HOME AUTOMATION

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Certificate

We hereby accept the work contained in this report titled: ***Home Automation***, as a confirmation to the required standards for the partial fulfillment of the degree of Bachelors of Science in Computer Science.

Internal Examiner

External Examiner

Project Supervisor

Head of Department

Declaration

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Abstract

This proposed system gives a chance to user to control home appliances in an intelligent manner from mobile phone. Just assume how helpful it will be able to control or Switch ON your Air Conditioner by using your mobile device when you come back home from your exhausted routine. System will study the routine of the user and will help the user in prediction operations and system will keep up to date the user.

Home Automation includes control of lightning, appliances, humidity, temperature and many other systems, to provide best environment and helps in energy efficiency. How about your Smart home having features on its own to detect a gas leakage, rain alert, fire sensor and unauthorized movements and alert you on your cell phone?

Goal of our proposed system is to create Home Automation by using raspberry pi that can control specific devices with the use of Artificial Intelligence. Home can be controlled by the end user from any mobile devices in intelligent manners as smart IOT device.

Contents

Chapter 1 Introduction

1.1. Overall Description

We tend to develop and automated home system with some features that aren't in the market.The system would consist of ahybrid app through which the connected appliances could be turned on or off regardless of where you are. Raspberry pie would be used to connect the electrical appliances to control it using flutter app. We are tending to develop a feature that will study the routine of the user and will help the user in prediction operations of the daily routine using AI. One feature that would be added is that if the user is close from his home the application will notify him to turn on some of the appliances if needed.Home Automation includes control of lightning, appliances, temperature and many other systems.

1.1.1. Objectives

Coming years are of AI and IOT so we tend to develop a home automation system that would have the features which current home automation system doesn't offer The main objectives of this project is to embed AI in the home automation system.

1.1.2. Problem Description

There are many outstanding home automation systems that offer many features like Samsung Smart Things, Amazon Alexa's but what they don't offer is routine prediction in which a routine would be analyzed and could do notify to automate the routine for the day. The secondary goal is to turn off the appliances from far. If someone forgot to switch off the lights upstairs or has left the home your kids went to play outside without turning off the television. The Home Automation system can turn them off from far away using the app.

1.1.3. Methodology

Application consists of graphical user interface which consists of different activities:

- **LOG-IN**
  Logged in to access the system
- **SELECT ROOM**
  Select the room of which appliances you want to turn on or off.
- **VOICE**
  If the user wants to do turn on or off any appliance, he can say it which would be done using voice recognition.
- **ROUTINE**
  This is the primary activity. It studies the routine of the user and helps the agent in prediction operations.
- **LOCATION**

  When the person is under the radius of 1 km of home the notification to turn on any appliance will be given.

- **NOTIFICATIONS**
  This basically is a source of reminder for the user. For Example (If there is no person in a room and the appliances are on for a pre-determined time then the notification would be sent).

1.1.4. Product Scope

The project goal is designing a prototype for controlling home appliances that can be connect wirelessly via mobile application that provides many features.

- The system can be used in wide range.
- System can learn the routine of the user.
- System can predict.
- The system can be used in home and offices.
- The system can remotely and automatic switch ON/OFF appliances.
- The system can recognize your voice to turn ON/OFF appliances.
- The system can alert you and send notifications to you.

1.1.5. User Classes and Characteristics

End user of this proposed system includes house owner and family members.
House owner, who act as the administrator and controls overall proposed system.
Family member can be visitor who is accessing the proposed system.
End user should know how to use mobile devices.

1.1.6. Operating Environment

Home Automation is developed to run on Android and iOS mobile phones with the following minimum requirements:

- Android:
  - Android version 8.1 or higher
- Apple iOS:
  - iPhone SE or higher
  - iOS 11 or higher
- Both devices must have:
  - GPS
  - Internet connection
  - Minimum screen resolution of 480x800

1.1.7. Assumptions and Dependencies

Our proposed system is aflutter application. To use the system internet of the home and the mobile from which application would be used is to be up. If one is down, then the home automation wouldn’t work

1.2. External Interface Requirements

1.2.1. User Interfaces

Home Automation user interface will be implemented using Google's material design.We will provide a user interface that is easy to use and also familiar to the users. The user will login into the app and the room attached to the system would be displayed in which he can choose the room and turn on/off the appliances.

1.2.2. Hardware Interfaces

The main piece of hardware for this project is Raspberry pi with sensors. The reasons behind choosing the raspberry pi because it is able to run couple of task at once.
Basically, Raspberry pi is a mini computer or a credit card sized computer. Raspberry pi has its GPIO pins, where some components and output devices are connected. Raspberry pi allows lower CPU usage of raspberry pi itself and allow for fastest response.

1.2.3. Software Interfaces

Our home automation Scene will be developed using Google's Flutter framework which runs on Dart programming language. Firebase will be used for the database, ML kit for AI, COLAB for Training model. Tensor Flow and Tensor Flow Light for generating model. Http Server for interaction of application and raspberry pie.

1.2.4. Communications Interfaces

An http server will be created for the connection of raspberry pie and the application.

1.3. System Features

1.3.1. Registration

Description and Priority

Registration process is easy and simple.
Each user has to register his/her self with unique email address and strong password with a unique house id and its password key.
User cannot access this system without registration process.

Stimulus/Response Sequences

Stimulus: User has to tap registration button on the screen.

Response: System will open the sign-up screen for the user

Stimulus: User has to fill all the credential correctly.

Response: System will create an account for the user and take him/her on the log-in screen.

Functional Requirements

REQ-1: User name must be unique.
REQ-2: Password should contain special characters.

1.3.2. Login

Description and Priority

For the login, registration process is compulsory. If the user already registered his/her self, then user can able to login after enter correct credentials.

Stimulus/Response Sequences

Stimulus: User has to tap Login button on the screen.

Response: System will open the Login screen for the user

Stimulus: User has to fill all the credential correctly.

Response: System will check the data from database than take the user on the home screen of home automation.

1.3.3. Logout

Description and Priority

This feature will log out the user from the system.

Stimulus/Response Sequences

Stimulus: User has to tap Log out button on the home screen.

Response: System will open the confirmation of log out bar for the user.

Stimulus: User has to tap on confirm log out.

Response: System will log out the user from the system.

Functional Requirements

REQ-1: Once the user logged out. He/she has to log in the system again for accessing.

1.3.4. Voice

Description and Priority

This feature will take the command from the user in voice and then apply on the system.

Stimulus/Response Sequences

Stimulus: User has to keep tap on the icon of voice while he is commanding.

Response: System will do process on that command and run the command.

Functional Requirements

REQ-1: Microphone of the mobile device should be enabled.
REQ-2: Voice of the user should be smooth and clear.

1.3.5. Select room

Description and Priority

This feature will display overall home structure. So, user can select and control the room individually.

Stimulus/Response Sequences

Stimulus: User has to tap “select room” on the screen.

Response: System will display all home structure on the screen.

Stimulus: User has to select room which he/she wants to control.

Response: System will open a new screen and display all the appliances of that room.

Stimulus: User has to tap appliances for switch on/off.

Response: System will switch on/off the appliances.

1.3.6. Routine

Description and Priority

This feature system will study the routine of the user and will help the user in prediction operations.

Stimulus/Response Sequences

Stimulus: User has to tap “ROUTINE” button on the screen.

Response: System will open the routine screen for the user.

Stimulus: User has to check and select the favorite routines.

Response: System will save the selected routines in database.

1.4. Nonfunctional Requirements

1.4.1. Performance Requirements

Responsive time is to be calculated to ensure the speed of this application. Application will be smooth and fast. No chance of any packet loses while communication between mobile and raspberry pi.

1.4.2. Safety Requirements

Both of the devices should connect with WIFI otherwise there will be a chance for packet loss during communication. This application will not cause any harm to your mobile devices.

1.4.3. Security Requirements

In this modern era, every user wants their data must be secured. So, providing security to our end users will be our first priority. Authentication process of this application is strong.

1.4.4. Software Quality Attributes

Reliability

This application will be reliable to every user.
Each Button and picture will be in working condition.

On each tap, information will be shown to user.

Availability

This application will be available for all users. User can access the application at any time from any place.

