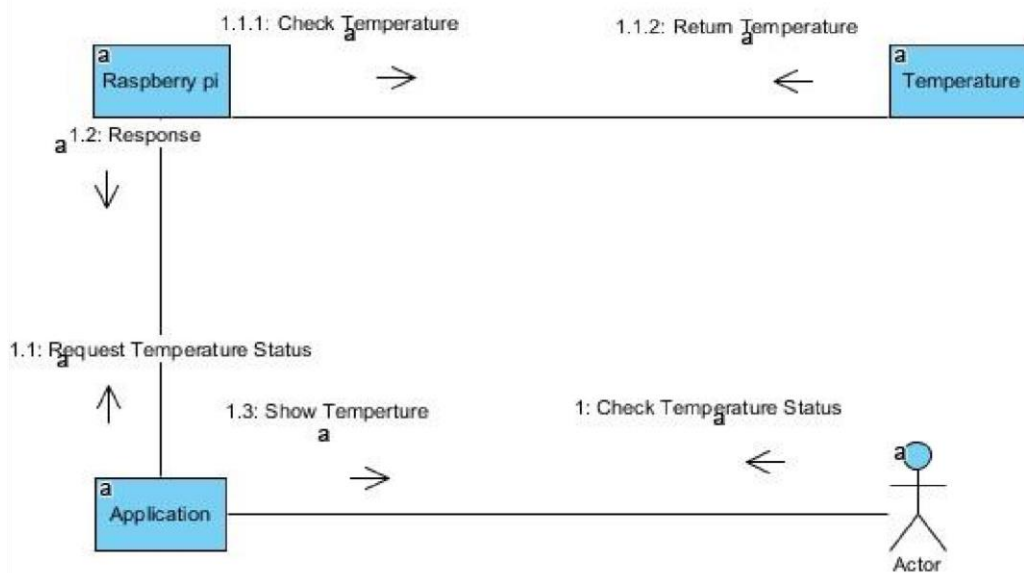


Figure 9. Update status

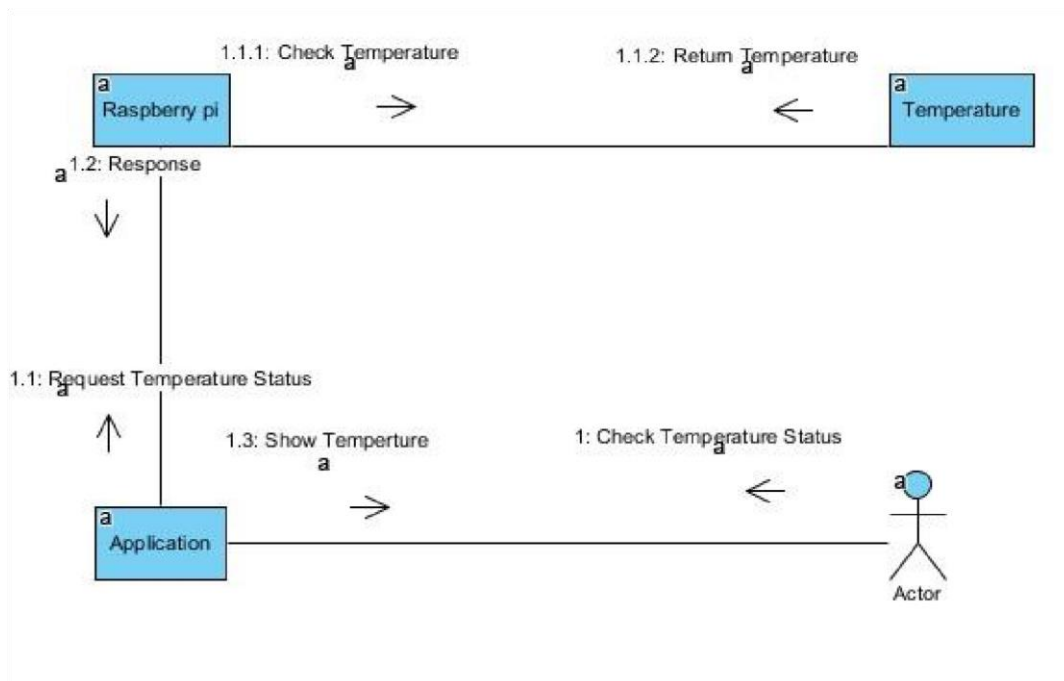


Figure 10. View temperature

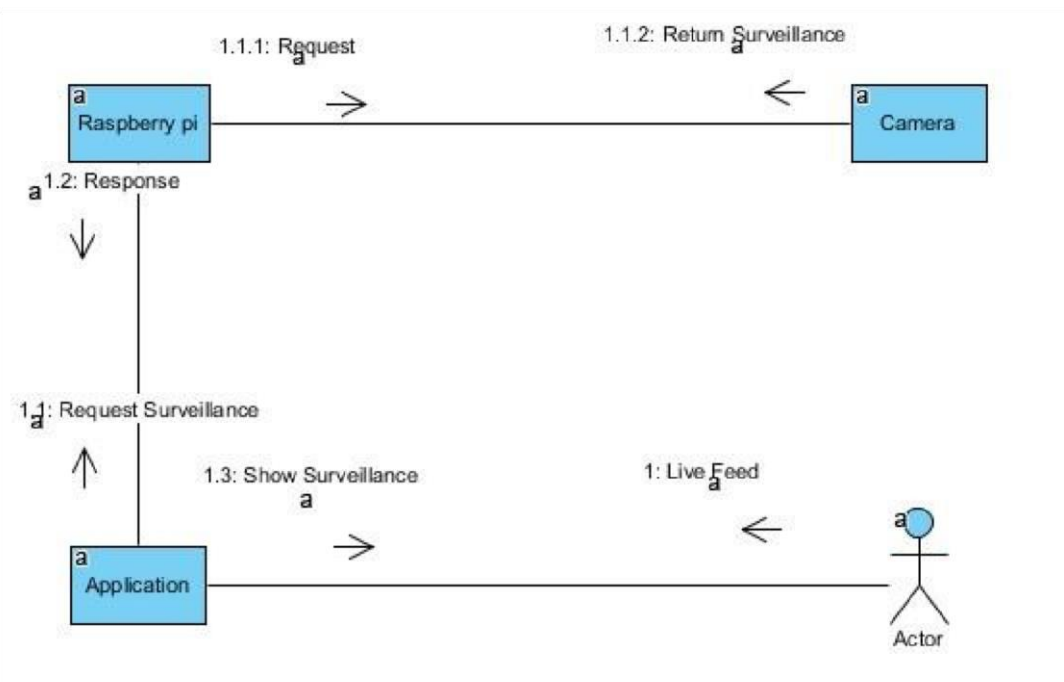


Figure 11. Surveillance



### 3.5 Component diagram

Component diagram is a special kind of diagram in UML. The purpose is also different from all other diagrams