



School of Science and Technology
CSD3999
Software Development Project

Autumn/Winter term
2018/2019

Date: 26 April 2019

Supervisor: Prof. Juan Carlos Augusto

Student Name: Constantin-Alexandru Apetrei

Student ID Number: M00536775

Campus: Hendon

Title: Android Application for Smart Home

Declaration

School of Science and Technology

Student Name: Constantin-Alexandru Apetrei

Student ID Number: M00536775

Module Number: CSD3999

I hereby confirm that the work presented here ion this report and all other associated material is wholly my own work. I confirm that the report has been submitted to TURNITIN and that the TURNITIN results are on CD attached to this report. I agree to assessment for plagiarism.

Signature: C-A Apetrei

Date: 26 April 2019

Acknowledgements

I would like to thank to my supervisor Professor Juan Carlos Augusto. His encouragement, knowledge and fully support helped me to realise what I need to in order to complete this project.

Secondly, I want to thank my family for everything that they have done for me and for their support. I would never be where I want to be without them.

In the end I would like to say a big thank you for everyone at Middlesex University. Being a university student on this campus was amazing and I will never forget my transformation trough the years. This university helped me to develop my skills and to change my life because I did not know what to do with my life. But, after this great experience I would like to say a big thank you! I also want to say thank you to some teachers that helped me to make my studies easier: Michael Heeney, Leonidas Aristodemou, Denis Tsvetkov, Prof. Juan Carlos Augusto and Prof. Franco Raimondi, who has been a mentor to me.

Abstract

We all live in a very fast changing world where the technology has changed significantly over the past 20 years. It has a progressively fundamental role in our daily experience and global economy. There are a variety of technologies that are becoming more common and important in people's life. For example, a lot of engineers struggle to combine a lot of automated devices with some scientific and organisational tools in order to create a very complex system for a fast-expanding range of applications and human activities, such as, home automation. Charles-Edouard Jeanerette known as "Le Corbusier" was a Swiss-French designer, writer and architect that considered a home to be a machine for living.

During the project development, I will have access to one of the university smart space labs to test and pair the application with the sensors or smart devices from the specific lab. There are some features that the Android app can have is the registration screen where the user will be able to login to get their smart home preferences and settings.

Access configuration will be the place where the user can make some arrangements to their profile. Another feature can be the app guide that will help them to find how to connect it to the smart devices around. Device and sensors screens will display a list of all the active devices in the smart home lab, and every single gadget will have a separate management page.

One of the most important parts of the smart home system is to get a successfully connection with the z-wave Vera Plus control system. I have done a lot of researches base on home automation and especially on z-wave (+Vera Plus) because I wanted to be able to understand how it works and how are the requests send to the end devices.

Table of Contents

DECLARATION	2
ACKNOWLEDGEMENT	3
ABSTRACT	4
1.INTRODUCTION	7
1.1 PROJECT DESCRIPTION AND DELIVERABLES	7
1.2 PROJECT OBJECTIVES	8
1.3 PROJECT OUTCOME AND LIMITATIONS	9
1.4 REPORT STRUCTURE	10
2.LITERATURE REVIEW	11
2.1 INTRODUCTION	11
2.2 DEFINITION	13
2.3 HISTORY	13
2.4 TECHNOLOGIES	14
2.4.1 PYTHON	14
2.4.2 MYSQL DATABASE	15
2.4.3 GOOGLE CLOUD APIs	15
2.4.4 HTML	16
2.4.5 JAVASCRIPT	16
2.4.1 CSS	16
2.4.1 BOOTSRAP	17
3.REQUIREMENTS SPECIFICATION	18
3.1 CURRENT SOLUTION	18
3.2 CURRENT APPLICATION FEATURES ALONGSIDE PROJECTS AIMS	19
3.3 FUNCTIONAL AND NON-FUNCTIONAL REQUIREIEMENTS	20
3.3.1 FUNCTIONAL REQUIREMENTS LIST	20
3.3.2 NON-FUNCTIONAL REQUIREMENTS LIST.	21
3.4 TARGET USERS	21

4.ANALYSIS AND DESIGN	22
4.1 POSSIBLE PROBLEMS AND SOLUTIONS	22
4.2 PROJECT DESIGN	23
4.3 PROJECT PLAN	25
4.4 POSSIBLE INTERFACE DESIGN	25
4.4.1 HOME PAGE	26
4.4.2 SIGN-UP PAGE.	26
4.4.3 SIGN-INPAGE	27
4.4.4 CONTROL PAGE.	27
5.IMPLEMENTATION	28
5.1 PROJECT GRAPHIC USER INTERFACE	28
5.1.1 HOME PAGE	28
5.1.2 REGISTER PAGE.	29
5.1.3 LOG-IN PAGE	30
5.1.4 CONTROL PAGE	31
5.1.5 NAVIGATION BAR.....	32
5.1.5.1 NAVIGATION BAR (USER LOGGED_IN MODE)	32
5.1.5.2 NAVIGATION BAR (USER LOGGED_OFF MODE).....	32
5.2 PROJECT GOAL REVIEWED	33
5.3 PROJECT CHALLANGES.....	33
5.4 SYSTEM EXPLANATION + CODE.....	35
6.TESTING.....	38
7.EVALUATION	40
8.CONCLUSION	41
9.BIBLIOGRAPHY	43
10.APPENDINX 1 - Testing	45
10.1 Insert Details Test.....	45
10.2 Database-Storage	46
11.APPENDINX - CODE	46

1 INTRODUCTION

1.1 PROJECT DESCRIPTION AND DELIVERABLES

The project involves the construction and design of an android application that will be used for smart home control. By using the Android app, the user will be able to command a fully functional home environment that is controlled by self-programming to create an interactive smart home functionality which improves residents' experiences. The project aim is going to be a setup of in-home internet-connected smart devices or sensors that will be remotely controlled by the Android application. Intelligent devices are some electronic gadgets that use protocols to communicate. A protocol is a kind of style in which a signal is mainly transmitted from one device to another to launch an action.

The project resources are used to carry out some of the most crucial project tasks, and they can be equipment, people, facilities or anything that is efficient in completing one of the project activities. One of the resources can be the equipment I am going to use to test and create the Android application. The equipment of the project is going to be the smart home sensors, intelligent devices, and the software. The facilities that I am going to use to test and set the app is going to be the smart space labs that contain the devices and sensors I will need for my project. Another resource that I will need to complete the smart home Android app will be a good piece of a software application like the ones I have talked about earlier on this paper.

The first step of the project will be the android application development. To design a good project, I will need to use one of the most popular

software applications such as android studio or eclipse that are two of the most preferred integrated development environment (IDE) for android application development. The outcome of the project is the actual application design which will be used to control all the intelligent devices or sensors inside a smart environment.

1.2 PROJECT OBJECTIVES

There is a list of the project objectives that are fundamental for this project:

- Research for voice recognition systems (APIs) that can convert speech-to-text and use the best one for the project.
- Find information about z-wave devices and their protocols. Learn how are the devices interacting with z-wave Vera Plus, how can users are able to find what is the device state.
- Design a user interface using JavaScript, HTML and Python. Also, learn more about them and how can they help you to build a mobile application.
- Understanding and identifying the device sensors in the house and how do they communicate with the central hub (Vera Plus).
- Change or modify the devices status by using the app.

- Create a safe system by creating an authentication for new users.
- Implement API to develop a nice and easy application for the users: use voice recognition
- Get a better understanding of programming languages that are going to be used in the development stage.
- Advanced research of the flask framework.
- Develop better experience for users willing to use smart home devices

1.3 PROJECT OUTCOME AND LIMITATIONS

The project outcome is very important because we need to know what this project can be. The android application will be easy to use, not difficult and will help users to control their smart home devices by using voice control. The system will be able to communicate with the house central hub. In my case the z-wave Vera Plus is the central hub and it is used to control all the smart devices in the house. During this project, a system will be developed and will be ready to communicate with Vera Plus, in order to control the end devices. The system will be able to register users, to be able to save their configuration if they want to leave the house or control however they want. The users will use voice commands to send orders to the devices using z-wave Vera Plus. The project will be limited because the users will need to be in the specific smart lab in order to use the application. Once they have left the house, they will not be able to change a device state. There are some restrictions of the query API that will be used in the project to make the android application communicate with the devices. Users will have to be inside the specific network range (Middlesex University).

1.4 Report Structure

This report will provide the overall project target and goals. Basically, this paper will contain all the important information and all the stages taken in order to develop an android application used to control smart home devices via voice control. The first chapter of the project is introduction and it will give a brief introduction about what is the project about and what is the main goal. In chapter 2, there will be a literature review that will provide the history, technologies, evolution and everything about the smart automation systems. Chapter 3 contains the entire project requirements specification including the non-functional and functional requirements and current solutions. Information about the project design, implementation and tests will be found in chapters 4,5 and 6. The evaluation, conclusion and references will be stated in the last three chapters.

2 LITERATURE REVIEW

2.1 Introduction

We all live in a very fast changing world where the technology has changed significantly over the past 20 years. It has a progressively fundamental role in our daily experience and global economy. There are a variety of technologies that are becoming more common and important in people's life. For example, a lot of engineers struggle to combine a lot of automated devices with some scientific and organisational tools in order to create a very complex system for a fast-expanding range of applications and human activities, such as, home automation. Charles-Edouard Jeanerette known as "Le Corbusier" was a Swiss-French designer, writer and architect that considered a home to be a machine for living. The idea of a home automation has been around for a very long time and people's expectations have changed a lot lately to completely turn the traditional house into a smart home. So, the concept home automation has started to become very well-known due to its various benefits and to different technologies that started to appear over the years.