Security

User information will be stored in the system with unique mail and strong password. Authentication process is strong so, unauthorized user can't access any account.

Maintainability

This application will keep up to date according to user requirements. Maintenance time will be set up at night when user is not using his application.

Usability

This application will be very easy to use, consisting of a user friendly interface, so that it will be of ease even if user don't have enough experience with android devices. The backgroud colours of the application are selected such that it will not hurt the eyes of the user.

1.5. Scenarios

First the user has to register his/her self with unique email and strong password. After registration system will take the user to the log in screen. Now user has to enter credentials. System will check the credential and take the user to the home page. Now user has to connect his mobile device with raspberry pi by tapping the plus sign button on the top right corner of the home screen. After connecting the device user can control his home. Some different features are underneath:

Login: At the point when user is close from his home. System will activate the login mode and after logged in, the main appliances of the home will turn on for the user.

Select room: User will tap on this feature. System will display a new screen with overall home structure. If user wants to control a specific room so, he can just tap on the room. System will take the user into the room. Now user can control his home appliances by using his mobile phone.

Voice: user can send his command by voice. By using voice icon, which is located on the right bottom on the screen. User has to keep tap on the icon button and send his command with clear and smooth voice.

Routine: system will study the routine of the user and will help the agent in prediction operations.

Notification: system will keep up to date the user. This is basically a source of remainders for the user.

Chapter 2 Literature Review

1.1 Introduction

Smart Home is the automation of homework or household activity. It gives a chance to user to control home appliances in an intelligent manner from your cell phone. Just assume how helpful it will be able to control or Switch ON your Air Conditioner by using your mobile device when you come back home from your exhausted routine. . System will study the routine of the user and will help the user in prediction operations. At the point when user is close from his home. System will activate the login mode and after logged in, the main appliances of the home will turn on for the user. Home Automation includes control of lightning, appliances, humidity, temperature and many other systems, to provide best environment and energy efficiency.

1.2 Related work

A few popular applications providing similar services are listed below:

- Domoticz home automation lite
- Amazon's Alexa
- Samsung smart Things

1.2.1 Domoticz home automation lite

The app automates every appliance at your home and you can control it through the mobile device from any place.

1.2.1.1 Terminology

Domoticz - Home Automation" app is compatible with all the Android smart phones, Tablets and all the Android Wears. It has many features like measure temperature in accurate readings 2. Easy control and monitor through graphs, dusk sensor, sleep mode, alarm, ventilation automatic on off, quick notification and timer.

1.2.2 Amazon’s Alexa

Amazon Alexa, Amazon's virtual assistant, will make your life easier when it comes to performing any task with your Android Smartphone. It helps in performing your daily chores.

1.2.2.1 Terminology

Amazon Alexa is compatible with Android and IOS . It Controls Alexa devices and many smart home devices. Enables devices, creates shopping list, turns on music, activate by calling the name "Alexa" Voice control feature and verbal commands.

1.2.3 Samsung Smart Things

Samsung Smart Things automating your home .Control and monitor your compatible devices through a single app and build your own smart home.

1.2.3.1 Terminology

It is compatible with both IOS and Android. Controls devices faster and efficiently like refrigerator, washing machine, dryer, dishwasher, air conditioner. Group multiple devices together to control them simultaneously.

2.2.3 Categorizing the Existing Techniques/Works/Researches

The feature sets of the aforementioned applications are described for the purpose of analysis and comparison. The two applications cover most basic features like providing alarm sensor, dust sensor, quick notification, smart recommendations, turns on music, creates shopping list, dish washer, dryer, checking weather. But they do not provide AI routine feature. Furthermore neither of the application provides all the above features collectively in one platform. Home Automation provides a one platform with collectively all the features which are individually available in other applications.

2.2.3.1 Limitations/Gaps within Existing/Works

After comparative study the limitations of existing applications are as follows:

- Samsung smart things only connect to smart devices, and all lacks the AI routine feature.
- There isn’t location detection in the current systems which would detect if the user is near home and would suggest to turn on appliances

2.2 Proposed Improvements in Existing Works

Home Automation will be implemented in Flutter & Raspberry pi using the python language so that it can target users who use Android or IOS. The objective is to provides a one platform with collectively all the features which are individually available in other applications.

2.3 Comparative Analysis

Table 1 shows comparative analysis between Scene It and existing applications. All major features are compared.

Features	**Home Automation**	**Amazon's Alexa**	**Domoticz**	**Samsung smart Things**
Routine Management	□	□	□	□
AI	□	□	□	□
Location Analyzer	□	□	□	□
Thermostat	□	□	□	□
Voice	□	□	□	□

Table 1: Illustrates the comparative analysis of existing application with Home Automation

2.4 Summary

This section aims to provide a detailed comparative analysis and study between Home Automation and other existing applications in home automation. All major features are discussed which highlights the unique features of Home Automation.

Chapter 3 System Design

3.1. Introduction

This System Design Document has been created to outline the proposed system design for Home Automation. The multi-platform mobile app intends to provide a platform for people to control home appliances in an intelligent manner from their cell phone.

3.1.1. Purpose

The purpose of this System Design Document is to provide a description for how Home Automation mobile application will be constructed.

3.1.2. System Overview

The Home Automation mobile application will help people to control home appliances in an intelligent manner from their cell phone. This app will be able to control or Switch ON your Air Conditioner by using your mobile device. This system will study the routine of the user and will help the user in prediction operations. At the point when user is close from his home. System will activate the login mode and after logged in, the main appliances of the home will turn on for the user. Home Automation includes control of lightning, appliances, humidity, temperature and many other systems, to provide best environment and energy efficiency. These goals are to be implemented through Flutter, Raspberry pi using the python language, Firebase database, ML Kit firebase, Tensor flow and Tensor flow lite.

3.1.3. Design Map

The Home Automation mobile application has a straightforward design with a flutter GUI and a Firebase back end with the idea of helping people to control their home appliances with their cell phone while also providing them with some useful features like Routine management, AI, Location Analyzer, Thermostat and Voice.

3.2. Design Considerations

3.2.1. Assumptions

It is assumed that the user has a Smartphone with an internet connection to use Home Automation mobile application.

3.2.2. Constraints

The Home Automation application will only work for phones that have the Android & iOS operating system. For connecting with all the household items from your cell phone you must connect mobile device with raspberry pi for accessing the home.

3.2.3. Design Methodology

The design is based around a user-friendly GUI on the front end and a reliable database on the back end with the business logic in the middle and features such as login logout, voice, select room and routine of the user and will help the user in prediction operations and raspberry pi for accessing the home.

3.2.4. Risks and Volatile Areas

None have been identified.

3.2.5. Risk Mitigation

None have been identified.

3.3. Architecture

3.3.1. Overview

The system of the Home Automation application is built with a database for securing user information and a GUI to allow users to find their lost items and additional subsystems such as login, logout, voice, select room and routine and raspberry pi for accessing the home. The use cases of the application are defined below.

Use Case_ID:	UC-ID-1
Use case name:	**Sign In**
Actors:	1. User
Description:	User would login.
Use Case_ID:	UC-ID-2
Use case name:	**Notifications**

Actors:	1.User
Description:	Users will get notification on location smartness and routine AI etc
Use Case_ID:	UC-ID-3
Use case name:	**Voice Control Activity**
Actors:	1. User
Description:	User can turn on appliances with voice command
Use Case_ID:	UC-ID-4
Use case name:	**Turn on/off appliance**
Actors:	1. Admin
Description:	User can turn on/off the appliances.
Use Case_ID:	UC-ID-5
Use case name:	**Routine AI**
Actors:	1. User
Description:	User can use this feature in prediction operations.
Use Case_ID:	UC-ID-6
Use case name:	**Location smartness**
Actors:	1. User
Description:	User can turn on their appliances from far home and the application would provide notification that you are close to home and could turn on the appliances using location smartness.

Table 2: Use Cases

3.3.2. Subsystem 1: Login

User can login into application by using correct credentials.

3.3.3. Subsystem 3: Select Room

User will be able to select and control the room individually.

3.3.4. Subsystem 4: Routine smartness

User will be able to use this feature according to their routine in prediction operations.

