ELECTRICITY CONSUMPTION READER AND TRACKER SYSTEM

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ABSTRACT

Electricity consumption issues have been an active area in Sri Lanka. In this paper, we introduce a cost effective solution that provides an effective service to the Ceylon Electricity Board (CEB). According to the recent survey in 2008, 4.1 million people consumed electricity from the CEB. Presently, the number of consumers increases and because of the growth of electricity usage many challenges are faced by the CEB every day. Our research fills the gaps in the existing literature and can be carried forward with the industry and interested parties. As a solution for the existing drawbacks and issues we developed a well-planned, user-friendly and well-functioning web site for the CEB to minimize the negative effects of the present system. This new system allows recording the customer records, bills, cost updates and other details. Any customer of the CEB can obtain logins and easy access to the details they want to know about billings and can pay the bills online through the web site. Furthermore, we developed two software specified especially to electricity consumer and to CEB engineers. Electricity consumers will be authorized to access the household electronic equipment and the main electrical switch remotely and control the on and off switches. CEB engineers will find the addresses of the household, which though power failures and any other issue regarding electricity.

***Key words*:** Electricity, Ceylon Electricity Board (CEB), Tracker, Power

1. INTRODUCTION

Ceylon Electricity Board (CEB) controls all major functions of electricity generations, transmission, distribution and retailing within the island. Presently, the meter readings are taken manually by going to every registered house, taking the electrical usage and then calculating the bill amount by hand. This tiring work is done by the employees of CEB and they have to walk door by door in the region they are allocated once a month on a particular day. They had to face many more circumstances while they do their job. Dog threats and consumers absence were the main problems they face [1].

People receive an electricity bill once a month, most probably in the last week of the month. They have no way of knowing their bill amount prior they receive their bill. Not only that, if the owners were out of the residency when the CEB employee comes for meter reading, they might not get the bill for that month and they will receive a huge bill of two months together in the following month.

One of the main problems that the consumers face with the electricity consumption is a power failure. When a power failure occurred, the consumers will have to wait until it gets fixed or call the CEB to fix it. Even when they have called CEB, the CEB engineers will have to face a problem of finding the correct house or the residency that has the power failure [2].

Through the system, we hope to minimize the drawbacks, difficulties and issues in the current system. We develop a well-planned, user friendly and well-functioning web site for the CEB that is eligible to record recent customer records, bill calculations, cost updating etc. [3]. Through that website, anyone who obtained loggings can log in to the system and check their details, calculate up to date bill [4] and make payments. We also plan to develop a digital display that is fixed near the residency's main switch so that any household can see the number of units they have used up to that time, the bill amount for the consumed units and other details regarding the electricity stream they receive. The proposed system consists of two android applications; one for the consumer and one for the CEB engineer. Using the application development for the consumer, they will be able to access their household electronic equipment or the main switch remotely and issue the power on/power off commands as necessary. They will be able to receive automated an SMS alerts regarding the bill details in a snap of sending a SMS to the CEB provided number. The application

developed for the CEB engineer will give the eligibility to find the residencies which has occurred a power failure, through a GPS tracking system [5].

The research group intended to develop an automated system that creates a huge difference in the industry. This will reduce the costs that CEB holds and will help the consumers to reduce their day to day electricity bill.

The objectives of the proposed system is as follows; this will coordinate all the related application well connected to the centralized data warehouse [6], view system details according to their permission levels, manage data, check the bill details, access the electronic devices remotely, track residencies and use the mobile application for the ease of use.

- In the system, one of the main administrators can have full permission to access all parts of the system and support to related parties.
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- Planned to maintain a centralized data warehouse [6] at the head office of the Ceylon Electricity Board and this will increase the reliability and minimize the time delay of the system.

- Security issues are taken into high consideration.

- Provide a number of access permission to access system each level user who is using the system.

- Using new technology to improve more accurate process in the ongoing system.

2. METHODOLOGY

Since, the use of smartphones has become much convenient during the last decade, the necessity of implementing a mobile based application to address the above mentioned issues seemed appropriate. As a result of that assumption, the ECRTS application has been implemented using the Android operating system.

The users can install the ECRTS application in their Android based smartphones. Through the application the users can view all the essential information from their electricity bill calculation to the number of units used. They will have the ability to control home appliances through the proposed application. E.g. turn on or off switches, bulbs, etc.

In the development of this research project iterative waterfall method has been selected as the software process model. Use of this process model iterates each phase in software life cycle, while ensuring the identification of problems at each phase of occurrence. If an error is detected it could be fixed by going back to the particular phase where it's occurring. This method also maintains the quality of the final product due to the fact that errors could be detected and fixed in early phases.

The ECRT system consists of a digital display with a device and two android applications. The digital display shows the customer the number of units, up-to-date bill amount, voltage, last payment and the usage of last three months. For that we connected live AC current to our current transformer and obtain the amperes and the voltage of the current stream. Then we calculate [7] number of units by calculating the number of amperes and voltage used. The calculation is;

Units (kWh) = kWh + [(real power / 3600) / 1000]

To obtain and transmit the data gained from the device we programed the chip inside the Arduino board with C programming language.