The idea of a home automation has been around for a very long time and people's expectations have changed a lot lately to completely turn the traditional house into a smart home. So, the concept home automation has started to become very well-known due to its various benefits and to different technologies that started to appear over the years. Thinking about the last couple of years, there are a lot of well-known home automation systems that are established on wired communication such as raspberry pi or Arduino. But, speaking about the present there are the Wireless

systems such as WI-FI, IOT and Bluetooth that could reduce the cost of implementation going very high for the existing buildings. With the progression of the wireless technologies like cloud networks or WI-FI, in the last decade, the wireless systems are really used everywhere and every day. Automation is a unique method, or a system used to control and manage a process by using electronic devices in order to reduce the human involvement to a minimum rate. If we really look at the home automation systems over the years, they all attempted to provide suitable, efficient and safe ways for home residents to access their homes.

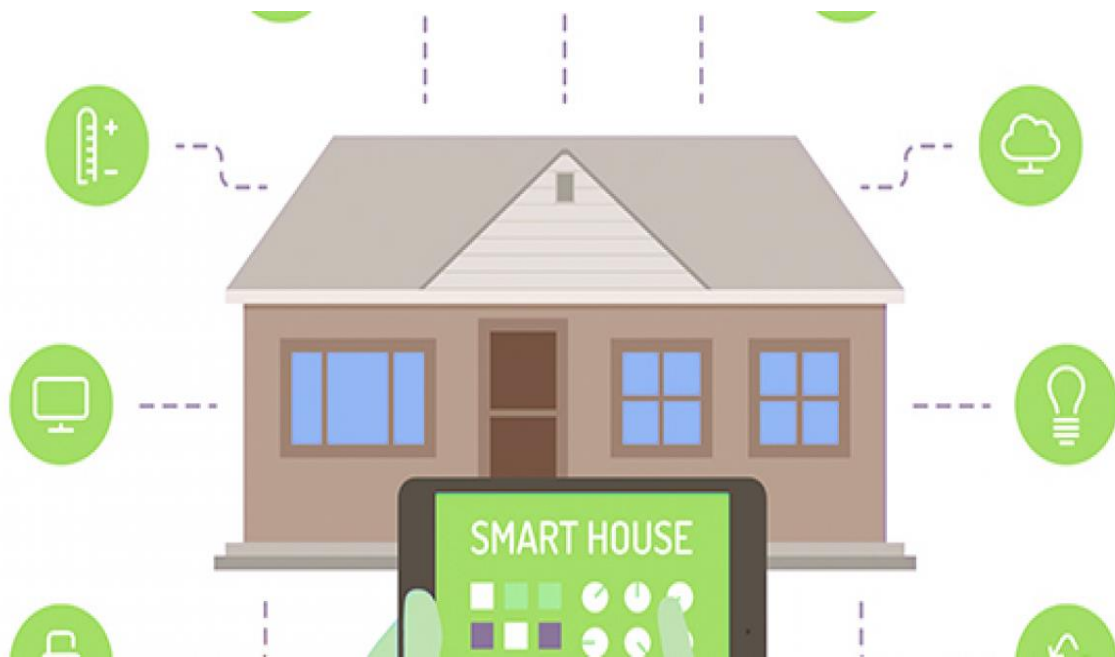


Figure1: smart application for smart house

2.2 Definition

A smart home is a term used to define a house which contains a communication network that connects different intelligent technologies together in order to provide a comfortable and safe environment that allows the house residents to perform several household tasks efficiently by accessing, monitoring and controlling them remotely. A smart home contains middleware, sensors and network [2] which has two mains interacting mechanisms such as, a smart load and a smart network [3].

A smart home can be controlled using, for example, a computer system or a smartphone application by using intelligent devices connected to the internet to allow the home inhabitants to control and access the house remotely using WI-FI. So, using this intelligent technology within the household, users will be able to see what is going on and gain control of all the smart device inside the house, even if they are not in there. One of the most important advantages of having a smart home is that it can make a huge difference in the costs of the utility bills because the inhabitants will be able to check the stage of the devices within the house.

2.3 History

The home computing and programmable thermostats appeared in 1980s and with them the term “smart house”. In the same decade a futuristic home created by the architect Roy Mason appeared in Florida, under the name of Kissimmee Xanadu, Home of the Future. The house rooms were run by Commodore computers [4], which played a very important role in the development of the personal computer industry in 1980s and they

could control everything starting from the house temperature to home security. Also, there was a robot voice that could warn if there is anyone around the house. The project was made for 1000 houses but in the end, it was considered a failed experiment and it was closed in 1996. A lot of electronic devices turn out to be smarter into the 1990's, such as the portable cd player, mp3 and mobile phones came in their own. In 1999, Microsoft have introduced their own vision of the smart home. The home was run by the Pocket PC also known as a, Windows mobile classic device, which was a personal digital assistant that could run the windows mobile operating system. It contained a lot of features such as lighting settings, smart locking, home monitoring system (CCTV), and a barcode scanner able to auto-add products to your online shopping list. So, the Microsoft vision of the smart homes was by far the closest idea on what the future is going to be.

2.4 Technologies

In order to complete this project, the following technologies and tools will be used.

2.4.1 Python

Python is an interpreted high-level programming language that has been created at CWI (Centrum Wiskunde & Informatica in Netherlands by Guido van Rossum. Over the years, python has been one of the top 5

programming languages worldwide [Figure2]. It is a very good choice for the people that want to learn a programming language because it is easy to read, high-level and it is a comprehend language.

Worldwide, Dec 2018 compared to a year ago:

Rank	Change	Language	Share	Trend
1	↑	Python	25.36 %	+5.2 %
2	↓	Java	21.56 %	-1.1 %
3	↑	Javascript	8.4 %	+0.0 %
4	↑	C#	7.63 %	-0.4 %
5	↓↓	PHP	7.31 %	-1.3 %

Figure2: smart application for smart house

2.4.2 MySQL Database

MySQL Database is an open source database management system. It was released in the early 1990s and name of the database comes from the co-founder, Michael Widenius daughter first name Maria [MariaDB]. The database is one of the most popular language for accessing, adding or managing a content in a database. It is free to use, easy to access, fast processing and managing.

2.4.3 Google Cloud (APIs)

It is a platform that is used by public cloud computing services. It provides a range of useful services for storage, computing, and application development that using Google hardware (android). The most important

and needed part of this platform are the APIs. Google Cloud APIs allows anyone obtain the power of everything imaginable from storage access to machine learning—based image. APIs can be accessed from server applications using Google Cloud client libraries in a wide range of the most popular programming languages.

2.4.4 HTML

HTML is a very used computer language made to create website and stands for Hyper Text Markup Language. It is one of the most popular programming languages in the world because the website that users creates can be seen by anyone connected to the Internet.

2.4.5 JavaScript

JavaScript is a client-side scripting language for the web. It is supported by almost all web browsers and JavaScript code can be easily written into a HTML page. The main purpose of it, is to enhance web pages to provide a good user-friendly experience.

2.4.6 CSS

Cascading Style Sheets (CSS) is a style sheet language used to create the design of web pages. It is used to define table sizes, text styles and other important aspects of web pages that could not be defined in a HTML page.

2.4.7 BOOTSTRAP

It is an open-source Cascade Style Sheets framework. That is used in mobile front-end web development and it contains JavaScript and CSS that work together to help build templates, buttons or any other interface components.

3. Requirement Specification

3.1 Current solution

Vera Plus is an easy and reasonable app controller for smart houses. All the smart electrical devices (kettle, lights, microwave and others) in the house connected to Vera Plus [Figure2] will allow users to control the devices simultaneously or individually in order to create the perfect custom solutions that fits their life. Controlling and viewing your system from anywhere you are and whenever you want can give the users a “peace of mind”. Vera Plus controller acts as a central hub inside the house and it can be accessed by using a mobile application or a web interface. This tool communicates with the smart devices by using a major wireless protocol such as Bluetooth, Wi-Fi, ZigBee and Z-Wave. The first two protocols are used for short range communication with a very low power consumption and last two protocols are used for home automation (smart home communications).

The latest version of Vera Plus known as “U17” is a web-based interface actually easy for people that are using the system constantly but for the other type of people such as the old or disable ones it gets very hard to navigate and this is a disadvantage for them. This happens because they must go through a variety of devices in order to find the right one and to be able to change one of the devices’ states, they must click the “ON or OF” button.



Figure3: Vera Plus- CONTROLLER

3.2 Current Application Features alongside Project Aims

Vera Plus latest version has a good web user interface and a good navigation system where the users can control all the smart devices inside the house using just a few clicks on the web interface. The features of the applications are not appropriate to all types of users because they have to open the tool every single time, they want to change a smart device state. The project aim is to create an android application that will be able to connect with the Vera Plus controller in order to be able to control all the smart devices in the smart home. So, the project main aim is to help the unexperienced people and the ones that are not that familiar with the latest technology (elder and disable people) by making the system more user friendly such as: User Preferences Settings, Voice Control and the system be able to recognise and execute two different commands the same time.

3.3 Functional and Non-Functional Requirements

One of the most important part of the project is the requirements part because here is where the users can see what the project are aims and expectations. I divided the requirements into two section: Functional and Non-Functional Requirements. This part will of the report will be very important at the end of the project because all the requirements list will be tested and demonstrated after the implementation stage to show if the project goal has been reached.

3.3.1 Functional Requirements List:

- The smart home user(administrator) will be able to access the application, create an account and allowing new users into the system.
- The users will need a valid account to gain access into the system: to obtain access they will need a valid username and password.
- The system will allow the logged users to set their own system preferences and save them.
- Users will be able to use voice control over the application once they are logged in, to help the users to control the smart devices (Example of Voice Commands: “Turn the kitchen light on”, “Turn the microwave on”, “Stop the radio music”).
- Users details, preferences and the devices records will be kept into a database.
- The system should validate the user’s data.
- Users will be able to control the devices from a single-interface or using voice control.

- The system will be able to show the state of the smart devices on interface(For example: if there is a light opened in the first bedroom and the user is in the second bedroom, he or she will be able to check the state of the smart devices in the app).
- The system will be able to execute at least two different commands in the same time.

3.2 Non-Functional Requirements List:

- Privacy: user information must be protected and private.
- The system must be easy to access and navigate.
- Appearance: the app should look attractive and simply to use;
- Good performance: speed.
- Capacity: records and number of users.
- Secured: useable and accessible to authorised users.
- Availability: hours and days of operation-24/7.
- Documentation: user guide, user documentation.

