CEB SELFCARE APP

Computer Engineering Project

CO3302

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Acknowledgement

CEB SELFCARE is a project developed for Ceylon Electricity Board to increase the efficiency of the service provided to their customers. Both the services providers and the customers, all citizens who uses national electricity supply service, will be beneficiaries of the project.

Abstract

There are some reasons for developing this kind of application. Some of main things are mention in here. 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. He also can update the tax rates.it also specify the list of customers that are not pay bill in a month. On the other hand, the admin has the ability to switch off the meter remotely and disconnect power supply, if the customer didn't pay bills and the customer has the chance to control his /her all electric appliances via website. So, he /she can be aware which device is consuming more power and can take necessary reactions to prevent electricity wastage. 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. <u>INTRODUCTION</u>

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. <u>AIM OF THE PROJECT</u>

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. <u>GOAL OF THE PROJECT</u>

For saving electricity & water and get those services easier

1.3. <u>MAIN OBJECTIVES OF THE PROJECT</u>

- Build a smart device which can measure electricity usage.
- Develop mobile responsive web 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. <u>SCOPE OF THE PROJECT</u>

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.

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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 CEB 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 web application.
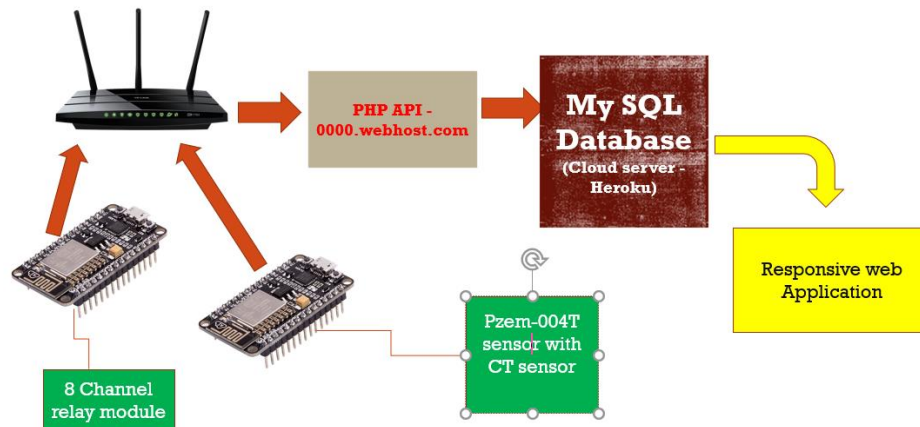
3.1. Device work Flow Diagram

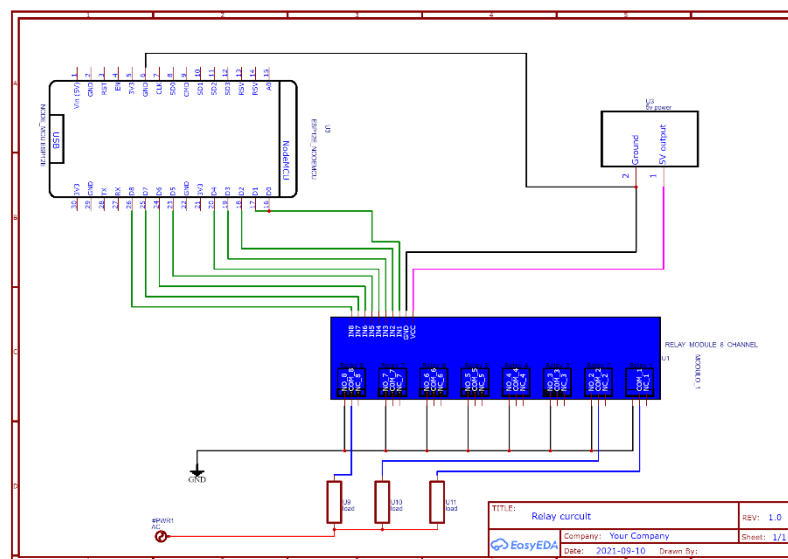**Figure 1-Simple Device Workflow Diagram**

