LOW COST AUTOMATION OF NON IOT ELECTRONIC APPLIANCES

A PROJECT REPORT

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BONA FIDE CERTIFICATE

Certified that this project report titled Low Cost Automation of Non IoT Electronic Appliances is the bona fide work of Ebenezer Isaac Veeraraju (2020178014) who carried out project work under my supervision. Certified further that to the best of my knowledge and belief, the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or an award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Monitoring of electronic devices is hard and it is easy to forget and leave a switch turned on. This can lead to Overheating/Over-Voltage of sensitive devices which can in turn lead to hazardous damage to life and property. It also uses electrical energy in an inefficient manner, which in turn contributes to the carbon footprint. Conventional Switch-Boards are also not accessible remotely and detailed usage of each device is not available which can be easily provided with basic software. Existing home automation systems are expensive and are focused on a single device, very few systems focus on converting existing devices to IoT.

IoT security is also a major concern in the consumer arena because IoT has access to people's private places. As any breach in IoT Security Systems could jeopardise an individual's privacy and confidentiality. Given this, a system that adheres to established security procedures and authentication is essential. This project aims to propose such a project that aims to solve the above problems by providing an easy to use graphic user interface that is platform in-dependant which will facilitate the operation of electronic devices remotely. The project also aims to propose a system with minimum installation charges to increase adaptability.

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CHAPTER 1

INTRODUCTION

A concise explanation of the project and the technologies employed while citing existing home automation frameworks and systems available in market.

1.1 INTRODUCTION

Automation performs a vital role in daily experience and global economy. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities.

The concept of home automation has been around since the late 1970s but with the enhancement of technology and smart services, people's expectations have changed a lot during the course of time to perfectly turn the traditional house into smart home and also think that what a home should do or how the services should be provided and accessed at home to became a smart home and so has the idea of home automation systems.

1.2 MOTIVATION

Many existing, well established home automation systems are based on wired communication such as Arduino based and raspberry pi based home automation systems. This does not pose a problem until the system is planned well in advance and installed during the physical construction of the building.

But for already existing buildings the implementation cost goes very high. In contrast, Wireless systems can be of great help for automation systems like Bluetooth, WI-Fi and IOT based home automation systems. With the advancement of wireless technologies such as Wi-Fi, cloud networks in the recent past, wireless systems are used every day and everywhere.

Home automation systems suffer four main challenges; these are poor manageability, inflexibility, difficulty in achieving security and high cost of ownership. The main objectives of this research is to design and implement a home automation system using IoT that is capable of controlling and automating most of the house appliances through an easy manageable mobile application.

The proposed system has a great flexibility by using Wi-Fi technology to interconnect its distributed sensors to home automation server. This will decrease the deployment cost and will increase the ability of upgrading and system reconfiguration.

1.3 ABOUT THE PROJECT

A fully programmable automation system for existing electronic devices with a user-friendly cross-platform graphic user interface built using Flutter. And providing a rich data insights using graphical representation techniques to monitor, manage, automate usage of electrical energy in a given infrastructure.

A proposed smart extension for existing switch board that listens for changes in the database and pairs with the application while conforming to all global standards for safety and security. This extension can then control the electrical appliances when there is a change is performed by the user in the database.

1.4 TECHNOLOGIES USED

The project is built on Flutter to meet the rising demand of mobile applications to be platform independent. The project also uses the Firebase Services like Firebase Realtime Database and Firestore Cloud Database for backend and authentication needs.

1.4.1 Flutter

Flutter is a cross-platform UI toolkit that is designed to allow code reuse across operating systems such as iOS and Android, while also allowing applications to interface directly with underlying platform services. The goal is to enable developers to deliver high-performance apps that feel natural on different platforms, embracing differences where they exist while sharing as much code as possible.

During development, Flutter apps run in a VM that offers stateful hot reload of changes without needing a full recompile. For release, Flutter apps are compiled directly to machine code, whether Intel x64 or ARM instructions, or to JavaScript if targeting the web. The framework is open source, with a permissive BSD license, and has a thriving ecosystem of third-party packages that supplement the core library functionality.

1.4.2 Firebase Realtime Database

Having a central place for storing application data is a common requirement for mobile applications. In this case, you would need to save user progress to a remote database so that users can have access to the data from any number of devices they own. That database is usually hosted somewhere, on

the Internet, making it accessible through a simple network connection. This concept is known as the cloud. You can think of the cloud as someone else's computer, or an entire infrastructure, which you've rented for various services.

Firebase Realtime Database is a solution that stores data in the cloud and provides an easy way to sync your data among various devices. The Realtime Database takes care of security with database rules, how data is saved to the database and the follows best practices for data structure by default. Therefore this database makes a great choice for this application.

1.4.3 Arduino - NodeMCU

NodeMCU is an open-source LUA based firmware developed for the ESP8266 wifi chip. By exploring functionality with the ESP8266 chip, NodeMCU firmware comes with the ESP8266 Development board/kit i.e. NodeMCU Development board.

Since NodeMCU is an open-source platform, its hardware design is open for edit/modify/build. NodeMCU Dev Kit/board consist of ESP8266 wifi enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol.

1.5 ORGANIZATION OF PROJECT REPORT

The thesis is organized into 5 chapters, describing each part of the project with detailed illustration and system design diagrams. The chapters are as follows.

Introduction : A brief description about the project and the technologies used therein.

Literature Survey : Summary of the literary survey conducted for the project whilst comparing existing methodologies with their respective advantages and disadvantages.

System Design : Detailed explanation of the proposed application's system design using relevant diagrams and description of modules and functionalities proposed in the project.

Implementation and Results : Presentation of the proposed system using screenshots and their relevant explanations.

Conclusion and Future Work : Takeaway from the proposed project and also recommendation for improvements on the same.

The above mentioned five modules are followed up with the References which deliberately explains and list all the reference documents used during the various phases of the project, which includes the journal papers,conference papers, white papers, articles and websites referred for tutorials.

CHAPTER 2

LITERATURE SURVEY/RELATED WORK

Summary of the literary survey conducted for the project whilst comparing existing methodologies with their respective advantages and disadvantages.

2.1 Literature Review on Home Automation System

Automation performs an increasingly vital role in daily experience and global economy. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities.

The concept of home automation has been around since the late 1970s. But with the enhancement of technology and smart services, people's expectations have changed a lot during the course of time to perfectly turn the traditional house into smart home, and also think that what a home should do or how the services should be provided and accessed at home to became a smart home and so has the idea of home automation systems.

A home automation system means to grant the endusers to manage and handle the electric appliances. If we look at different home automation systems over time, they have always tried to provide efficient, convenient, and safe ways for home inhabitants to access their homes. Regardless of the change in user's hope, growing technology, or change of time, the appearance of a home automation system has remained the same.

2.1.1 Challenges of Home automation systems

Home automation systems suffers four main challenges; these are poor manageability, inflexibility, difficulty in achieving securityand high cost of ownership,The main objectives of this research is to design and implement a home automation system using IoT that is capable of controlling and automating most of the house appliances through an easy manageable web interface. The proposed system has a great flexibility by using Wi-Fi technology to interconnect its distributed sensors to home automation server. This will decrease the deployment cost and will increase the ability of upgrading, and system reconfiguration.

2.1.2 Bluetooth based home automation system using cell phones

In Bluetooth based home automation system the home appliances are connected to the Arduino BT board at input output ports using relay. The program of Arduino BT board is based on high level interactive C language of microcontrollers; the connection is made via Bluetooth.

2.1.3 Zigbee based home automation system using cell phones

To monitor and control the home appliances the system is designed and implemented using Zigbee. The device performance is record and store by network coordinators.

2.1.4 GSM based home automation system using cell phones

Because of the mobile phone and GSM technology, the GSM based home automation is lure to research. The SMS based home automation, GPRS

based home automation and dual tone multi frequency (DTMF) based home automation, these options we considered mainly for communication in GSM.

2.1.5 Wi-Fi based home automation system using cell phones

Wi-Fi based home automation system mainly consist three modules, the server, the hardware interface module, and the software package. The figure shows the system model layout. Wi-Fi technology is used by server, and hardware Interface module to communicate with each other. The same technology uses to login to the server web based application. The server is connected to the internet, so remote users can access server web based application through the internet using compatible web browser.

2.1.6 Cloud Based home automation system

Home Automation using cloud based system focuses on design and implementation of home gateway to collect data about data from home appliances and then send to the cloud-based data server

2.1.7 Raspberry pie home automation with wireless sensors using smart phone

Home Automation System has been developed with Raspberry Pi by reading the algorithm and subject of Email. Raspberry Pi guarantees to be an efficient platform for implementation powerful, and economic smart home automation. home automation using Raspberry pi is better than any other home automation methods in several ways.

2.2 Literature review on home automation system for physically disabled peoples

Generally the Art of controlling the home appliances automatically sometimes remotely is called home automation system. Home Automation systems are highly increasing to Comfort in life and also improving quality of life. As we are in the Era of never ending growth of internet and its applications So, the topic of home automation systems getting most popularity due to its countless advantages. This paper focus on the studies and review of multiple home automation systems designed for disable peoples from multiple features standpoints. This research will be helpful for the disable persons to find an efficient and usable system with respect to the categories divided for the comparison.

Comparison Table					
Systems	Ease of Use	Costs	Scalable	Security	Total Sum
Home automation system using Android application	2	2	2	2	8
Home Automation system based on Gesture HumanMachine Interface (GHMI)	2	1	1	2	6
Home Automation System Using Voice Recongnition Module HM2007	0	0	0	0	0
IOT Based Home Automation System Using Intel Galileo Board	1	2	2	2	7
Home Automation System Using Speech Recognition and Machine learning	0	0	0	0	0
Home automation system using Electro-Oculography (EOG) Signal	2	1	1	1	5

Figure 2.1: Automation System Comparison for the Disabled

2.3 A Literature Survey on Smart Home Automation Security

2.3.1 Challenges in Home Automation Security

The changing concept of security in modern homes has an impact on the advancement of technology. Sophisticated security systems using microphones, proximity sensors, contact sensors, cameras, alarms etc. has been changed from a simple lock and key based security system. Today, users can access and control their homes remotely from anywhere and at any time in the world by connecting modern homes to the Internet which is very popular.

2.3.1.1 From a Homeowner's Point of View

There is a huge difference between what user thinks is the implementation of access control and th access control and security measures that are actually implemented.

The owner also has to consider the social implication of rejecting access to a guest. Though the owner may have to consider the guest's feelings, a guest may feel insulted. The owner may need to change user access control rules often which is a big security threat.

Along with home security system, there can be more devices connected to a home network like mobile phones which go with other user and connects to external other networks.