3.4 Target Users

The main goal was to create an android application able to help unexperienced or elderly people to use the android application. The system will allow the user to speak in order to send the command and change the device state. There are a lot of old and unexperienced people that cannot or do not know how to use complicated application systems.

4. Analysis and Design

4.1 Possible Problems and Solution

One of the possible problems could be that the Vera Plus that is the central hub in order to interact and control all the smart devices inside the smart home does not have a voice interface software installed that is able to establish the communication between the user and the smart home. Also, the smart devices installed in the university labs cannot be controlled that easy. Even, the Vera Plus latest version is not able to establish the connection using a voice command because it does not have this type of functionality.

The possible solution can be the designing of a system that is able to take voice command and the device to respond with a message showing the state of the device. There are several steps that the system will have to take in order to transmit the command to the central hub (Vera Plus).

Step1: The user will give the voice command (Open Lights) to the system (smart home app).

Step2: The system will send the command to the central hub (Vera Plus Controller in our case).

Step3: The hub will request the smart device state.

Step4: The smart device state goes back to the system.

Step5: Now the system is matching the user request with the smart device state.

In this stage there are 2 possible outcomes (6.1 and 6.2)

Step6.1: If the system decides that the states are the same.

Step6.1a: The system sends back the message to the user: “The selected device has the same state as your request”.

Step 6.1b: If the system decides that the state is not the same.

Step 6.1c: The system sends a command back to the central hub: “Change device state”.

Step 6.2: If the request is successfully processed

Step 6.2a: The successfully request goes back to the central hub

Step 6.2b: Central hub sends it to the system

Step 6.2c: The system sends a message to the user: “The selected device has changed its state”

4.2 Project Design

There are a variety of different tools and programming languages that I am going to use in order to build the system that I need for my project.

The coding part of the system will use different programming languages: HTML, CSS, JavaScript, Python and MySQL database. The front end of the project will be done by using the first three programming languages listed above. In the back-end of the project I am going to use MySQL for my database and Python for flask framework in combination with the

Google Cloud API and text to speech API. I am using the CSS and HTML5 because they are the best designing tools to implement and design a GUI (Graphic User Interface). This tool is used for complex web application and simple websites. The reason I chose to use HTML and CSS in order to build my system graphic user interface is because I know that they can help me to achieve one of the projects' goal by having a decent user interface.

I am using Google Cloud API's such text to speech and voice recognition because it can convert audio-to-text and text-to-audio. It does it very easily by adding real time audio-to-text conversion to your applications such as voice commands. You can also use the Google Cloud API to build voice triggered smart apps and speak to users naturally, improving usability and accessibility. Text-to-Speech is also available in both standard and neural versions. By applying the latest in a digital speech originality and has the capability to make the voices of your applications almost indistinguishable from recordings of people

As a storage system (Database) I chose to use MySQL because I need a database for my project and it is an open source SQL derivate. This database system can really help me to store the users details and preferences data. MySQL is one of the best storage systems in the world and I have been using it since I was in high school. Below I will add as an example the User table for my project.

JavaScript is also a very important part of building the system because it is a part of HTML5 and can help me to create a very attractive and efficient user interface. The most important part is that JavaScript has one of the

most popular data formats that can exchange data on the web and it is called JSON (JavaScript Object Notation).

4.3 Project Plan

The plan part of the project was important because you must order the tasks and make sure you are ready for any bad things or problems that may occur during the project developing. I have created a list of rules to use it as a booklet.

List with steps done between October – April 2019 in order to develop my final year project: Plan System and start investigation, find and discuss with supervisor, project proposal and planning, researches about the project, start interim report, start think about possible project development,

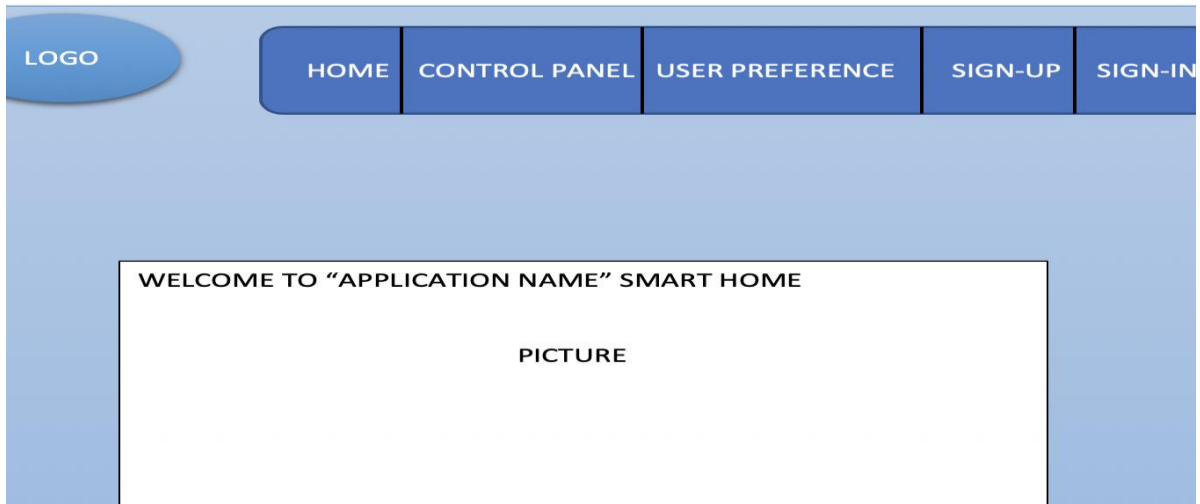
start project development, work on early prototype, design early design, start design implementation, test early prototype, finish interim report, develop application, research about the application problems, test system, evaluate system, fix errors, final application testing, evaluate application and conclusion.

4.4 Possible Interface Design

In this section is displayed the web pages templates because they have been done before the implementation stage. They are very basic description of the android application real web pages.

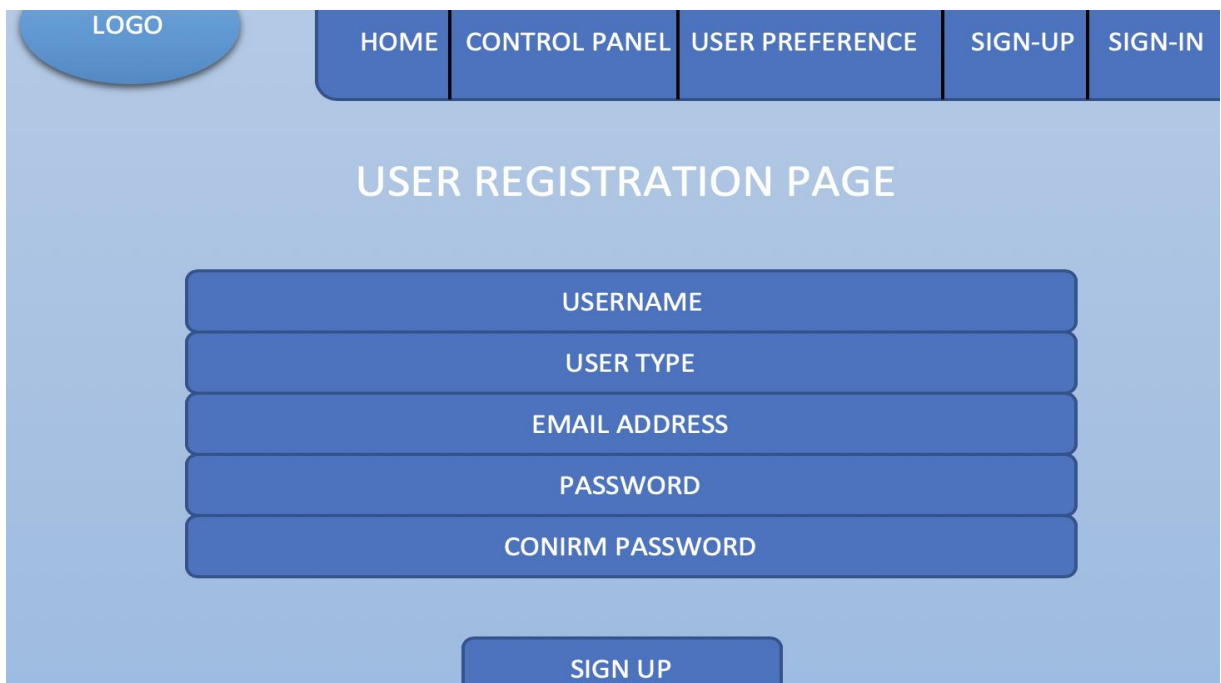
4.4.1 HOME PAGE

This is how the user page look before the implementation stage



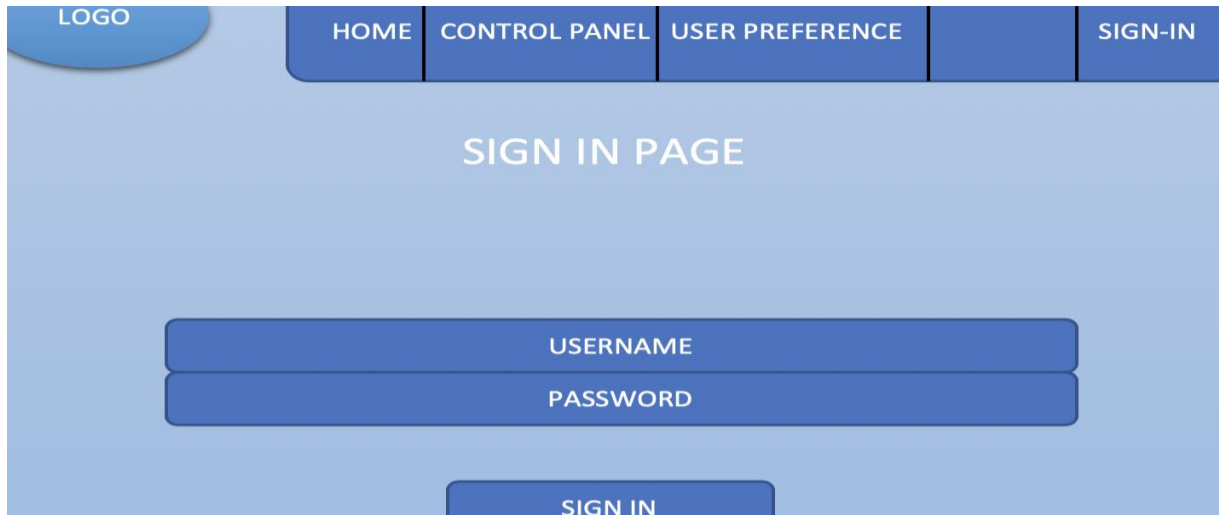
4.4.2 Signup Page

This is how the registration page is going to be and the users will have to complete all fields in order to gain access to the application.