3.3.5 Subsystem 5: Location smartness

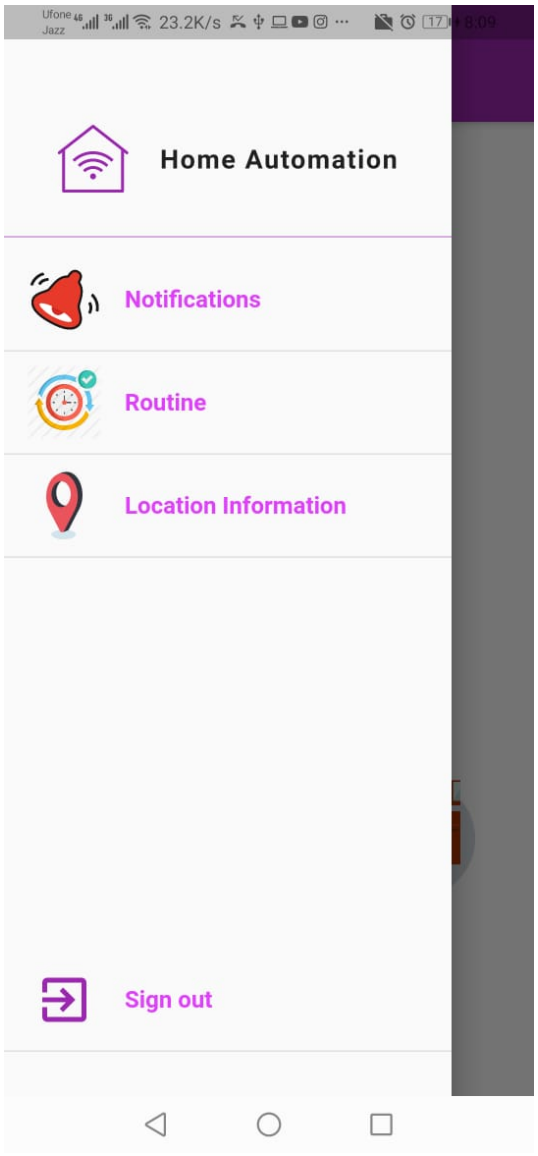
User will also be able to turn on or off the location smartness.

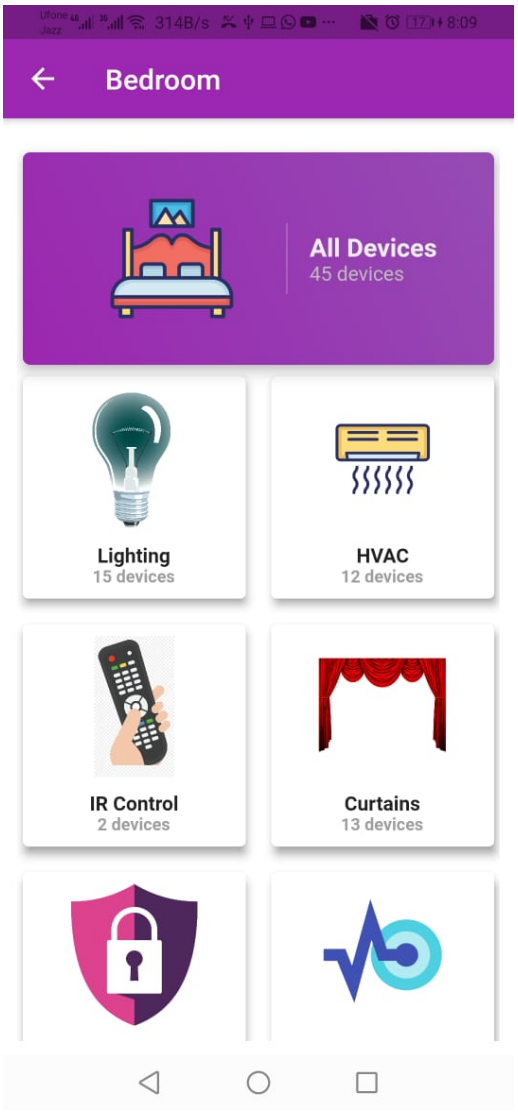
3.4. Database Schema

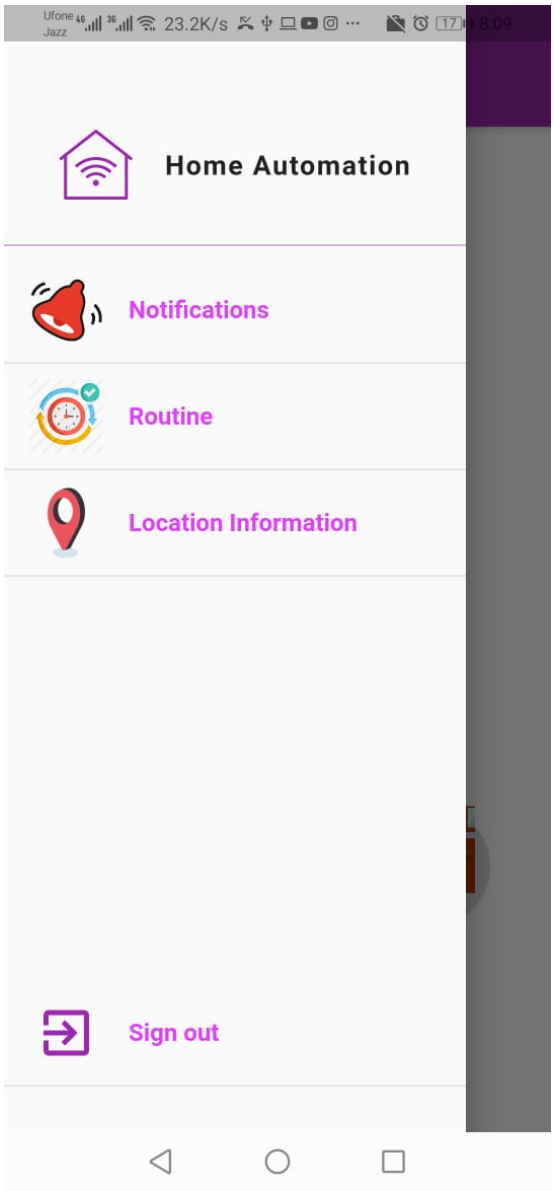
The Home Automation mobile application will use a Firebase No SQL database and will contain tables that store the information of the users such as login information or routine information.