An attacker can compromise home automation system by using these devices as a gateway to home network when these devices get connected to home network because user are careless in this case.

Most of the times people are unaware, misinformed or careless about various security risks while choosing home automation system due to the money issue.

2.3.1.2 From a Security Engineer's Point of View

Unlike in companies, one can't enforce policies or security procedures that affect the convenience of people at home or their guests.

People are careless about even simple security policies.

Home may consist of people of different age groups e.g. Senior citizens which are not cable of understanding the technical aspect of the security system is more vulnerable to social engineering.

An attacker who hacks a home automation network can cause a wide range of damage, including theft, vandalism, emotional harm, permanent damage to electronic devices, loss of reputation, financial damages, blackmail, environmental damages, physical harm to a home's inhabitants, granting unauthorised access to anyone.

The mixed ownership of devices at home and guests with varying technical knowledge and different intentions compounds security issues at home.

2.4 IoT Based Home - Substation Automated Coordination Using Arduino

The home automation systems involve making homes even smarter. Homes can be interfaced with sensors including motion sensors, light sensors and temperature sensors and provide automated toggling of devices based on conditions. More energy can be conserved by ensuring occupation of the house before turning on devices and checking brightness and turning off lights if not necessary. The system can be integrated closely with home security solutions to allow greater control and safety for homeowners. The next step would be to extend this system to automate a large-scale environment, such as offices and factories. Home Automation offers a global standard for interoperable products. Standardization enables smart homes that can control appliances, lighting, environment, energy management and security as well as the expandability to connect with other networks.

In addition to this, we are introducing one more access to communication through substation in home automation system. It is called three party communication. Remote control by customer and by substation. In certain conditions, riders will be provided for customer over substation based on tariff rates, based on time of day and need of customer. It helps individuals in their home by only controlling, they can do what they require. It enables communication gateway for all components of the future distribution substation and improve grid monitoring.

In this project, a novel architecture for low cost and flexible home control and monitoring system using Android based Smart phone is proposed and implemented. The proposed architecture utilizes a micro web server and Bluetooth communication as an interoperable application layer for communicating between the remote user and the home devices. Any Android based Smart phone with built in support for WiFi can be used to access and control the devices at home. When a Wi-Fi connection is not available, mobile cellular networks such as 3G or 4G can engine thus eliminating the need for an external voice recognition module. In this paper, working of simulation on IoT based homesubstation automation is presented.

CHAPTER 3

SYSTEM DESIGN

Detailed explanation of the proposed application's system design using relevant diagrams and description of modules and functionalities proposed in the project.

3.1 SYSTEM ARCHITECTURE

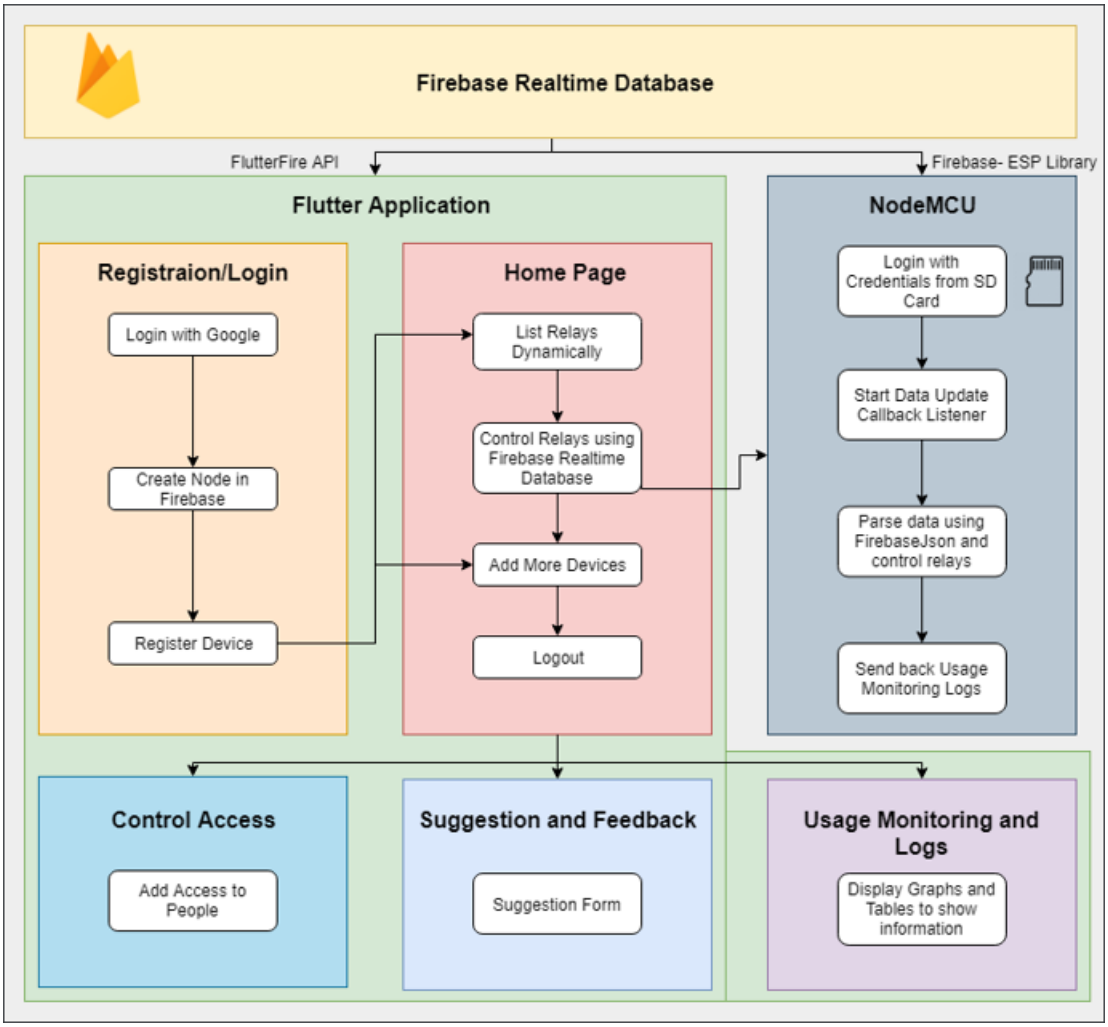

Figure 3.1: Architecture Diagram

The Project has three entities in the system. They are clearly shown in the diagram below. The NodeMCU listens to changes made in the database and toggles relays as per requirement.

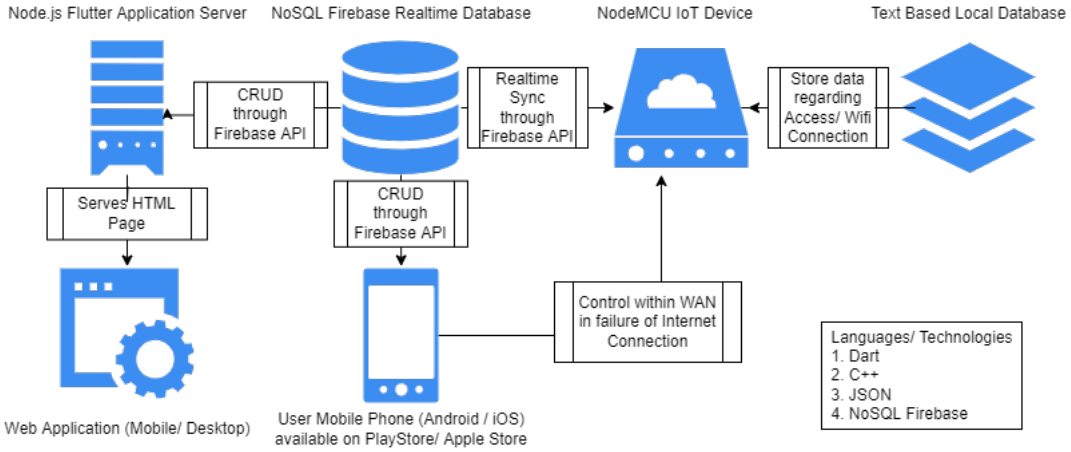

Figure 3.2: Operational Diagram

The Flutter Application handles all data manipulation tasks including registering the IoT device and also the control of the relays. The Firebase Real-time Database handles the data stream for the NodeMCU and also handles Google Authentication. The goal of the system is to move as much computational tasks to the Flutter Application as possible.

3.1.1 NodeMCU

The NodeMCU is a micro-controller that connects to a WiFi Network and starts a stream callback listener to listen to changes made in a specific path in the database. It then toggles the relay switches with the help of GPIO pins provided on the NodeMCU Controller. The NodeMCU Controller is an Arduino based Micro-controller so the code for the same can be written with the help of the Arduino IDE. The NodeMCU in itself does not support SD Card Capabilities and therefore we need to connect an SD Card Module with the help of GPIO

Pins. Data related to WiFi Credentials and Google Authentication will be stored in the SD Card.

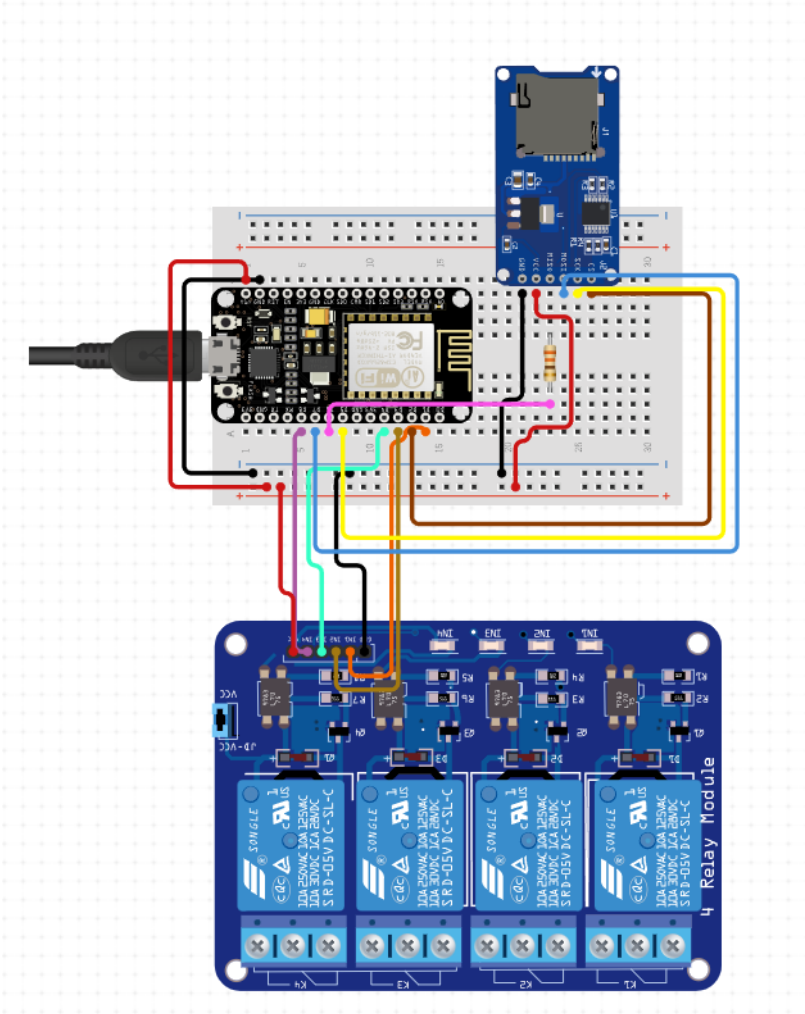

Figure 3.3: Basic Circuit Diagram

3.1.1.1 Peripherals Required

The following peripherals and modules will be required to connect the NodeMCU according to requirement.