4.4.3 Signing Page

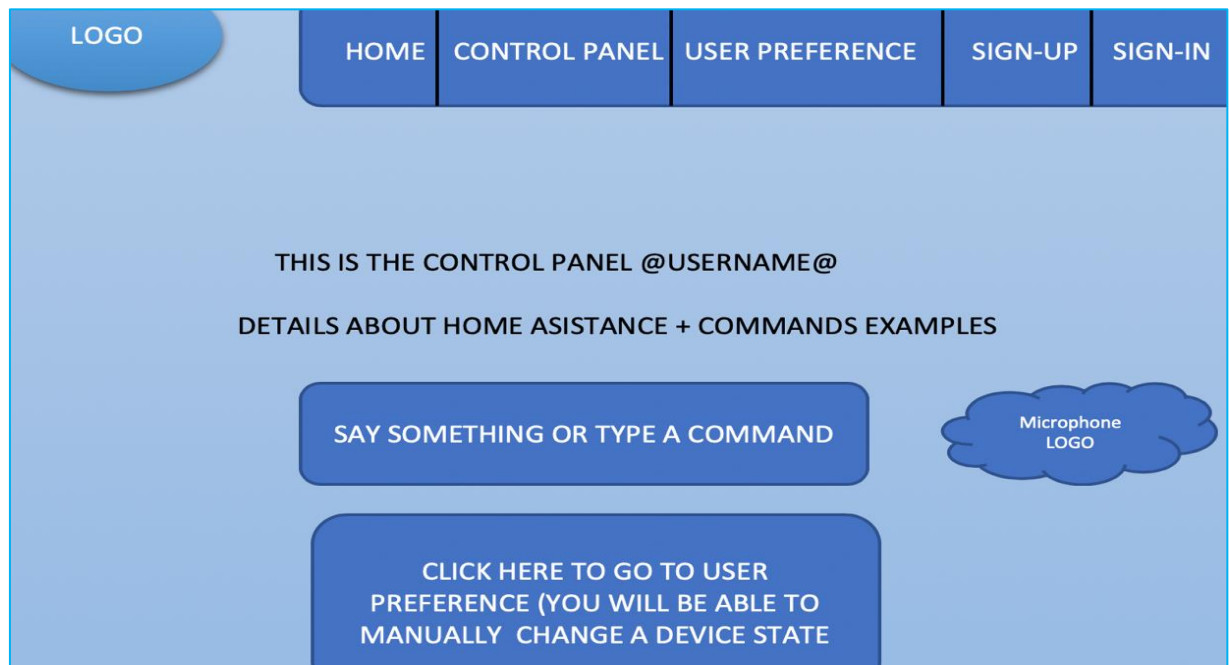
Users must use this page to login to the smart home application by using the registration form details.



The Sign In Page features a navigation bar at the top with a 'LOGO' button on the left and five menu items: 'HOME', 'CONTROL PANEL', 'USER PREFERENCE', an empty space, and 'SIGN-IN'. The main content area is titled 'SIGN IN PAGE' and contains a form with two input fields labeled 'USERNAME' and 'PASSWORD'. Below these fields is a 'SIGN IN' button.

4.4.4 CONTROL PANEL

In the control panel, the user must use the microphone to control the devices.



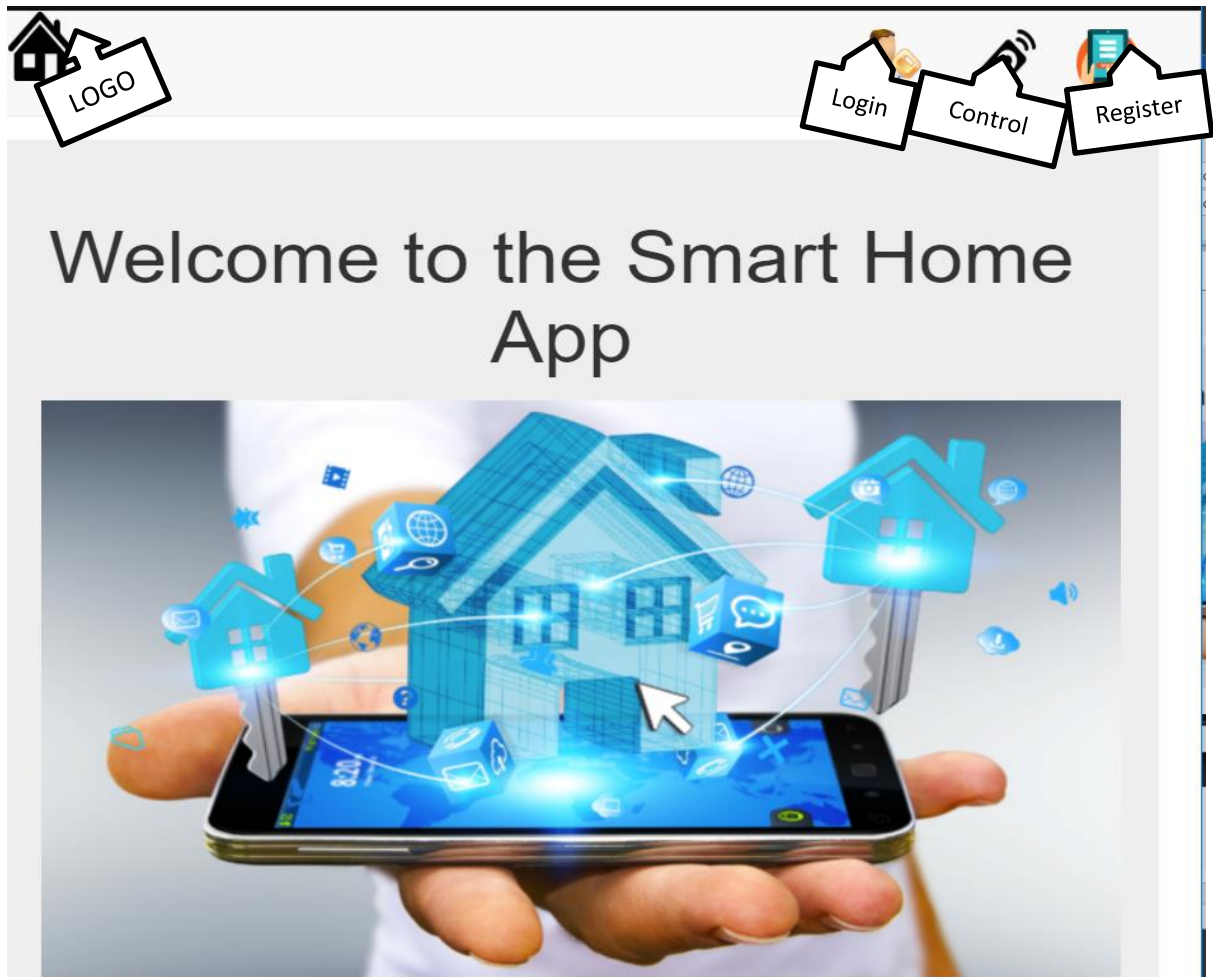
The Control Panel page has a navigation bar with a 'LOGO' button and five menu items: 'HOME', 'CONTROL PANEL', 'USER PREFERENCE', 'SIGN-UP', and 'SIGN-IN'. The main content area displays the text 'THIS IS THE CONTROL PANEL @USERNAME@' followed by 'DETAILS ABOUT HOME ASISTANCE + COMMANDS EXAMPLES'. There are two primary interactive elements: a large button labeled 'SAY SOMETHING OR TYPE A COMMAND' and a cloud-shaped icon labeled 'Microphone LOGO'. At the bottom, there is a button that reads 'CLICK HERE TO GO TO USER PREFERENCE (YOU WILL BE ABLE TO MANUALLY CHANGE A DEVICE STATE)'.