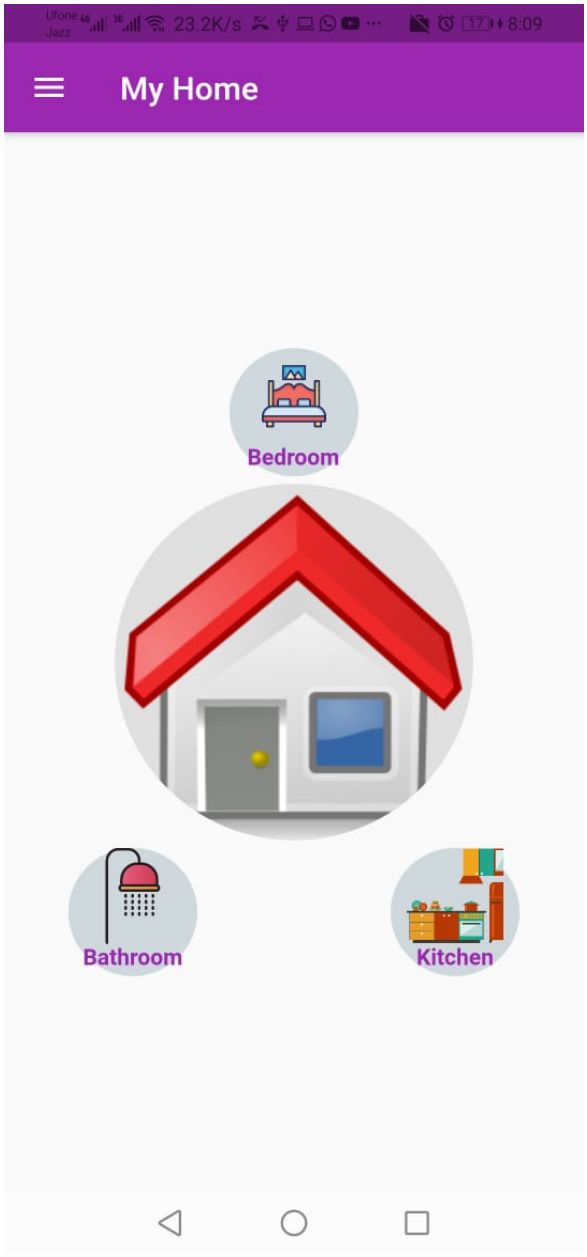
3.5. High Level Designs

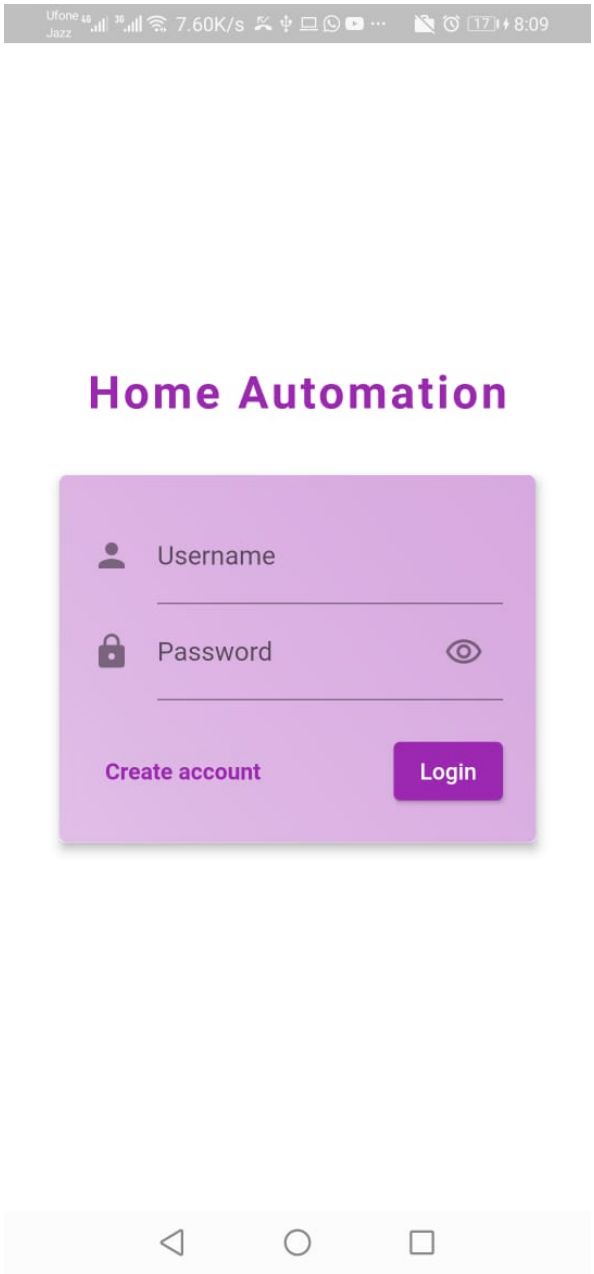
Home Automation is a GUI based mobile application and the GUI will be implemented in Flutter & Raspberry pi. Some example screenshots of the implementation have been attached below.

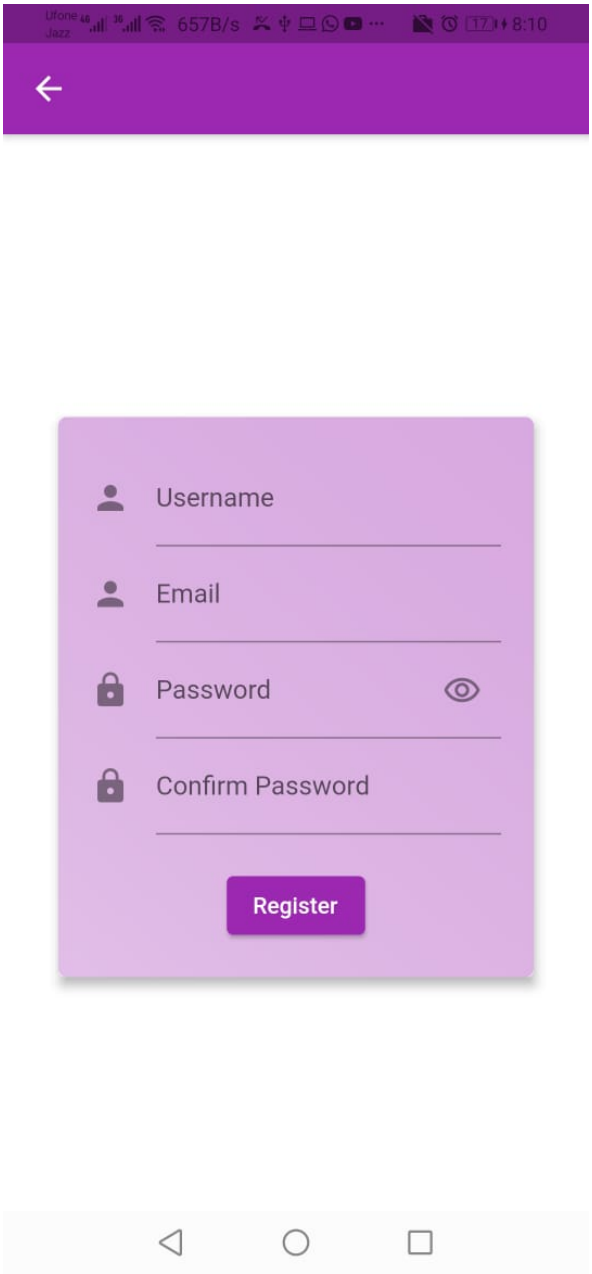

Home Automation
Notifications
Routine
Location Information
Sign out


Bedroom
All Devices
45 devices
Lighting
15 devices
HVAC
12 devices
IR Control
2 devices
Curtains
13 devices


Home Automation
Notifications
Routine
Location Information
Sign out


My Home
Bedroom
Bathroom
Kitchen


Ufone
Jazz
7.60K/s
8:09
Home Automation
Username
Password
Create account
Login


Ufone
Jazz
657B/s
8:10
Username
Email
Password
Confirm Password
Register

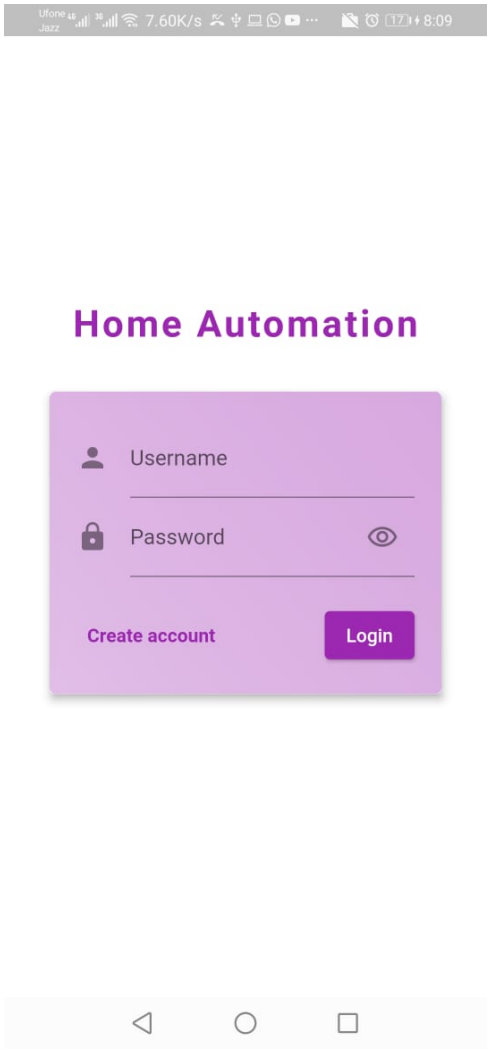


Figure 1: GUI Screenshots
Figure 2: Sign In Screenshot
Figure 3: Sign Up Screenshot

3.6. Low Level Designs

Home Automation will have multiple features and use cases as we have discussed before and we can see the low level designs based on the following diagrams.