NodeMCU - ESP8266 : NodeMCU is an open source IoT platform. It includes both firmware which runs on the ESP8266 WiFi SoC, and hardware which is based on the ESP-12 module. The applications in these samples that are running on NodeMCU are written using Lua scripting language which is quite simple and easy to understand.

8 Channel 5V DC Relay : A 5v relay is an automatic switch that is commonly used in an automatic control circuit and to control a high-current using a low-current signal. The input voltage of the relay signal ranges from 0 to 5V. 8 Channel Relays are 5V Relays connected in series into a single module.

AC to DC Adapter : An AC adapter converts alternating current from one voltage to another, while a DC adapter converts alternating current into direct current. Since the latter is more widely used, the term AC adapter is often used to refer to DC adapters. It converts AC power from the wall plug and provides 12V DC power supply to the circuit.

SD Card Reader : A Reader Module is needed in the communication between the memory card and the MCU. Sunfounder SD/TF card module can meet your needs. With standard SPI port, this module supports both SD and TF cards. Through the file system and SPI port driver, the MCU can read and write the file inside the Micro-SD card.

SD Card : The micro-SD card is the smallest consumer-focused flash memory card in use today. It's a variation of the standard SD card (short for Secure Digital) and uses a similar set of electrical connections. That makes it possible to use micro-SD cards in standard SD card slots with the use of an adapter. A maximum of 32GB storage micro-SD card can be supported by the NodeMCU Micro-controller.

PCF8574 GPIO Extender : The PCF8574 is a silicon CMOS circuit. It provides general purpose remote I/O expansion for most micro-controller families via the two-line bidirectional bus (I2C). The device consists of an 8-bit quasi-bidirectional port and an I2C-bus interface.The PCF8574 is an I2C bus to 8-bot parallel bus IO expander IC. It provides GPIO expansion for many micro-controllers in a simple and cost-effective method. The interface for this IC is I2C (or I2C) using SDA (Data) and SCL (Clock) lines.

Figure 3.4: Finished Product for Installation

DC to DC Buck Converter : A Buck converter steps down a DC voltage from the input to the output. The circuit operation depends on the conduction state of the MOSFET: On-state: The current through the inductor increases and the diode blocks. A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while drawing less average current) from its input (supply) to its output (load).

3.1.1.2 Modules

Hardware Connections and Casing : This module handles the initialization of the NodeMCU Device and also checks that all the modules are connected properly to the NodeMCU in the setup function.

Persistent Network Connection : This module helps in maintaining stable internet connection and tries to reconnect to the WiFi Network in the case of Network Disconnection. It reads WiFi WPA2 Handshake Credentials from the SD Card provided by the user.

Data Update Stream Callback Listener : This module listens to any changes in the given Database Path and also maintains a authenticated HTTP Socket with the Firebase Server by a keep alive function that is called every 15 seconds.

Parsing Firebase Data-Snapshot into JSON : The listener module receives a Firebase Data-snapshot as a result and therefore it needs to be parsed to JSON before it can be really easily by the NodeMCU Micro-controller.

3.1.2 Flutter Web/Desktop Application

Flutter is a cross-platform UI toolkit that is designed to allow code reuse across operating systems such as iOS and Android, while also allowing applications to interface directly with underlying platform services. Flutter was chosen for this project since the application will benefit from being available on multiple platforms. Flutter can achieve this requirement easily as it has a single code-base for the application and can be compiled into executables for multiple platforms according to requirement. For the current project, executables for

the platforms iOS, Android, Web and Windows Desktop have been complied for distribution. With just some basic customization, application executables for all the given platforms have been compiled. Flutter also has a very huge community support which makes developing of apps faster. It is based on a developer friendly programming language called Dart which was developed by Google specifically for the use of development of Flutter Applications.

3.1.2.1 Modules

Registration : This Module deals with Registration process of registering the IoT Device with the Firebase Database and connecting it to the user's account on the Firebase Real-time Database. The user needs to login with Google Authentication to create an account.

Access Control : This module offers the user to share access to his account to another user as per requirement. The user can also specify expiry date for the shared user and also has the option to revoke access to the shared user at any given time.

Usage and Monitoring Logs : This module reads and aggregates the usage logs stored in the Firebase Real-time Database and compiles them into Readable Data Representational Formats like graphs and pie charts so that the user can get useful insights regarding the usage of each relay registered in his account.

Manage Devices and Relays : This module handles the management and organization of devices and relays in the user's account and also gives the interface to control the relays individually.

3.2 NOSQL DATABASE

NoSQL systems are purpose-built solutions, designed to address specific technical requirements. NoSQL systems originated to provide high throughput, fault-tolerant horizontally scalable simple data storage and retrieval with a bare minimum of additional functionality.

3.2.1 Firebase Real-time Database

Firebase Real-time Database is a cloud-hosted database that supports iOS, Android, Web, C++ and Unity platforms. Real-time means that any changes in data are reflected immediately across all platforms and devices within milliseconds.

Even though other NoSQL databases are available on the market, Firebase was chosen mainly because it offers the application to start a stream callback listener on client side so that it reduces the network strain imposed by the application. It reduces the network data usage significantly because the data is downloaded only if there is any new change in the database.

MongoDB, though it offers a similar function, it is not offered officially and it is also not available on the NodeMCU Micro controller. Firebase Real-time Database has a readily available library that can be used with Arduino IDE and which is specifically designed to be used with the ESP8266 chip.

Along with these benefits, Firebase also offers the capability to handle the authentication requirements of the application by using its Token based Google Authentication API.

3.2.2 Firestore Cloud Database

Cloud Firestore, which is also referred to as Google Firestore, is an integral part of the Google Firebase platform. It takes the form of a cloud-based NoSQL database server that does an excellent job of storing and syncing data. In fact, web and mobile apps can interact directly with Firestore with the use of native SDKs. Firestore is a high-performance database that supports automatic scaling. Besides, it is quite easy to use and very reliable. Developers can work with Firebase using a wide variety of technologies such as Java, C++, Unity, Go, Node.js SDKs, REST, and RPC APIs.

User Data like location list, room list, room list are stored on this database while realtime application data like relay status which needs to be instantaneous are stored in the realtime database. The approach was used to minimize data usage and also to increase application performance by using providers for nested collections stored in the firestore cloud database.


```
{
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    "created_time": "timestamp",
    "homes": [
      {
        "accessList": [
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            "email": "ebnezr.isaac@gmail.com",
            "expiry": "2022-07-31 00:00:00.000",
            "status": true
          }
        ],
        "name": "Villa",
        "rooms": [
          {
            "devices": [
              {
                "device-id": "iot-device-001",
                "relays": [
                  {
                    "lastModified": "2022-06-21 20:24:24.799252",
                    "name": "Bulb",
                    "status": false
                  },
                  {
                    "lastModified": "2022-06-12 17:55:14.813760",
                    "name": "Ceiling Fan",
                    "status": false
                  },
                  {
                    "lastModified": "2022-06-12 18:15:19.333598",
                    "name": "CFL",
                    "status": false
                  }
                ]
              }
            ]
          }
        ]
      }
    ]
  }
}
```


Figure 3.5: NoSQL Database Design

3.3 MODULES AND ALGORITHMS

An overview into the prominent algorithms that provide core functionalities in the proposed application.

3.3.1 Registering an Account

Any user who wants to use the application needs to create an account and also register devices into the account complete setup.

INPUT : Create an account with the Mobile Application and complete Setup.
PROCESS : The user can create the account by signing into the application and also complete setup after that.

1: Download the Application from the Play Store/iOS App Store.
2: Open the application and signing with Google using the prompt.
3: Create a Home in the Application.
4: Select the created Home and Create a Room Object in the application.
5: Now click on add new device and register the product by providing the Serial Number.
6: Now add new Relays into the Relays by selecting the registered Device.
7: Give arguments like RelayName and NotificationDelay.
8: Repeat step for all connected relays with the product.

OUTPUT : A functional account with registered devices.

3.3.2 Controlling the Relays

After setup the user can start controlling the relays in the relays tab available in the Home Page.

INPUT : Required Status of Relay for a particular electrical appliance.

PROCESS : The application updates status in the database and the NodeMCU listens to the change and toggles the switch according to requirement.

1: Navigate to the Relays Page using the Navigation Drawer.
2: Use the switch in the user interface to toggle the Relay on and off.
3: The application updates the information in the Datbase
4: NodeMCU gets notification about change in the database.
5: NodeMCU parses the Datasnapshot and toggles the relay status according to the status in the Database.
6: Application gets turned on or off when NodeMCU reacts to the data update.

OUTPUT : Electrical Appliance gets turned on or off according to user input.

3.3.3 Mark Room as favorite

An user can mark a room as favorite so that it is opened first at the start of the application.

INPUT : Marks the preferred home and consequent room as favorite

PROCESS : The user marks the room as favorite using the icons displayed near the Room Name.

1: Open Dashboard in the application.
2: Click heart icon of desired room to be set as favorite.
3: Application stores the index of the home as a Shared Preferences variable.
4: When the application gets restarted, the shared preferences are read and the user is navigated to the favorite room to start controlling the relays.

OUTPUT : Favorite Room gets opened during application startup

3.3.4 Viewing Usage Insights

A user can view insights generated from the logs of the user usage in the form of graphs and pie charts.

INPUT : Frequent usage of application to control electrical appliances.
PROCESS : The logs are stored on each interaction and are aggregated and shown in the form of graphical charts ans pie charts.

1: Click the Usage Insights on the left drawer.
2: Select Duration span of required graph
3: Application fetches logs during the specified duration.
4: Display Aggregated Graphs and Data Representation Models to provide insight.

