CEB SELFCARE APP

Cloud Computing Applications

CO3261

(Mini Project-02)

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Acknowledgement

Abstract

There are some reasons for developing this kind of application. Some of main things are mention in below. The electricity billing system is a new system that is design to replace the manual billing system and this is speedup the calculations of bills. This system creates awareness on consumption and a way to save and manage power by each individual consumer. The power consumed by user is monitored by Arduino with Node MCU separately. That information is saved to cloud database. Database is connected to mobile application and web application. According to that information the bill is automatically generated and users can identify their usage at a particular time. Admin and each user have login username and password to applications. Admin can add or remove users. He also modifies the personal information of the customer. He also checks the list of connection in a particular feeder. He can update the unit cost of electricity and water. He also can update the tax rates.it also specify the list of customers that are not pay bill in a month. In the modern world time is very limited because of that we have to manage our time in very perfect way. Physically bill paying is very time-wasting thing and it want lot of man power, as a solution for that also we can use this product. It will much helpful for modern world for saving lot of things. Because there are lot of power need modern world. When using low electricity that is important for save the environment. When consume less power can reduce the number of toxic fumes released by power plants, conserve the earth's natural resources and protect ecosystem from destruction. This will contribute to the healthier and happier world.

CONTENT

CHAPTER-01

1. INTRODUCTION

With the development of the technology, many fields of the world have been changed and upgraded. When comparing with Sri Lanka, though Sri Lanka have developed with some fields, the bill reading system of electricity still have not changed. The system follows the manual system yet. So, we decided to change the bill reading system from manual to automatically. So, the main purpose of this system is to read the current bill by the user himself without any complex calculations. From this system the usage of current can be reduced. As well as, from this self-care app both user and the system provider are updated with the current usage and the overall usage. From this system, it is decided to perform both bill reading and bill paying system from only one system. So, this software can be known as two in one software. The system consists with both hardware part and a software part. The software part consists with Android application only for the Service provider there is a desktop application. But in this project, I am only developing android application and its services. From the hardware part, the used units of the device are calculated in a cloud server. The result which is given from the hardware part is taken from the software part and from the software the output or the usage units and the bill is shown to the user. So, both hardware part and the software part are interacted with each other well.

1.1. AIM OF THE PROJECT

The aim of this project is to develop a system for monitoring and managing the electricity and water usage in Real-time and to develop a system for addressing a desktop application and a mobile application to read the units of the used current, bill and pay the bill via smart phone.

1.2. GOAL OF THE PROJECT

For saving electricity & water and get those services easier.

1.3. MAIN OBJECTIVES OF THE PROJECT

✓ Build a smart device which can measure electricity usage

✓ Develop Android applications for customer to view all usage info and bill info.
✓ Make a secure and easy way of reading /paying the bill.
✓ Build up a trusted connection with the service provider and the user without less breakdowns.

1.4. SCOPE OF THE PROJECT

With the development of the world people always find easy ways to do their day-to-day work. Though in the bill paying and bill reading system have not been updated yet, people have to face for some problems. The problems are shown in below.

- With the current system lots of man power is wasted for manual meter reading.
- Customers are not able to view their current usage easily.
- If the usage passes a certain limit additional charges are applied on the bill.
- People are not aware of peak and off-peak times of electricity usage.
- There's no single platform for customers to manage and pay their electricity bill using mobile application.

Since these are very common issues among all the customers in Sri Lanka as well as all around the world this project can have an impact on all the people who own a smartphone and a payment card, which is quite a larger percentage. The smart meter system has three main sub systems. They are,

✓ Registering, login and authentication system
✓ The card payment verification system
✓ Security system Above three subsystems are interconnected together to create our full system.

In the registering, the account numbers regarding to the CEB of the customer is taken first. After verifying the account, the details of the customer are taken. After the verification succeed the account is created successfully. After creating the account unique user name and a password is provided to the customer. In the future login, customer can log with the account with entering user name and the