ERD:

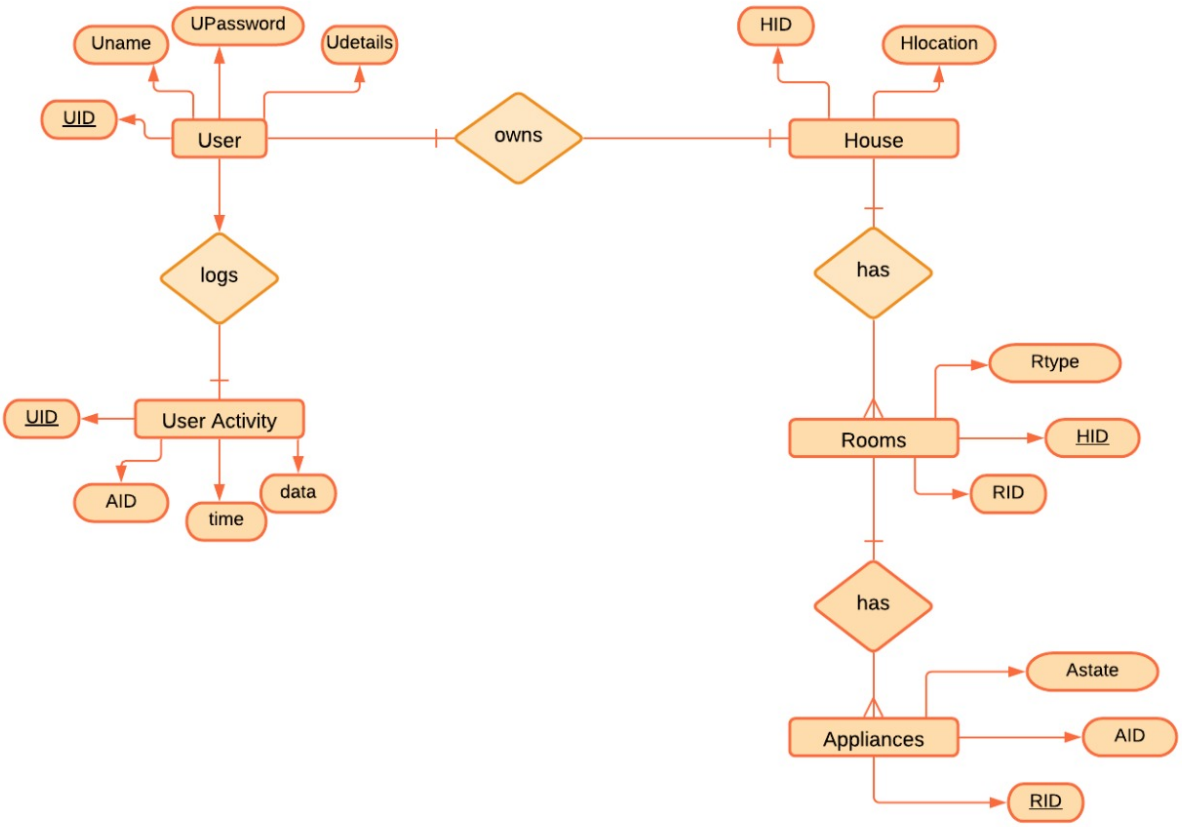


Figure 4: ERD

Use Case Diagram:

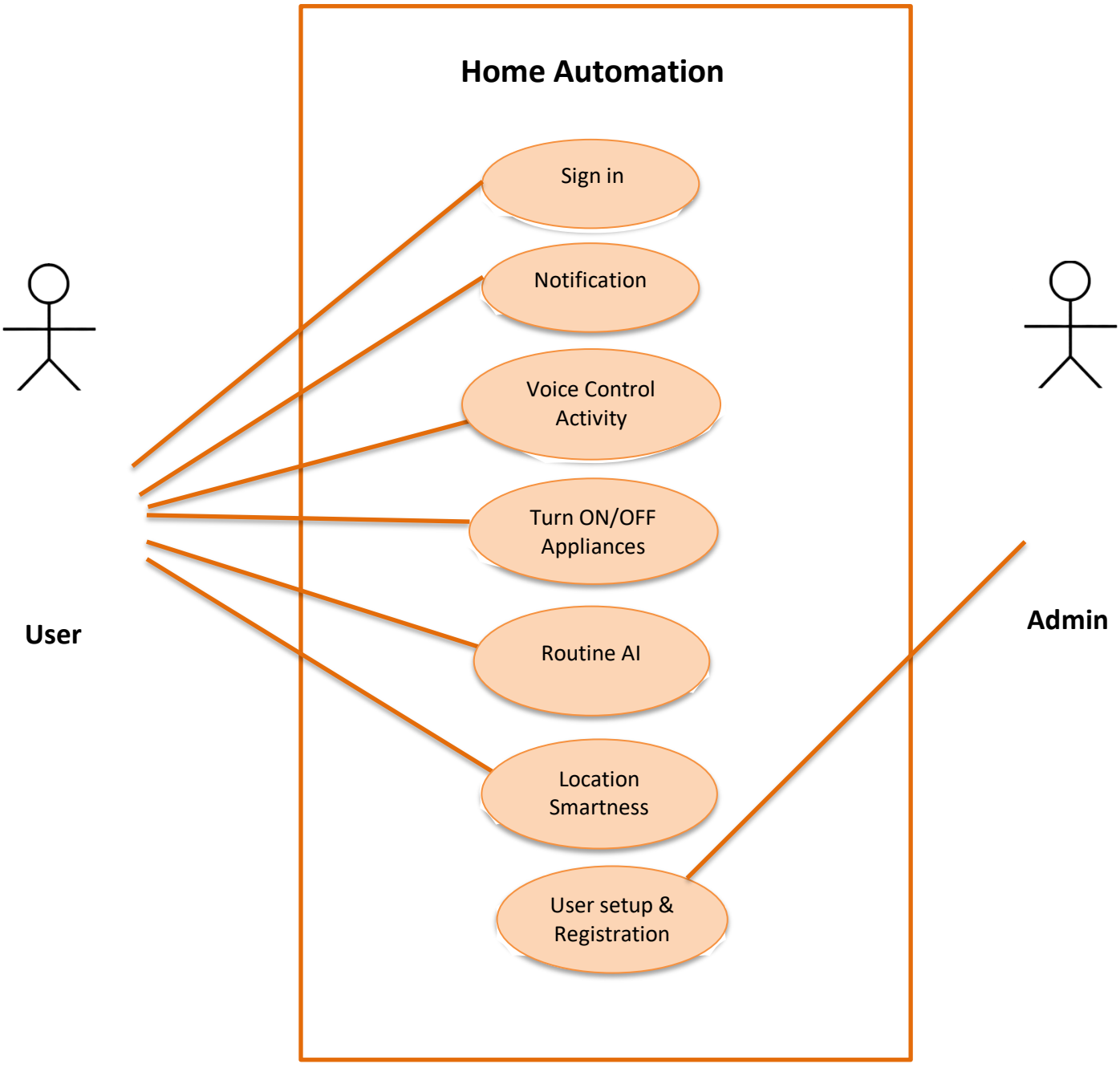


Figure 5: Use Case Diagram

DFD:

