ANDRIOD BASED PATIENT ROOM AUTOMATION SYSTEM

By

Capt Mohsin Ali

Capt Azam Saeed

Capt Nouman Jamil

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CERTIFICATE

Certified that the contents and form of project report entitled **"Android Based Patient's Room Automation System"** submitted by Capt Mohsin Ali, Capt Azam Saeed, Capt Nouman Jamil have been found satisfactory for the requirement of the degree.

Supervisor: _____

A/P Bilal Rauf

Department of CSE

Military College of Signals

DECLARATION

No portion of the work presented in this dissertation has been submitted in support of another award or qualification either at this institution or elsewhere.

DEDICATION

“We dedicate our project work to our beloved parents, who are supporting us for every stage of life. We also dedicate our project work to our teachers, who tried their best to make us efficient enough so that we may survive in this competitive era”

ACKNOWLEDGEMENT

This work has been of immense success due to the contributions and support of many individuals from all aspects of our life. We give the ultimate thanks to ALMIGHTY ALLAH for his guidance during the course of our study who made it possible to complete this thesis / project successfully.

We are greatly thankful to our project supervisor “Sir Bilal Rauf” support under whose able guidance this work has been completed. We are indeed extremely grateful for his inspiring guidance and kind sympathetic attitude which this thesis (project report) would not have seen the light of the day. Indeed we are thankful to all teachers of the department.

Lastly, we would like to express our profound to all people who have supported and encouraged us one way or the other during our graduate degree program. Notably amidst those are our precious group members and our families.

ABSTRACT

In today's World everyone is looking for the automation so that the work needed to be performed is done easily, accurately and efficiently. The same stands good for the daily routine work and office work from simple tasks to the one which are highly complex in nature.

The concept of IoT [11] devices was built to make the life comfortable and to automate the things so that they can be operated from anywhere through Internet. This project "Android Based Patient Room Automation" revolves around the same concept.

The system provides automated atmosphere to the patients and maintenance staff in hospitals in order to make them comfortable and provide congenial environment. The system consists of Arduino based hardware module along with Java based android application for controlling various appliances/facilities/electric equipment in modern patient rooms in hospitals which are easy to operate and give the congenial environment to the patients specially the handicapped / war wounded patients which are deprived of operating these facilities due to their physical limitations.

The software application is designed to be user friendly for ease in operating without technical details. The list of appliances/facilities will be displayed which will be modified/operated by the user.

The hardware module consists of the Arduino board which is programmed to receive the instructions and further change the status of particular device/ electric load.

The system can be used in modern hospitals in order to provide comfortable environment to the users. The same can be used in CMHs where the war wounded patients are given treatment. The system provide great room for further improvements/ modifications as it commensurate with the concept of IoT[11] devices used today.

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Introduction

1.1 Description

Android Based Patient Room Automation System, is a hardware cum software system intends to provide a solution for the automatic handling of various things/ electric equipment in order to provide the congenial environment for the users. It is intended to be used in hospitals to facilitate the patients.

1.1.1 Purpose of this document

The purpose of this document is to explain the purpose and features of the system, hardware components, application classes and data flow in the application. It would also tell that what the system will do, the constraints under which it must operate and how the system will react to external inputs. The testing methods which have been used will also form part of the document in the end.

1.1.2 Document Conventions

a. Words in bold, in any paragraph, refer to a specific term defined earlier in document or in the glossary.
b. Following pair of words are used interchangeably:-
    1) manager and maintenance staff
    2) user and patient
c. Conventions used to prepare the document is given bellow
    1) Font – Arial, size 11
    2) Center headings, Font-Arial, Bold, size 14, underline
    3) Main headings, Font – Arial, Bold, size 14
    4) Sub headings, Font – Arial, Bold, size 12
    5) Sub-sub headings, Font-Arial, Bold, size 11

1.1.3 Scope of the development project

a. For

[The handicapped/old aged / physically deprived patients in hospitals]

b. What

[Provide new technology and software usage in the new evolving system]

c. The

[Android Based Patient Room Automation]

d. Is

[A facilitation for the users]

e. That

[Will provide more comfortable and congenial environment for users]

f. Our Product

[Provides full control over the things and include hardware and software modules.]

1.1.4 Intended Audience and Reading Suggestions

a. **Project Supervisor**: It will help to supervise the project and guide the team in a better way.

b. **Development Team**: It will help the developer to develop the product and to trace back the functional requirements.

c. **Testing Team**: It will help the testers to understand the constraints.

d. **Users**: The potential stakeholders of the system, for the maintenance, use and modifications of the system.

e. **UG Project Evaluation Team:** Evaluation committee which will evaluate the progress of UG Projects.

1.2 Literature View

This section provides the overall description, features and functionalities, objectives and characteristics pertaining to the project. Thus, it gives the detailed view of the project and explains the need of the system and how the objective is intended to be achieved.

1.2.1 Product Perspective

The system consists of hardware and Software modules. The software module will consist of android application which can be operated in user mode and manager mode. In user mode the electric devices of the particular room can be operated while in manager mode all the rooms can be managed and the new user can be introduced. A particular user can change into manager mode by providing the username and password. Each room will have the android mobile phone/ tablet for the same purpose. Hardware components will be connected with Arduino board which will be further connected with Wifi receiver. Once the user clicks the input signal is sent to Wifi receiver which in turn sends the signal to the microprocessor chip and it will perform the action in response to that particular signal.

1.2.2 Product Features

In our patient room automation system, the user indicates the person who is using the product (most of the times it is patient himself). The user basically has rights to choose a device, turn it on & off, regulating the certain devices and adjust the things according to his/her comfort. The main functionalities include

a. Lights
b. Fan (ON/OFF/Regulation)
c. TV (ON/ OFF/Volume UP/DOWN, Channel UP/DOWN)
d. Window blinds (OPEN /CLOSE)
e. Emergency bell
f. Call (maintenance staff)
g. AC (ON,OFF and regulation)

1.2.3 Problem Statement

In the current prevailing hospital environment, the handicapped/ physically challenged patients have to face problem to control the electric loads/ facilities due to which they have to remain liability on some other person who should carry out their routine works and should be available every time on their call. This creates a problem not only for the one who is looking after the patient but creates a psychological burden on the patient too as all the things related

to the patient are looked after by the attendant. The manual operation of different devices/ electric load keeps the patient from operating them physically.

1.2.4 Objectives

Objective is to develop android based system which will automate the handling of electric appliances/loads which were previously handled manually. The hardware will be connected to the Arduino board which will get the instructions from the user through android application connected with the WiFi.

1.2.5 Deliverables

First Progress Report: including SRS Document
Second Progress Report: including System Design (Hardware and Software)
Third Progress Report: Demo of integrated system
Final Report: including complete documentation of the system and user manual

1.2.6 User Classes and Characteristics

This project is intended to be used by various user classes. These classes can be listed as follows

1.2.6.1 Patients: These include two categories

1.2.6.1.1 Handicapped/ old aged patients:

These are the users who are deprived of controlling the things in a normal manner due to their physical incapability.

1.2.6.1.2 War wounded patients:

These include those war wounded people in military and para military forces who have been injured in war and needed to be looked after.

1.2.6.2 Managers:

These include the administrative/ maintenance staff in the hospitals who will be responsible to manage the network and have overall control of network.

1.2.7 Operating Environment

Application will operate on android enabled devices with SDK version 4.0 and above.

1.2.8 Design and Implementation Constraints

Description	Rationale
The android app for user and management staff will be built in minimum Android v4.0	All latest android smart phones are using minimum v4.0
The television controls will be kept limited to ON, OFF, VOLUME UP and DOWN and CHANNEL UP and DOWN	To minimize the complexity issues which may not be much beneficial for the project perspective
Range of the wifi may be limited as per the scope of the project	Depending upon the type and make of wifi router being used

1.2.9 Assumptions and Dependencies

a. Android OS will be available on the hardware designated for the software product.
b. Each room will have the dedicated android device i-e mobile phone / tablet designated for the purpose.
c. The device should be WiFi enabled.
d. The project prototype will be limited and will display and handle all the facilities of a single room.

System Requirements

2.1 System Feature Requirements

This section provides the requirements according to the features and functionalities the system will provide.

2.1.1 Controlling Appliances/Electric load

2.1.1.1 Description and Priority

In this feature the microprocessor receives the WiFi signal and further takes action accordingly. This is the most important feature and has the priority of 1.

2.1.1.2 Stimulus/Response Sequences

The microprocessor chip triggers the particular event and action is performed on the particular appliance/ electric load in result.

2.1.1.3 Functional Requirements

Requirement-1: The system shall be able to turn the electric light/ bulb ON/OFF as chosen by the user on app.

Requirement-2: The system shall be able to turn the fan ON/OFF and adjust the speed as chosen by the user on app.

Requirement-3: The system shall be able to turn the window blinds OPEN/CLOSE as chosen by the user on app.

Requirement-4: The system shall be able to turn the TV ON/OFF, adjust the volume LOW/HIGH and search the channels UP/DOWN as chosen by the user on app.

Requirement-5: The system shall be able to indicate the emergency to the management staff/ nursing by updating the status on management staff app

Requirement-6: The system shall sound the buzzer/ alarm which is also connected with system to indicate the emergency.

Requirement-7: The system shall be able to indicate the notification by the user to the management staff when the routine call is made by the user/ patient by updating the status on management staff app.

2.1.2 Emergency Calling

2.1.2.1 Description and Priority

In this feature the management staff/ nursing will be able to send the message to the concerned doctor when he/she gets the emergency notification from the patient. This feature has the priority of 2.

2.1.2.2 Stimulus/Response Sequences

Once the patient gets the emergency notification from the particular room/ patient, the message is sent to the concerned doctor through manager/maintenance staff app.

2.1.2.3 Functional Requirements

Requirement-1: The system shall send the direct message to the concerned doctor from maintenance staff device when he/she receives the emergency notification from the patient/user.

2.1.3 Manager Login

2.1.3.1 Description and Priority

In this feature the maintenance staff/ nursing will be able to login by providing valid username and password as the manager and can set the preferences and register the new device. This feature has the priority of 1.

2.1.3.2 Stimulus/Response Sequences

Once the maintenance staff login by providing the valid username and password he/she can change the preferences and assign the room number and doctor’s phone number.

2.1.3.3 Functional Requirements

Requirement-1: The system shall allow the maintenance staff/ manager to login by providing the valid username and password.

Requirement-2: The system shall allow the maintenance staff/ manager to operate the equipment/ electric load in any room by changing the preferences in the manager log.

Requirement-3: The system shall allow the maintenance staff/ manager to change the doctor's mobile number in preferences by providing the valid password.

Requirement-4: The system shall allow the maintenance staff/ manager to register the user device by changing the preferences.

Requirement-5: The system shall allow the maintenance staff/ manager to change the old password by providing the old and new password.

2.1.4 Other Nonfunctional Requirements

This sub section lists the non-functional requirements of the system.

2.1.4.1 Performance Requirements

Requirement-1: The system shall not add more than three seconds to the time required to perform an action. For example, if it takes 2 seconds to turn the TV on normally, it shall take no longer than 5 seconds for the TV to turn on through the system.

2.1.4.2 Safety Requirements

Requirement-1: The system shall be protected from electric shocks and surges.

2.1.4.3 Security Requirements

Requirement-1: The system shall not allow any personal data / credentials pertaining to the user.
Requirement-2: Any kind of security breaches in the system should be taken care of.

2.1.5 Software Quality Attributes

Software Quality Attributes are listed as follows.

2.1.5.1 Availability

Requirement 1: The system shall be available 24/7 provided the device is connected to the network.

Requirement 2: Less than one minute shall be needed to restart the system after a failure, 99.90% of the time.

2.1.5.2 Maintainability

Requirement 1: The existing system functionality shall not be affected more than 3-5% by adding the new functionality.

Requirement 2: The system shall allow the easy hardware management and replacement in case of fault.

Requirement 3: The programming code developed shall conform to programming style standards and shall be commented thoroughly.

2.1.5.3 Portability

Requirement 1: The interfaces of user and maintenance staff mode of app shall be compatible with every android device.

2.1.5.4 Reliability

Requirement 1: The system defect rate shall be less than 1 failure per 100 hours of operation.

Requirement 2: The system should not take more than 5 hours to repair after failure.

2.1.5.5 Usability

Requirement 1: After a 15 minutes training time 9 out of 10 new users shall be able to use the app.

Requirement 2: Expert users of android devices shall not need any training time. They shall be familiarized to the software as soon as they will start using it.

2.1.5.5 Reuse

Requirement 1: The system shall be designed to allow further modifications to include more functionalities according to the changing requirements.

2.2 External Interface Requirements

This section provides the external interface requirements of Android Base Patient Room Automation System.

2.2.1 User Interfaces

This sub section lists the functional requirements pertaining to the user interfaces

Requirement 1: The app shall have option to sign in as manager.