password. In the account, the account details of electricity bill are shown separately. They are electricity side, the current usage, overall usage and the calculated bill is shown in the account properly.
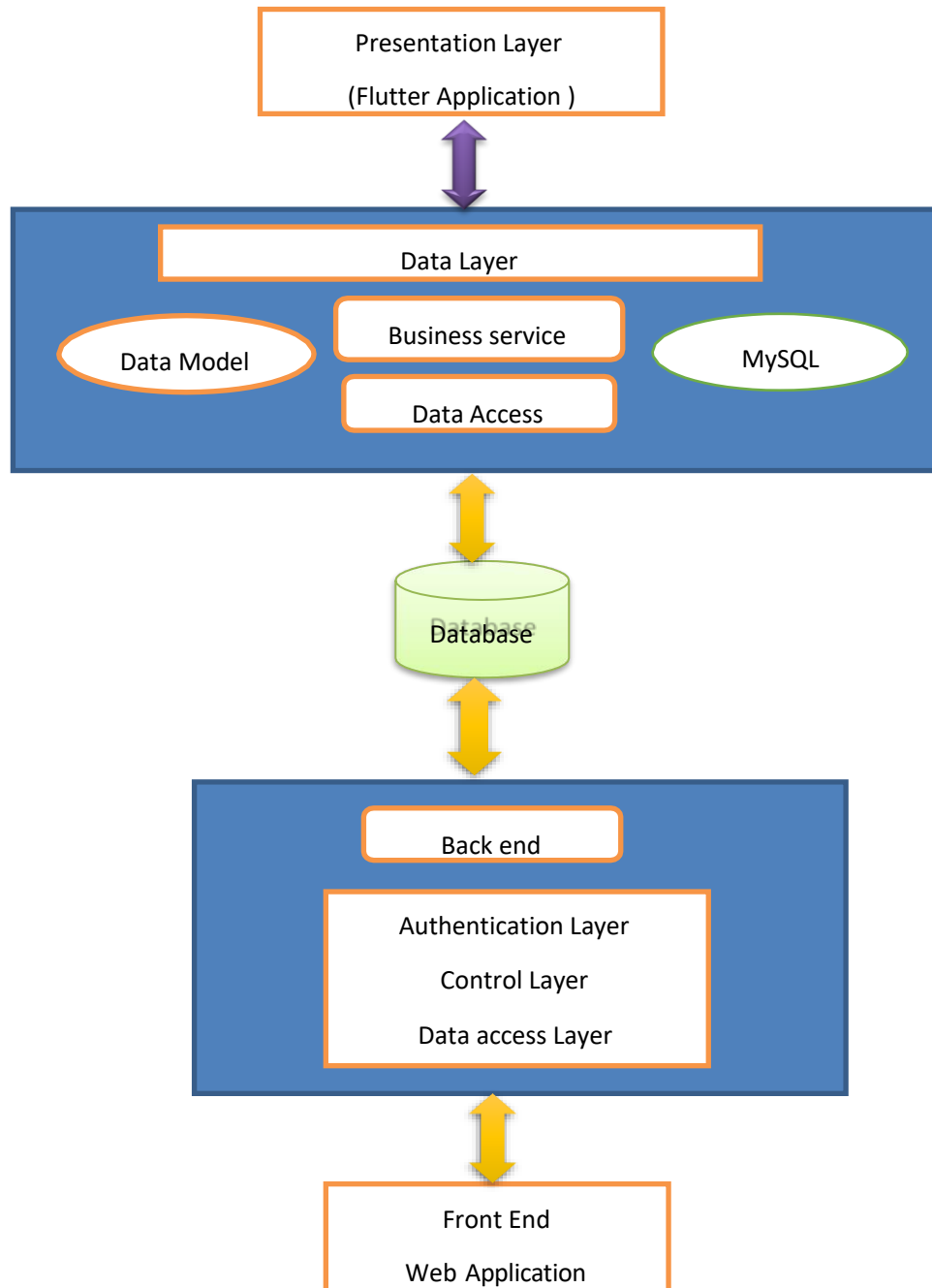
CHAPTER-02

2. PROBLEM SPECIFICATION

- ✓ In the current system, the usage of both current is read from manual. So, with this current system lots of manpower is wasted.
- ✓ Customers can not be able to check or view their usage easily and directly. Because they have to do some calculations to get the result.
- ✓ Because of the ignorance of the usage, sometimes the user limit is passed without knowing. So, the additional charges are added to the bill.
- ✓ People have the lack of knowledge about the peak and off-peak times of electricity usage. As a result, we the customer use their devices in peak times, that will affect to increase the bill.
- ✓ There is no single platform for customers to manage read and pay the electricity bill.

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3. DESIGN METHODOLOGY

The CES SELFCARE application is for Customers who willing to getting update about their Real-time electricity . The customers can create their own smart Meter account and utilize the service. According to the project, the administrator can access the all users records through web application. The administrator can get details about usage of all users. The main usage of the web application is to generate automatic report at the end of week or month. So, through the web application we analyst the peek time of electricity and water usage of a day. Users can manage their electricity usage within necessary limits and pay bills themselves. All the information of customer, such as Realtime electricity usage, customer details is stored in a database that is accessible by the administrators should be given permission to access them and create bills according to them. Users Realtime Electricity usage is measures and recorded by hardware component that easily plug to switches and wirelessly connect with mobile application and web application.