We used a SIM900 [8] unit to communicate the details between the digital device and the main DB. A mobile SIM card is used inside the SIM900 to get that task done. A SMS gateway was needed to send the details acquired from the digital device to the DB. But an SMS gateway is costly to purchase. So that we implemented a fully functioning SMS gateway [9] ourselves to get our task done. We used C# programming language to implement the gateway [10].

Now that we have data transmitted to our MSSQL database, stored procedures were used to display the data in the DB on the ASP.NET website.

The system provides two android apps; one for the consumer and one for the engineer. For the Android apps we used WCF (Windows Communication Foundation) services to get the data from the main DB [11].

As an additional function, we are trying to develop a system that a customer can handle and control the electronic equipment from outside the residence. As a testing session, first we try the same for a controlled range using Bluetooth technology. We have included a program in the

chip fixed into the Arduino board to connect the Bluetooth device fixed into the Arduino board and the other device [12-13].

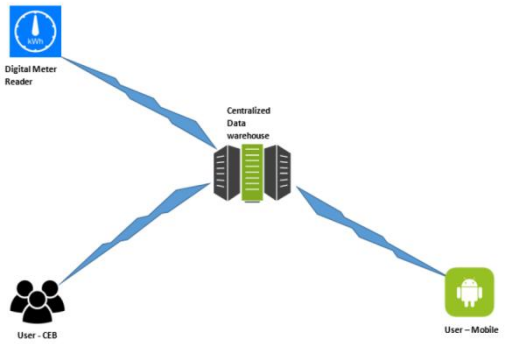

Figure 1: Architecture Diagram of the System

3. RESULTS

We were able to achieve most of our goals after starting the research project. Although we had to make some new changes and enhancements to the system in order to improve the whole system, we managed to keep the ratio within our limitations we agreed with.

Basically, our systems consist of two android applications, successfully working digital meter reader and display, centralized data center and the web site. The Bluetooth remote access system we developed to control the household electronic equipment from a distance, is kept as a feature of the system, not as a function. After fully enhancing the system, we are considering about long range remote access controlling the equipment.

Reliability: In order to achieve reliability, the team has used a prototype methodology that improves the accuracy of the system. By testing time to time the final output is expected to be error free. Using different kinds of testing methods the development team ensures the reliability of the system.

Availability: Users can use the ECRTS application any time they need. All the necessary information is stored on a cloud server. The application is prepared to serve the users any time on demand.

Maintainability: When the application is up and running it often requires continuous maintenance. In general, software remains operational for an extended period of time after initial implementation and requires regular maintenance to ensure that the software operates continuously at peak performance levels. Application patches are expected to be given out to the users as bugs and other issues are discovered.

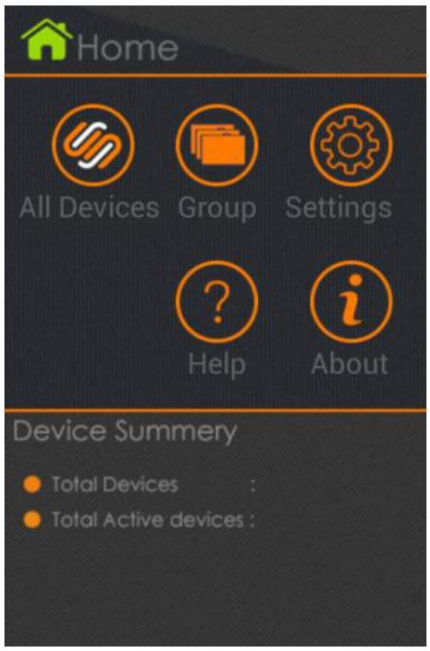

Figure 2: Android Application

Figure 3: Main Page of the Web Site

4. CONCLUSION

At present, electricity has become an essential resource for almost every work in our daily life. We can't imagine a world without electricity. As Sri Lankans, we pay the electricity bills monthly and the electricity usage is calculated manually. The meter readers note down the number of units to calculate the bill. This job is tiring and nearly

45000 employees used to do the same job monthly. So, the CEB (Ceylon Electricity Board), the sole electricity provider in the island bears a huge expense due to this manual system.

The research team came up with the idea of automating the entire electricity consumption related activities. Through this approach, monthly electricity consumption per residency will expect to reduce. The Electricity Consumption Reader and Tracking System will be an ideal solution to overcome the difficulties and drawbacks related to electricity consummation.

We use a digital device, a website and two Android apps to enhance our research idea and fulfil our goals.

1. The digital device – This is used to calculate monthly electricity usage by units, digitally. It will show the online bill amount and it interconnects with the residency's main switch panel.

2. The website – This is implemented to install in CEB with strongly implemented backend that gives eligibility to calculate the online bill amount and automatically update all the devices in the residencies' digital devices at once.

3. An Android app for consumer – This application will give the customer the opportunity to remotely access the residency's main switch panel and control it.

4. An Android application for engineer – This is a GPS based application which gives the ability to track any residency which faced to a power failure.

When comparing with the existing systems used for smart meter reading, the workload is covered by only reading the meter automatically. But the proposed system, ECRT is cost effective and enable more advanced features. It is capable of reading the up-to-date electricity usage and calculating bill amount at any point. Additionally, it gives the customer the freedom to control their switchboard remotely: in other words, they can switch on or off their switch board even if they are not at home. GPS based android system enhances the complete system into another step by giving the electric engineer the ability to track the residences for any power failure via GPS technology.

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