Requirement 2: The app shall display the list of appliances which can be controlled.

Requirement 3: The app shall display the current status of the appliances whether they are in ON or OFF mode.

Requirement 4: The app shall display the TV controls on separate page showing the ON, OFF, VOLUME UP/DOWN, CHANNEL UP/DOWN buttons.

Requirement 5: The app shall display the AC controls on separate page showing the ON, OFF, temperature UP/DOWN buttons.

2.2.2 Hardware Interfaces

Requirement 1: The system shall operate on 220v AC power supply.

2.2.3 Communications Interfaces

Requirement 1: The app shall use HTTP protocol for communication.

System Architecture and Design

3.1 Overview of modules / components

The system can be divided in to two major modules. Hardware interface and software interface. The software interface consists of two sub modules for the patient and the maintenance staff. Likewise the hardware interface consists of several sub modules which include

1. Arduino Mega 2560 Development Board
2. Wifi Module ESP8266
3. Android Phone
4. DC Motors (fan and blinds)
5. LEDs
6. IR Tx

3.2 System Architecture

Layered Architecture (4-Tiers) will be used to implement Android Based Patient Room Automation. From a high level perspective, a service-based solution can be seen as being composed of multiple services, each communicating with the others by passing messages. Conceptually, the services can be seen as components of the overall solution. However, internally, layers are made up of software as well as hardware components and these components can be logically grouped into presentation,session, communication, and business logic layers.

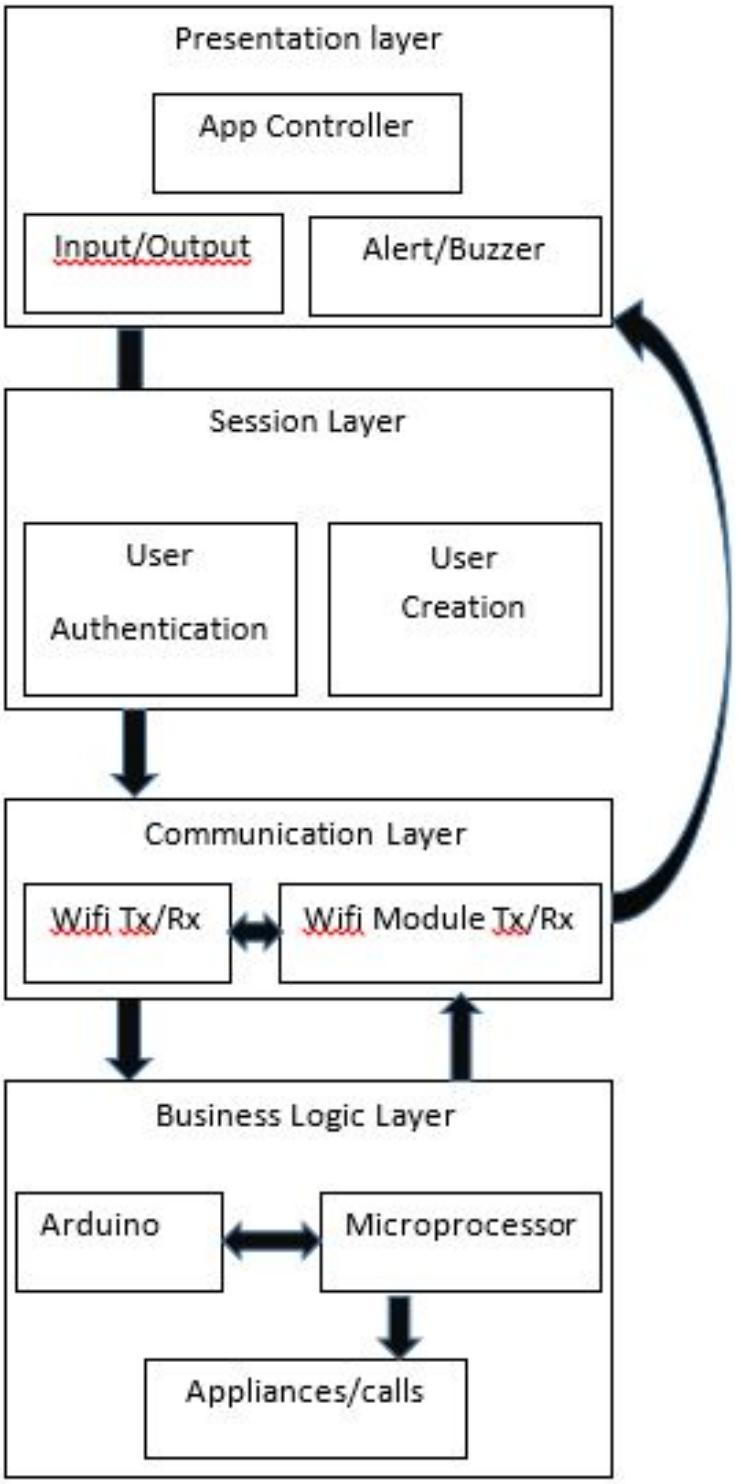

Fig 1: System Architecture

3.3 Layers Details

The details of the layers are discussed below:

3.3.1 Presentation Layer

The presentation layer provides the platform for interaction of the users (Patients and Maintenance staff) with the system. It displays the user interface to the user in order to operate the facilities.

3.3.2 Session Layer

The session layer is responsible for the user authentication and registration of new user. The user will remain part till the session expires.

3.3.3 Communication Layer

Communication Layer is only responsible for the communication between the presentation layer and business logic layer.

3.3.4 Business Logic Layer

This layer receives request from Communication Layer for the implementation of the functionality and it performs the functionality after going through the logic that what this request meant and how it should be implemented with the help of microprocessor.

3.4 Overall Structure of the System

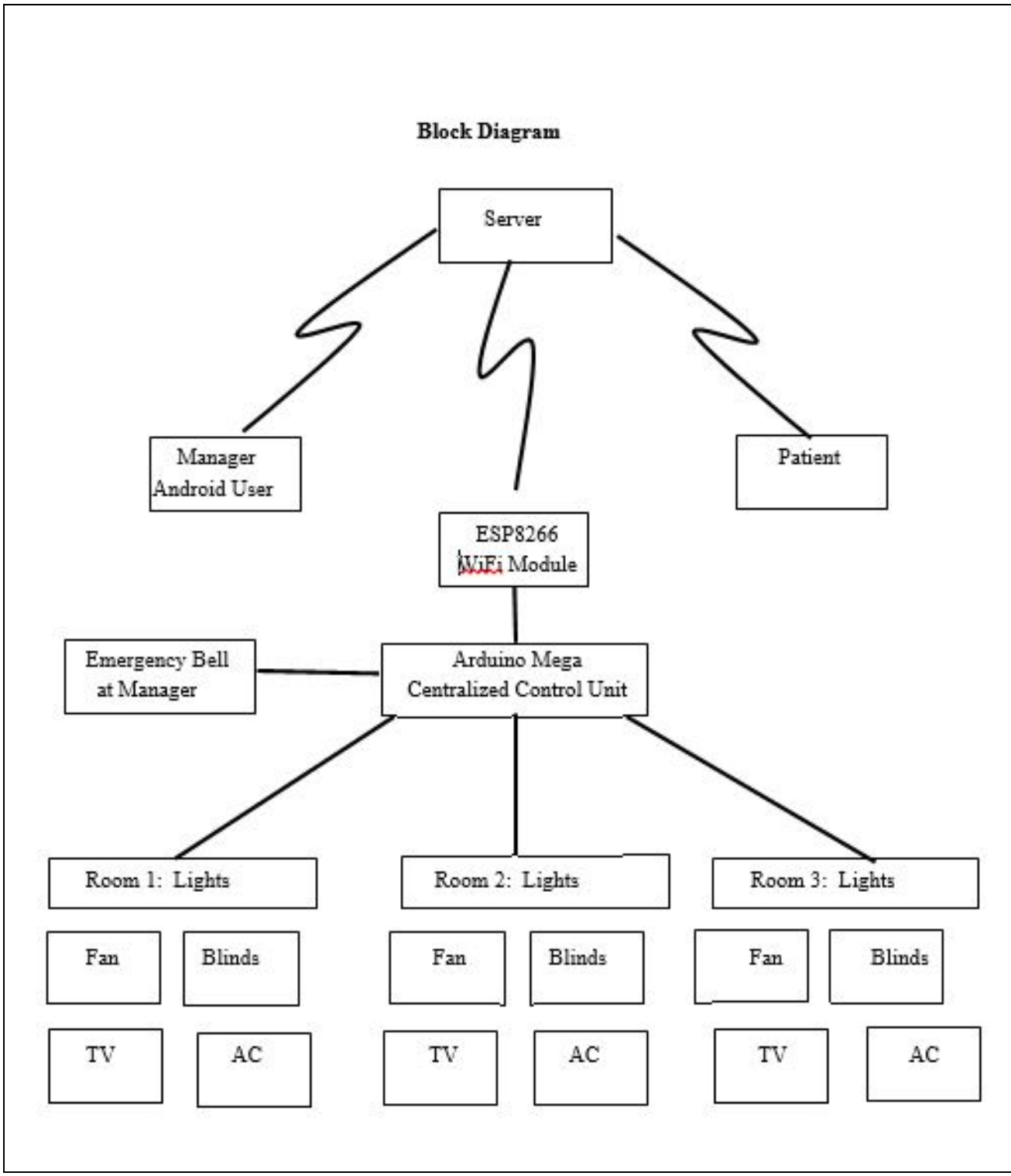

Fig 2: System Structure

3.5 Design Pattern

The design pattern we are using for Android Based Patient Room Automation is Façade Pattern. The reason for using Façade Pattern is because the overall layer is abstract to the user and it provides a simplified interface within a system and thus it hides the complexities of the subsystem from the client.

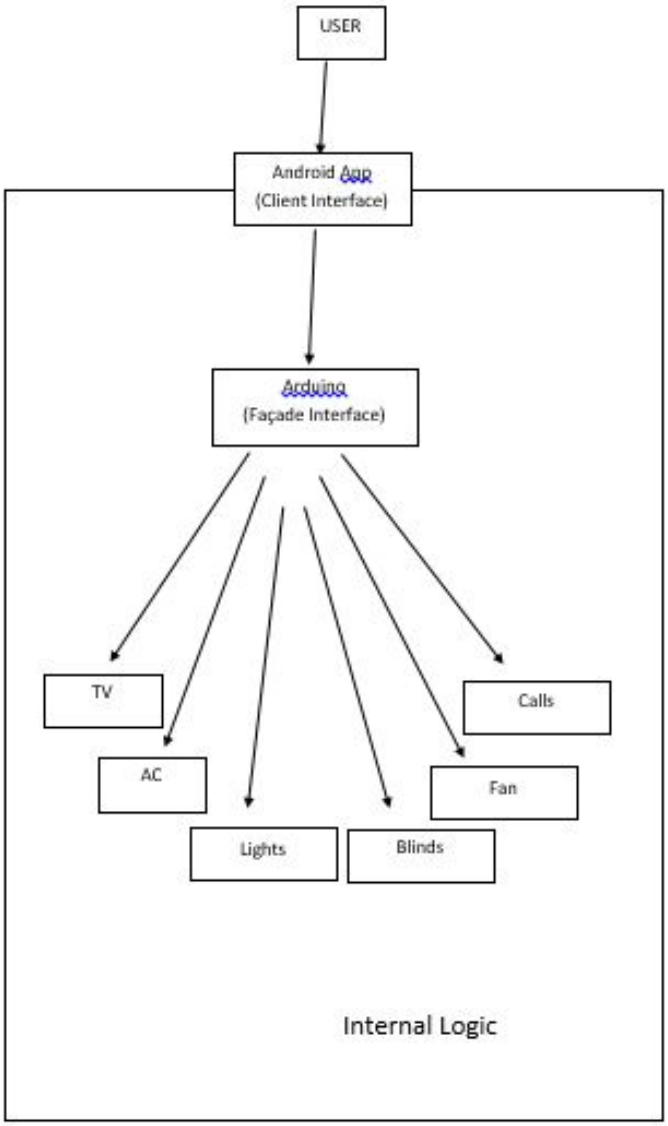

Fig 3: System Design

In ABPRA, the client is given the simplified user friendly interface while hiding all the hardware complexities which are involved in executing the commands given by the user. In this way with respect to client there is only one single call.