1.1. Architecture Design

```
┌─────────────────────────────────┐
│       Presentation Layer         │
│     (Flutter Application )        │
└─────────────────────────────────┘
                 ↕

┌─────────────────────────────────────────┐
│  ┌─────────────────────────────────┐     │
│  │          Data Layer              │     │
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│                                            │
│   ╭──────────╮  ┌──────────────┐  ╭──────╮│
│   │Data Model│  │Business service│ │MySQL ││
│   ╰──────────╯  └──────────────┘  ╰──────╯│
│                 ┌──────────────┐          │
│                 │ Data Access   │          │
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           ┌──────────┐
           │ Database  │
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┌─────────────────────────────────────────┐
│      ┌──────────────┐                     │
│      │   Back end    │                     │
│      └──────────────┘                     │
│      ┌──────────────────┐                 │
│      │Authentication Layer│               │
│      │  Control Layer     │               │
│      │ Data access Layer  │               │
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           │  Front End    │
           │Web Application │
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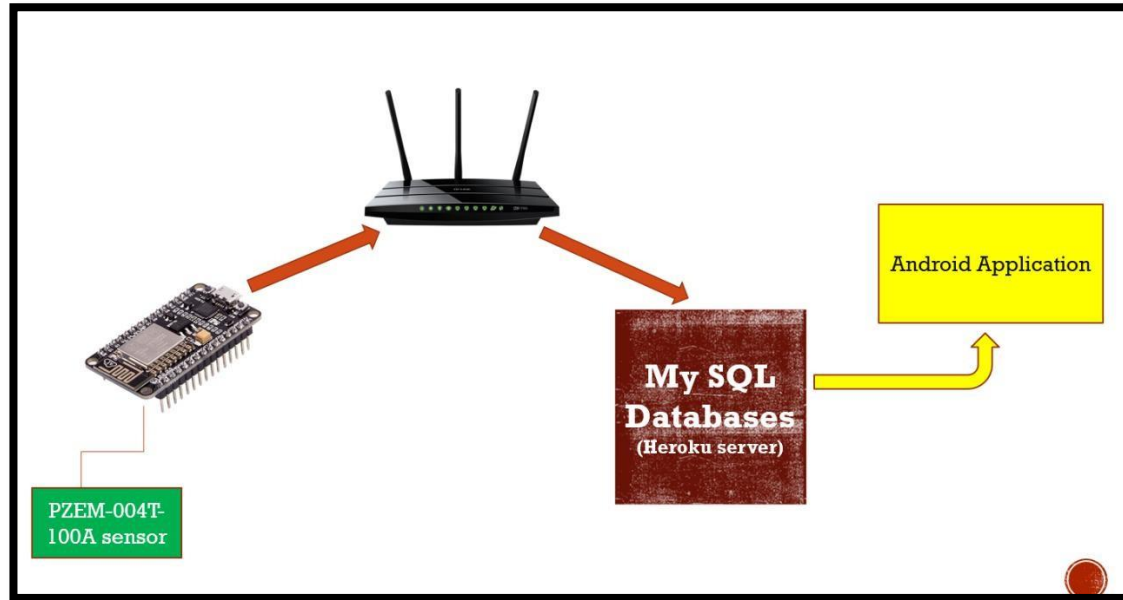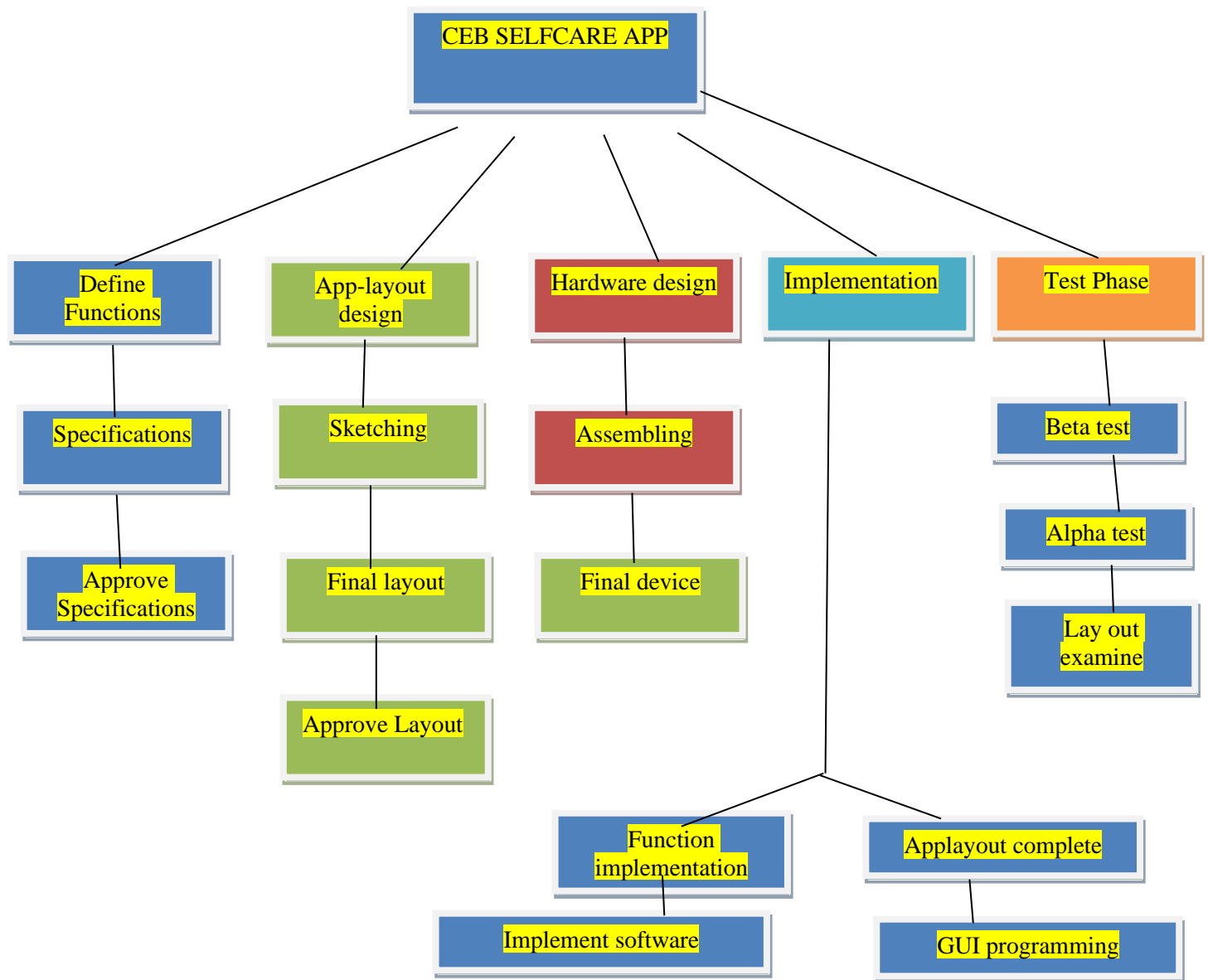
2.2. Device work Flow Diagram

Figure 1-SIMPLE DEVICE WORKFLOW DIAGRAM

✓ Here I have used Two node MCUs because as above work flow diagram another module is working for relay control. Because GPIO pins are not enough to connect all the device for one module.

✓ On the other hand, other display modules and how they working are not include to this diagram.

2.3. Device work Flow Diagram