discussed so far. It does not describe the functionality of the system but it describes the components used to make those functionalities.

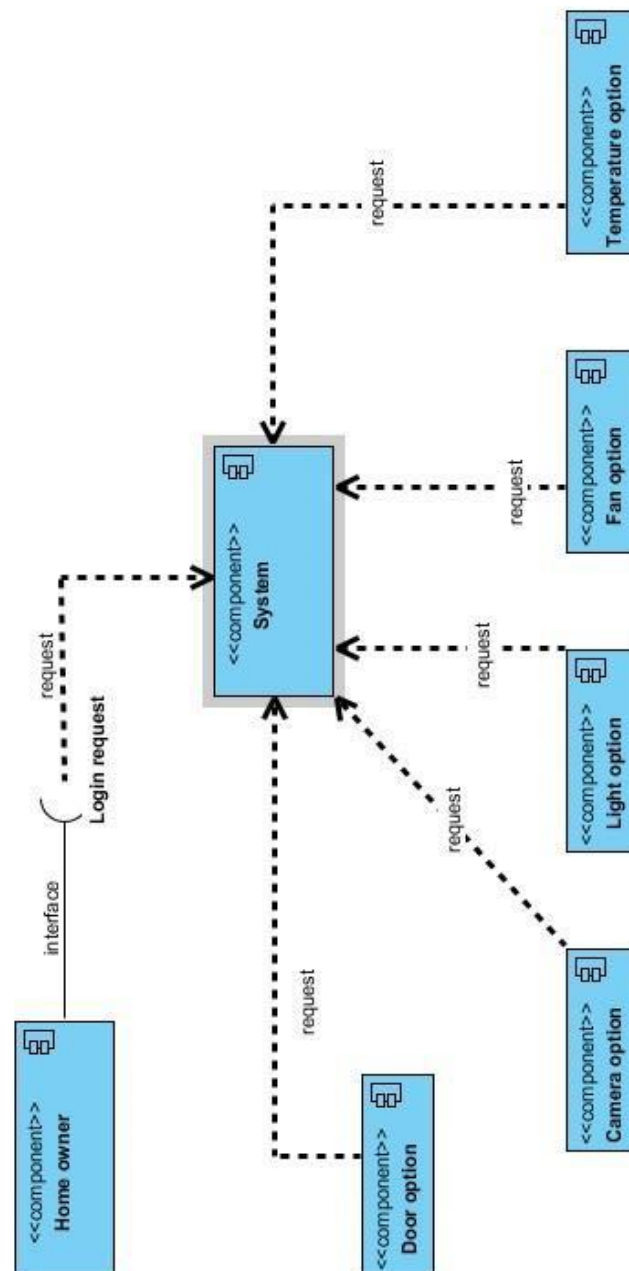


Figure 12. Component diagram

### 3.6 Class diagram

In software engineering, a class diagram in the Unified Modelling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