5.Implementation

5.1 Project Graphic User Interface

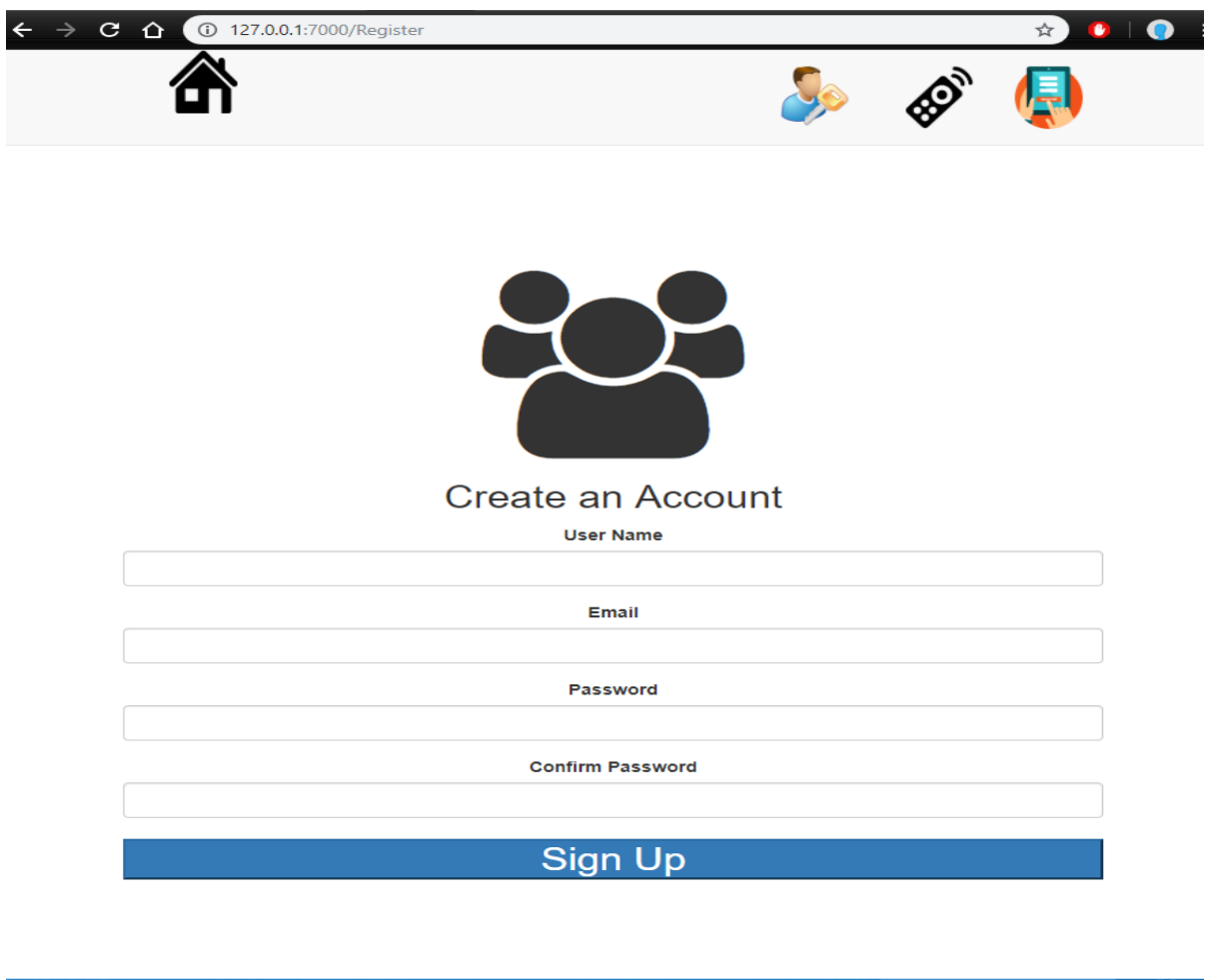
5.1.1 HOME PAGE

This page is also the index page and it is the first page on the application. You can get back to home page all the time you press the Logo Button on the left-side corner.



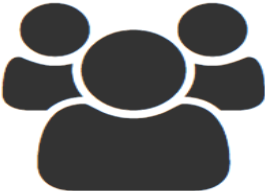
5.1.2 Register Page

Registration Page is the page where the users must create an account in order to use and control the Application. They need to complete every single field in order and then click on the Sign-Up Button (Blue Button). After they have successfully registered, the system will direct them to the Login page.



127.0.0.1:7000/Register

Home User Mobile Document



Create an Account

User Name

Email

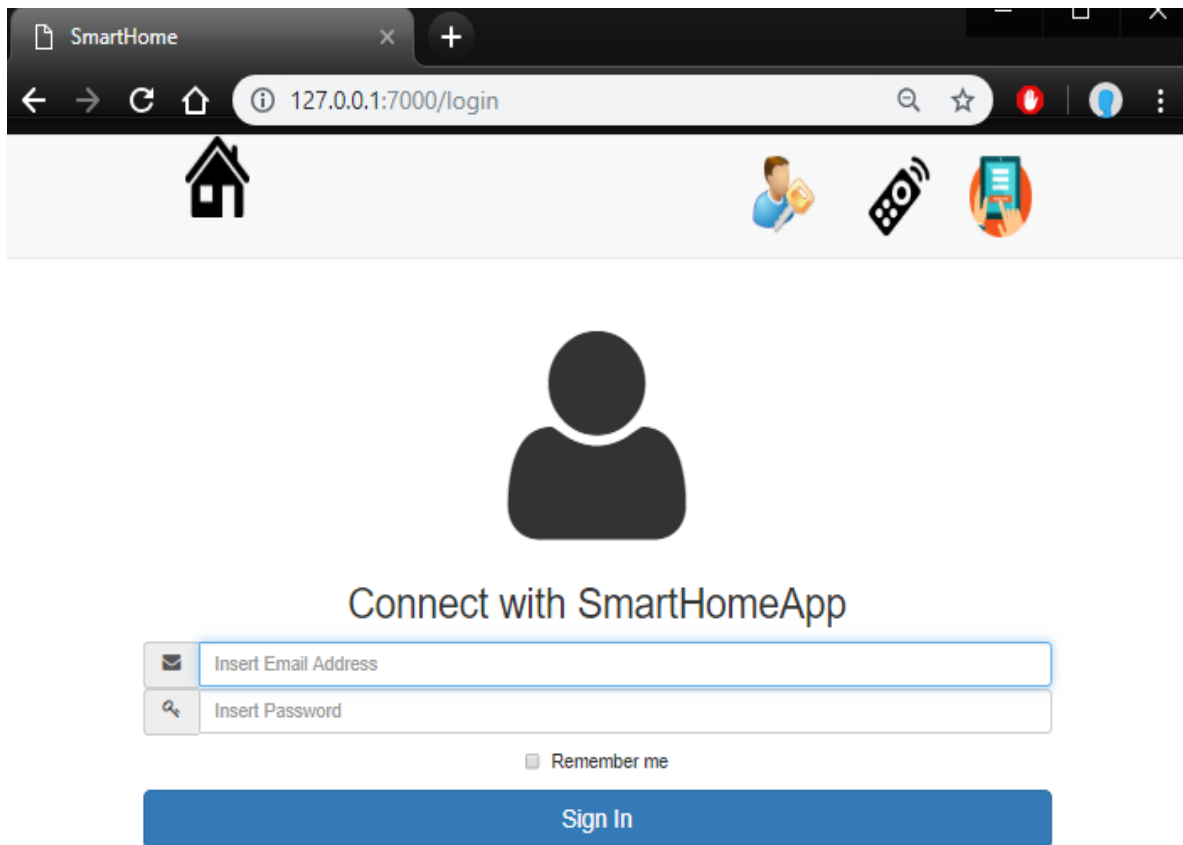
Password

Confirm Password

Sign Up

5.1.3 Login Page

This page is the login page where the user or users will have to insert their username and password that they have registered with. Once they click the Sign-In button and the system will confirm their identity then they will be able to access all the features within the application.



The screenshot shows a web browser window with the title 'SmartHome'. The address bar displays '127.0.0.1:7000/login'. Below the browser window, there is a navigation bar with four icons: a house, a person with a key, a remote control, and a smartphone. The main content area features a large black silhouette of a person. Below the silhouette, the text 'Connect with SmartHomeApp' is displayed. Underneath this text are two input fields: 'Insert Email Address' and 'Insert Password'. A 'Remember me' checkbox is located below the password field. At the bottom of the form is a blue 'Sign In' button.