```
                    ┌─────────────────────┐
                    │  CEB SELFCARE APP   │
                    └─────────────────────┘
```

Define Functions	App-layout design	Hardware design	Implementation	Test Phase
Specifications	Sketching	Assembling		Beta test
Approve Specifications	Final layout	Final device		Alpha test
	Approve Layout			Lay out examine

```
              Function
           implementation          Applayout complete

          Implement software          GUI programming
```

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4. Implementation

In this phase our designed project will code and develop. The project is mainly a mobile application and therefore, this phase consisted of two main tasks.

1. Front end development
2. Back-end development (sever side development using Heroku)

The above mention two tasks will be executed in parallel. Front end development will be doing using java and flutter. And back end will be developed using PHP

language. Such as dream viewer and an Android studio is going to use as text editors. Here in the server the bill calculations and all process going to be done.

4..1 **Mobile Application**

- **LOGIN AND SIGN-UP FORMS**
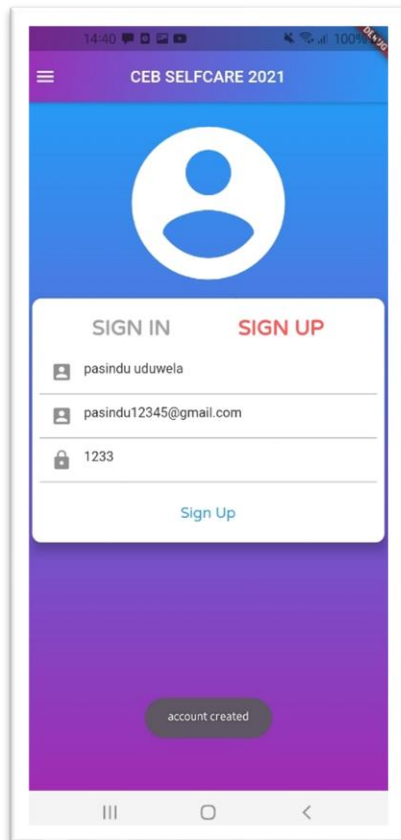
Figure 2-SIGN UP form view
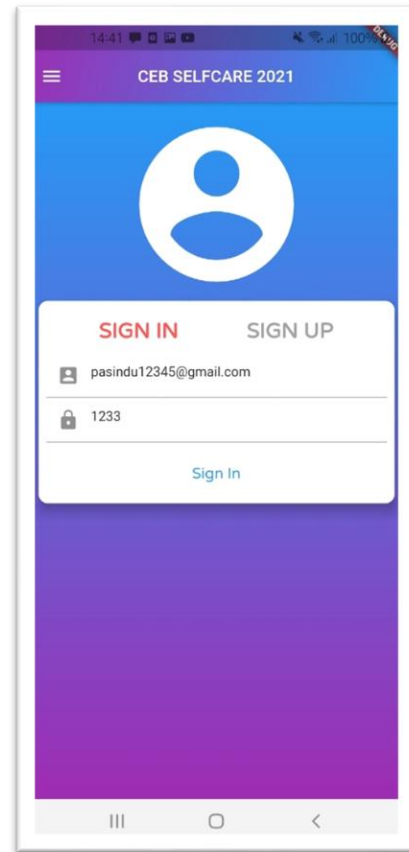
Figure 1-SIGN IN form view

✓ Here both sign in and sign-up forms are connected to the Heroku database using PHP APIs. The PHP APIS are kept in free web server. I have used 0000 web hosting to do this .All the PHP files Related to this application was kept in that free server. To use this free web hosting services, we should create an account and create a project. Then by using the c panel we can easily upload any php script into this server.
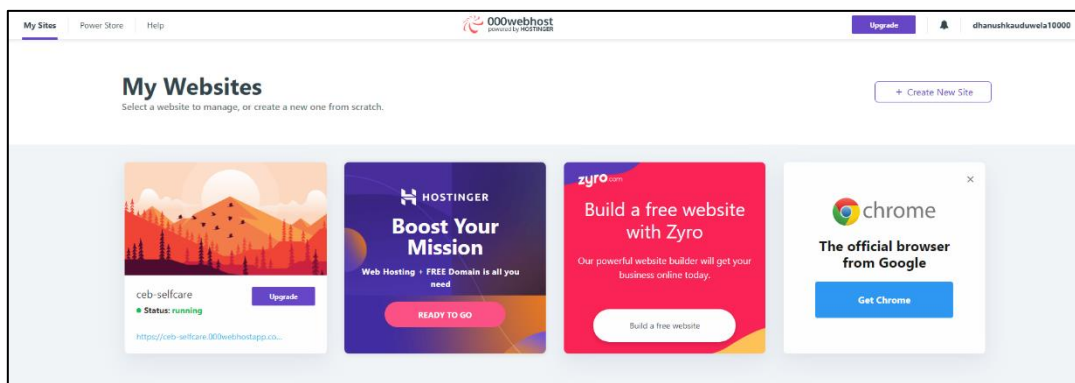
Figure 3-Project Create on 0000 webhost server

✓ All the PHP APIs relate to this app is kept on the Public_html folder.

Figure 4-PHP APIs working in the server

✓ To connect the flutter front end with the back end I have use http 0.13.3 dart package. By using this package, we can data the internet. Here the purpose is to send data to the server.