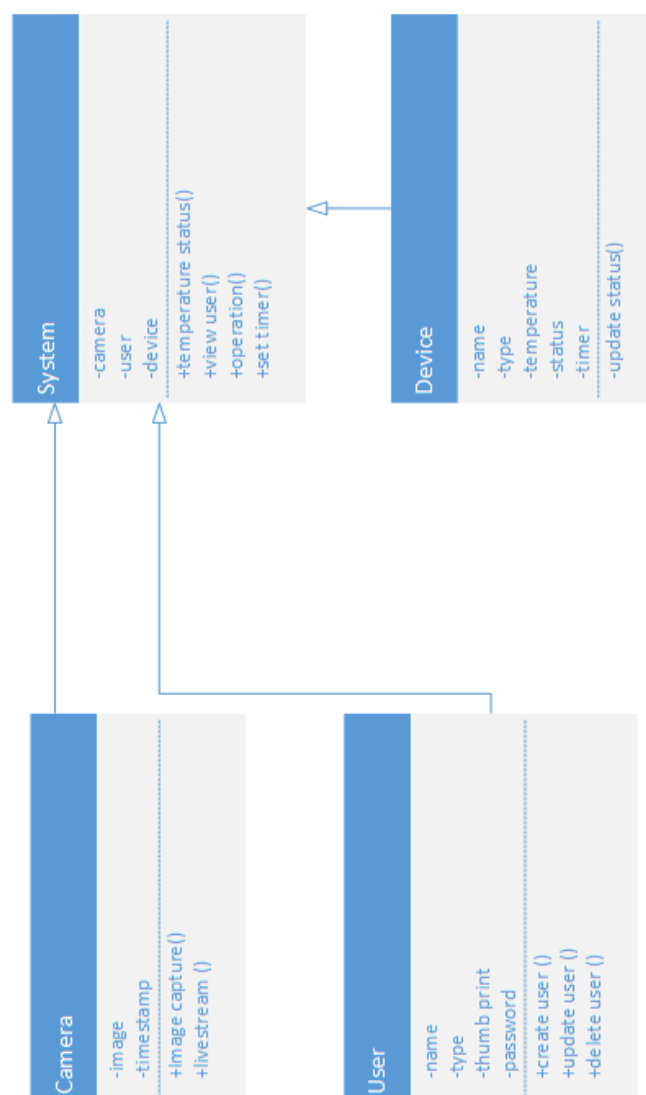


Figure 13. Class diagram



## CHAPTER 4

### IMPLEMENTATION

#### 4.1 Switch board

The switch board we are using with heat sensor tells us the humidity and temperature of the room. We can easily turn on and off our module by android application from anywhere with any WAN, LAN or static IP. We can also turn on/off the switch board by physical button.

Hardware which we use are Relay module as switches, Arduino as controller, ESP8266 as Wi-Fi/server, and DHT12 as temperature sensor.

#### 4.2 Lock

We unlock the door by fingerprint scanner and also with android application and we can also store user's fingerprints in that module.

Hardware which we use for it are Fingerprint module, Arduino, LCD screen, Relay, Electric lock and ESP8266.

#### 4.3 Main door camera

Camera continuously streams live video on LAN, users can watch that live stream on that same LAN and at the same time that module scan the face of any person if came in front of the main door and capture the picture of what it scanned and send it to the server to save that picture in database. Using open CV to capture pictures.

Hardware which are used for this module are Camera and Raspberry pie.

#### **4.4 Main server**

Connect all modules with itself and connects them with database and communicates between android application and modules. Manage all the users and databases using python language to program them. Hardware which is for this module is Raspberry

## CHAPTER 5

### USER MANUAL

#### 5.1 Login

In login you can add username and password given to you by your admin.

For first time login by default

Username: Admin

Password: Admin

IP address and Socket of your server device will be given by our team.

After login you will directed to home page. On Home page you will find

- Menu
- Security
- Temperature
- Lock
- Settings

#### 5.2 Menu

- Switch: In switch you will see the number of outlets and you can update its status.
- Timer: You can set time for certain switches

### **5.3 Security**

- Live Feed: You can view live feed of the main door camera.

### **5.4 Temperature**

- To view temperature of specific room.

### **5.5 Lock**

- Unlock or lock main door
- Set timer: to set timer main door

### **5.6 Setting**

- View User: View users of application
- Add User: Add user of system
- Delete User: Remove user from system

## CHAPTER 6

### CONCLUSION AND RECOMMENDATIONS

#### 6.1 Future enhancements

Furthermore, looking at the current situation we can build cross platform system that can be deployed on various platforms like IOS, Windows. Limitation to control only several devices can be removed by extending automation of all other home appliances. Network can be connected to internet and Security cameras can be controlled from other places, allowing the user to observe activity around a house or business. Security systems can include motion sensors that will detect any kind of unauthorized movement and notify the user. Scope of this project can be expanded to many areas by not restricting to only home.





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