3.6 Use case Diagram

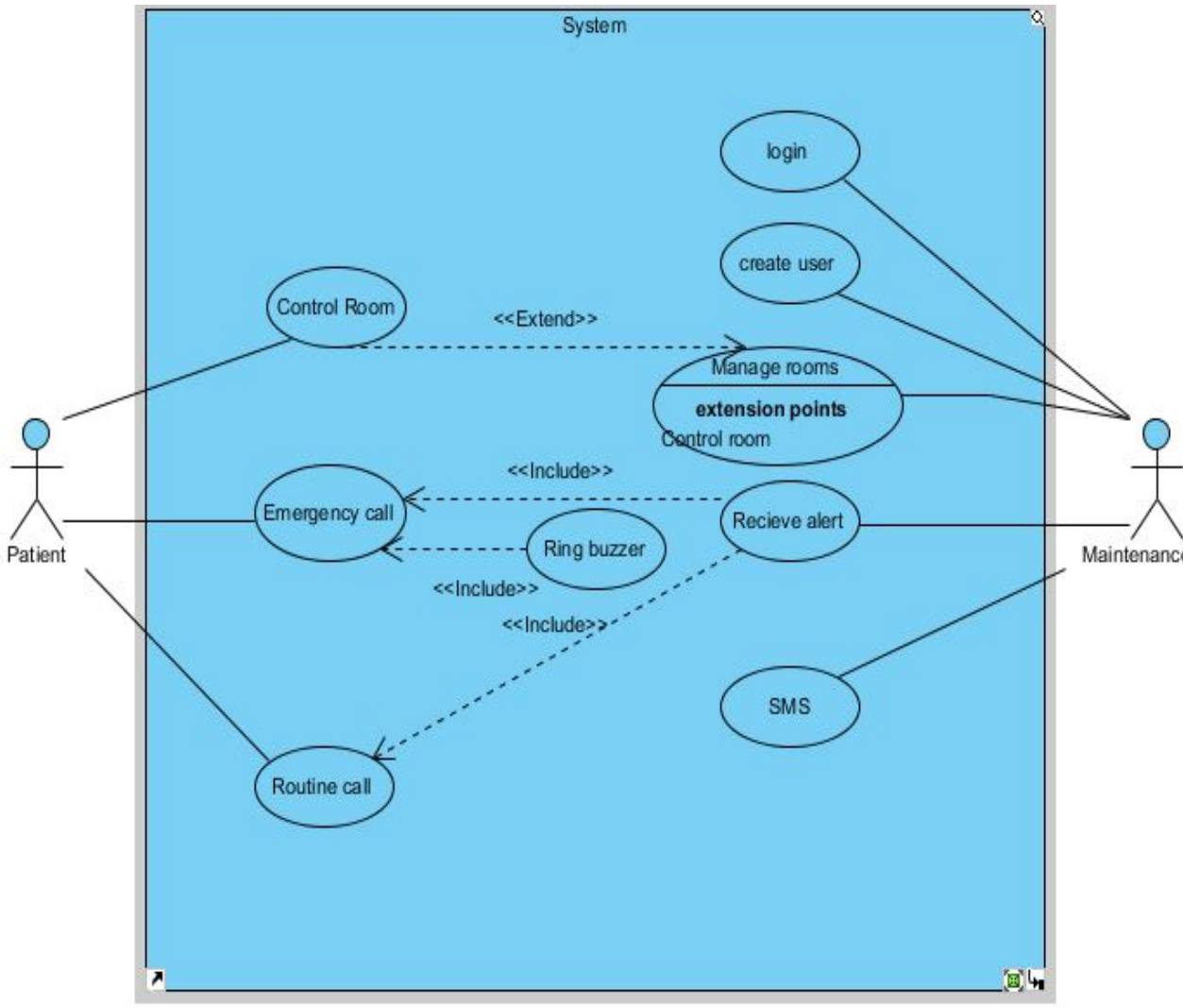

Fig 4 : Use case diagram

3.7 Use Cases Description

This section lists the Use Cases for ABPRA. The various user classes identified the following Use Cases and primary actors:

Actors	Use Cases
Maintenance Staff	Login Create users Manage room Receive alert SMS
User/Patient	Control room Emergency call Routine call Ring buzzer

3.7.1 Login

Use Case ID:	1
Use Case Name:	Login
Actors:	Maintenance staff
Description:	Maintenance staff tries to login to the system.
Preconditions:	When the user clicks the button to login as a Maintenance staff on the

	login page.
Post conditions:	If the use case was successful, the actor is now logged into the system. If not the system state remains unchanged.
Normal Flow (primary scenario):	This use case starts when an actor wishes to log into the System as the Maintenance staff. The system requests that the actor enter his/her password. The actor enters his/her password. The system validates the entered password and logs the actor into the system.
Alternative Flows:	Invalid Password If in the *Basic Flow* the actor enters an invalid password, the system displays an error message.

3.7.2 Create User

Use Case ID:	2
Use Case Name:	Create User
Actors:	Maintenance Staff
Description:	Maintenance staff has to login to the system to create users and then he/she can be able to register the patient
Preconditions:	Maintenance staff has to login.
Post conditions:	The System must record the change.
Normal Flow (primary scenario):	The actor creates the specific user which will then be registered permanently. No need for their signup again and again. Click on create button as required.
Alternative Flows:	

3.7.3 Manage Room

Use Case ID:	3
Use Case Name:	Manage room
Actors:	Maintenance staff
Description:	A user wants to handle the electric equipment in any room
Preconditions:	User should be logged in as a maintenance staff
Post conditions:	If the use case was successful, the actor can now handle/control any of the appliance in any room
Normal Flow (primary scenario):	This use case starts when an actor wishes to handle the electric appliance of any room. The system requests that the actor is logged in as a Maintenance staff. If the user is successfully logged in , he/she can control the electric equipment/ load/appliances in any of the rooms which are connected with the system.
Alternative Flows:	The user might not be able to handle electric equipment due to error

3.7.4 Receive Alert

Use Case ID:	4
Use Case Name:	Receive Alert
Actors:	Maintenance staff
Description:	Maintenance staff will receive the alert when the patient will do the routine call
Preconditions:	Maintenance staff should be connected through wifi

Post conditions:	If the use case was successful, the actor can now receive the alert
Normal Flow (primary scenario):	This use case starts when the patient press the routine call button. If the use case is successful, the maintenance staff will receive the notification alert.
Alternative Flows:	The maintenance staff might not get an alert if he/she is not connected through wifi

3.7.5 SMS

Use Case ID:	5
Use Case Name:	SMS
Actors:	Maintenance staff
Description:	A user wants to generate SMS to the concerned doctor as soon as he receive the emergency bell/ring by the patient
Preconditions:	Maintenance staff got an emergency bell/ring
Post conditions:	If the use case was successful, the actor can now generate SMS
Normal Flow (primary scenario):	This use case starts when an actor gets an emergency bell/ring by the patient The maintenance staff wants to generate urgent SMS to the doctor. If the use case is successful, the user/maintenance staff will be successful to generate a SMS
Alternative Flows:	The user might not be able to generate SMS due to error in sending

3.7.6 Control Room

Use Case ID:	6
Use Case Name:	Control room
Actors:	Patient
Description:	A user wants to handle the electric equipment in any room
Preconditions:	User should be registered by the maintenance staff
Post conditions:	If the use case was successful, the actor can now handle/control any of the appliance in room
Normal Flow (primary scenario):	This use case starts when an actor wishes to handle the electric appliance of any room. If the user is successfully registered , he/she can control the electric equipment/ load/appliances in any of the rooms which are connected with the system.
Alternative Flows:	The user might not be able to handle electric equipment due to error

3.7.7 Emergency call

Use Case ID:	7
Use Case Name:	Emergency call
Actors:	Patient
Description:	Maintenance staff will receive the ring when the patient will do the emergency call
Preconditions:	Patient and maintenance staff should be connected through wifi
Post conditions:	If the use case was successful, the actor can now send the emergency bell to the maintenance staff

Normal Flow (primary scenario):	This use case starts when the patient press the emergency call button. If the use case is successful, the maintenance staff will receive the ring.
Alternative Flows:	The maintenance staff might not get an ring if he/she is not connected through wifi

3.7.8 Routine call

Use Case ID:	8
Use Case Name:	Routine call
Actors:	Patient
Description:	Maintenance staff will receive the alert when the patient will do the routine call
Preconditions:	Both patient and Maintenance staff should be connected through wifi
Post conditions:	If the use case was successful, the actor can now send the routine call alert to the maintenance staff
Normal Flow (primary scenario):	This use case starts when the patient press the routine call button. If the use case is successful, the maintenance staff will receive the notification alert.
Alternative Flows:	The maintenance staff might not get an alert if he/she is not connected through wifi

3.7.9 Ring buzzer

Use Case ID:	9
Use Case Name:	Ring buzzer
Actors:	Patient
Description:	When the patient will do the emergency call the buzzer will ring
Preconditions:	Patient clicks the emergency call button
Post conditions:	If the use case was successful, the buzzer will ring
Normal Flow (primary scenario):	This use case starts when the patient press the emergency call button. If the use case is successful, the buzzer will ring indicating the emergency
Alternative Flows:	The buzzer might not ring due to connection problems

3.8 Activity Diagrams

This sub section shows the activity diagrams of the system.