✓ To access the Heroku GUI database panel cannot be grant in the free user trail .Without premium package in Heroku server I have connect the Heroku server to my local host phpMyAdmin panel. To do that first the filed called infig in MySQL installation folder should be carefully change and rewrite new connection path. After connecting to the server, we can execute any query using command line or GUI interface.
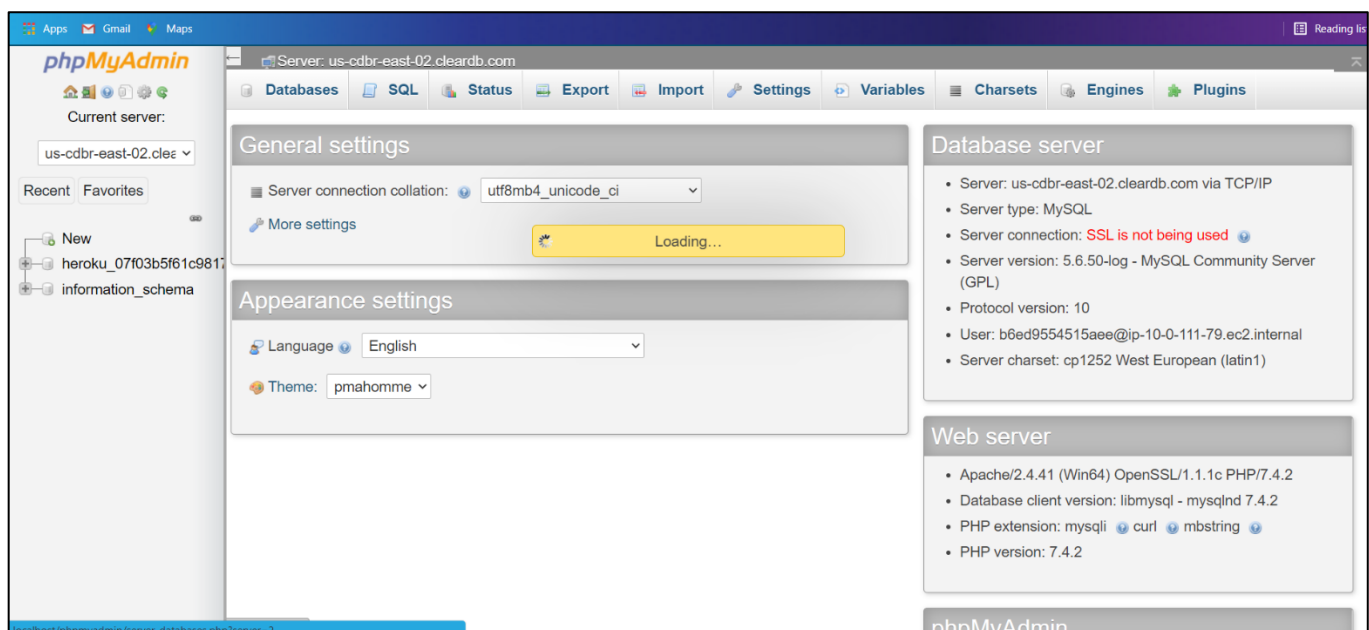
Figure 5-After connecting the local host PHP My Admin panel with Heroku Server

Some created Forms in the App
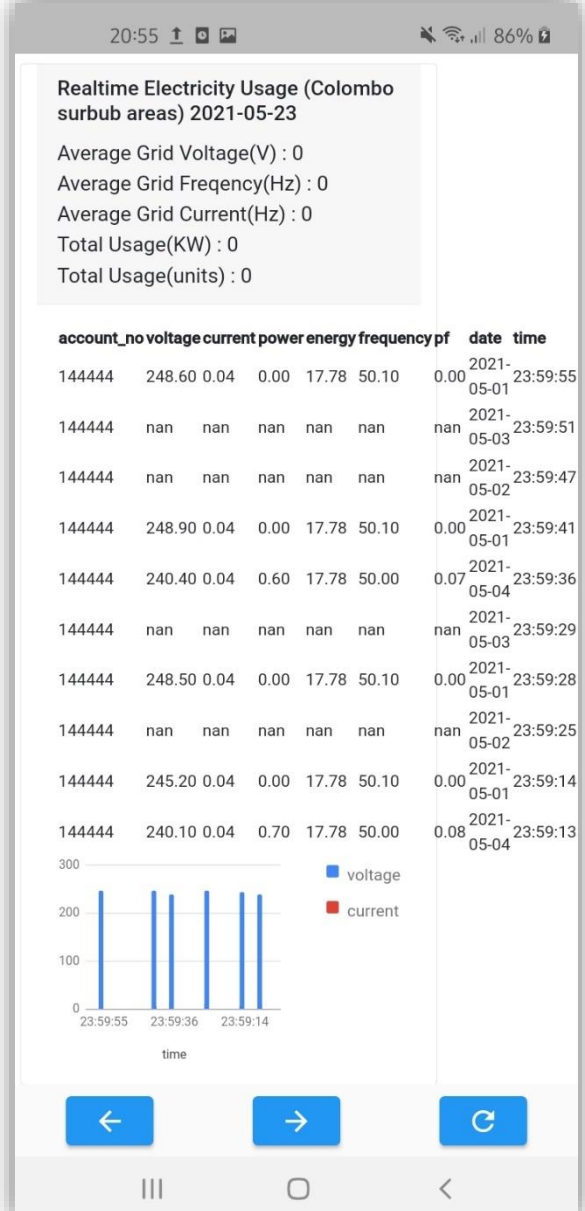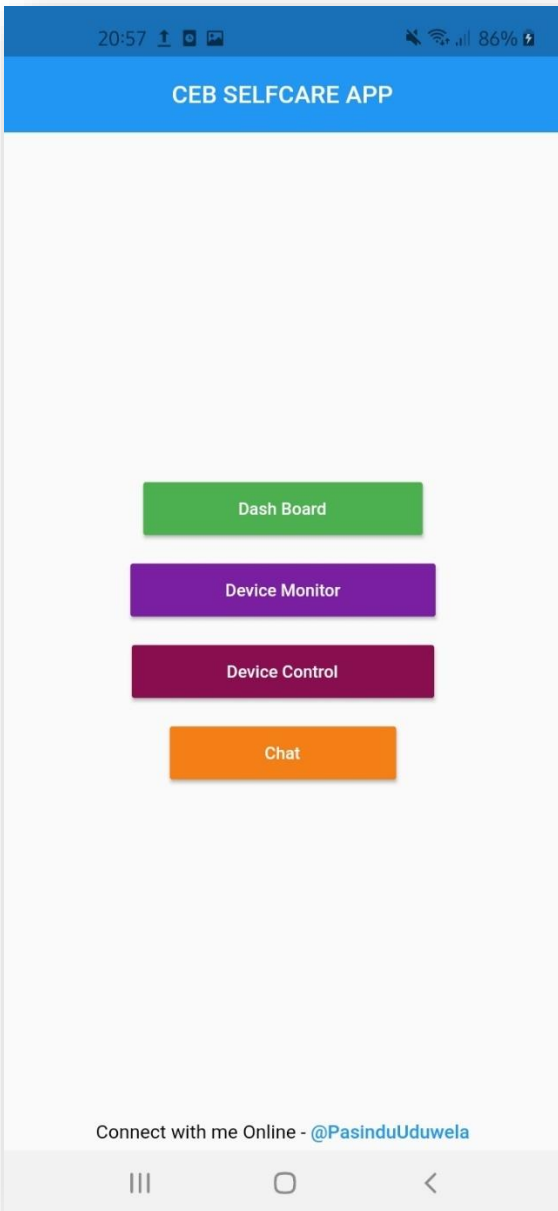
Figure 6/7-Home Page & Device monitor Form
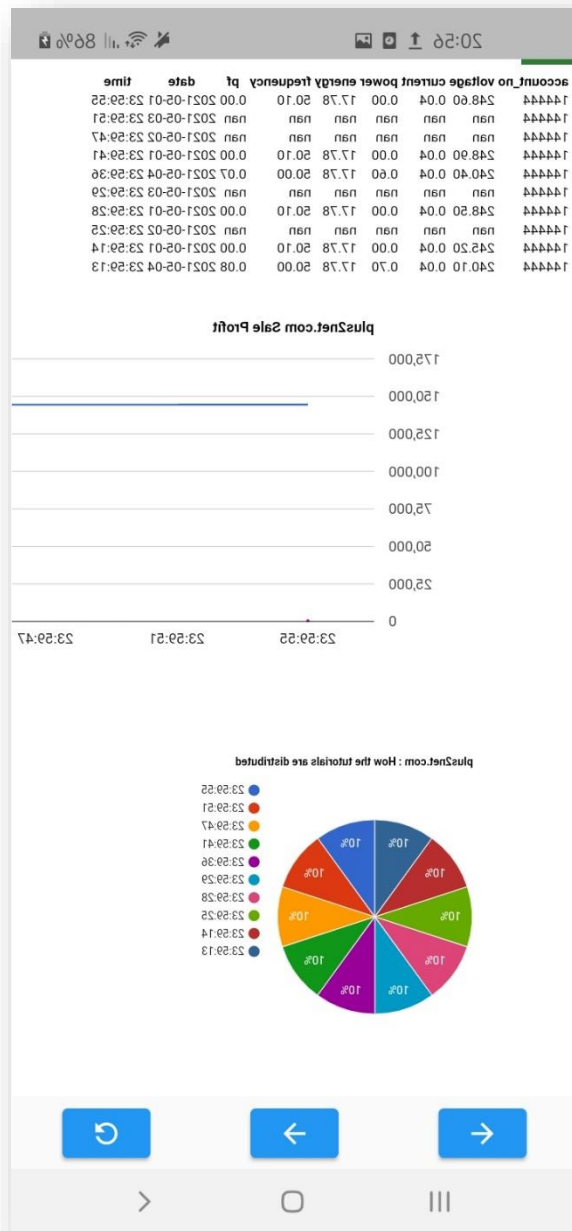
Figure 8/9-Device monitor Form and Device control Form

Here these forms are loading a website. Because connecting MySQL is harder at the moment .Therefore I use flutter web view dart package to load Website .Each button on the home page has a URL link connector with the website page. Website is host using hosting service.

Name-www.eduetor.com

✓ At the moment still the web site is developing for Administration and bill generating process.so bill generating part is not working. Some customer insert update delete forms are working and those html forms also can be loaded within this flutter app.

Website can be access using below user name and password.

Username-pasindu uduwela
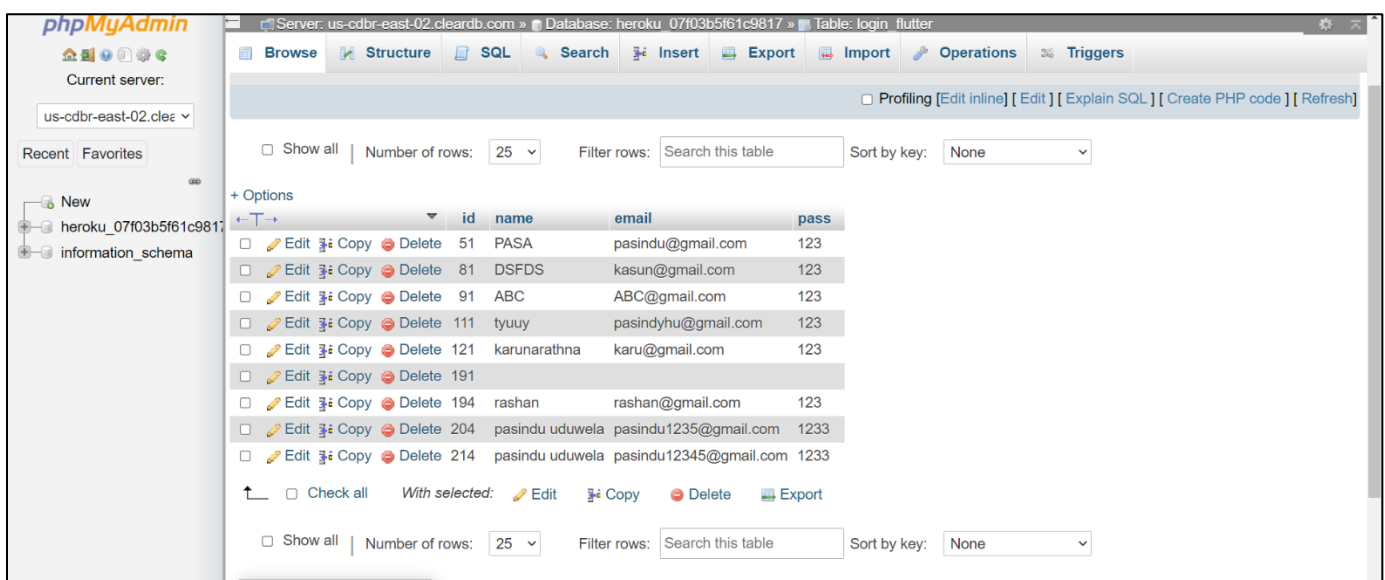
Password-123

✓ Still the device control button is not working because it needs the ip address of node mcu.But there is no option to detect the ip address of that nodemcu and sed that details to server or we cannot connect with that remotely at the moment .but withing home network app can be work without any errors.

4.2   Cloud databases

All the cloud databases are created in the Heroku server. Still the application connects with two data tables .The are

1. Login futter table
2. Elec usage table

Figure 7-Cutomer login detail kept in the Login_flutter table

Figure 8-elec_usage table structure

4.2 Devices

Figure 9-device with display

Figure 10-relay works for remotely control any device

The device has an LCD display and it showing all the details to the customer .The details showing are-

1. Current (Still measure 3 bulbs+ one device)

2. Voltage

3. Power factor

4. Frequency

5. Energy

6. Powe

7. Cost

8. Unit