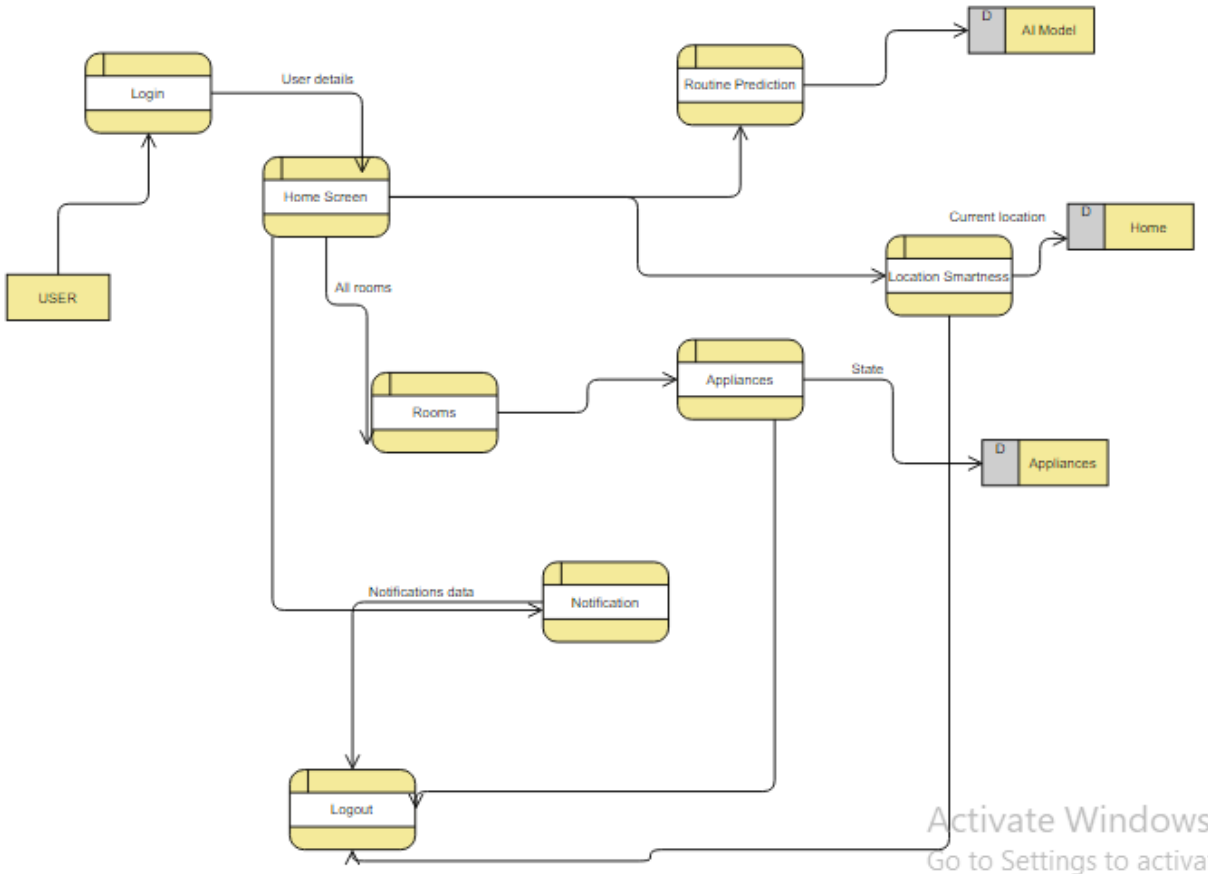


Figure 6: DTA FLOW DIAGRAM

Appendix A: Glossary

Asynchronous: Code that allows completion of tasks on different threads or time slots.

Dart: A programming language used in the Flutter framework.

Firebase: Firebase is a backend service that provides powerful features for building mobile apps. It has three core services: a real-time database, user authentication and hosting.

Flutter: A framework developed by Google to make cross-platform mobile apps with a single code base.

Raspberry pi: It is the hardware that would turn on the lights and appliances in connection with flutter.

Chapter # 4 Implementation

1 Discussion

For our project Home Automation, we have used Flutter for the project. We have connected flutter with raspberry pie for the electrical appliances to be controlled by the app. For the implementation of AI we have generated mock dataset for the prediction of electrical appliances to be opened by trigger to be set. We have used Google Colab for the dataset creation and model implementation which would be converted to tenser flow model and then to tenser flow light. After the conversion to tenser flow light it would be deployed to Firebase ML kit through which our app will interact with the trained model. User Profile System and UI of the project is almost complete with the AI model and Raspberry Pie basic implementation.

2 Tools and Technologies

- VS Code, Android Studio, Raspberry Pie Os and Google Colab
- Flutter
- Dart
- flutter:
  - sdk: flutter
  - http: ^0.13.3
  - provider: ^5.0.0
  - cupertino_icons: ^1.0.2
  - firebase_core:
  - dart convert
- python:
  - pandas
  - numpy
  - sklearn

3 Implementation so far (AI PART):

```
[ ] dataset=pd.read_csv('6.csv')
```

```
dataset
```

	timestamp	room_id	total_people	light 1	ac	fan	light2
0	2021-07-25 02:27:46	1	4	False	True	False	False
1	2021-07-25 22:49:09	1	1	True	True	True	True
2	2021-07-25 19:44:32	1	5	True	False	True	False
3	2021-07-25 08:30:33	1	2	False	True	False	True
4	2021-07-25 06:32:12	1	4	False	False	False	False
...	...	...	...	...	...	...	...
995	2021-07-25 16:18:07	1	1	False	True	False	False
996	2021-07-25 14:09:44	1	1	True	True	False	False
997	2021-07-25 10:02:15	1	3	False	False	False	True
998	2021-07-25 16:20:21	1	5	True	False	True	True
999	2021-07-25 19:33:06	1	4	True	False	True	False

1000 rows × 7 columns

```
[ ] data=pd.DataFrame()
```

```
[ ] data['timestamp'] = pd.to_datetime(dataset['timestamp'], errors='coerce')
    data['timestamp'] = pd.to_datetime(data['timestamp'], format = '%d/%m/%Y %H:%M:%S')
```

```
[ ] column_1 = data.iloc[:,0]

    ds=pd.DataFrame({"year": column_1.dt.year,
                  "month": column_1.dt.month,
                  "day": column_1.dt.day,
                  "hour": column_1.dt.hour,
                  "minute": column_1.dt.minute,
                 })
```

```
[ ] del dataset['timestamp']
```

```
[ ] dataset
```

	room_id	total_people	light 1	ac	fan	light2
0	1	4	False	True	False	False
1	1	1	True	True	True	True

```
X=ds.iloc[:,[0,1,2,3,4,5]].values
Y=ds.iloc[:,[7,8,9,10]]
```

