

Mobile Based Electricity Billing System (MoBEBIS)

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Abstract- Billing is a critical function of both the Electricity and the Water Boards towards getting a meter read. Meter reading, even though it looks simple, is far from simple and involves processes that can give various problems. Most problems, currently seen, result from the manual processes followed. Calculation errors, delays in system updating and fault tracking issues are the major problems that companies find difficult to find answers for. This paper suggests a mobile based system to collect, process and notify consumers about consumption. This system will be reliable, efficient and accurate to suit the requirements of these companies. The proposed solution uses evolving Mobile Technologies, over a solution which uses Mobile applications to handle a company's day today work. The burden on the Meter Reader is lessened and other new features have also been introduced. Customer interaction with the company is improved and customers can easily view their current electricity usage using their mobile phones. However, the feasibility of such a project for a third world country like Sri Lanka, is a concern with regard to the cost factor involved. The project demands substantial investments. Will the country be able to meet the costs involved? Yet, most of the problems related to Electricity Billing are addressed through this system and this might prove to be the best solution for specific companies to optimize services on a low budget

Index Terms- Mobile Based billing, Meter Reading, Electricity Billing

I. INTRODUCTION

The current procedure with regard to the billing process for electricity is not a fully automated system. It involves manual processes from the time the Meter reader starts reading the meter until the system is updated with the current reading. A meter reader visits a house, does the meter reading, and then manually calculates the amount considering the units consumed. Back in the office a data entry officer enters the meter readings into the system manually. The procedure is far from satisfactory and it is believed a better system using available technologies would definitely be an advantage.

To overcome problems with this manual approach a few solutions are identified. 'Smart Meter'[1] and 'Java Based Meter Reading System'[2] are some of the solutions. But they are not much welcome in a third world country like Sri Lanka, because the initial cost is very high.

There is also another major problem. When everything is automated there is no 'Fault tracking', so there will be a lot of

illegal issues like illegal power consumption. A further problem is the vast sums of money required to update or maintain this device[3].

However, to meet the problems associated with the major problems related to the Manual Billing process it is suggested to use a mobile device (android mobile phone). The proposed system is mobile and Web based. The System eliminates most of the error prone manual calculations and manual data entering. It increases the interaction between the company and their customers. The System update happens fast and customers can have the flexibility to get to know their electricity usage at any time they want. This will help reduce unwanted power consumption.

The product could be a welcome solution for the Ceylon Electricity Board and the Water Board. They could easily use the system for a faster, easy and error free environment to suit the comfort of customers.

II. RESEARCH METHODOLOGY

Problem Identified

The Electricity Board and the Water Board currently use a manual process for billing purposes due to the following reasons: They have got used to the manual process and they can go along with it even though there are concerns associated with it. They are reluctant to change their current process since it will be an extra effort. The Electricity Board or the Water Board cannot invest a huge amount of money for a new solution. However, the customers face immense problems with the current procedure of using this manual process to calculate Bills.

The Meter reader's perspective is that the reading is collected manually from the meter and calculations for a specific month after which, the data gets manually entered to the system. There is no route map for guidance or a plan covering each and every house. Another issue is that complaints cannot be made at the time of meter reading but back in the office.

From the customer's perspective there is no way of knowing their current electricity usage or calculating it manually with the given formulae. There is also no facility to compare the previous month's electricity usage with the current month. When they need to make complaints about the bills or about the device it is considerably difficult for the customers with the current system.

Finally from the Electricity Board's perspective, all these processes are manually maintained. This is a big burden for them. Another serious issue is that they do not have a proper way to communicate with their consumers when they want to notify

about power failure or the latest news related to power consumption.

Solution Proposed.

The suggested solution highlights the following: MoBEBIS is a Web site. MoBEBIS consists of two separate Mobile applications which are given to both Meter reader and the Customer (Customer is able to use the system only as a subscriber to this particular system.) A Web site is maintained basically for administrative purposes.

Meter readers will get the best benefits from this particular system. From the beginning of the day, a mobile phone with a route map called Walk Order Map (fig 4) which has the route of houses that he has to cover within a day, will be in use. Whenever a meter is read, the particular meter is indicated with the red color confirming that the reading is already captured. This leaves no room for 'missed' readings especially for novice Meter Readers. Meter readers are not required to do the calculation manually. All that needs to be done is to get the meter reading and send it to the system as bulk. Then the system does the calculation and proceed bills are sent to the relevant consumers via SMS. Importantly, the Meter reader can make complaints then and there whenever a fault is seen or an illegal power usage is spotted. In such a case, an image of that particular meter can be sent. This option is also provided through the system.