All these data except cost are send to database .The bill generating process is done within the web hosting server. Using a PHP API, the bill is calculating according the unit prices.

4.2 Web Application(admin)

Administrator has the power to manage all the customers and can get average grid voltage, average power consumption like information. On the other hand, some services are still to be complete. Using web application payment gateways and report generating as pdf can be done. On the other hand, customer complains can be make using the mobile app admin can view it using web application.

Here the main advantage using of this technique is website can be access very easy and some machine learning concepts can be added to this system very easily.

The web page is responsive to show in android platfrom.Below are some screenshots of it.

CHAPTER-05

RISK

Risks that can affect to this project can be divided into two major parts. They are-

1. Risk that can affect during the project development
2. Risk that can affect after the project development

<u>Risk that can affect during the project development</u>

Risk	Possible solutions
Incapable of finding monetary resources for establishing web application	✓ Use free or partial free services like Heroku which provides free and limited web-based storage and services. ✓ Purchase web service for a monthly basis and disable extra service charges payment option deducting option within the server.
Incapable of delivering the project on right time.	✓ Increase the number of parallel tasks ✓ Use tools for speeding up the tasks. (As example drag and drop GUI tools can be used in programming. Some software's like proteus, Atmel studio help to code Arduino programming using virtual equipment's.)

The budget of full system is higher	✓ Sensors that we using is little bit cost. For a home we 10-15 sensors for measure the usage of all devices in each part of the home. Therefore, as a demo we are only using a one sensor for only one equipment.
Payment methods cannot we implement	✓ Still payment methods cannot be added without having a business registration number.Payhere,stripe and other all payment gateways need Br and some legal documents should be submitted to them.

Risk that can affect after the project development