3.2. Circuit Diagrams of the Device

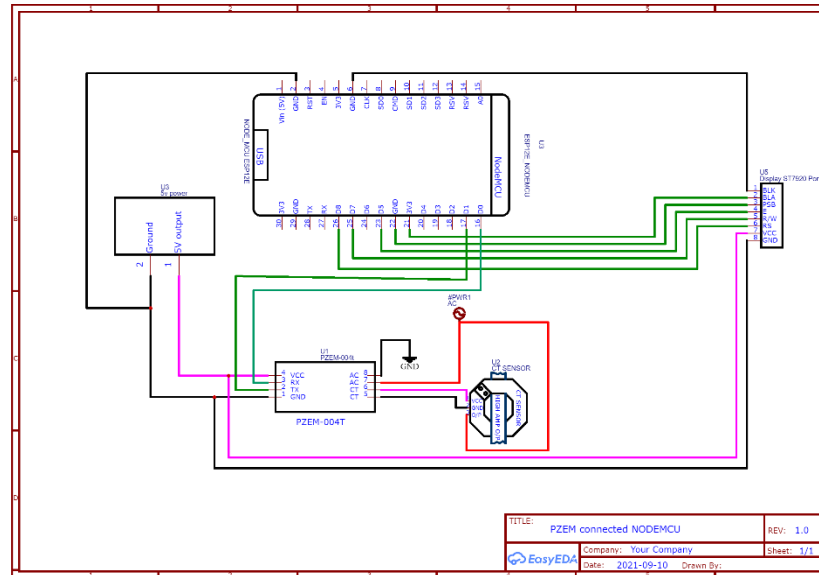**Figure 2-Relay module control Node MCU circuit diagram**

Figure 3-PZEM Module control Node MCU circuit Diagram

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4. <u>Implementation</u>

The project is mainly a web 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 JavaScript, CSS, AJAX, PHP and Html. And back end will be developed using PHP. Such as dream viewer and an Android studio is going to use as text editors. Here inside the device bill calculations and all process going to be done. Those calculated data are sent to the cloud and future use to generate reports and bill and graphs.

4.1. <u>Web Application (User/Admin)</u>

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 platform.

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

On the other hand, signup forms email verification things done by using smtp and Php mailer libraries. The contact form also uses those two libraries to send email. The google maps API key and some function also use to the project to generate map.

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.

4.2. <u>Cloud databases</u>

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

- Login futter table
- Elec usage table
- StatusLED
- Customerverfy
- relaystatus

4.3. <u>Devices</u>

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

- Current (Still measure 3 bulbs+ one device)
- Voltage
- Power factor
- Frequency
- Energy
- Power
- Cost
- Unit

All these data are observes using the PZEM 004T sensor and except cost data variable all others are send to database. The bill generating process is done within the web hosting server at the moment.

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5. <u>RISK</u>

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.

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6. <u>Milestones</u>

Task	duration	%Complete
Planning	2 weeks	100
Analysis	2weeks	100
Designing views	4 weeks	100
Prototyping	6weeks	100
Programming each view	4 weeks	100
Device implementation	4 weeks	100
Testing and debugging	2weeks	100
Finalizing	2 weeks	100

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7. <u>FUTURE DEVELOPMENTS</u>

- ### <u>Completing the hardware system</u>

Due to the Covid 19 pandemic, the development of the project was limited. One of the major problems was the unavailability of hardware that is capable of running the system. In current system it cannot be run when a power failure occurs. Because it has no battery backup to hold the device running for few hours. As a result of this, it is unable to send and store the last read data to the cloud when sudden power loss occurs. On the other hand, meter will rest its stats to initial values also. To avoid that it is better to have a local storage device that can be connected with node MCU.

But due to the limited number of GPIO Pins and very low inbuilt memory in ESP 32 development board it better to use some advance development board like raspberry pi. Still the circuit diagrams are not printed as a PCB and the suitable project box is not design yet. In the future the system can be completed with the all the hardware parts. So, it will help to make clear the structure of the system and market it.

- ### <u>Future energy consumption and cost prediction</u>

Still the system is running without any machine learning algorithms. The ultimate goal of the project is also project also reduce the energy wastage and predict future energy consumption and cost. This will help to save energy at one side and it will help to save our money. For this I am going to use Long short-term memory (LSTM) is an artificial recurrent neural network (RNN) architecture and time series analysis and forecasting algorithms.

- ### <u>Add payment gateway to do real transaction</u>

Still the system is not approved by any authority and current it is in under developing mode. After completing the project and clear all the bugs we can use this.

- ### <u>Add more security features</u>

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 or hashed and save in the database.

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8. <u>RESULT AND EVALUATION</u>

- 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.
- Using the current system User can On and Off his electric equipment remotely.
- The Active and inactive status of the device is show in the google map.
- Email send contact forms are working and login email verification is working inside the local host.
- The Php APIs are working well to retrieve and store data from the Heroku cloud database.
- The calculated cost is showing in the device but still it is not use to generate the bill through our web application

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9. 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 project. Users can manage their electricity usage within necessary limits. There is a web application for the customer. By using that web 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 web 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 device and send to server and write them in separate table within same database. Then Real time graphs are generating to show the usage of electricity through the web application.

CHAPTER-10

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