SmartHome

127.0.0.1:7000/login

Connect with SmartHomeApp

Insert Email Address

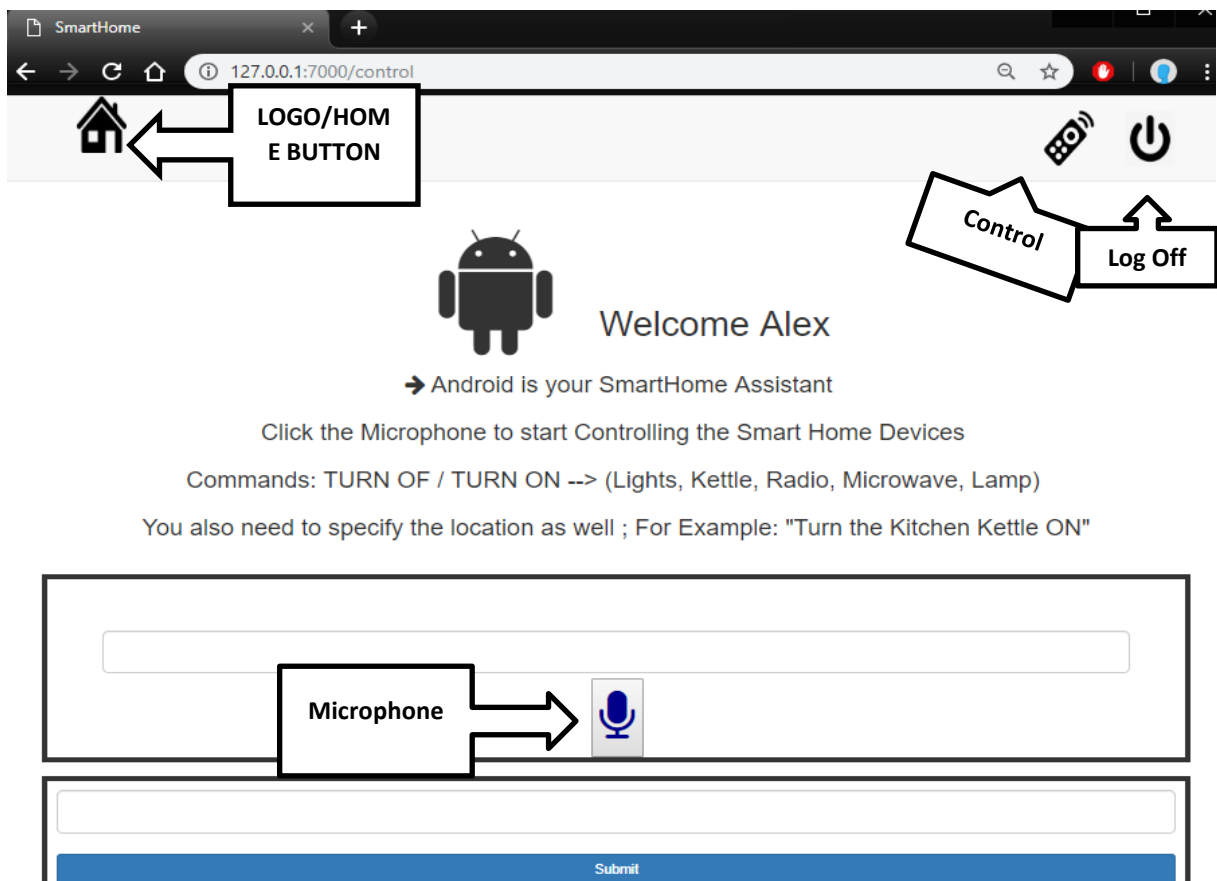
Insert Password

☐ Remember me

Sign In

5.1.4 Control Page

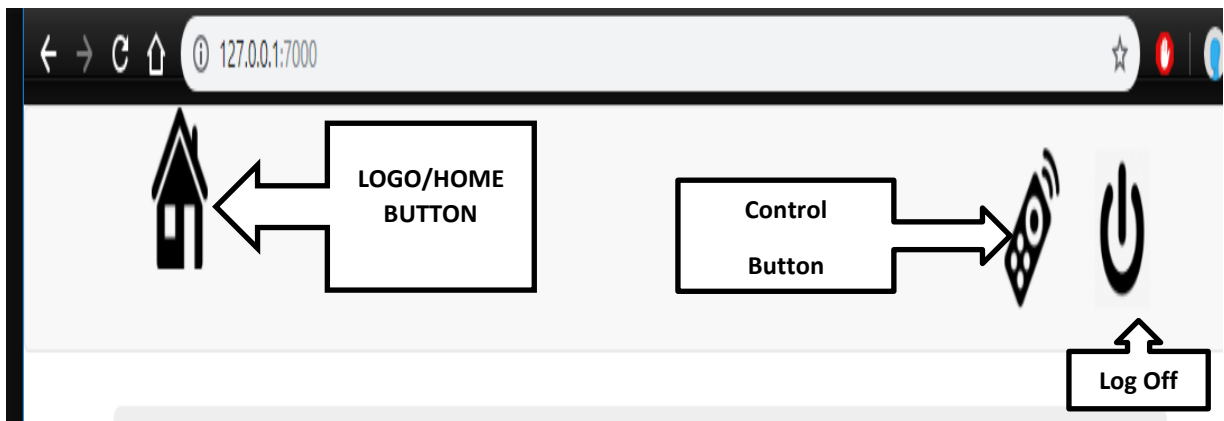
The control page is the main page of the application because here is the main control panel. Users will be able to send a voice command or a command to any of the end devices in from the smart home. All the users need to do is to click on the microphone button and give a command (bedroom light ON or corridor light OFF).



5.1.5 Navigation BAR

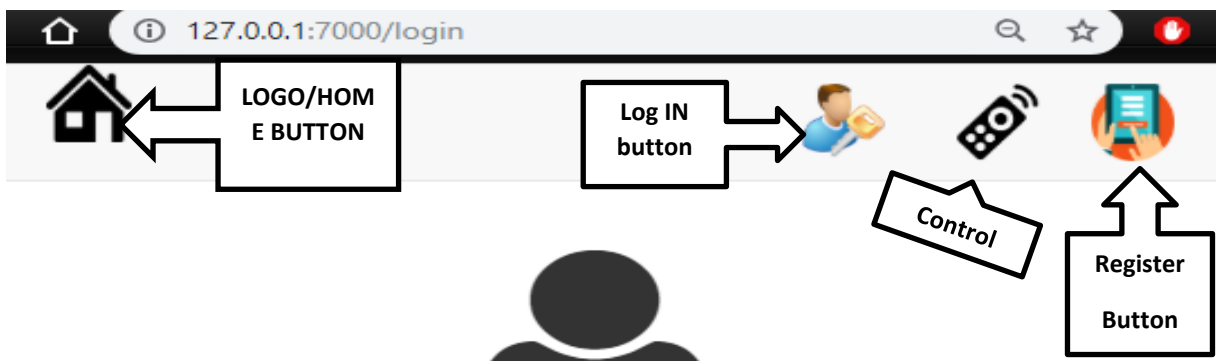
5.1.5.1 Navigation Bar (User Logged IN Mode)

If the user is Logged In, the navigation bar will only display the pages that the user can go. Once the user clicks the Log Off Button (right hand side), the user will see the other pages as well.



5.1.5.2 Navigation Bar (User Logged Off Mode)

If the user is Logged In, the navigation bar will only display the pages that the user is able to go. Once the user clicks the Log Off Button (right hand side), the user will see the other pages as well.



5.2 Projects Goals Reviewed

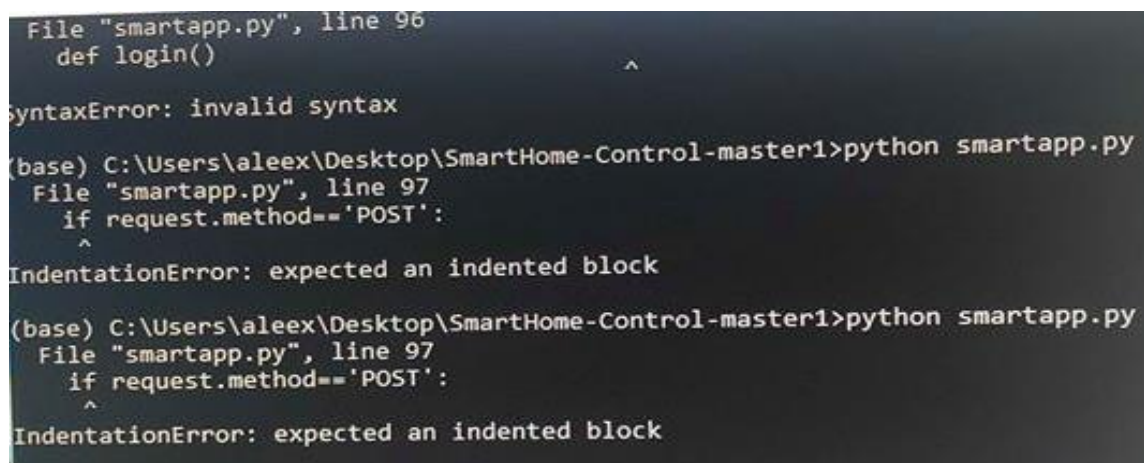
The smart home android application system helps any logged in user to control all the smart devices of a household similar with the one used for this project (Middlesex University – designed lab – Farmside Building – Hendon Campus) device by using simple voice control. So, once the project implementation has started, the application development is going to take a while and will need to go through a lot of errors and processes in order to obtain a successful fully working application. The aim of the project was very important from the beginning, create an android smart application for elderly and inexperienced people. This is the main reason why this application is going to use voice commands

5.3 Project Challenges

In the Hendon Campus of Middlesex University there is a well-equipped smart house laboratory in the Farmside Building. The devices in the house can be controlled by using the z-wave kit Vera Plus. The outcome of the project is to create an android application that can connect with the the lab in order to control the smart devices. So, the main problem was to find out how does Vera Plus communicate with the devices. This is the moment that I have been stuck for a while but after some research has been done, I have figured out how they communicate by using the google Developer tool. So, after I have realised how Vera communicates with the end devices, I had to see how I can do it in my own code. So, the developer tool showed me that Vera Plus uses “Post” & “Get” as the request method. Another good thing that I have found was that every single device has a unique device number.

Python might be an easy to read programming language but in the same time is complicated to use it. I had a lot of problems due my implementation stage because of the python version and missing packages. I have used windows terminal to run python but I had some complicated errors and I have tried to find a way to solve them. After doing some research I have found out that the best way to work with python is by using Anaconda Prompt. It is basically same as the normal command prompt but you can use it without having to change any paths or directories.

Another challenge was to solve the IndetationErrors in my python code. I know that the identation is only used to help users make the code look good but the amount of indentation matters a lot. Same happened to me when I have tried to arrange my code and put spaces and comments around. I have realised that even a missing or an extra space in python code block is able to cause an unexpected behaviour or error (IdentationError) You cans see the error that I have been trough in the Anaconda command line window (Figure4



```
File "smartapp.py", line 96
def login()
^
SyntaxError: invalid syntax

(base) C:\Users\aleex\Desktop\SmartHome-Control-master1>python smartapp.py
File "smartapp.py", line 97
    if request.method=='POST':
    ^
IndentationError: expected an indented block

(base) C:\Users\aleex\Desktop\SmartHome-Control-master1>python smartapp.py
File "smartapp.py", line 97
    if request.method=='POST':
    ^
IndentationError: expected an indented block
```

Figure4: Anaconda Command Line Showing Indentation Errors

5.4 System Explained + Code Screenshots

This section will represent the description of the model system after all the implementation has been done. The system has been completed by using the following modules: Graphic User Interface, Google Cloud APIs, Core Methods and MYSQL Storage.

GUI have been explained and demonstrated on the first part of the implementation part (see Table of Contents to find it). The user has to login to the system and will be able to send a command using graphic user interface into the Google Cloud API. I have used the google API to be able to convert text to speech, so the users can give commands to the devices by using a voice recognition system. After that I have used some methods such as “POST” & “GET” and the devices unique id in order to send and retrieve data to the devices the same way Vera Plus does. So, if the user command is valid, the request will be sent to the z-wave Vera Plus. After the Vera will verify the state and will be able to change it, the device status will be stored in the MySQL database and a message (text) will be send to the cloud API. The cloud API gets the message and converts it into a speech and displays it to the user.