Risk	Possible solutions
Failures of web hosting services	✓ Frequently gets local backups. ✓ We can purchase secondary service that gives by cloud services
It may become harder to market	✓ Contact and explain the user to benefits of such a new system
There might be security issues and legal issues still after the deployment.	✓ Devices should be sealed and and firmware's updates or any modification that customer can do should be blocked. ✓ We should get a permission from Ceylon Electricity Board to test this system and compare with manual system. If manual system and our system is same, we can test this device for a cluster of houses.

CHAPTER-06

FUTURE MODIFICATIONS

- ✓ Can add payment gateway for real payment methods

- ✓ Long Short-Term Memory (LSTM) Algorithms can be added to this responsive website and it will help to generate for energy forecasting and budget forecasting diagrams. But only using mobile application we can't do it.because for a day there might be 10000 -2000 lines are recording in databases .to run such algorithm we need more computational memory and power. Still core i7 processors are not enough to do that and we should go for Xeon processor that have 12 cores or higher.

- ✓ Still the app works for only one customer and there are no options to create database and tables for join a new customer with new device.

- ✓ Still the device control cannot be done outside of the house .for that the relay control node Mcu also connected to the website using static ip address.

- ✓ Chat message system can be added to the flutter application. On the other hand, relay circuits should be modified to on off full device. Because if customer didn't pay the bill CEB can disconnect the power supply using their admin application

- ✓ Still databases are not protected by MySQL injections therefore more security features should be added .

- ✓ The customer password can be encrypted using AES encryption methods.

- ✓ The mobile application can be added some more sperate tables and graphs time to show all the results in descriptive manner

- ✓ Unit cost changing methods also should developed.

CHAPTER-07

RESULT AND EVALUATION

- ✓ Still the system shows the all the sensor details in chart very precisely but the graphs and table tawing have a delay. Because the reason is we are using free servers except the admin web site hosting server.