OUTPUT : Graphical Data Representational Models according to requirement.

CHAPTER 4

IMPLEMENTATION AND RESULTS

Presentation of the proposed system using screenshots and their relevant explanations.

4.1 GOOGLE PLAY STORE

The application can be readily downloaded from the Google Play Store by searching for the application name ”MycroLinks”. It has been listed in the Productivity Category tagged as an Home Automation application.

Figure 4.1: Feature Image for Google Play Store Listing

4.2 APPLICATION LAUNCHER ICON

On Installation of application, a launcher icon like shown above can be found in the app drawer of your smartphone.

Figure 4.2: Application Launcher Icon

4.3 SPLASH PAGE

This page is displayed at the start of the application while the smartphone boots up the processes required by the Flutter application.

Figure 4.3: Splash Page

4.4 AUTHENTICATION PAGE

This page is displayed after the flutter application has successfully booted its processes and also has made connection with the Firebase Database. This page only appears if the user has not signed in to the application previously.

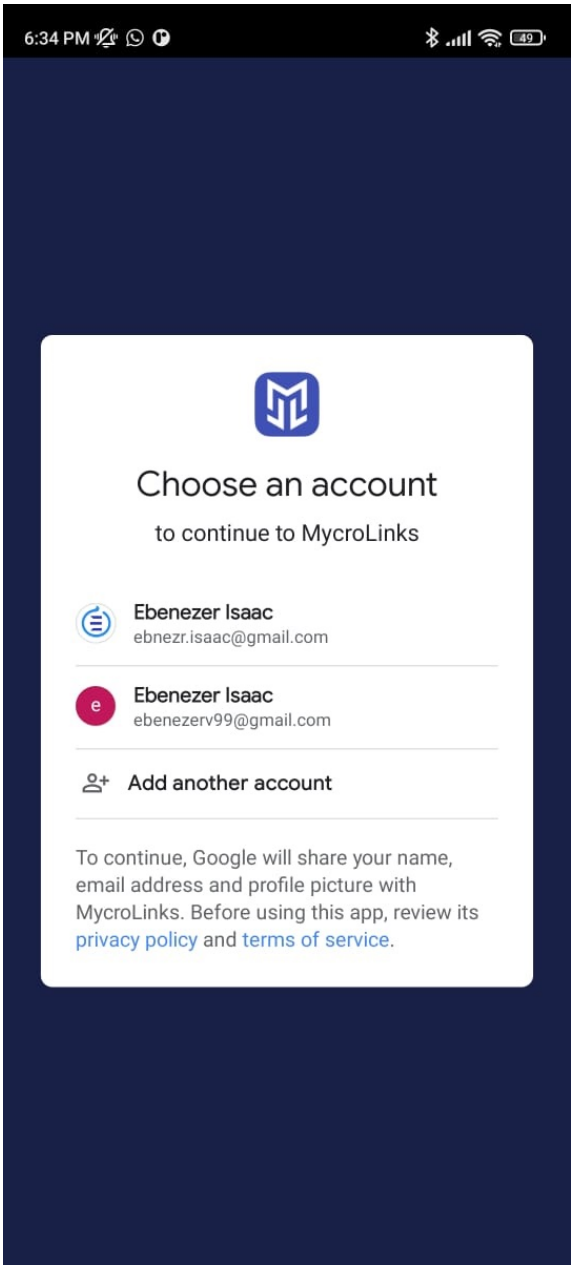

Figure 4.4: Authentication with Google Signing Prompt

4.5 NAVIGATION DRAWER

The Navigation Drawer can be opened by the user at any point while using the application. The user can choose the click the burger navigation icon available on the top left of the application or use gesture navigation too. The user needs to swipe from lefty to right to open the navigation drawer using gesture.

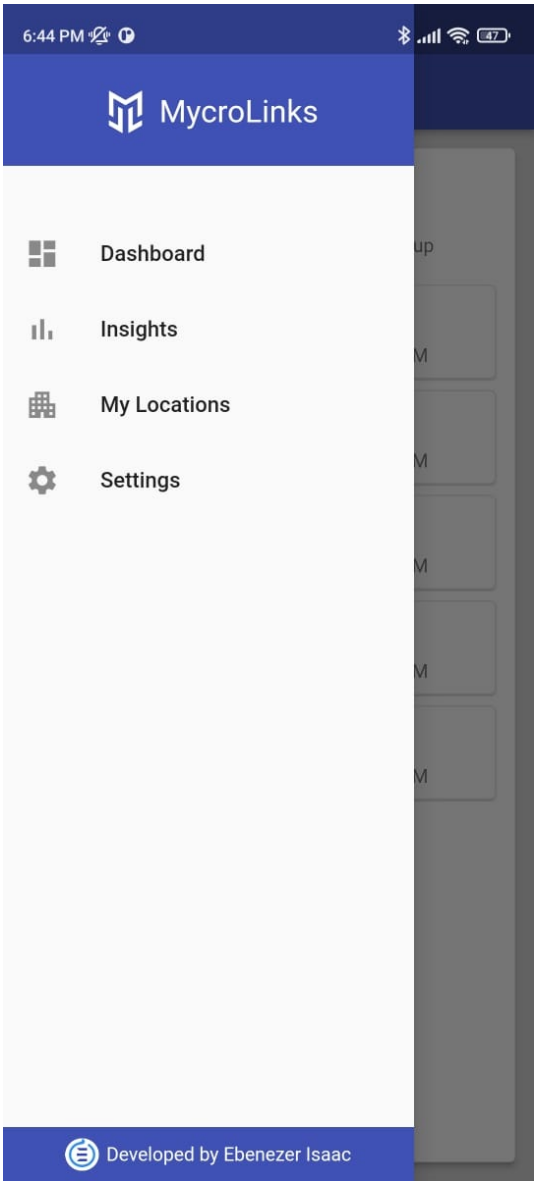

Figure 4.5: Navigation Drawer

4.6 DASHBOARD

This page is the home page of the application. But it lists the recent rooms accessed by the user. The dashboard redirects the user to the room for easy access at the start of the application.

4.6.1 Recent Rooms History List

The user can set the favorite room from the recents room list by clicking on the heart icon. Only 5 rooms will be shown at maximum in the recents list.

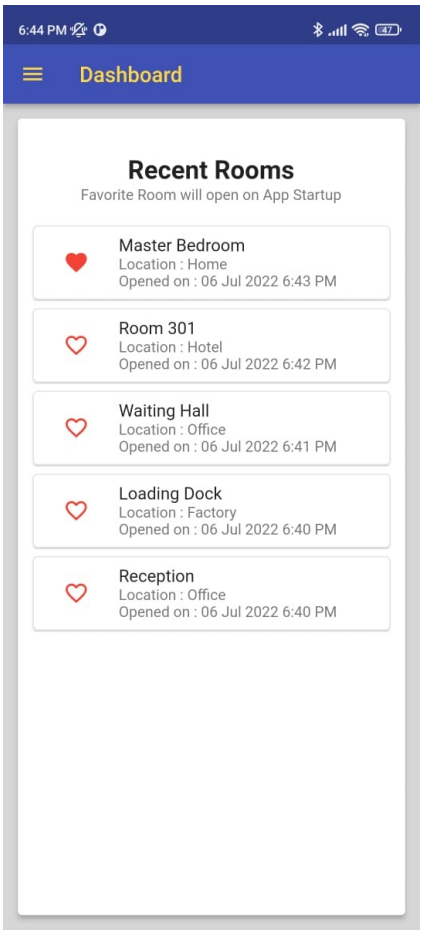

Figure 4.6: Dashboard

4.6.2 Delete History Item

This alert dialog is shown when the user left swipes on the recent room item. The user is then expected to confirm the action intended so that it can be updated in the shared preferences.

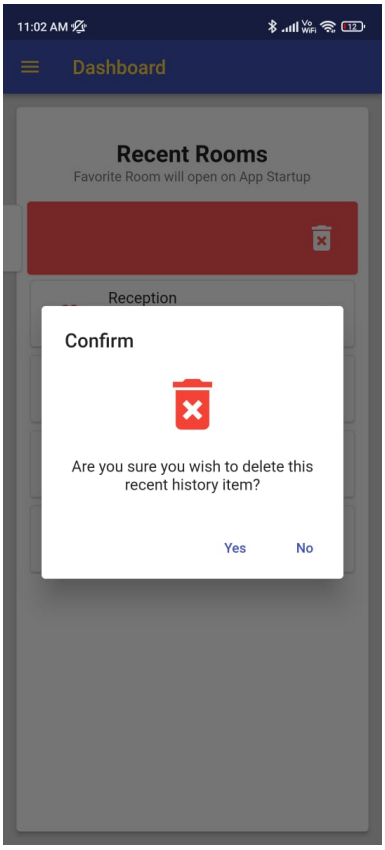

Figure 4.7: Delete Recent History

4.7 LOCATIONS

The user can create multiple locations which can contain multiple rooms. This feature in the application is provided solely for the purpose of organizing the registered devices so that it can be scalable if the user decides to register more devices into the account.

4.7.1 Locations Page

This page lists all the locations created by the user in the account. The user can also create new locations by tapping the add icon on the top right corner of the screen. The user can also edit the location name by tapping on the edit icon.

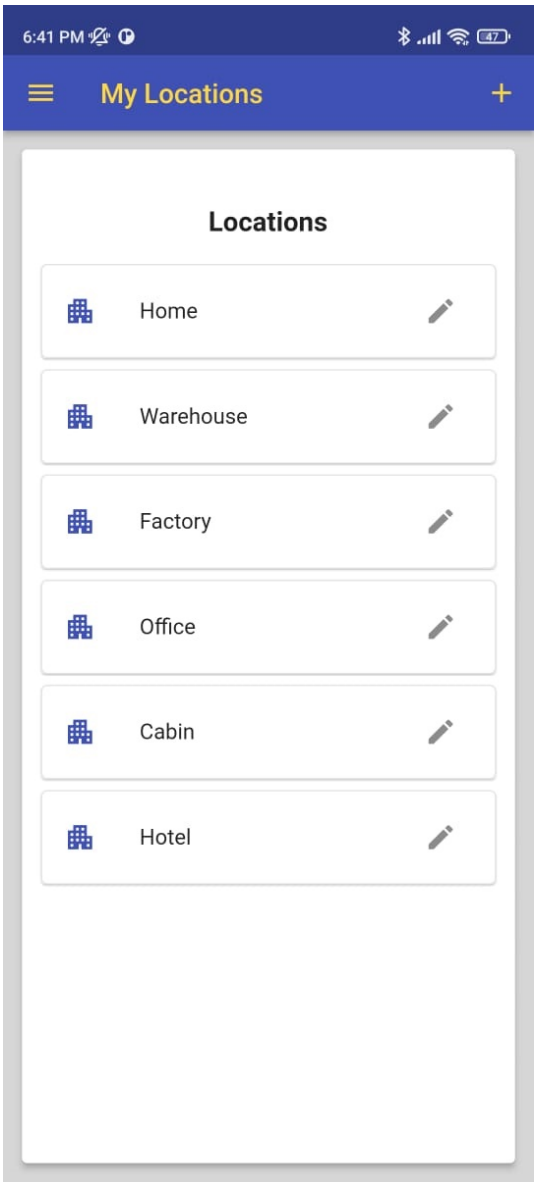

Figure 4.8: Locations Page

4.7.2 Add Location

A popup dialog box is opened when the user clicks on the add icon on the top right corner of the screen, it asks the user to provide a location name so that it can be created in the database. The user needs to add locations and rooms to continue to register a device.