3.8.1 Activity Diagram- Application

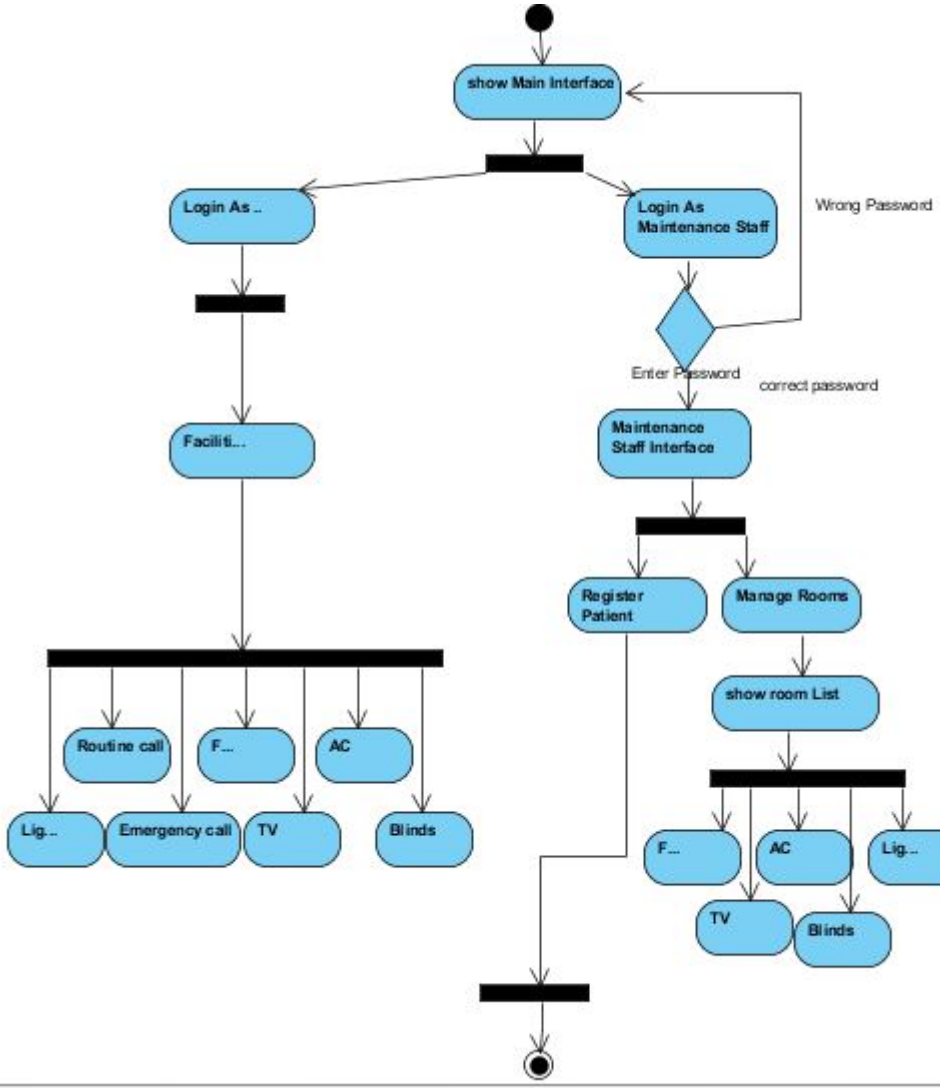

Fig 5: Activity Diagram-Application

3.8.2 Activity Diagram -TV

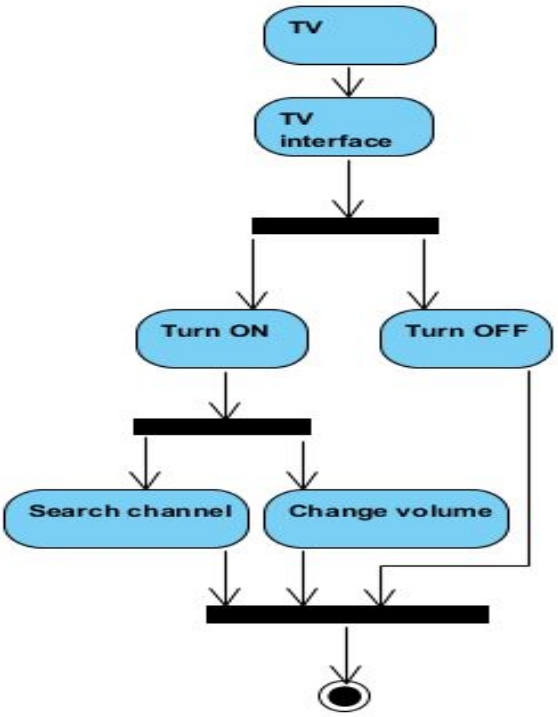

Fig 6: Activity Diagram-TV

3.8.3 Activity Diagram- Blinds

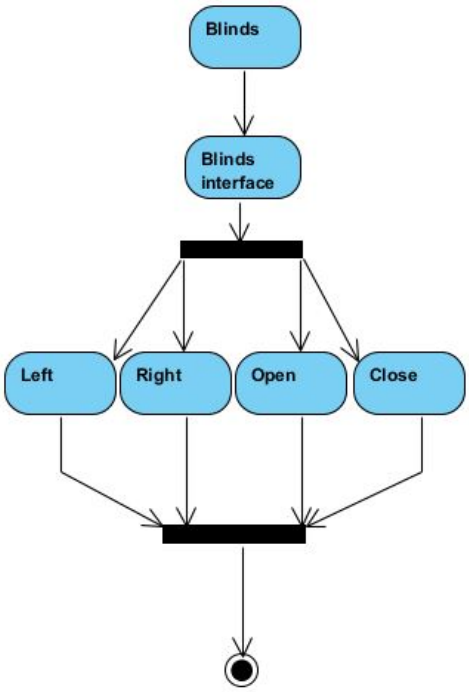

Fig 7: Activity Diagram-Blinds

3.8.4 Activity Diagram-AC

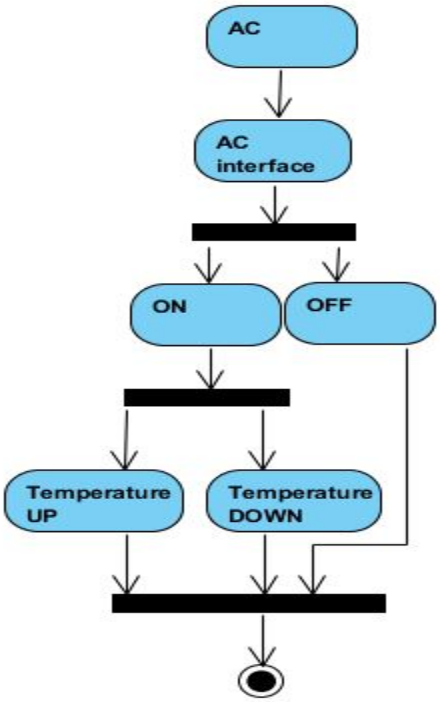

Fig 8: Activity Diagram-AC

3.8.5 Activity Diagram- Light

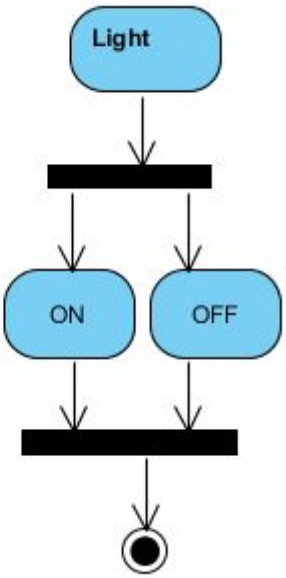

Fig 9: Activity Diagram-Light

3.8.6 Activity Diagram- Routine Call

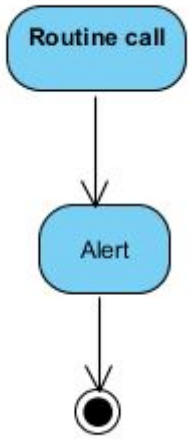

Fig 10: Activity Diagram-Routine Call

3.8.7 Activity Diagram- Emergency Call

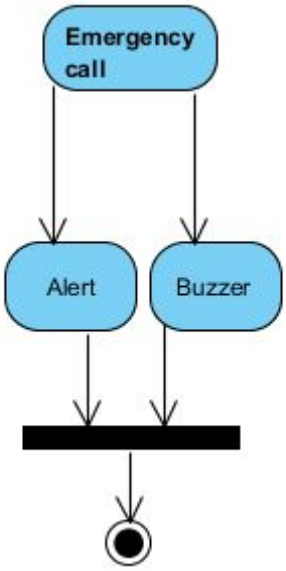

Fig 11: Activity Diagram-Emergency call

3.9 Class Diagram

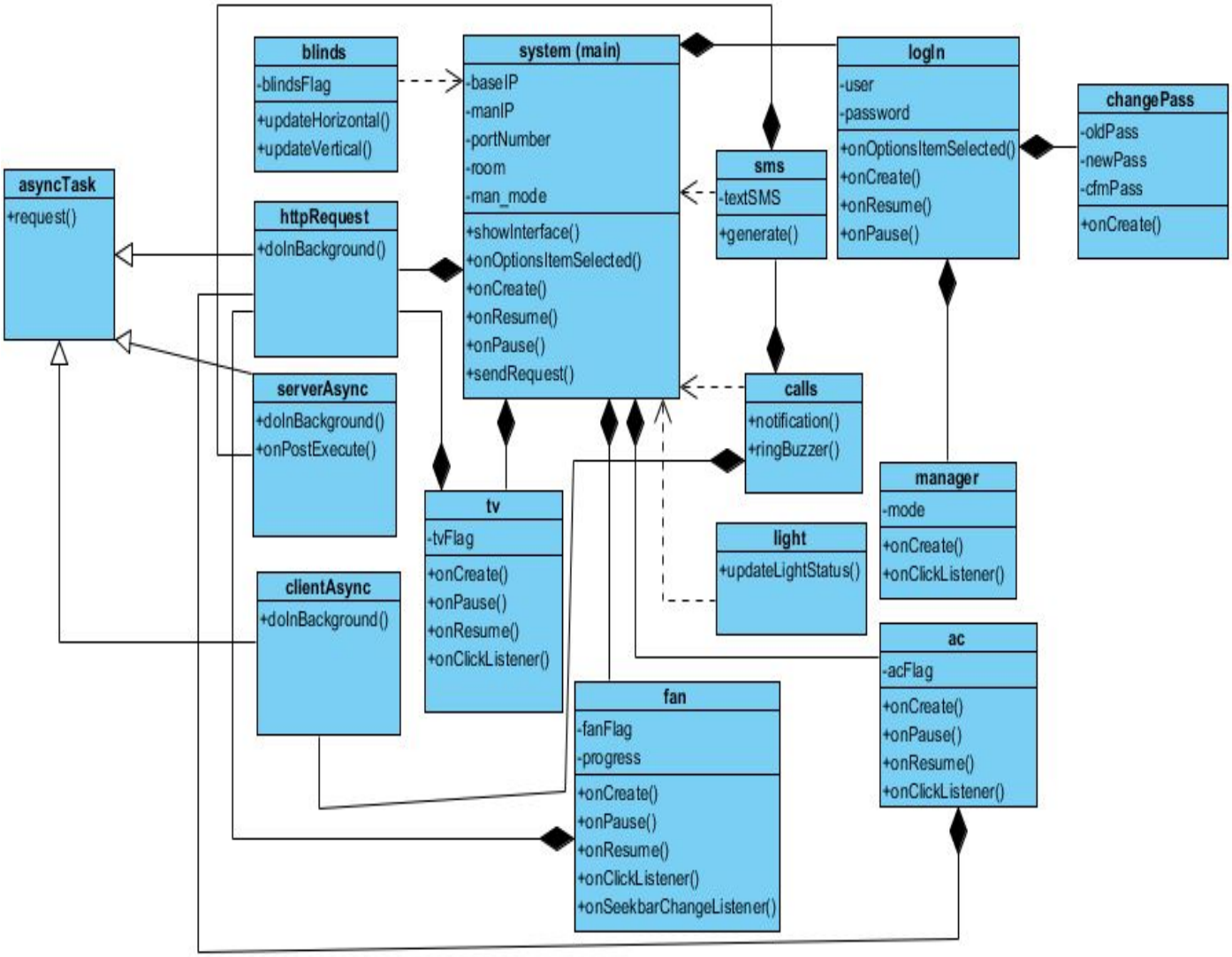

Fig 12: Class Diagram

3.9.1 system (main)

Main class which contains instances of blinds, tv, light, fan, ac, calls for calling the function according to the instruction received. It shows the items in list and updates the status of each facility. The instance of login class is contained in order to change in to manager mode.

3.9.2 logIn

logIn class gets the username and password and checks if it is valid user by using the instance of the manager class. It also contains the instance of changePass class to change the password. If the username and password provided are correct then the user is directed to the manager mode by different activity.

3.9.3 manager

Manager class shows the manager view in which different fields can be set and the client is allotted the room number and the manager IP can also be changed. The fields which are changed are further updated.

3.9.4 changePass

This class is used for the purpose of changing the old password. The old passwords is checked whether it is correct and if it is correct then the new password replaces the old one.

3.9.5 asyncTask

Acts as the parent class to httpRequest, serverAsync and clientAsync to carryout the asynchronous tasks.

3.9.6 ttpRequest

Child class of asynchTask and is used to send the asynchronous http request which is transferred to the Arduino through wifi for handling of particular equipment.

3.9.7 clientAsync

Child class of asyncTask for client asynchronous tasks to get buffered data.

3.9.8 serverAsync

Child class of asyncTask for server asynchronous tasks to get the buffered data.

3.9.9 ac

ac class checks the flag and send the string by http request accordingly.

3.9.10 fan

fan class checks the flag and send the string by http request accordingly alongwith the progress of seekbar.

3.9.11 calls

Calls class checks the flag, checks the type of call and send the string by http request accordingly.

3.9.12 blinds

blinds class checks the flag and send the string by http request accordingly.

3.9.13 tv

tv class checks the flag and send the string by http request accordingly.

3.9.14 lights

lights class checks the flag and send the string by http request accordingly.

3.9.15 sms

sms class send the sms if the manager mode is on.

3.10 Sequence Diagrams

This sub section shows the sequence diagrams of the system

3.10.1 Sequence Diagram-Patient

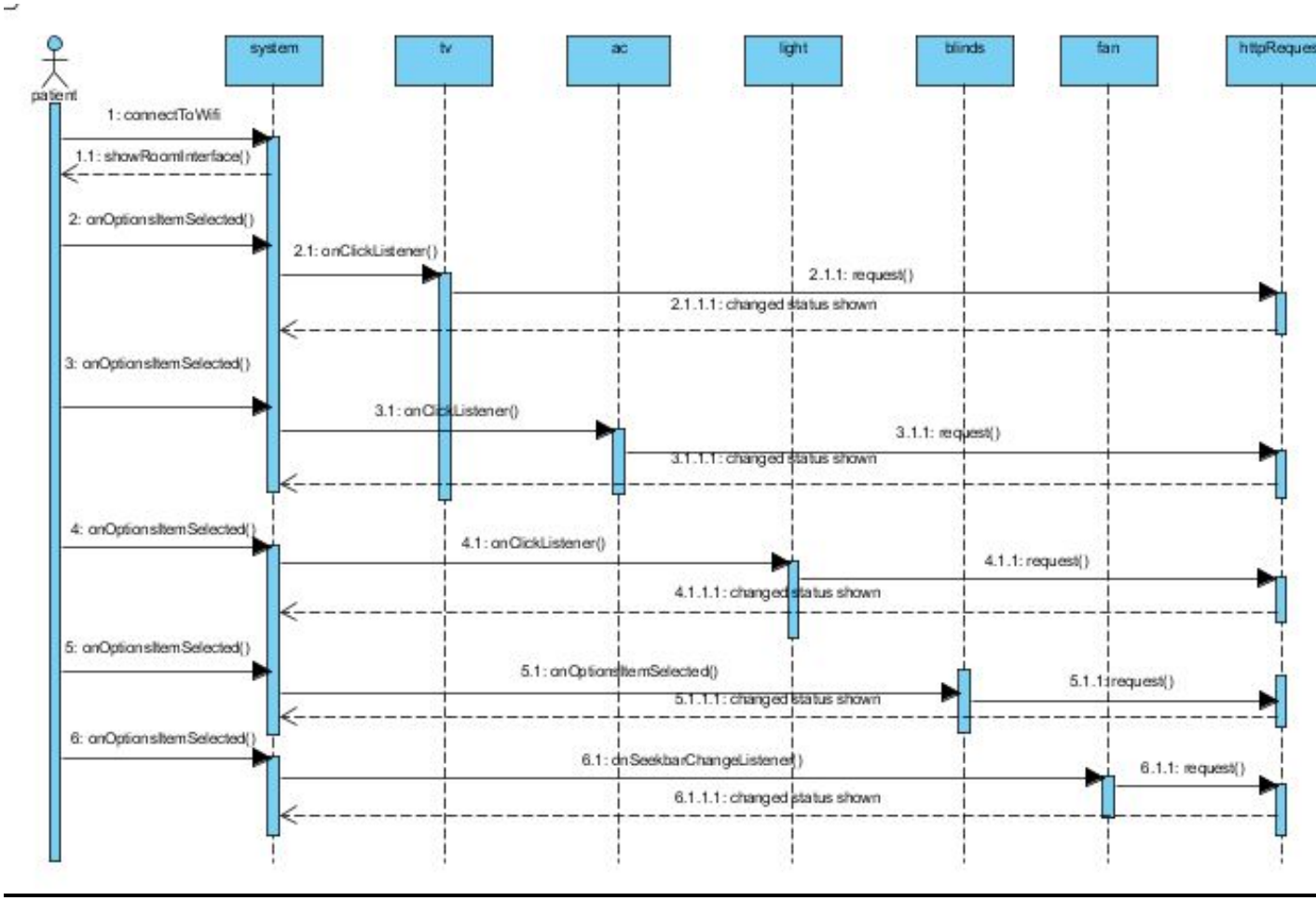

Fig 13: Sequence Diagram-Patient

This sequence diagram is when the patient user makes the interaction with the system. The patient should be connected with the system through Wifi. When the user is connected, the room facilities are shown to the patient and when the user selects the particular facility, its controls are shown to the user and then he/she can handle the electric appliances/load/equipment and make calls(routine and emergency).