As you can see in the screenshot below, the methods “Post” & “Get” are used exactly in the same way as in Vera Plus. I have used the method “Post” to send a request of changing a device state. In Order to confirm the device, I want to control I have added the ID, state, name and location device

```

38 @myapp.route('/control', methods=['POST','GET'])
39 @mandatory_login
40 def control():
41
42     if request.method=="POST":
43         userRequest=request.form['userrInput']
44         if userRequest=='BedRoom-LIGHT-ON':
45             deviceId=540
46             newState=1
47             deviceName='BedroomLight'
48             deviceLoc='BedRoom'
49
50             rand=random.random()
51             verifySt = checkState(deviceId,newState,deviceName,deviceLoc)

```

Figure5: using Post to send request (Project code data)

To discover the devices current state and ID I have used the queryAPI provided by my supervisor. Once I have had the query API available, I have added the device unique id to my devices in the database and code.

See picture below to see the server API provided. I have used the logging details of the query API in order to log in to the server and obtain the information needed. The API is only available to be used in the Middlesex University Campus.

Table Device States: this table hold the records of the device state. The application will communicate with the database to store the devices states requested by the user.


















			deviceId	deviceName	deviceLoc	deviceState	id	
<input type="checkbox"/>				540	BedroomLight	Bedroom	0	5
<input type="checkbox"/>				540	BedroomLight	Bedroom	0	6
<input type="checkbox"/>				540	BedroomLight	Bedroom	1	7
<input type="checkbox"/>				39	[B]BigLamp	LivingRoom	0	8
<input type="checkbox"/>				39	[B]BigLamp	LivingRoom	0	9
<input type="checkbox"/>				39	[B]BigLamp	LivingRoom	1	10

Figure6: MySQL Database Table showing Device State

Table User: stores the records of users after they have registered using the application system. Once the user has been created an account, the registration details will be sent and stored in the database as you can see in Figure3. There are four fields that the application will store in the database: ser ID, User name, Email and Password.

☐ Show all | Number of rows: 25 | Filter rows: Search this table

+ Options

				id	userName	email	password
<input type="checkbox"/>	Edit	Copy	Delete	28	Alex	aleex.apetrei@yahoo.com	apetrei7
<input type="checkbox"/>	Edit	Copy	Delete	33	aa	aa@yahoo.com	ala
<input type="checkbox"/>	Edit	Copy	Delete	34	2	alabala@yahoo.com	ala
<input type="checkbox"/>	Edit	Copy	Delete	45	AlexApetrei	CA871@yahoo.com	00

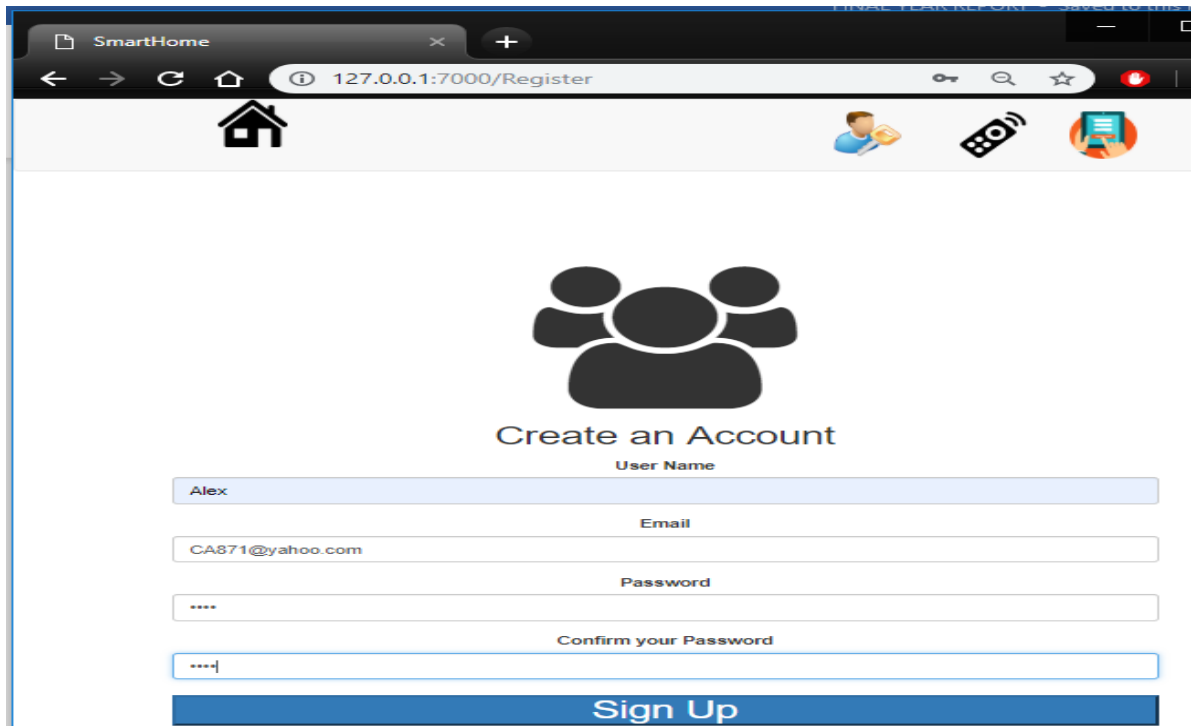
☐ Check all | With selected: Edit Copy Delete Export

☐ Show all | Number of rows: 25 | Filter rows: Search this table

Figure7: MySQL Database Table showing all the Users

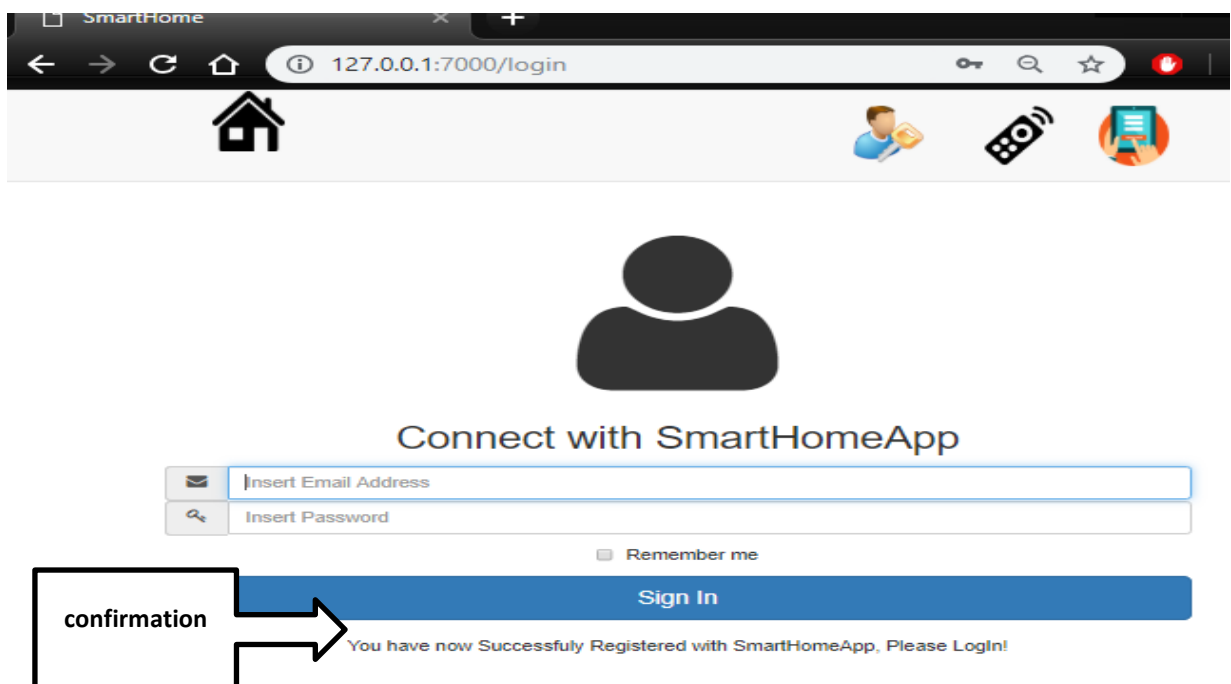
6. Testing

➤ User Complete Registration



A screenshot of a web browser showing the 'SmartHome' application at the URL '127.0.0.1:7000/Register'. The page features a header with a home icon and three user-related icons. The main content area is titled 'Create an Account' with a group of three people icon. Below the title are four input fields: 'User Name' (containing 'Alex'), 'Email' (containing 'CA871@yahoo.com'), 'Password' (containing '****'), and 'Confirm your Password' (containing '****'). A blue 'Sign Up' button is at the bottom.

➤ User successfully Registered



A screenshot of the 'SmartHome' application at the URL '127.0.0.1:7000/login'. The page features a header with a home icon and three user-related icons. The main content area is titled 'Connect with SmartHomeApp' with a single person icon. Below the title are two input fields: 'Insert Email Address' and 'Insert Password'. A 'Remember me' checkbox is present. A blue 'Sign In' button is at the bottom. A confirmation message is displayed below the button: 'You have now Successfully Registered with SmartHomeApp, Please Login!'. A box labeled 'confirmation' with an arrow points to this message.