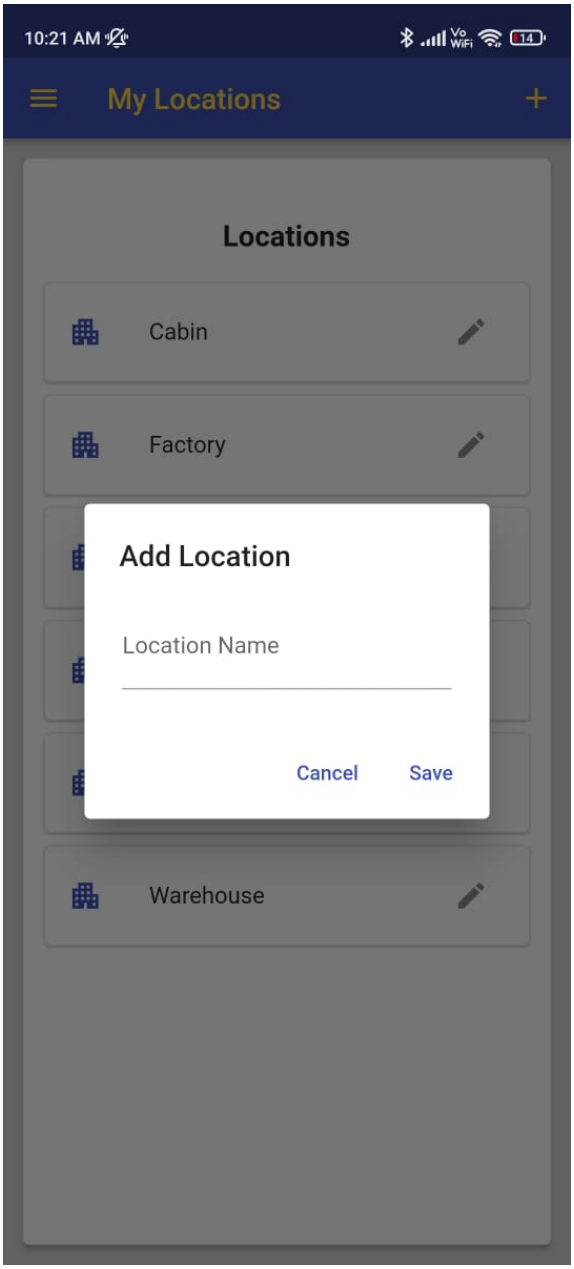

Figure 4.9: Add Location Form

4.7.3 Delete Location

A location item can be deleted from the location list if the user triggers gesture interaction by swiping from right to left on the item that the user wishes to delete. A confirmation popup dialog is displayed to the user to confirm deletion.

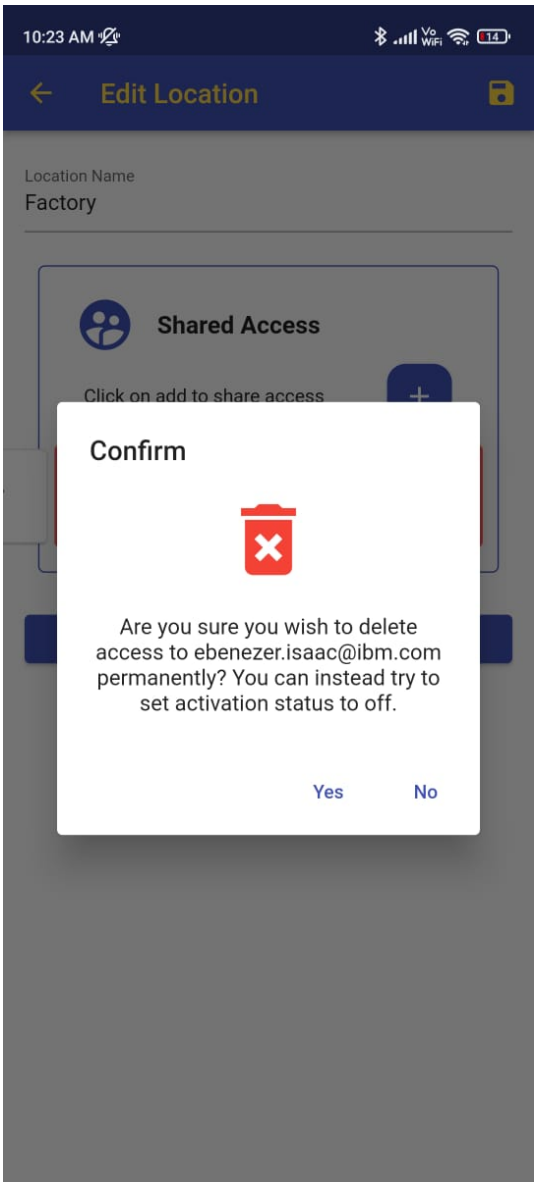

Figure 4.10: Delete Location Confirmation Dialog

4.7.4 Edit Location

The user can edit a location by clicking on the edit icon given for each individual location in the list. The edit form also provides the functionality to share access of the location and all its subsidiaries like rooms and devices to another user of the application.

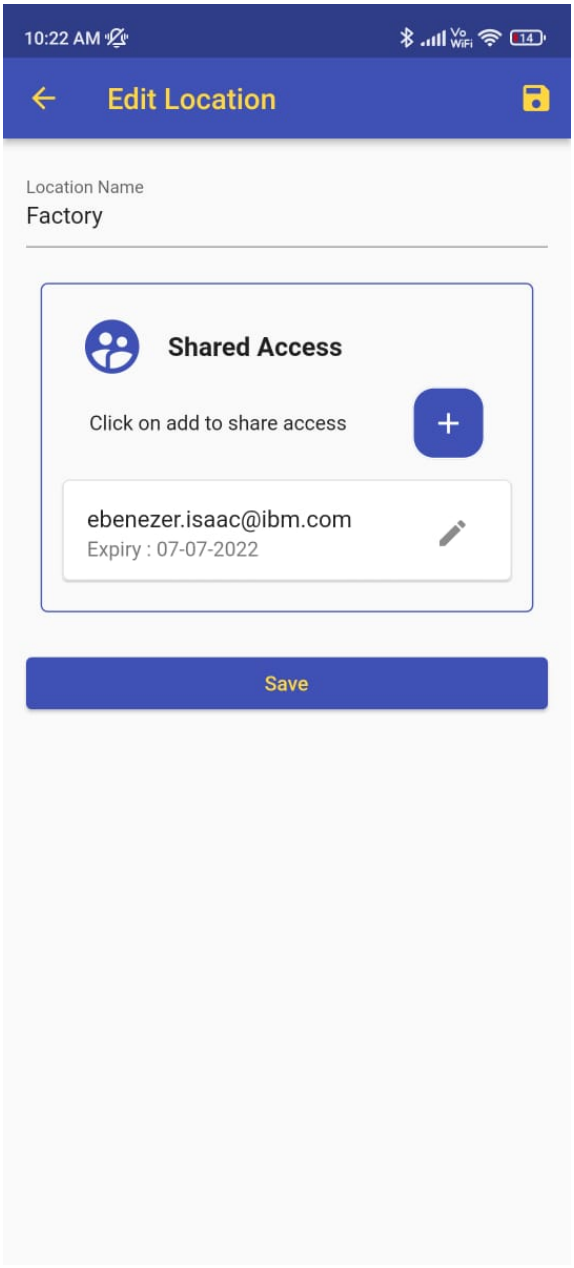

Figure 4.11: Edit Location Form

4.7.5 Shared Access Form

When the add icon in the edit location form is clicked, a dialog form is shown to the user where the user can input details of the account that is to be shared. The user needs to provide the email of the user to share access of the location.

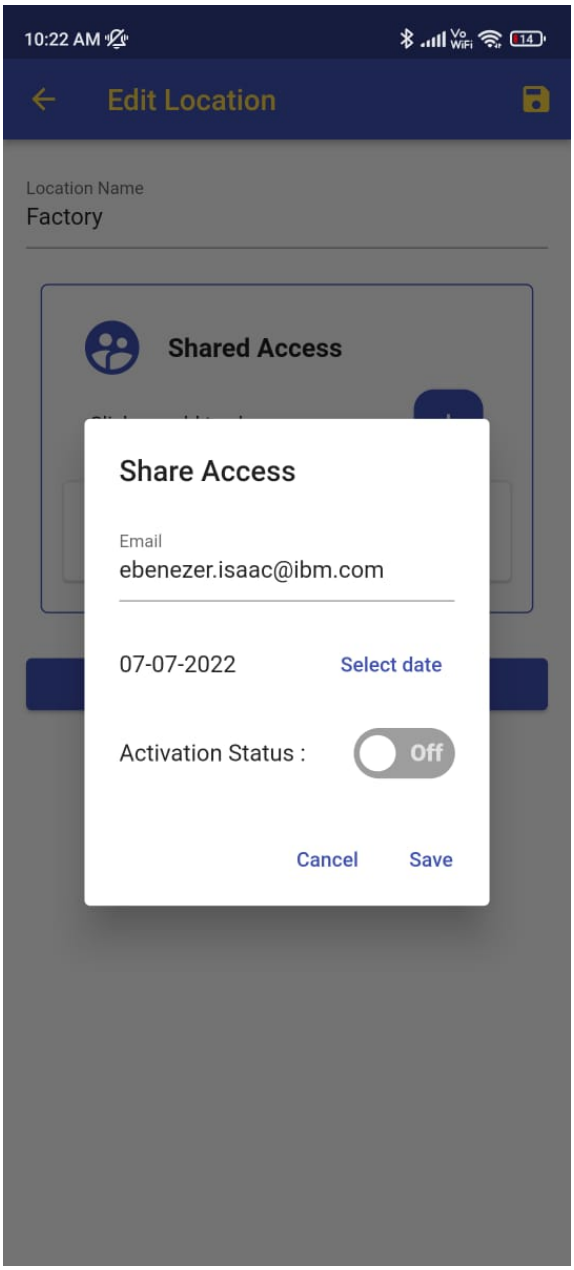

Figure 4.12: Shared Access Form

An optional expiry date and activation status are provided to the user for further customization. The same form is displayed if the user clicks on the edit icon on a particular shared access item. The details entered previously by the user are populated into the form so that the user can edit them.