3.10.2 Sequence Diagram- Maintenance Staff

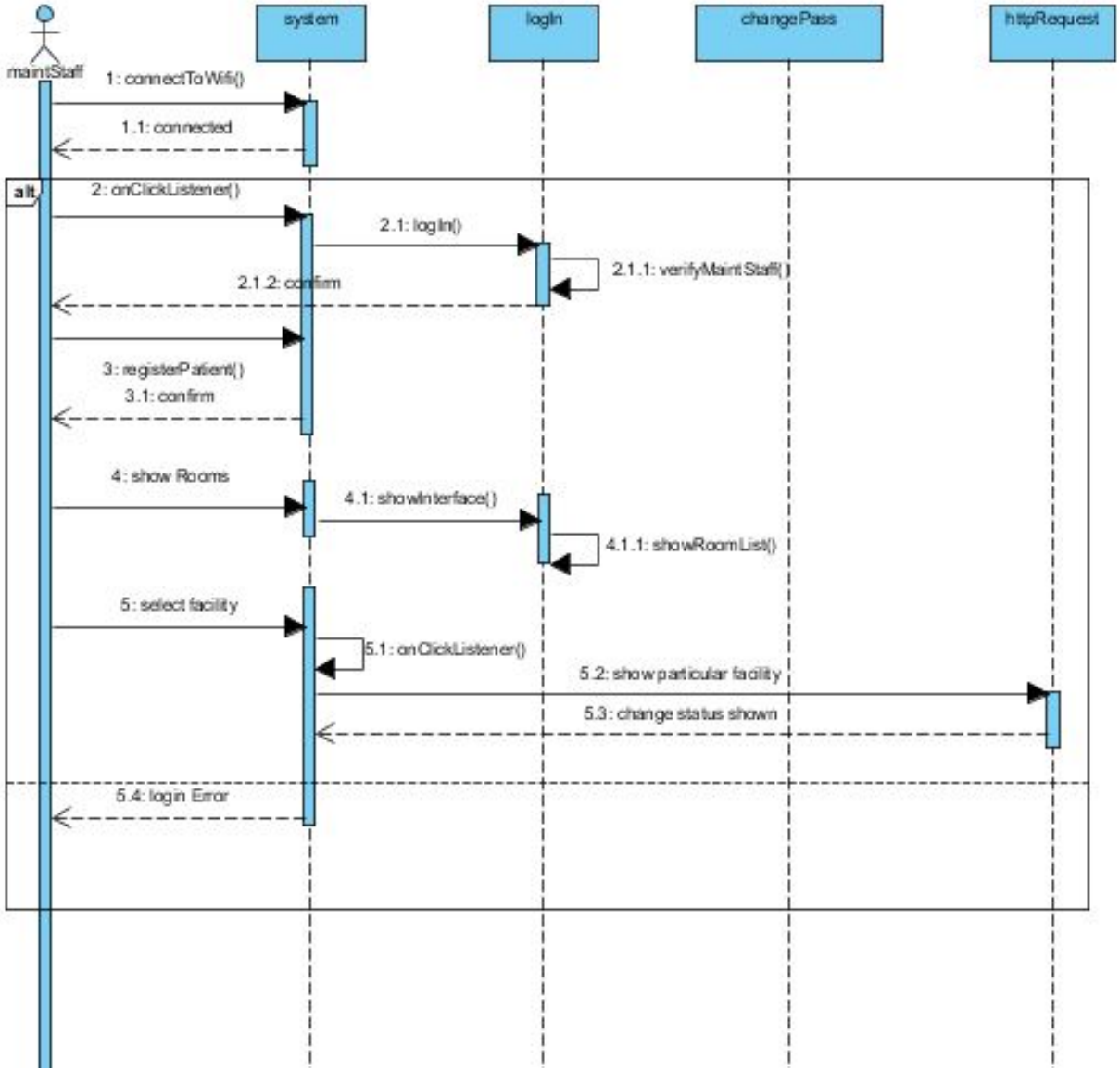

Fig 14: Sequence Diagram-Maintenance Staff

This sequence diagram is when the maintenance staff makes the interaction with the system. The device should first be connected with the system through Wifi. Maintenance staff enters the password and logs in. If the user is successfully verified, he/she can now create new user or can handle the equipment/ electric loads in all the rooms. The list of rooms are shown to the user and he/she can select the particular room which he/she want to control and further on selecting the particular facility the user can handle/control/manipulate the facility. If the maintenance staff is not verified through password, then the activity dies down.

3.10.3 Sequence Diagram-Patient and Maintenance Staff

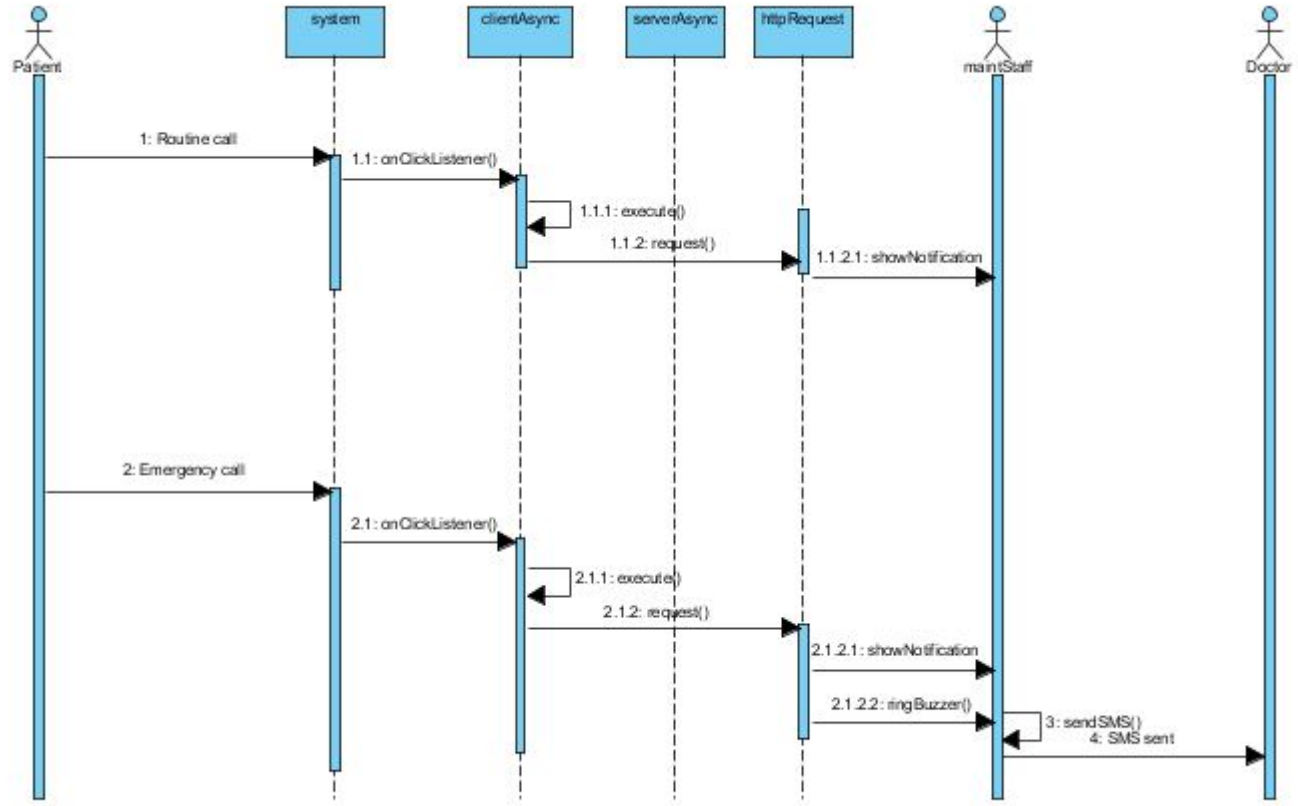

Fig 15: Sequence Diagram-Patient and Maintenance Staff

This sequence diagram is when the patient user makes the call. On clicking the facility onClickListener function will be called , and it will check if it is routine call or emergency call. If the button pressed is for the routine call then it will send the notification on the maintenance staff application. If the emergency call button is pressed, then it will ring the buzzer showing emergency and the notification will also be sent to the maintenance staff application which will further send predefined SMS to the concerned doctor.

3.11 User interface issues

3.11.1 Connection to Wifi Module: The user interface may change the state of electric devices to On/OFF but it may not change in real as the user device is not connected with Wifi module.

3.11.2 Layout: The layout of android app might change according to the display size of user device.

3.12 Detailed description of components

3.12.1 Arduino Mega 2560 Development Board[7]

Idenfication	Arduino Mega 2560 [7]
Type	The Arduino MEGA[7] is a microcontroller board based on the ATmega2560. It has a USB host interface to connect with Android based phones, based on the MAX3421e IC.
Purpose	It is bridge between WIFI module ESP 8266[8] and electric appliances for handling of electric appliances by android app
Function	It takes input from Wifi module ESP 8266[8] and pass it to microcontroller which will further process it and the processed output will be passed to the specific electric appliance through output pin
Subordinates	It provide 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 16 MHz crystal oscillator, a USB connection, a power jack, and a reset button and microcontroller embedded on it
Dependencies	**Connected Components** a. Wifi module b. Electric appliances It is dependent on Wifi module for input. It is used by microcontroller for input and to execute output
Interfaces	The Arduino can "talk", (transmit or receive data) via a serial channel, so any other device (wifi module) with serial capabilities can communicate

	with an Arduino.
Resources	Wifi module should be in working condition to carry out the tasks required to be performed by Arduino Mega[7] . Secondly the microcontroller need to be programmed and sketches are needed to be uploaded to it in order to take out the required functionality.
Processing	It takes input from Wifi module ESP 8266[8] through the input pins designated for the purpose and will pass it to the embedded microcontroller which will further process the received signal. The instruction is then passed by the micro controller to the specific pin for which the signal is received to perform the required functionality.
Data	The component will be on standby state until it receives input signal from wifi module.