➤ Database Showing User has stored registration details

☐ Show all | Number of rows: 25 | Filter rows: Search this table

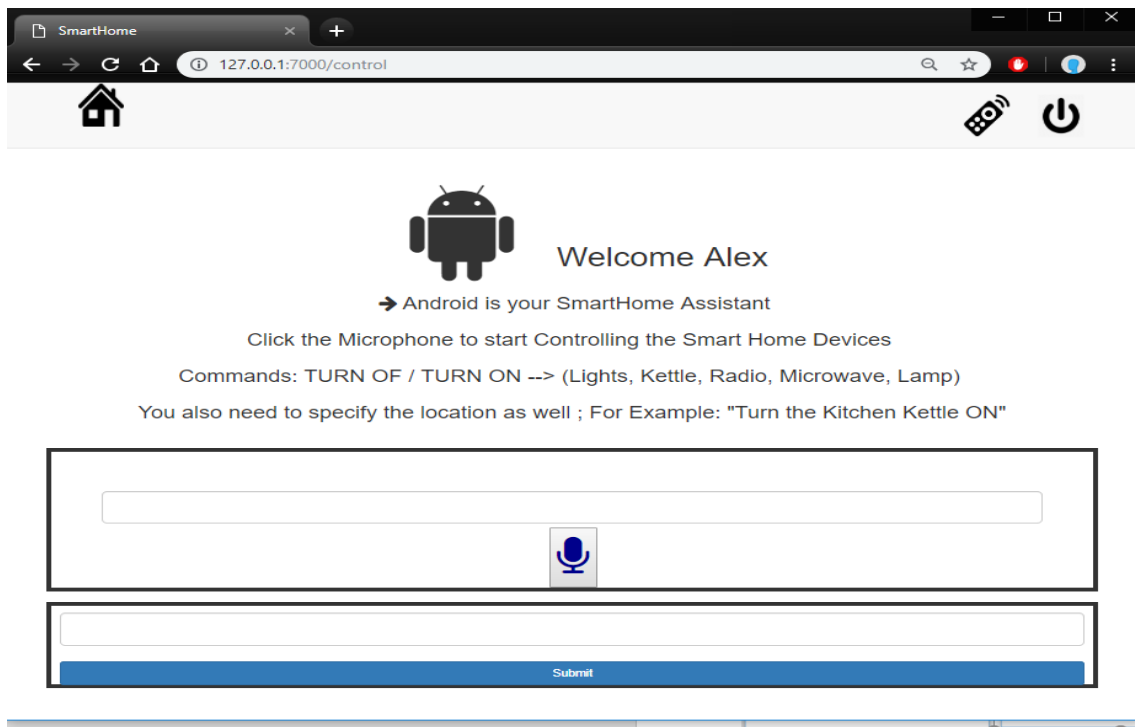
+ Options

					id	userName	email	passwo
<input type="checkbox"/>	Edit	Copy	Delete		28	Alex	aleex.apetrei@yahoo.com	apetrei7
<input type="checkbox"/>	Edit	Copy	Delete		33	aa	aa@yahoo.com	ala
<input type="checkbox"/>	Edit	Copy	Delete		34	2	alabala@yahoo.com	ala
<input type="checkbox"/>	Edit	Copy	Delete		45	AlexApetrei	CA871@yahoo.com	00

↑ ☐ Check all With selected: Edit Copy Delete Export

☐ Show all | Number of rows: 25 | Filter rows: Search this table

➤ User has Logged in successfully using the registered details



7.Evaluation

During the first stage of the project I have stated that I want to create an android application that is able to control smart home devices using voice control. At this stage all I can say is that I have achieved 80% of my project goal. After testing the system so many times I have found some errors with my code that occur when I try to control some devices in my application by using voice control (voice recognition). But at least some of my project code is working fine and there are no errors. I am happy to evaluate my project as a good one because of the voice recognition implementation. According to some researches and users' opinions I gave found out that voice-controlled system turns out to be the best one to fit the business.

I have managed to evaluate the voice recognition system. I have been fully surprised to see a lot of people preferring to use a voice command application instead on a normal remoted controlled one. More than half of the students that I have showed the application were impressed by the system and they said that voice recognition is the home future. Most of the people that have evaluated my smart android application liked the idea of using voice recognition to control smart home devices and they also asked questions if the application can be improved or implemented in the houses in the future.

I have also received some good feedbacks about my application graphic user interface. Most of the people that have seen my system were impressed and liked the design. More than 90% of the users rated my application graphic interface as very good, easy to use and control. When it comes to the control part, there has been some bad reviews of it because my application could not open a door or close a door because that is one

of the main problems I have had during the implementation stage and then tests showed that the Door states are not changing when I want the application to. So, after this bad review, I have decided to remove the Door state part from the code.

So, after an overall evaluation I can say that my project was a good one and the system can be improved in the future.

8. Conclusion

In conclusion, the system that I have developed during my project has been a very good one and I have met 90% of the requirements and goals planned in the early stages. During the project development and implementation, I have found some difficulties on how to create the application. First, I wanted to create my application by using android studio but I have realised how complicated the process will be and after I have had some big errors I have stopped. So, I have decided to use python in order to create my android application. During the developing stage, I have had some problems but I have managed to resolve 90% of them and I have ended up with a really working application!

During this project I have gained some deep python skills and learned how to use an API. I have learned a lot more then I could have ever thought I will learn in my independent studies. I have learned how to use python in combination with CSS, HTML and JavaScript. For me, it was the first time when I have tried to create an android application and all I can say is that I am happy for this opportunity. Now I have obtained more knowledge about how the Cloud API's work, and how you can retrieve data from a server.

To end this conclusion, all I want to say is that I have learned a lot of good things during my final year project and I am looking forward to improving the project even more, to be able to control all the devices in the house. The system can be improved in a way to help disabled people to use the house devices very easy. I think that this can be done by adding some extra features that will allow them to talk to the system and there will be no need of pressing any button.

9. Bibliography

(n.d.). Retrieved from Android: <http://www.android.com/>

(n.d.). Retrieved from Z Wave: <https://www.uk-automation.co.uk/z-wave-automation/>

Android Apps for Controlling Home Lighting, Appliances, Thermostats and More | Smarthome Home Automation Superstore. (n.d.). *Smarthome.com*, https://www.smarthome.com/android_apps.html.

Contro, C. ©.-2. (n.d.). Retrieved from Vera Plus: <https://getvera.com/controllers/veraplus/>

Control4.com. (n.d.). *Home Automation and Smar Home Systems*. Control4. [online] Available at: <http://www.control4.com/> [Accessed 11 Jun. 2016].

Google. (n.d.). Retrieved from Google Cloud API: <https://console.cloud.google.com/freetrial/signup/tos?pli=1>

HalfHill, T. R. (December 1982). Computers In the home of 90s.

Hansen, E. (2010). *Home, Smart Home*.

HE, X. (2008). SMART HOME. *From a concept to a LIVING PRODUCT*.

Herroku, P. b. (2001-2019). <https://www.python.org/doc/essays/blurb/>.

John Wiley & Sons. (18 December 2008). *Android 4 Application Development*. USA.

journaldev. (n.d.). Retrieved from Python Flask : <https://www.journaldev.com/15524/python-flask-tutorial>

Lee, W.-M. (8 March 2011). *Beggining Android Application Development*.

Li., H. L. (Shankgai 2009). Intelligent oven in smart home environment.

ANDROID APPLICATION FOR COLLEGE MANAGEMENT SYSTEM. (2017). 41-44.

Niing L, a. P. (2011). Appliicance commintment for household load scheduling. *Smart Grid*, 441-419.

Hansen, E. (2010). *Home, Smart Home*.

Steele, J. (October 2010). *The Android Developer's Cookbook*.

University, M. (n.d.). <https://www.mdx.ac.uk/our-research/research-groups/intelligent-environments-group>.

Wang, L. (2015). Design of Smart Home System Based on WiFi Smart Plug.

Y Pang, S. J. (2016). Wireless Smart Home System Based On Zigbee.

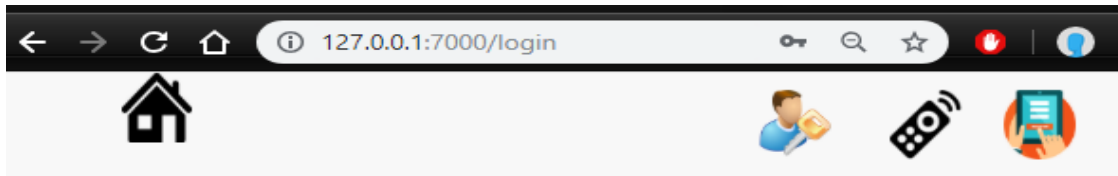
Yan, Z. (2016). Complex Systems Smart Home Security Studies based Big Data Analytics. 41-52.

journaldev. (n.d.). Retrieved from Python Flask :
<https://www.journaldev.com/15524/python-flask-tutorial>

(n.d.). Retrieved from Z Wave: <https://www.uk-automation.co.uk/z-wave-automation/>

10.Appendix 1 – Testing

10.1 Check User Input – Valid Field



Connect with SmartHomeApp

☐ Remember me



Create an Account

10.2 Database test – Show Devices Details

☐ Show all | Number of rows: 25 | Filter rows: Search this table

+ Options

				deviceId	deviceName	deviceLoc	deviceState	Id
<input type="checkbox"/>	Edit	Copy	Delete	540	BedroomLight	Bedroom	0	5
<input type="checkbox"/>	Edit	Copy	Delete	540	BedroomLight	Bedroom	0	6
<input type="checkbox"/>	Edit	Copy	Delete	540	BedroomLight	Bedroom	1	7
<input type="checkbox"/>	Edit	Copy	Delete	39	[B]BigLamp	LivingRoom	0	8
<input type="checkbox"/>	Edit	Copy	Delete	39	[B]BigLamp	LivingRoom	0	9
<input type="checkbox"/>	Edit	Copy	Delete	39	[B]BigLamp	LivingRoom	1	10
<input type="checkbox"/>	Edit	Copy	Delete	39	[B]BigLamp	LivingRoom	1	11
<input type="checkbox"/>	Edit	Copy	Delete	546	KitchenLight	Kitchen	1	12
<input type="checkbox"/>	Edit	Copy	Delete	547	CorridorLight	Corridor	1	13
<input type="checkbox"/>	Edit	Copy	Delete	546	KitchenLight	Kitchen	1	14
<input type="checkbox"/>	Edit	Copy	Delete	546	KitchenLight	Kitchen	0	15
<input type="checkbox"/>	Edit	Copy	Delete	547	CorridorLight	Corridor	1	16
<input type="checkbox"/>	Edit	Copy	Delete	547	CorridorLight	Corridor	0	17
<input type="checkbox"/>	Edit	Copy	Delete	39	[B]BigLamp	LivingRoom	0	18
<input type="checkbox"/>	Edit	Copy	Delete	540	BedroomLight	Bedroom	0	19

11. Appendix 2- Code

Is only available on the finalyear.rar only. A link will be included here in order to be able to have a look at the code part of this project.