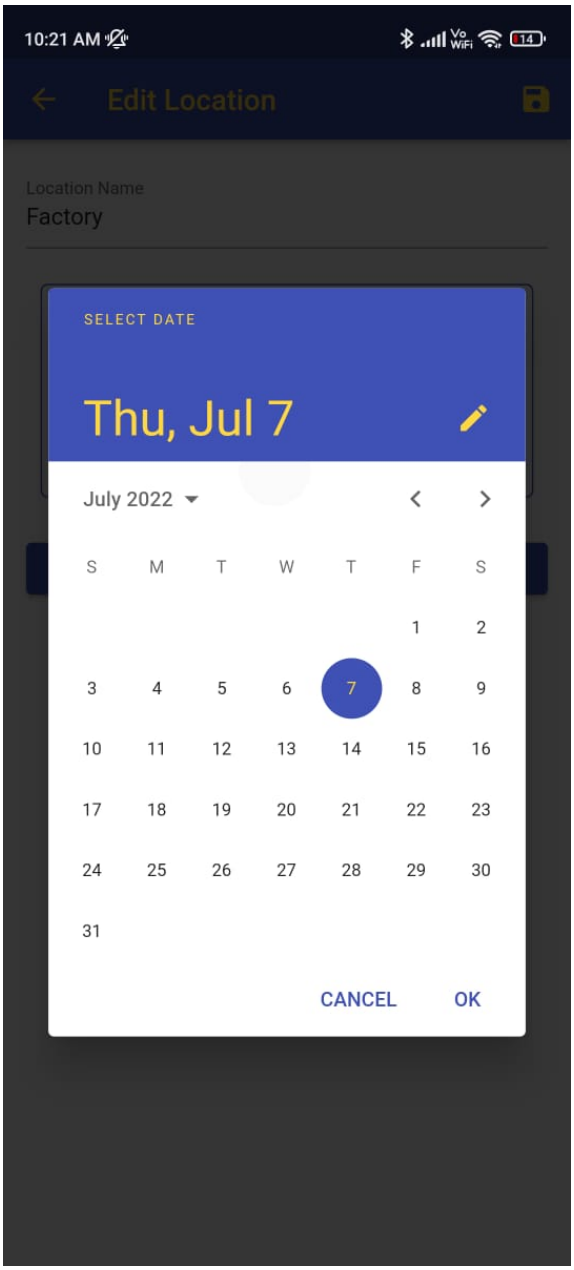

Figure 4.13: Date Picker

4.7.6 Delete Shared Access

The user can choose to delete access to a shared account by simply swiping from right to left on a particular shared access account listed in the edit location form. A confirmation dialog is displayed to the user to confirm the deletion.

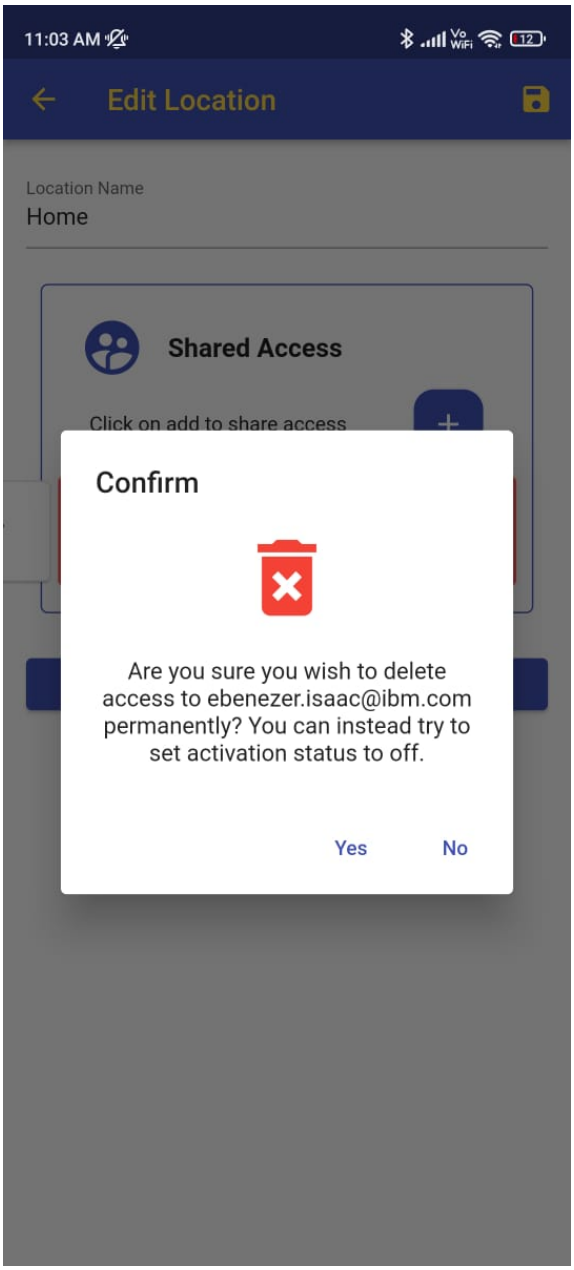

Figure 4.14: Delete Shared Access

4.8 ROOMS

The user can navigate to this page by clicking on any item listed in the locations page. This page allows the user to edit, add, view rooms in the given locaiton.

4.8.1 Rooms Page

This page lists all the rooms created by the user in a particular location. The user can also create new rooms by tapping the add icon on the top right corner of the screen.

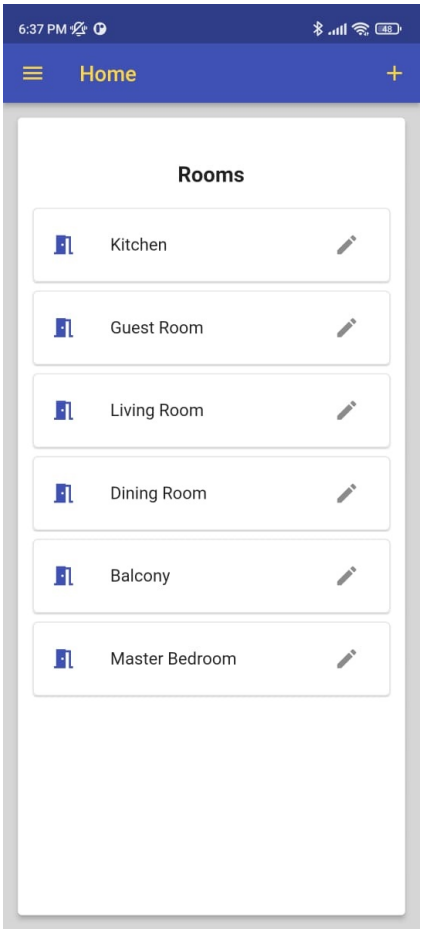

Figure 4.15: Rooms Page

4.8.2 Add Room

A popup dialog box is opened when the user clicks on the add icon on the top right corner of the screen, it asks the user to provide a room name so that it can be created in the database. The user needs to add locations and rooms to continue to register a device.

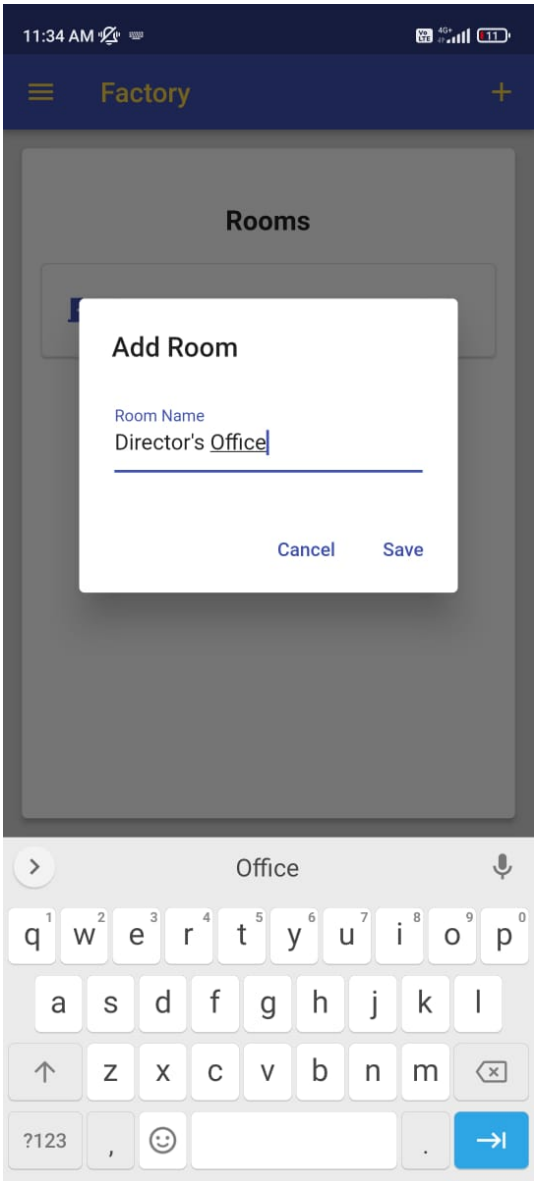

Figure 4.16: Add Room Form

4.8.3 Delete Room

A room can be deleted from the room list if the user triggers gesture interaction by swiping from right to left on the item that the user wishes to delete. A confirmation popup dialog is displayed to the user to confirm deletion.