3.12.2 Wifi Module ESP8266[8]

Idenfication	The ESP8266 WiFi Module[8]
Type	The ESP8266 WiFi Module[8] is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. ESP8266 wifi module is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.
Purpose	It is a bridge between android device and arduino mega[7]. ESP8266 module comes pre-programmed meaning, you can simply hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers
Function	ESP8266 takes the input signal from the android device to handle the commands provided by the user through android app. The wifi module gets the received signal and further pass it to arduino for handling of particular instructions

Subordinates	This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existance interfaces, it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.
Dependencies	ESP8266 is dependent on Android application for input signal. The arduino mega[7] is dependent on wifi module to get it connected with the user app and perform the required functionalities
Interfaces	This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices with minimal development up-front and minimal loading during runtime.
Resources	Android app is the prime resource for passing the instructions so the app needed to be connected to the wifi for transmission.
Processing	ESP8266[8] provides the wifi-ability to the arduino device for communication with user app and further process it. The received signal is passed to the arduino for handling particular instructions
Data	The component will be on standby state until it receives input signal from the user app

3.12.3 Android device

Idenfication	Android device
Type	Android enabled device supporting minimum version 4.0
Purpose	Platform where the android app operates
Function	In project point of view, the android device provides the wifi connectivity and for running the user app
Subordinates	a. Wifi connectivity b. Operating system
Dependencies	Power supply
Interfaces	Android app developed for the project is the only internal interface
Resources	Android Operating System
Processing	The android device provides the wifi connectivity for communication with wifi module ESP 8266[8] and for running the user app which contains the user interface for handling and passing instructions
Data	The device will be on standby state until interacted

3.12.4 Android app

Idenfication	“Patient room automation” on android device
Type	Utility app
Purpose	Provides user interface for automatic handling of electric appliances
Function	It facilitates the user to interact with different electric appliances. The user app is user friendly which provide easy to use interface and handling of different loads
Subordinates	It consists of buttons, sliders and controls for handling electric loads
Dependencies	It is dependent on android device which provides it the platform to run on it. The wifi connectivity is also the main ingredient for communication.
Interfaces	User interface provided by app provides communication with wifi module. The error will be generated in case the app is not connected through wifi.
Resources	Android device is an important external component with the wifi-ability
Processing	The user app provide the user friendly interface for controlling appliances e.g fan, light, tv,AC,blinds, emergency bell and routine call for maintenance staff.
Data	The app is in standby mode for interacting and changing the state of electric appliances by user

3.12.5 **Electric Appliances**

Idenfication	Electric appliances in patient room include a. TV b. AC c. Blinds (DC motors) d. Lights (LEDs)
Type	
Purpose	Utilities for the patient
Function	Routine usage appliances
Subordinates	
Dependencies	Dependent on user input through user app and command of arduino board which has the functionality to implement it
Interfaces	
Resources	Connection with the proper pins for output
Processing	1. Lights (ON/OFF) 2. Fans (ON, OFF and regulation) 3. TV (ON/OFF, volume UP/DOWN, channel searching) 4. Window blinds (OPEN ,CLOSE and SLIDE)
Data	

3.13 Reuse and relationships to other products

a. The project is designed to make it reusable for the future projects as well. Arduino ATMEGA 2560[7] provide 54 I/O pins (of which 15 are PWM outputs) which can provide further extension of project in future.

b. The android application can be used on any android enabled device as it will provide the flexible layout and can be used in automation systems in different capacities (organization automation, building automation, home automation etc) with little modifications.

c. Arduino sketches may be reused in further expansion of the project or can be reused in designing different automation systems.

3.14 Design decisions and tradeoffs

Factors	**Alternative 1** **Idea I**	**Alternative 2** **Idea II**	
Factors	**Idea I**	**Idea II**	**Final Decisions and Reasons**
Processing speed **(ATMEGA 1280)**	Processing speed of Microcontroller ATMEGA 1280 may be low.[9]	Advanced microcontrollers may be used to enhance speed	Processing speed of ATMEGA 1280 is 16 MHz and it suffice the requirements of our project
Packet loss **(**Wifi Module ESP8266**)**	Wifi module ESP 8266[8] is a cost effective but can result in packet loss	Better Wifi modules i-e : wifi shield may be used which may be more effective against packet loss but may be costly	Wifi module ESP 8266[8] suffice the requirements of our project
Range **(**Wifi Module ESP8266**)**	Wifi module ESP 8266[8] may provide limited range when number of rooms are increased.	Wifi shield may be used to have better range but it will be costly for the project requirements	We need to automate only one room for the project limitations. So Wifi module ESP 8266[8] suffice our project requirements
IO pins	Arduino Uno can be used which provide 14 IO pins[9]	Arduino Mega[7] provide 54 IO pins	Arduino Mega is used which provide more IO pins

System Implementation

The previous chapter discussed the detailed architecture and design, based on which this chapter will concentrate on the implementation details of the system.

We have categorized implementation details into hardware and software modules. Therefore, in the remaining of this section implementation details regarding these modules have been presented.

4.1 Software Module Implementation

Software module is further divided into android app development and Arduino microprocessor Programming.

4.1.1 Android App Development

Android app consists of two different modes for the user/patient and the manager/maintenance staff. The user mode is the default mode when the application is installed. The user can control the appliances of particular room for which he/she is registered. The application main interface is given as per Fig 16.

The user need to sign in as the manager if he/she wants to control all the room appliances. To sign in he/she has to provide the password.

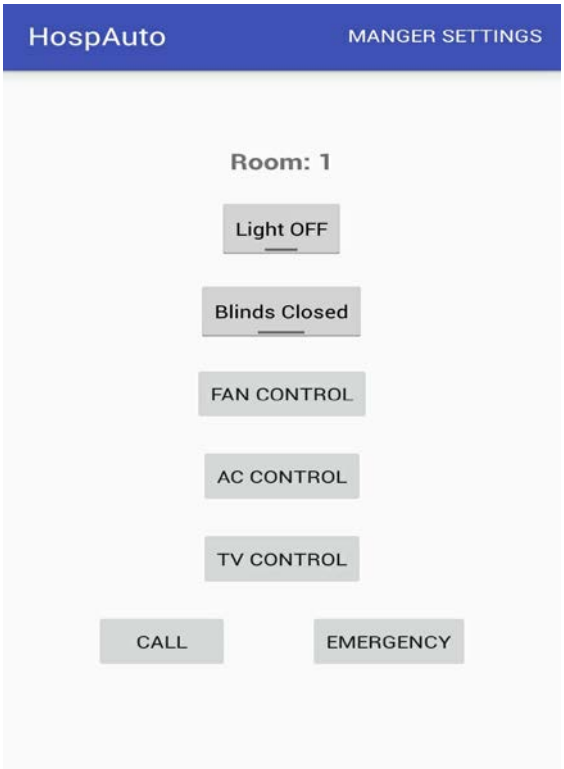

Fig 16 : Application main interface

4.1.1.1 How Electric Appliances are handled

When the user presses the light button the state is changed by pressing button, the preferences are set and http async request is forwarded consisting of network ip address, port number and the formatted string consisting of the room number, the particular appliance and its state. It will check for the availability of server before sending the request. The preferences are checked each time when the application is turned ON and the updated state of each appliance/facility will be shown. Further, the app will remain on ON mode and the screen will not be OFF will the time app is not closed or shutdown. This is done by keeping the screen ON option in layout parameters.

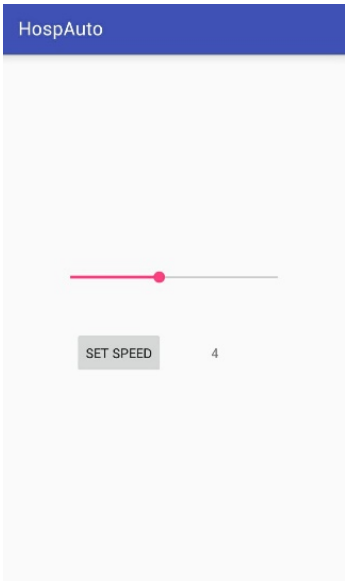

Fig 17 : Fan control interface

On pressing the fan button, the fan activity will start which will show the seek bar which can be slided for turning it ON/OFF or adjusting the speed. The progress is divided by 10, so that the 0 indicates OFF mode which can further be increased upto 9 which indicates the FULL speed that can be given. Any change will be recorded in the preferences and the http async request is forwarded which contains the three parameters as described above. The application fan control interface is given as per Fig 17.

On pressing the AC button, the AC activity will start which will show the buttons to turn the AC ON/OFF and adjusting its temperature. When the user presses any of the button the state is changed and the same procedure will be carried out. The application AC control interface is given as per Fig 18.

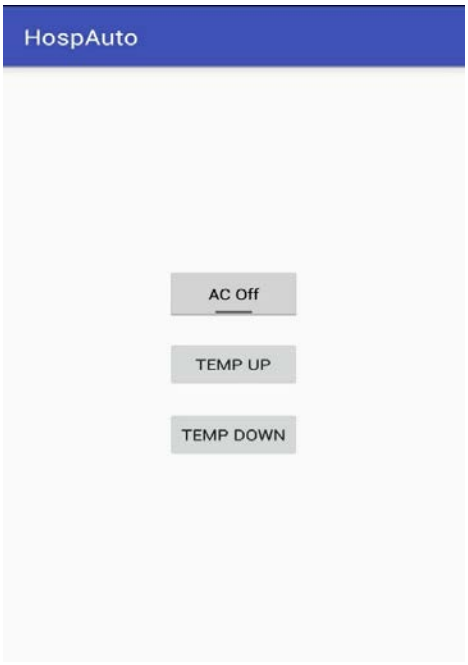

Fig 18 : AC Control interface

On pressing the TV button, the TV activity will start which will show the buttons to tutn the TV ON/OFF, adjusting the VOLUME and CHANNEL UP/DOWN. Other states will only be changed when the TV is in ON mode. When the state of any button is changed, the http async request is forwarded and same the updated state is recorded in the preferences. The application TV control interface is given as per Fig 19.

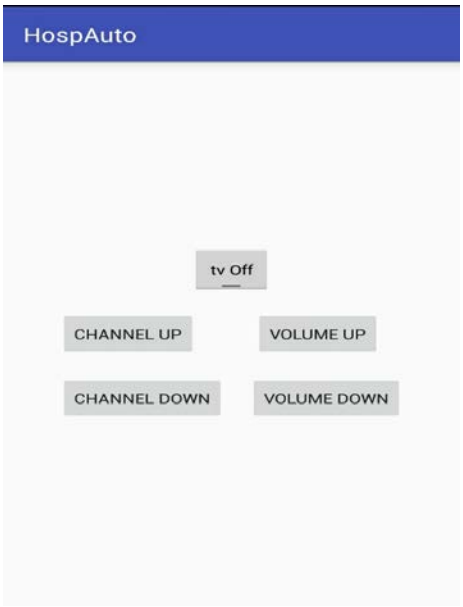

Fig 19 : TV Control interface

On pressing the Blind button, the preferences are set and the http async request is forwarded.

On pressing the call button, it will check if the manager mode is OFF, if it is OFF it will make clientAsyncTask class object which will carry the manager ip address, port number and the message which we want to display on the manager/maintenance staff phone as the notification. Further for the manager/maintenance staff device the serverAsyncTask class object is created , which will read the buffered data and the notification will be displayed on his/her device. The toast is created to inform the client or maintenance staff of notification ‘SENT’ or ‘RECIEVED’ respectively.

On pressing the emergency call button, it will check if the manager mode is OFF, if it is OFF it will make clientAsyncTask class object which will carry the manager ip address, port number and the message which we want to display on the manager/maintenance staff phone as the notification. Further for the manager/maintenance staff device the serverAsyncTask class object is created , which will read the buffered data and the notification will be displayed on his/her device. The serverAsyncTask will also create the http request object and pass the ip address, port number and the message which will send the http request. After executing this , the server will execute the onPostExecution function which will check if the manager mode is turned ON and it will send the message on the doctor’s phone by creating object of the smsManager class which contains five parameters, the first parameter contains the phone number and the third contains the message to be forwarded to the doctor, while keeping other parameters NULL.

The user can switch to MANAGER mode by pressing the button on the top right corner on app interface. The login page will be displayed. If the username and password is correct, the manager activity will start otherwise the toast will be generated showing that the username or password is incorrect. The application Manager login interface is given as per Fig 20.

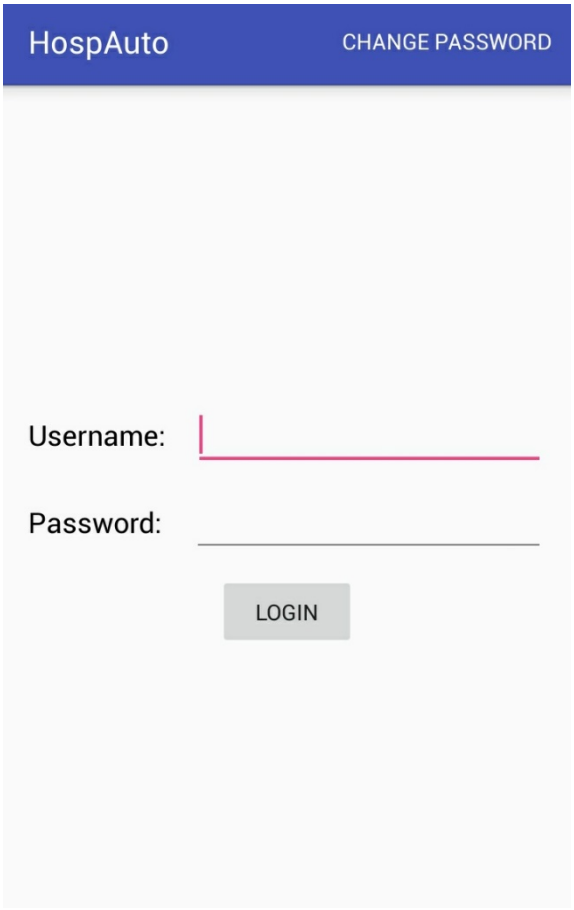

Fig 20 : Manager Login interface

In the manager activity, the manager can shift to user mode or manager mode by pressing the checkbox and further network ip, manager ip , room number and doctor's phone number can be changed/updated. Those credentials can be changed by clicking the SAVE button. On clicking SAVE button, the preferences will be updated and the toast appears notifying that the preferences are 'SAVED'. The application Manager interface is given as per Fig 21.