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.10, random_state=0)
```

```
from sklearn.ensemble import RandomForestClassifier

rlf = RandomForestClassifier(random_state=0)
rlf.fit(X_test,y_test)
rlf.score(X_test,y_test)
```

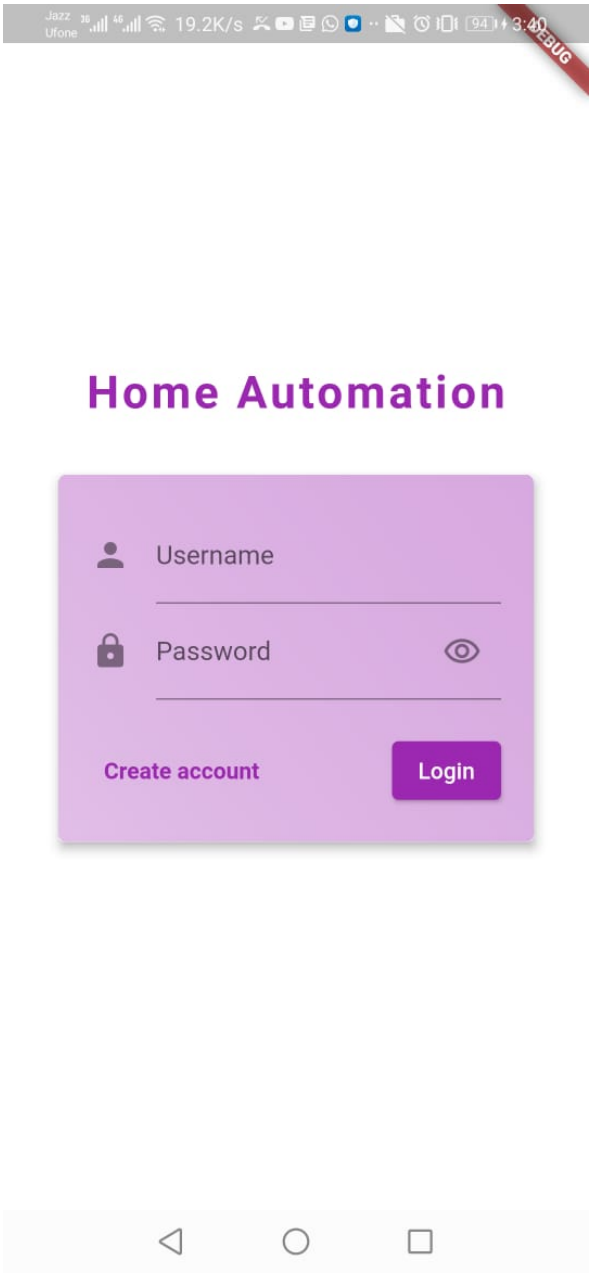
```
0.96
```

Dataset Schema:

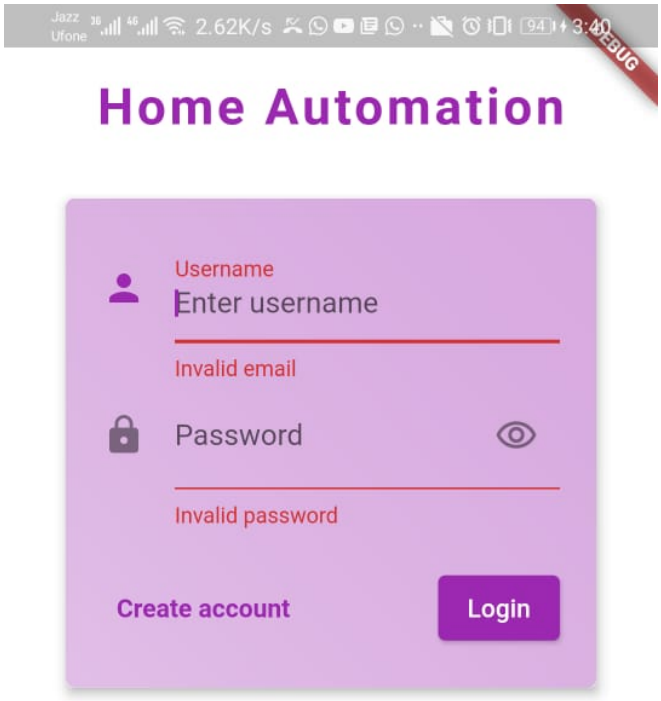
year	month	day	hour	minute	room_id	total_people	light 1	ac	fan	light2

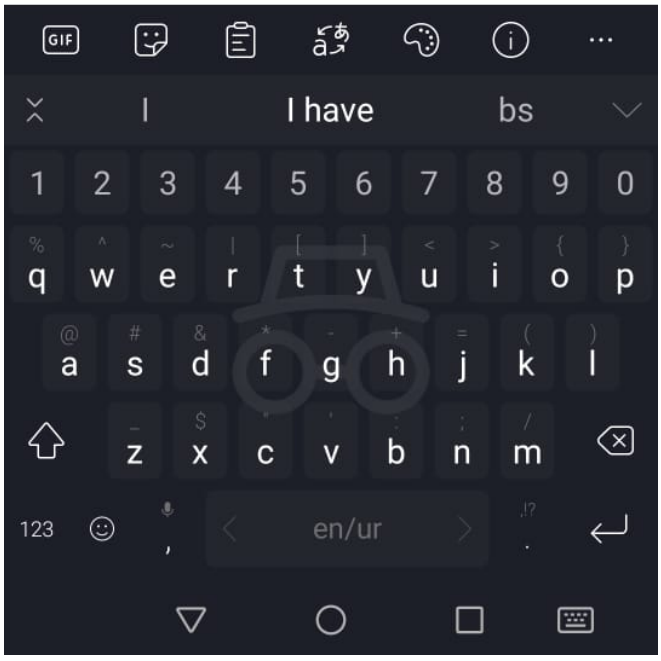
Flutter App

Login:

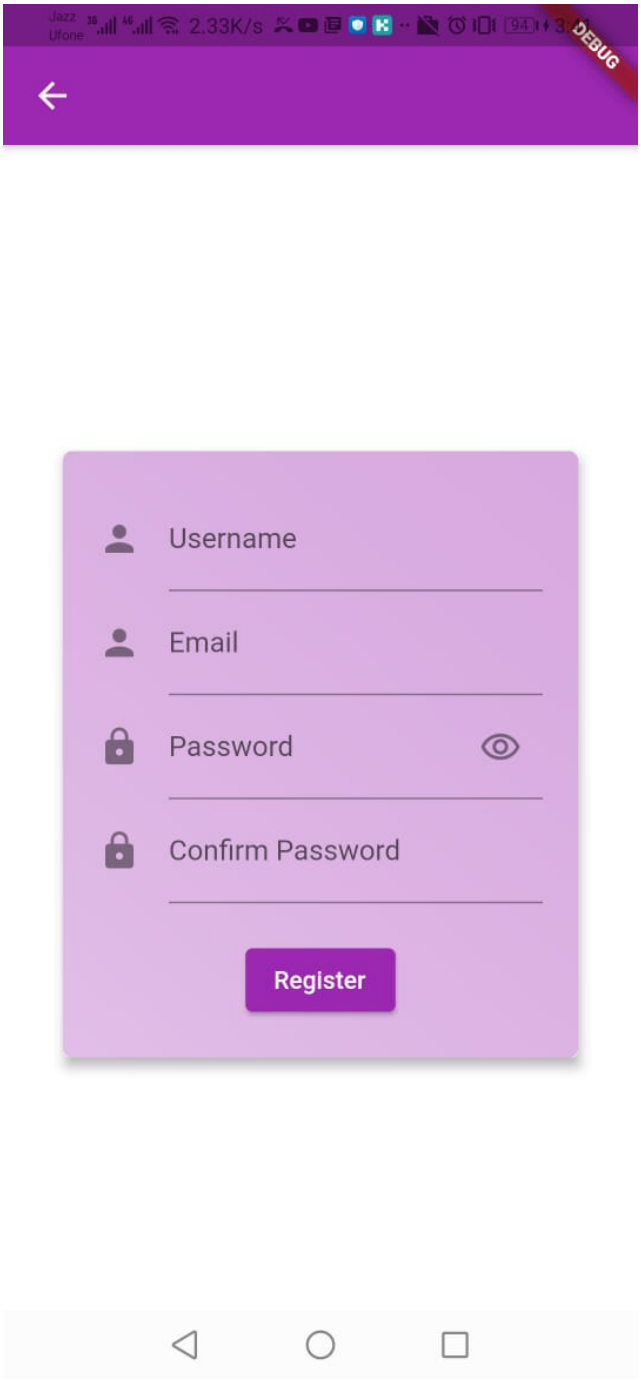


Login Validations:

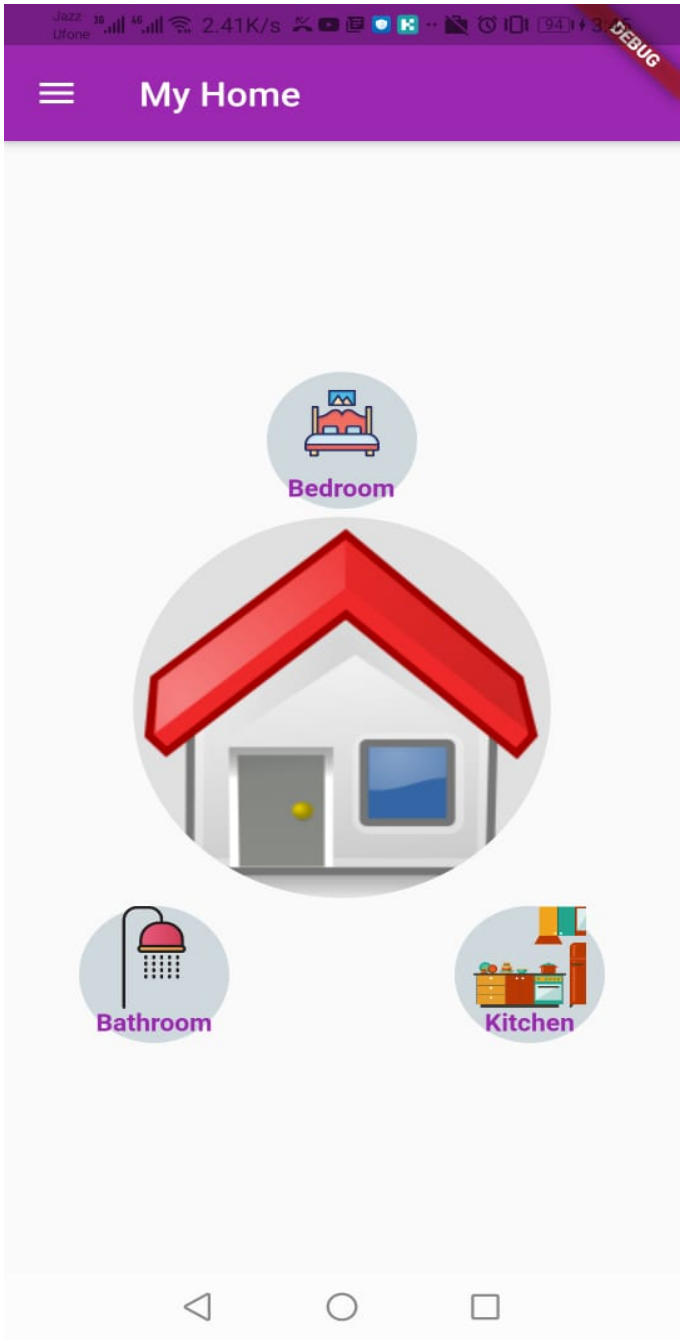




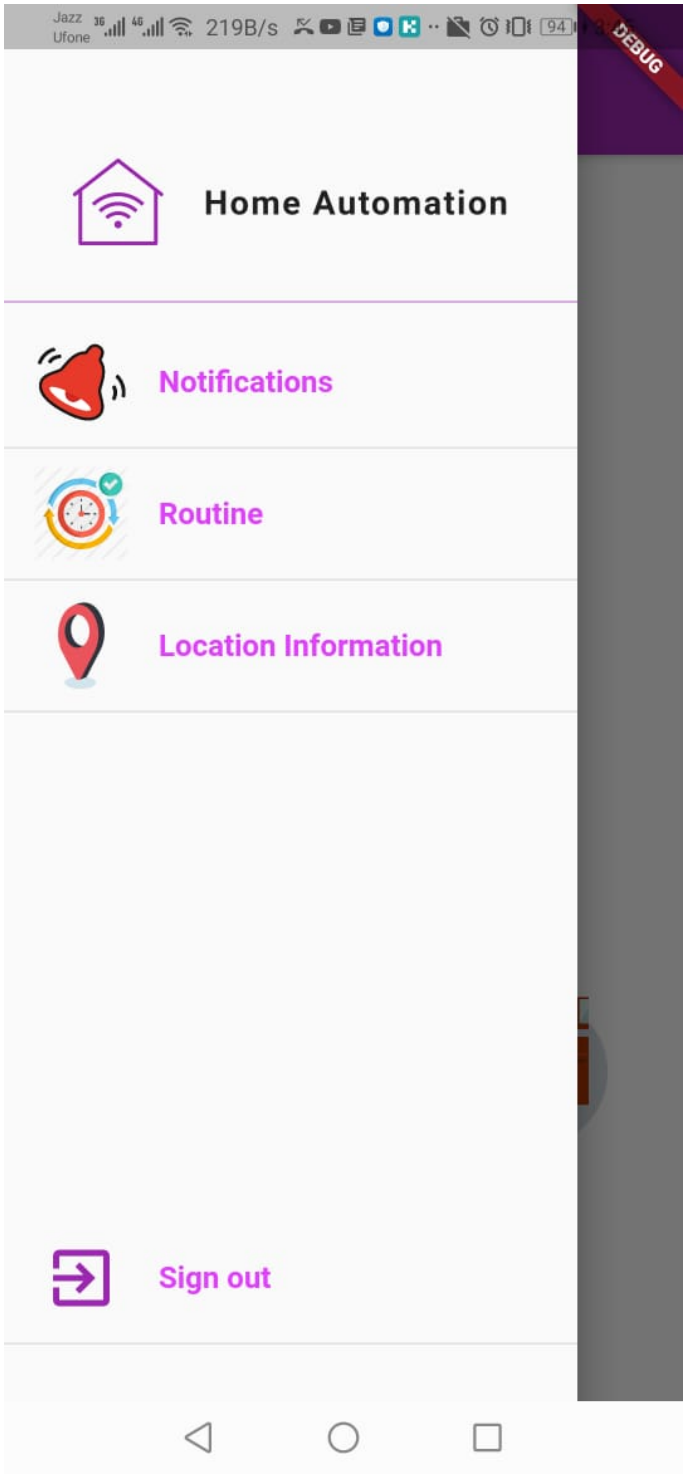
Sign Up


Jazz
Ufone
2.33K/s
DEBUG
Username
Email
Password