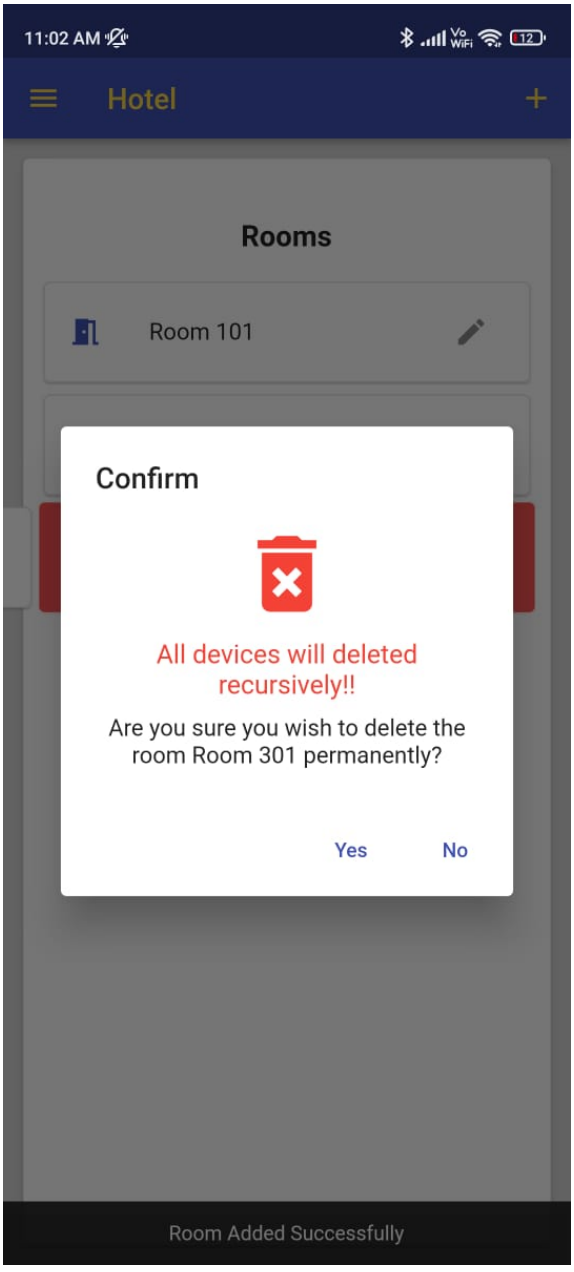

Figure 4.17: Delete Room Confirmation Dialog

4.8.4 Edit Room

The user can edit a room by clicking on the edit icon given for each individual room in the list. The edit form also provides the functionality to register devices in the room which will later allow the user to register relays for the device.

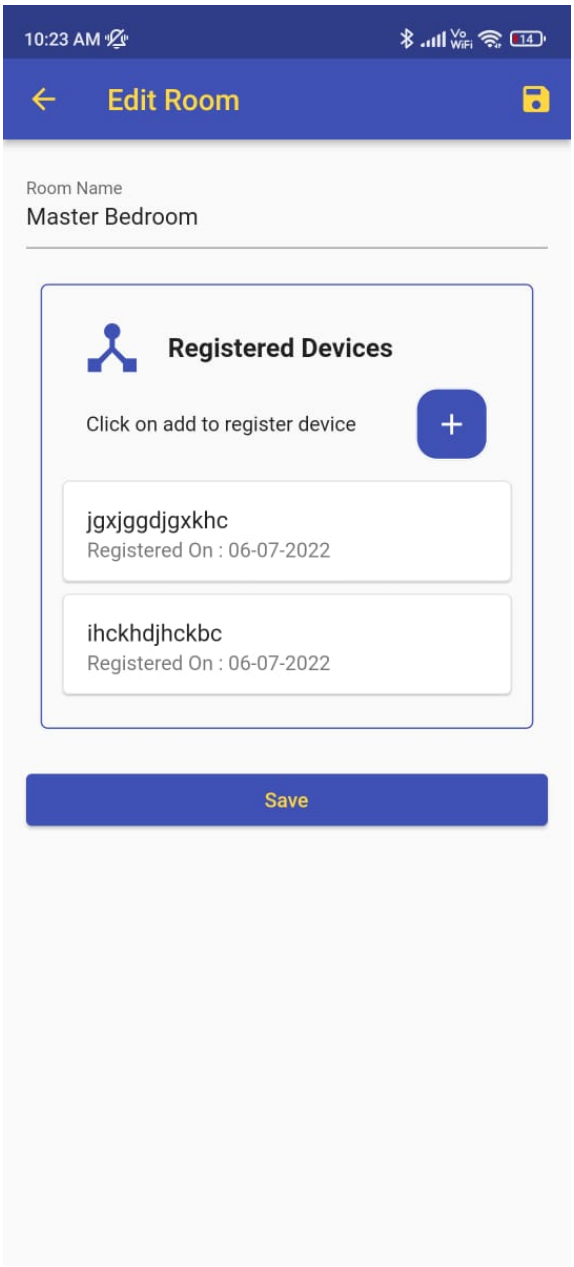

Figure 4.18: Edit Room Form

4.8.5 Register Device

When the add icon in the edit room form is clicked, a dialog form is shown to the user where the user can input the unique device Id provided to the user for each device that was purchased. The user can provide the id here so that it is registered in the preferred room created by the user.

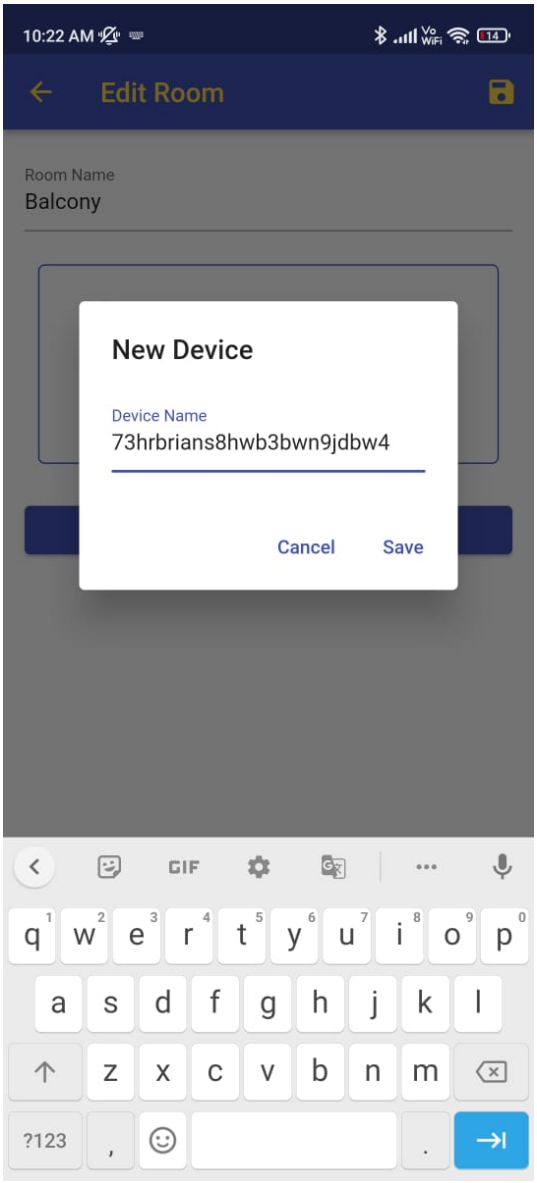

Figure 4.19: Register Device Form

4.8.6 Delete Device

The user can choose to delete a device by simply swiping from right to left on a particular device listed in the edit room form. A confirmation dialog is displayed to the user to confirm the deletion.

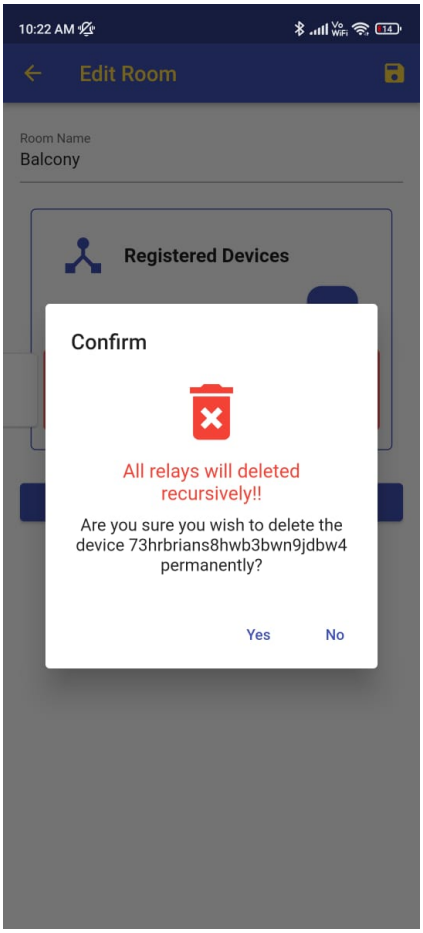

Figure 4.20: Delete Device

4.9 RELAYS

The user can navigate to this page by clicking on any room listed in the rooms page. The user can also access this page from the dashboard by clicking on any of the recent rooms.

4.9.1 Relays Page

This page lists all the relays registered by the user in a particular room. The user can control and view the status of the existing relays registered by the user. A switch is provided to the user for controlling the relays. The user can also register new rooms by tapping the add icon on the top right corner of the screen.

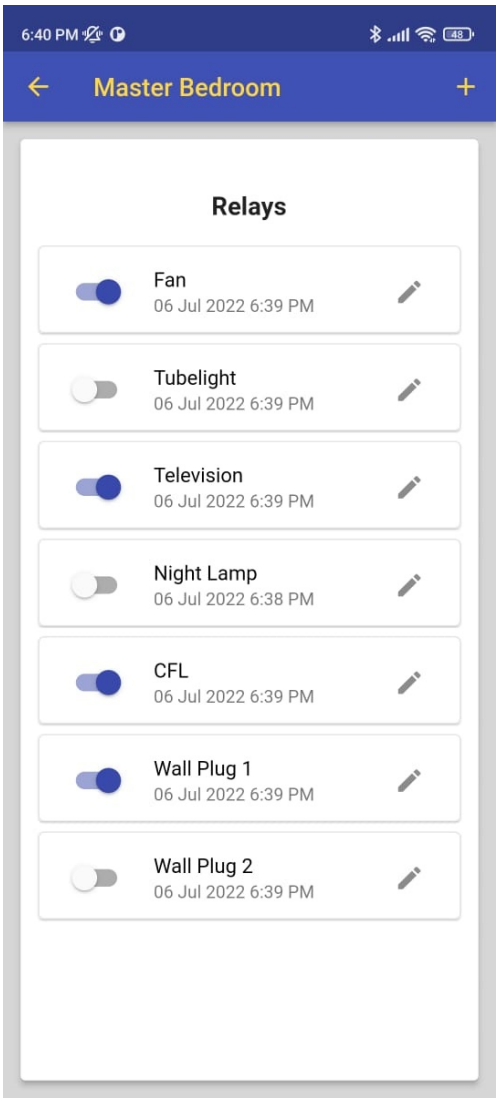

Figure 4.21: Relays Page

4.9.2 Register Relay

A popup dialog box is opened when the user clicks on the add icon on the top right corner of the screen, it asks the user to provide a relay name, select the device the relay should be registered to and also the relay Id that the appliance is connected to with the device. The details are then stored in the database.