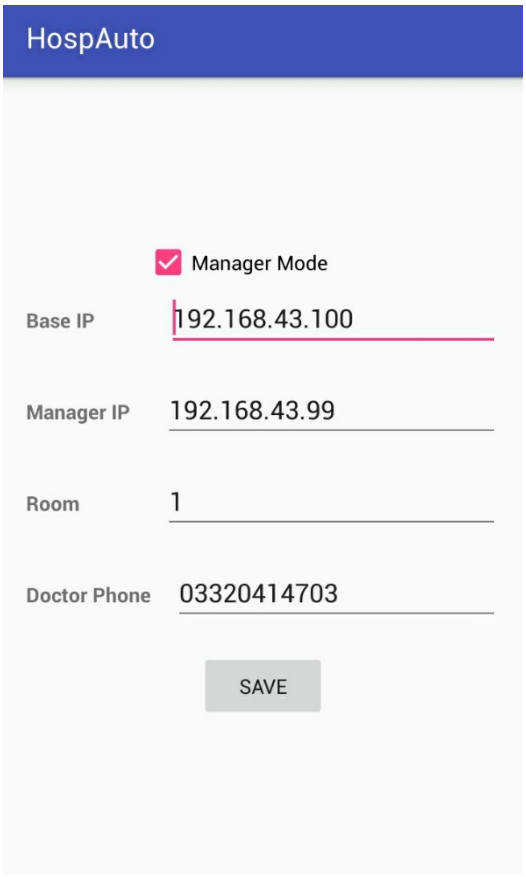

Fig 21 : Manager interface

4.1.2 Arduino Microprocessor Programming[1][2]

Arduino programming is done to control the electric appliances/ facilities based on the signal received. The Arduino will receive the command through esp8266 Wifi module which gives the Arduino wireless connectivity to it in order to communicate with the android application. The output pins of Arduino are defined and they are configured with LOW initially, which indicated the OFF mode. Further the access point is configured and the ip address and port is given along with the network is assigned within which it has to communicate.

The Arduino will always be on standby mode to listen to the instructions which are received through esp 8266[8]. If the instruction is received, it will decode the instruction through serial.read() function, the first chunk will indicate the room number, the second will indicate the device/appliance which need to be handled and the third will indicate the state to which we need to be changed.

The next thing we need to do is to make the series of nested if-else statements:

4.1.2.1 For light

The voltage of light will be updated by using the digitalWrite() which carries the two parameters, the pin number and the voltage to be assigned i-e : LOW/HIGH

4.1.2.2 For blinds

The voltage adjustment will be done by using digitalWrite(). When the instruction for blind OPEN is received, the blinds will move anti clock wise which is done by doing digitalWrite(5,HIGH) and when the instruction for blind CLOSE is received, the blinds will move clock wise which is done by doing digitalWrite(4,HIGH)

4.1.2.3 For AC

When the command for the AC is received , it will check which button is pressed, and according to which it will consist of the if-else statements which will send the hexadecimal code of that button through irsend.sendNEC(hexa_code,data_bits) function to the AC receiver to turn it ON/OFF and temperature UP/DOWN.

4.1.2.4 For TV

When the command for the TV is received , it will check which button is pressed, and according to which it will consist of the if-else statements which will send the hexadecimal code of that button through irsend.sendNEC(hexa_code,data_bits) function to the TV receiver to turn it ON/OFF and volume and channel UP/DOWN.

4.1.2.5 For Fan

When the command for the Fan is received , it will increase or decrease the voltage of the fan by multiplying it with 28. analogWrite(pin-number,command*28) is used for this purpose. All together we have the analog voltage adjustment from 0 to 255, so when the command= 0 is received, then 0*28 = 0, so the voltage will be 0 passed to the function and the fan will be turned to OFF mode.

4.1.2.6 For Emergency

When the command for the emergency is received, the buzzer voltage will be turned HIGH for 3 seconds and then it will be turned OFF.

4.2 Hardware Implementation

The basic hardware components include

a. Arduino Mega 2860[7]
b. Wifi module ESP 8266[8]
c. Motor driver IC L293D[3]
d. 2* DC motors 5v
e. IR Tx and Rx [4]
f. Adapter 5v, 2A
g. Transistors TIP 120[5], resistors, LEDs, buzzer 3906[6]

Pin 0 of Arduino is used as Rx and Pin 1 is used as Tx for connection with ESP 8266[8] which provides the wifi connectivity to the Arduino microprocessor.
The buzzer is connected with Pin 2 which is used for emergency call.
Pin 4 and Pin 5 are connected with the DC motor through the motor driver IC. The motor is used for the blind open and close.
Pin 6 is connected with the DC motor through transistor which is used for fan.
Pin 9 is used for IR LED Tx.
Pin 13 is used for LED which depicts the light.

Testing

5.1 Introduction

Most important issue related to any project is to ensure that the quality of the product is high and it is efficient therefore testing of the software is conducted. In Software projects special importance is given to the testing and it is one phase of Software development life cycle, no software project is completed without testing. Testing techniques which are used in testing of Patient Room Automation to obtain the high quality product are discussed in this chapter.

5.2 Testing Techniques and Levels

Testing of the software projects involve different levels of testing to make sure that the software which is being developed is error and fault free. Patient Room Automation has different modules which were developed separately depending up on the functionalities. Therefore testing of all the functions has to be done and testing while integrating all the modules. The different levels at which testing was done are discussed here.

5.3 Unit Testing

Unit testing involves the testing of each module at the completion and sometimes during the development of the functionalities. The testing of each function is carried out on the basis of the defined data sets.

5.3.1 Light Function

The light function was checked by turning the light button ON/OFF on the android app. The ESP 8266[8] was not receiving the command as the Rx side of ESP was connected to the Rx side of Arduino Mega[7]. That was then changed by connecting Rx side to Tx of Arduino Mega[7]. That showed the correct output as was demanded.

5.3.2 Blind Function

The blinds functionality was checked for its movement in clockwise and anticlock wise when the blinds are commanded to be opened or closed. One directional movement of blinds was achieved by using DC motor, which can turn the blinds ON but anticlock wise movement was the problem. That was then achieved by using motor driver IC L293D. It was then connected to pin 4 and pin 5 of Arduino such that the when command is given to turn blinds OFF then motor moves clockwise and after delay it shuts it off indicating that the blinds are closed now.

When the command is given to turn the blinds ON , the motor rotates anti clockwise and after some delay it shuts it off indicating the blinds are closed.

5.3.3 Fan Function

The fan functionality was checked for its movement at different speed which gave its correct output as desired.

5.3.4 TV Function

The TV functionality was tested using 6 LEDs for indicating the ON/OFF, channel UP/DOWN, volume UP/DOWN which showed the correct output as was desired. This was further checked by using the remote control of TV by using separate buttons for each sub function and it gave the desired results as was expected.

5.3.5 AC Function

The AC functionality was tested using 3 LEDs for indicating the ON/OFF and temperature UP/DOWN which showed the correct output as was desired.

5.3.6 Call Function

The call function was checked by making one device as manager and the other device as user/patient. When the button was pressed on patient side, it didn't showed the notification on the manager side as was expected due to connection problems which were latter ractified and the results were seen as desired.

5.3.7 Emergency call Function

On pressing the emergency call by the user/patient, the manager should get the notification, the bell buzzer should ring outside the patient room and the sms should be generated automatically on the doctor's phone. When the functionality was checked it showed the notification and buzzer range but the SMS was not generated. The functionality was then added after further studies and the testing was carried out which gave satisfactory results.

5.4 System Testing

System testing is the level of testing which comes when the whole system has been developed and integrated. The complete system was tested in different places with different

conditions to verify that those conditions do not disrupt the performance of the system. The significant finding was that the range of the IR Tx is low, the 1000 ohm resistor was replaced with 500 ohm , which increased the bit but it needs to be further increased by using NPN transistor.

The second observation was regarding increase/decrease in TV volume. When the button is pressed it increases by only one hop which creates the difficulty for the user as user has to press the button multiple times while increasing or decreasing it. This was ractified by calling the same function twice on one time button press.

5.5 Test cases description

5.5.1 Login

Test Case ID:	1
Test case name	Login
Description:	Maintenance staff tries to login to the system as the manager
Preconditions:	User is not logged in as maintenance staff
Post conditions:	Maintenance staff is logged in in a manager mode
Expected Result	When the user enters the username and password, it checks whether the username and password provided are correct. If they are correct then the manager can switch to manager mode. If the username and password provided are incorrect then error message is shown
Actual Result	The user was able to change its status to manager mode when the correct username and password provided. The error was shown when the wrong username and password entered.

5.5.2 Control Electric Appliances/Load

Test Case ID:	2

Test case name	Control electric appliances/load
Description:	A user wants to handle the electric equipment in any room
Preconditions:	User should be logged in as a maintenance staff
Post conditions:	If the test case was successful, the actor can now handle/control any of the appliance in any room by changing the room number
Expected Result	The maintenance staff can control the electric equipment/ load/appliances in any of the rooms which are connected with the system.
Actual Result	The system was checked and found to get the correct output as expected

5.5.3 Generate SMS

Test Case ID:	3
Test case name	Generate SMS
Description:	A user wants to generate SMS to the concerned doctor as soon as he receive the emergency call/ring by the patient
Preconditions:	Maintenance staff got an emergency call
Post conditions:	If the test case is successful, the SMS will automatically be generated from the manager mobile indicating the emergency room number.
Expected Result	The predefined message should automatically be generated and sent to the doctor whose number is provided by the maintenance staff when the emergency call button is clicked from the patient android app.

Actual Result	The system was checked and found to get the correct output as expected

5.5.4 Handle Electric Appliances/Load

Test Case ID:	4
Test case name	Handle electric appliances/load
Description:	A user wants to handle the electric equipment in any room
Preconditions:	User should be allocated the room by the maintenance staff
Post conditions:	If the test case is successful, the user/ patient can now handle/control any of the appliance in his/her room
Expected Result	The maintenance staff should login as the manager in order to allocate the room and then the user/patient can handle the electric appliances/load of the particular room.
Actual Result	The system was checked and found to get the correct output as expected

5.5.5 Generate notification

Test Case ID:	5
Test case name	Generate notification
Description:	A user wants to make routine call to maintenance staff for routine purpose
Preconditions:	User should be allocated the room by the maintenance staff

	User presses the call button Maintenance staff is logged in as manager
Post conditions:	Maintenance staff/ manager gets the notification
Expected Result	When the maintenance staff is logged in as the manager he/she should get the notification indicating the room number from which the call is made. When the maintenance staff is not logged in as manager he/she should not receive the notification.
Actual Result	The system was checked and found to get the correct output as expected

5.5.6 Ring Buzzer

Test Case ID:	6
Test case name	Ring buzzer
Description:	A buzzer rings when the user/patient clicks the emergency call
Preconditions:	User should be allocated the room by the maintenance staff User presses the emergency call button
Post conditions:	Buzzer rings for indicating emergency
Expected Result	When the user clicks the emergency call button, the buzzer should ring for 3 seconds to indicate emergency.

Actual Result	The system was checked and found to get the correct output as expected

5.5.7 Light Control

Test Case ID:	7
Test case name	Light control
Description:	A user can turn the light ON/OFF through android phone
Preconditions:	User should be allocated the room by the maintenance staff User is connected to the network
Post conditions:	User can switch the light ON/OFF by toggle button
Expected Result	When the user toggles the button on his/her phone the light switches its mode
Actual Result	The system was checked and found to get the correct output as expected

5.5.8 Fan Control

Test Case ID:	8
Test case name	Fan control
Description:	A user can turn the fan ON/OFF and adjust its speed through android phone

Preconditions:	User should be allocated the room by the maintenance staff User should be connected to the network
Post conditions:	User can turn the fan ON/OFF and adjust its speed by seek bar
Expected Result	When the user slides through the seek bar the fan speed is adjusted accordingly. When the speed is kept at 0 the fan turns OFF. When it is at 1 the fan turns ON with slow speed. At 8 fan moves with its maximum speed.
Actual Result	The system was checked with the different positions of seek bar and found working correctly as per the expected result.

5.5.9 Blinds Control

Test Case ID:	9
Test case name	Blinds control
Description:	A user can turn the blinds OPEN/CLOSE through android phone
Preconditions:	User should be allocated the room by the maintenance staff User should be connected to the network
Post conditions:	User can turn the blinds OPEN/CLOSE
Expected Result	When the user toggles the button on his/her phone the blinds should open and close

Actual Result	The system was checked and found working correctly as per the expected result.