- ✓ Sensor data writing to the Heroku database is slower. Therefore, there is a 2 second small delay in showing the app.
- ✓ All the graphs and tables are real time updating in the application.

CHAPTER-08

CONCLUSION

Today's bill reading system is done by manually. And also, there is no single platform for customers to manage and pay their electricity bills. So, I decided to create a system to read and pay the bill by customer itself. this system consists with a hardware part and a software part. When considering about software part, both user and the service provider are updated with the current single usage and the overall usage. But administration part is not going to develop in this project. Only the customer part will be developed in this mini project. Users can manage their electricity usage within necessary limits. There is an Android application for the customer. By using that android application customers can view their electricity usage of current months and previous months. On the other hand, they can limit their usage by application. I am doing only the customer part. there is another separate application for the service provider. But that part is not going to develop. When considering about the hardware part, it can easily plug to switches and wirelessly connect with WIFI. Then for certain time stamps it will send data to the cloud server. Then all calculations will be done within the server and write them in separate table within same database. Then Real time graphs are generating to show the usage of electricity through the Android application.

CHAPTER-09

APPENDIX

➢ Erg.abdn.ac.uk. 2020. Communications Protocols. [online] Available at: [Accessed 8 January 2021].

➢ Innovators Guru. 2021. *PZEM-004T | Specification | Price | Arduino Library | Pinout*. [online] Available at: <https://innovatorsguru.com/ac-digital-multifunction-meter-using-pzem-004t/> [Accessed 17 January

➢ Brownlee, J., 2021. *A Gentle Introduction to Long Short-Term Memory Networks by the Experts*. [online] Machine Learning Mastery. Available at: <https://machinelearningmastery.com/gentle-introduction-long-short-term-memory-networks-experts/> [Accessed 23 May 2021].