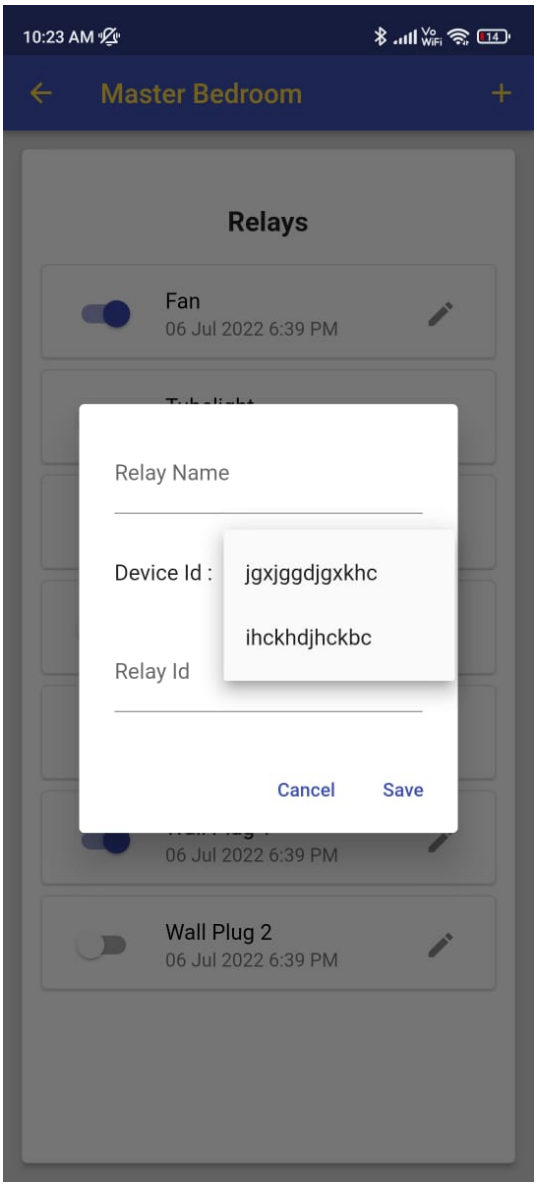

Figure 4.22: Add Relay Form - Select Device

The user needs to add relays to allow control of the relays remotely. The device listens to changes in this relay node for changes and changes the status of the relay on the device accordingly.

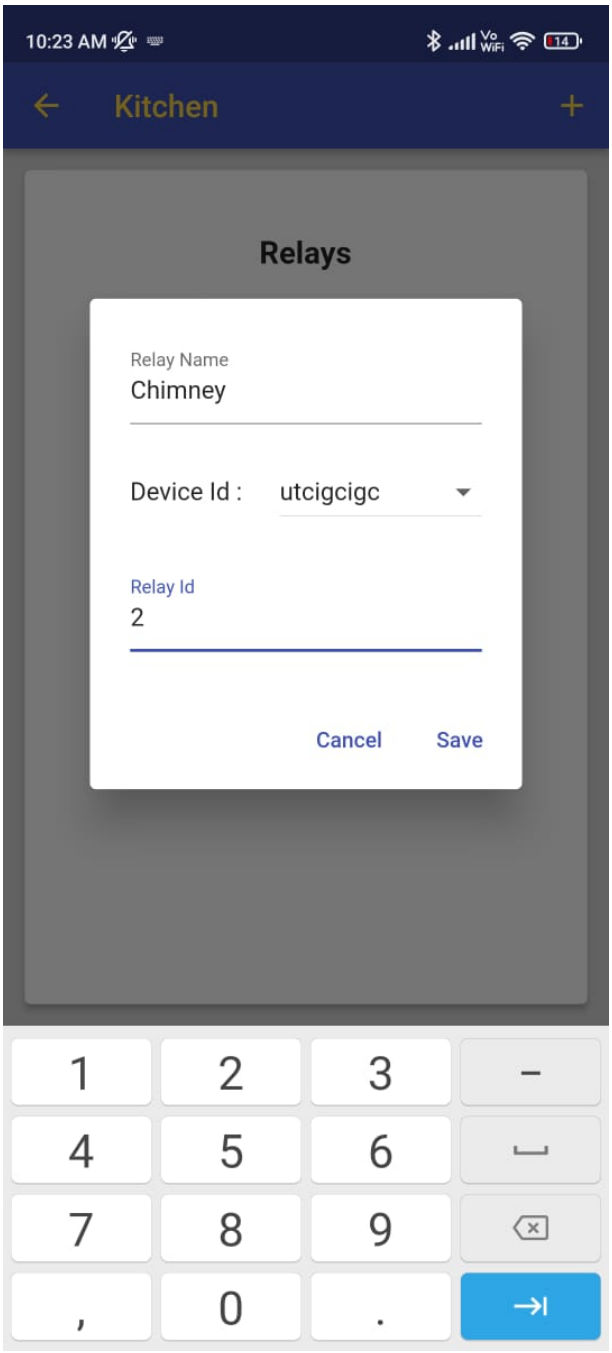

Figure 4.23: Add Relay Form - Relay Details

4.9.3 Delete Relay

A relay can be deleted from the relay list if the user triggers gesture interaction by swiping from right to left on the item that the user wishes to delete. A confirmation popup dialog is displayed to the user to confirm deletion.

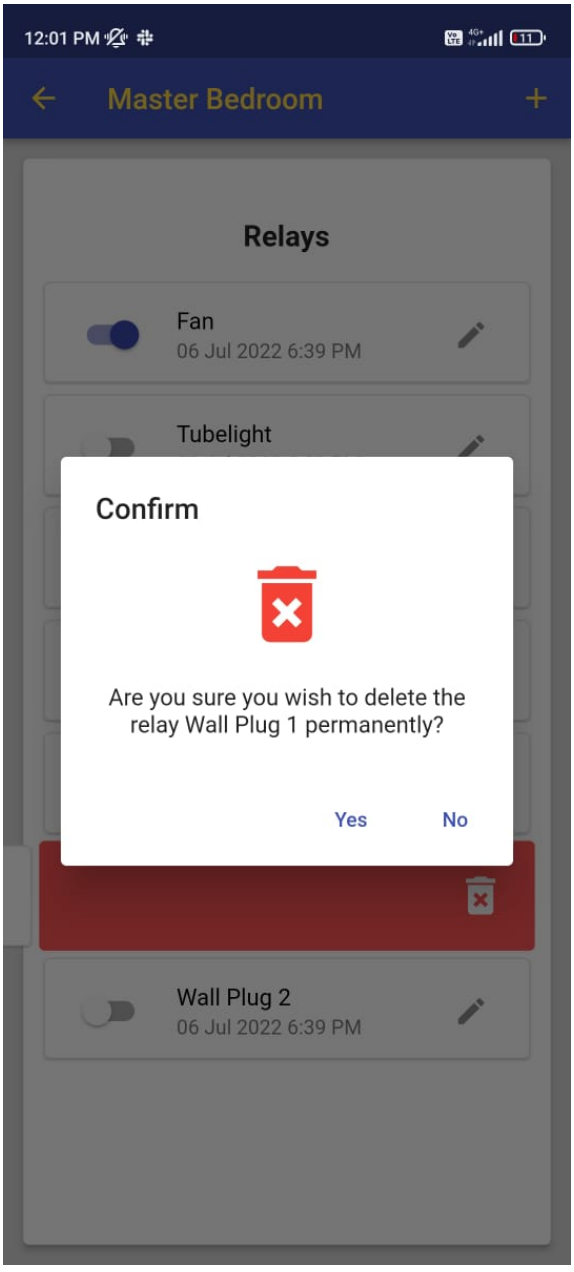

Figure 4.24: Delete Relay Confirmation Dialog

4.9.4 Edit Relay

The user can edit a relay by clicking on the edit icon given for each individual relay in the list. The user is allowed to edit only the name of relay. The user will have to delete and recreate a new relay if the user intends to edit the relay Id or the device Id. The editing of the relay Id and device Id has not been provided because such a change will required alterations in the connection of the electrical appliance with device.

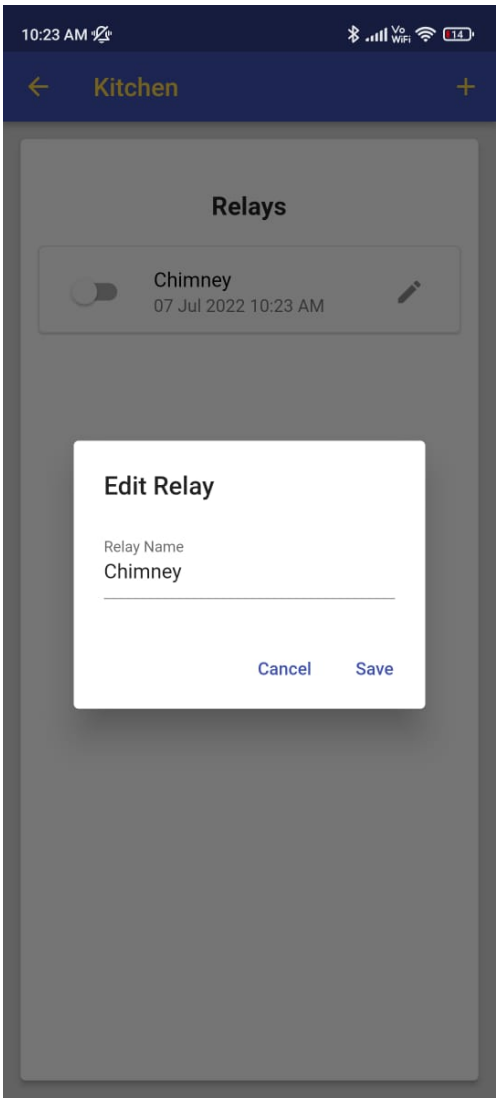

Figure 4.25: Edit Relay Form

CHAPTER 5

CONCLUSION AND FUTURE WORK

Takeaway from the proposed project and also present recommendations for improvements on the same.

5.1 CONCLUSION

"Home automation" refers to the automatic and electronic control of household features, activity, and appliances. In simple terms, it means you can easily control the utilities and features of your home via the Internet to make life more convenient and secure, and even spend less on household bills. A system has been proposed that meets the infrastructure automation needs of the Indian Society at a cost effective basis. The system can be installed easily and be ready for use almost immediately. Even though infrastructure automation is taking a slow pace in real world application. Generic automation of existing electrical appliances would be the first step towards a fully automated society.

5.2 FUTURE WORK

Another stream of computer science receiving huge traction is the Machine Learning and Artificial Intelligence Systems. IoT offers a very open adoption design for implementation of such a technology. With the big data that can be generated with this proposed system, useful predictions and automation can be implemented easily.

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