Confirm Password
Register

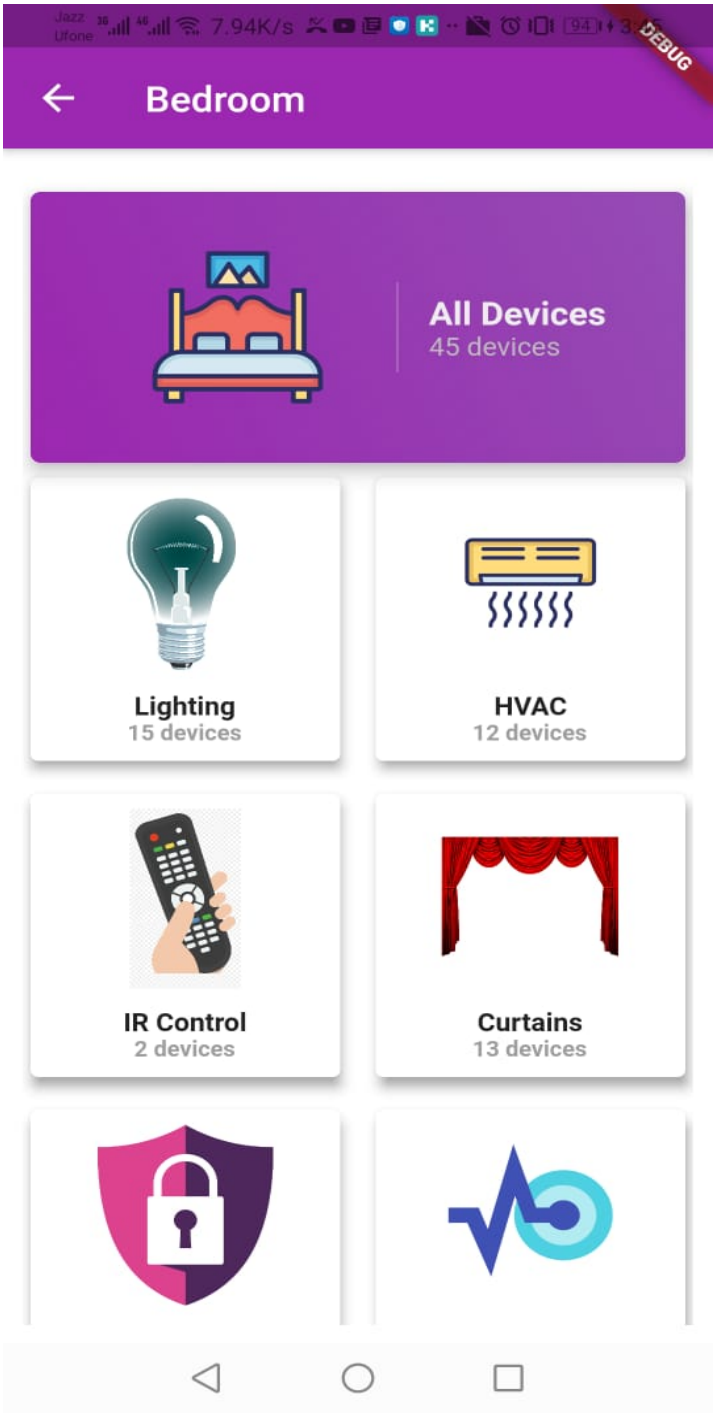
Home Screen:



Side Bar


Jazz
Ufone
219B/s
DEBUG
Home Automation
Notifications
Routine
Location Information
Sign out

Room Page:


Bedroom
DEBUG
All Devices
45 devices
Lighting
15 devices
HVAC
12 devices
IR Control
2 devices
Curtains
13 devices

References

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monk, S. ((November 20, 2012)). *programmi ng the raspberry pi.* McGraw-Hill Education Tab; 1st edition.

Raschka, S. (September 2015). *Python Machine Learning.* Packt.

https://www.samsung.com/us/smartthings// - Samsung Smart Things
Domoticz - **Domoticz**
Amazon Alexa on the App Store (apple.com)- Amazon's Alexa