5.5.10 TV Control

Test Case ID:	10
Test case name	TV Control
Description:	A user can switch the TV ON/OFF , adjust its volume and change the channels
Preconditions:	User should be allocated the room by the maintenance staff User should be connected to the network
Post conditions:	User can switch the TV ON/OFF , adjust its volume and change the channels
Expected Result	The TV should be turned ON when the ON/OFF button is pressed if the TV is OFF The TV should be turned OFF when the ON/OFF button is pressed if the TV is ON When the TV is ON the Volume can be increased/decreased by pressing the buttons The user should be able to change the channel UP/DOWN when the TV is turned ON Nothing should be done when the TV is OFF
Actual Result	The TV was not able to turn ON by pressing ON/OFF button when the TV was OFF The system was checked and found working correctly as per the expected results in rest of the functions.

FUTURE WORK

The purpose of this project was to learn various aspects of android, java and Arduino. The interface is designed to maintain an easy approach for a common man with little knowledge of Android devices. The primary aim to develop this system is to provide sense of automation to the people in our surrounding and make a certain progress in this field. Future work will be focused on improving the quality of this application with add-on features including

a. Inculsion of automatic bed positioning to adjust the bed position.
b. Wifi router to be used to further increase the range.
c. To enhance its capacity to make it workable for the multiple rooms.
d. Auto feedback functionality for showing the updated status of the appliance/ electric load when it is changed by any user.
e. More TV and AC controls to be inserted within the system to provide the functionality as done by any conventional remote control.
f. The user interface will be modified and pictures of various facilities will be shown in place, to make it user friendly and easy to operate for the people not well conversant with English language.

CONCLUSION

The increased scope of automation has introduced us with the different dimension of development and production. With the introduction of IoT[13] (Internet of Things) concept, the time is not far when each of the electric devices being used in homes and offices will be automated and they would be operable from thousand of kilometres. In order to keep up the pace with the modern world, we have to progress in this direction in which our project “Android based patient room automation” is the way forward and the initial step with in our scope.

Appendix A: Glossary

ABPRA Android Based Patient Room Automation system

Activity diagram: An analysis model that shows a dynamic view of a system by depicting the flow from one activity to another. Similar to a flowchart.

API (application programming interface): specifies how some software components should interact with each other. In addition to accessing databases or computer hardware, such as hard disk drives or video cards, an API can be used to ease the work of programming graphical user interface components.

Assumption: A statement that is believed to be true in the absence of proof or definitive knowledge.

Class: A description of a set of objects having common properties and behaviours, which typically correspond to real-world items (persons, places, or things) in the business or problem domain.

Class diagram: An analysis model that shows a set of system or problem domain classes and their relationships.

Constraint: A restriction that is imposed on the choices available to the developer for the design and construction of a product.

Data flow diagram: An analysis model that depicts the processes, data collections, and flows among them that characterize the behavior of a business process or of a software system.

Dependency: A reliance that a project has on an external factor, event, or group outside its control.

Feature: A set of logically related functional requirements that provides a capability to the user and enables the satisfaction of a business objective.

GUI: Graphical user interface

Hardware: A computer and the associated physical equipment directly involved in the performance of data-processing or communications functions.

Hardware Interface: The logical and physical characteristics of each interface between the software product and the hardware components of the system.

Implementation: Execution of a plan, idea, model, design, specification, standard, algorithm, or policy.

Interface: A point where two systems, subjects, organizations, etc., meet and interact.

IO pins: Input Output pins

Non-functional requirement: A description of a property or characteristic that a software system must exhibit or a constraint that it must respect, other than an observable system behaviour.

OS: Operating System

Perspective: The way in which objects appear to the eye.

Post condition: A condition that describes the state of a system after a use case is successfully completed.

Precondition: A Condition that must be satisfied before a use case may begin.

PWM: Pulse Width Modulation

References: List of any other documents or Web addresses to which this SRS refers. These may include user interface style guides, contracts, standards, system requirements specifications, use case documents, or a vision and scope document. Provide enough information so that the reader could access a copy of each reference, including title, author, version number, date, and source or location.

Scope: The portion of the ultimate product vision that the current project will address. The scope draws the boundary between what's in and what's out for the project.

SMS: short message service

SOC: System on a chip

Software requirements specification: A collection of the functional and non-functional requirements for a software product.

Specification, requirements: The process of documenting a system's requirements in a structured, shareable, and manageable form. Also, the product from this process.

Usability: Fit for use; convenient to use.

Use case: A description of an interaction between an actor and a system that results in an outcome that provides value to the actor.

Use case diagram: An analysis model that identifies the actors who can interact with a system to accomplish valuable goals and the various use cases that each actor will perform.

User: A customer who will interact with a system either directly or indirectly (for example, using outputs from the system but not generating those outputs personally). Also called end user.

User Interface: the logical characteristics of each interface between the software product and the users.

User requirement: User goals or tasks that users must be able to perform with a system, or statements of the user's expectations of system quality.

Validation: The process of evaluating a work product to determine whether it satisfies customer requirements.

Wi-Fi: Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections

Wi-Fi Router: used to provide access to the Internet.

Appendix B: Bibliography

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Appendix C: User Manual

WELCOME

Thank you for using the Android Based Patient Room Automation system

This user's manual is designed to be a reference for the operation of the Android Based Patient Room Automation system (ABPRA)

Here you can find detailed operation information related to the ABPRA.

Overview and Environment

The following sections give a brief overview of the Smart Monitoring System and the minimum requirements needed to run the software

Overview

It is software that comes with hardware required for the automatic handling of electric equipment/ load.

It provides the user with a graphical interface to control the electric equipment through the android app. The interface is user friendly and shows the list of equipment which can be operated. The application can be handled in user and manager mode both. The manager has the option to register new device and customize the preferences.

Environment

Android enabled device supporting version 4 and above.

Installation

Simply download the apk file on the device on which the application needed to be installed. After the application is installed, the user should connect the device with the WiFi hotspot which is already made by the manager.

Configuring WiFi Hotspot

Manager should create the hotspot from the SETTINGS option in his/her device so that other users can be connected to it. Fig 3-1 shows the option to create the hotspot.

Fig 3-1 Configuring WiFi Hotspot

How to Use Software

This section describes the various features offered by the software and how to use these.

Main Menu

The figure 3-2 shows the main menu which is displayed when the application is started.

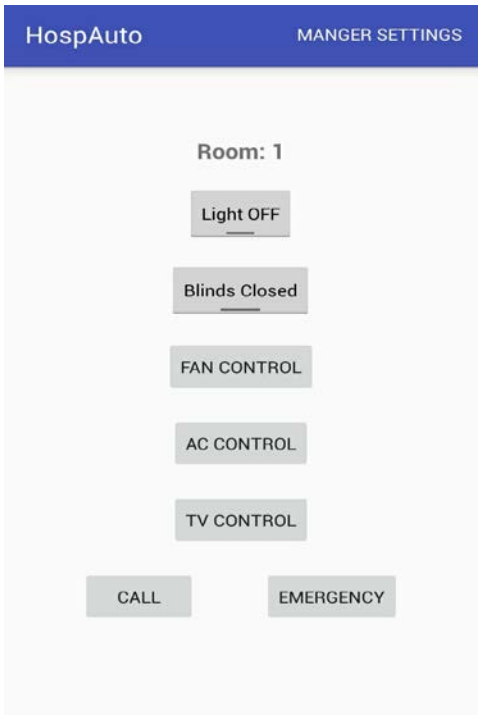

Figure 3 – 2 Main Menu

Light Button

On clicking the Light button the toggle button the light will be turned ON and OFF.

Blinds Button

On clicking the Blinds button the toggle button will OPEN/CLOSE the blinds.

Fan Menu

On clicking the Fan button the new page will appear.

On clicking the Fan control the screen appears as shown in Fig 3-3

Figure 3 – 3 Fan Menu

The speed of the fan can be adjusted between 0 and 9. At 0 the fan is OFF and at 9 the fan is at maximum speed.

AC Menu

On clicking the AC Control, the following menu will appear as shown in Fig 3-4

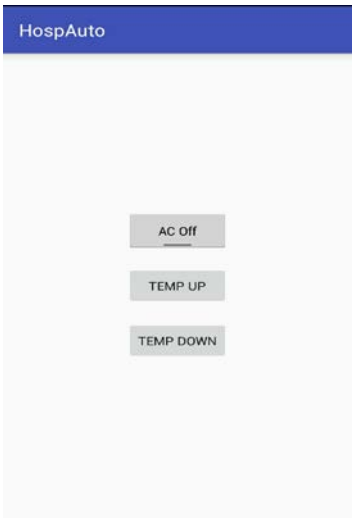

Figure 3 – 4 AC Menu

AC can be turned ON and OFF by the toggle button. When it is turned ON, the temperature can be increased and decreased by clicking the TEMP UP and TEMP DOWN buttons respectively.

TV Menu

On clicking the TV Control, the following menu will appear as shown in Fig 3-5

Figure 3 – 5 TV Menu

TV can be turned ON and OFF by the toggle button showing TV off initially. When it is turned ON, the channel can be changed by clicking the CHANNEL UP and CHANNEL DOWN buttons and the volume can be adjusted by VOLUME UP and VOLUME DOWN buttons respectively.

Call Button

On clicking the call button, the notification will be sent on the maintenance staff device.

Emergency button

On clicking the Emergency button, the notification will be sent to the maintenance staff and the buzzer will ring for 3 seconds showing the emergency in particular room. As soon as the notification is received on the maintenance staff device the pre-formatted text is forwarded to the concerned doctor having the id of the particular patient's room.

Manager Settings

On clicking the Manager Settings button in main menu, following screen appears as shown in fig 3-6

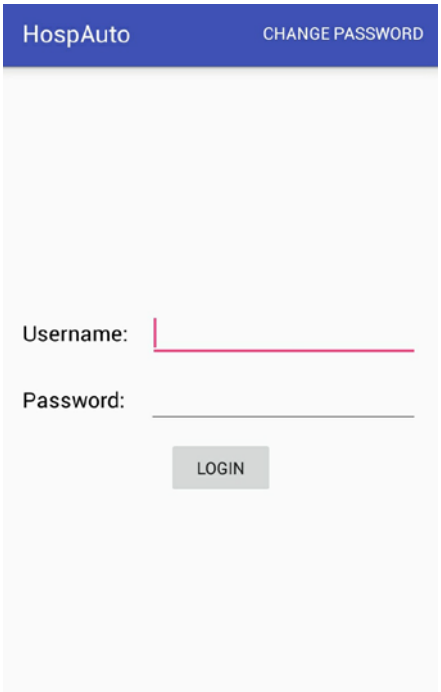

Figure 3 – 6 Login

The user has to provide the username and password in order to Login as the Manager. If the username and password provided are wrong the error will be displayed.

Manager Preferences

When the username and password provided are correct, the following screen will be displayed as shown in fig 3-7

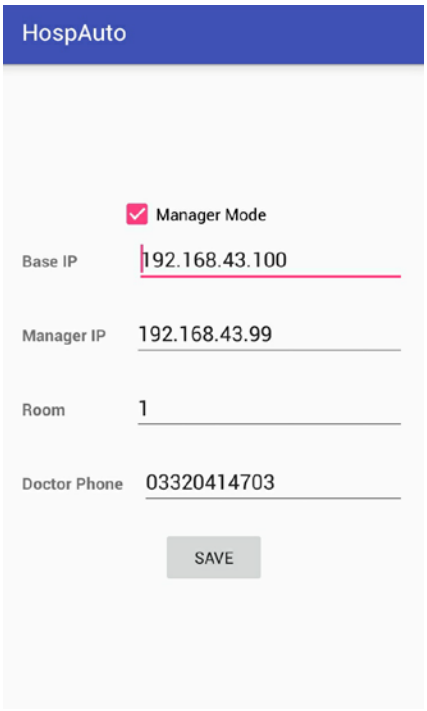

Fig 3-7 Manager Preferences

The user can now change the preferences after login.

He/she can change into user mode/ manager mode by the check box.

He/she can change the base IP. The base IP is the network IP and should remain same for the same network.

The manager can register the particular device by signing in as Manager and then changing the Manager IP and turning OFF the Manager mode and clicking the SAVE button.

The doctor’s phone can be provided which is used in case of emergency.

Change Password button

On pressing the CHANGE PASSWORD button on the top right corner, the screen will appear as shown in fig 3-8

Fig 3-8 Change Password Form

The old password of manager can be changed by providing the old and new password and clicking CHANGE PASSWORD button.

Note

The application will remain turned ON when left in idle state in order to make it usable anytime by the user. In order to turn OFF the screen, the application need to be turned OFF.