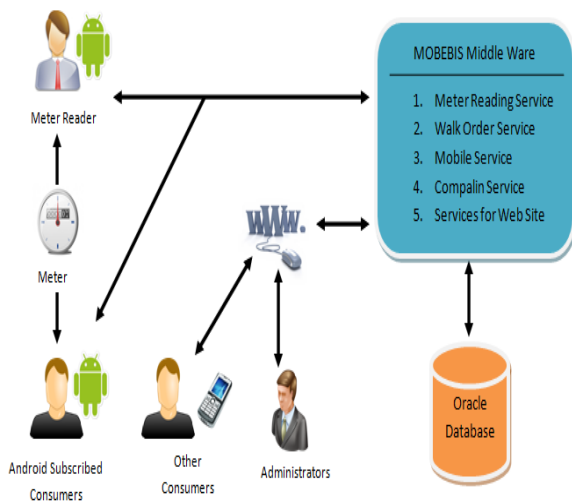


Fig 1. The System Overview will also be benefited using this system. There is a separate Mobile application developed for the customers so that they can be interactive members of this process. If the customers wish to know the current power consumption/ units consumed with the up-to-date bill, they can send the current reading of the meter to the SMS Manager Windows Service (3.2) via customer mobile application itself or SMS via normal mobile phones and the calculated amount will be received via an SMS. Self-Billing Subscribers are given an option where they can submit their monthly meter reading by taking an image (3.5) of the digits of the meter. Instructions are given to the customers and they can take an image of the meter and send it to the system. Then the

system identifies the digits using Image Processing Library (3.1). Then the system gets updated after processing the bill using identified digits and most importantly a meter reader does not have to come and take the reading since it is already provided by the customer.

A customer can view bills when necessary. By selecting the intended month, a customer can view bills. Customers are also given a facility where they can make complaints against the service and a track record of the complaints made by him can be viewed for the status of the complaints via the system. Another feature in this system is where the customer can subscribe/ unsubscribe the functions given. On the other hand, customers can use the Website to make payments, track complaint status and so on.

This application provides the Electricity Board with some features to help with administration as well. The built Web application is for administrative purposes. An area manager/ a responsible administrator can assign Meter readers to a particular route using this system. Technical officers will be able to keep track of the complaints / tasks assigned to them. The Electricity Board can publish any instant messages (Like sudden power drops due to maintenance purposes) without going for public media so that they can save money.

III. RESEARCH FINDINGS AND EVIDENCE

The system implementation is the arithmetic approach of problem-solving and planning for a software solution after the purpose and specifications have been determined. Under this section it discusses some specific library and service implementation of the system. All these services and library implementations come under sub parts of the MoBEBIS middleware and Android Mobile Application development.

A. Images Processing Library

The image processing library is related to the Android application which is used by the Android Mobile Consumers who are going to subscribe to the Self Billing Service. That application is capable of sending consumers monthly reading as an image to the MoBEBIS Middleware via Web service (3.3).[6,7]

When the system receives the image it is processed in this library to identify the current reading for the particular consumer. The steps to be followed are briefly described below.

First it retrieves the image from a Web Service to the library. This is called Acquisition. Then there is Gray Scaling the image so that the image continues tone image to an image that a computer can manipulate. Next it identifies the threshold value and applies it to the image using Otsu thresholding approach. Thereafter, it isolates the numeric area from the image, using Blob Counter after which it applies the Media Filter to remove noise from the image. Then the system does the segmentation to analyse the pixel in each digit. Finally Neural Network identifies digits.

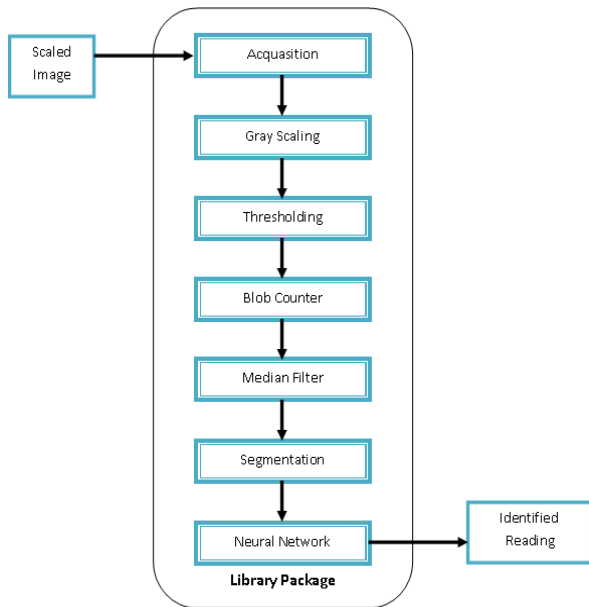


Fig. 2 System Diagram for Image Processing

B. SMS Manager Windows Service

The main idea of having an SMS service is to have better communication with consumers and SMS is the ideal way to achieve it. When the bill is processed by the system, billing details are sent via SMS. Besides this the consumer can make service requests like Get last Month Bill which is published by the MoBEBIS services for a better interaction with MoBEBIS. Some of the requests that consumers can make from the system are as follows:

1. Requesting Bill upto Current Date/ Last Bill
 Consumer can make a request via SMS.
 Eg - REQ TODAY [AccNo][Current Reading].
 REQ LAST [AccNo]
2. Subscribing and Unsubscribing to the Services
 Consumer can subscribe and Unsubscribing to/from services via SMS.

Eg - REQ [SUB/UNSUB] [AccNo] [ServiceNo]

C. WCF REST Services (Meter Reading Service)

Meter Reading Service is the key service given to a Meter Reader to submit daily collection of reading to the system using an android application. Android consumers registered with the monthly reading service, can send their reading to the system in the form of an image. All Services are implemented as WCF REST Service [4].

D. Encryption Library

This application needs to be secure when in use. Therefore the Rijndael encryption algorithm Rijndael [5] is used in this application.

E. Customized Adjustable Camera

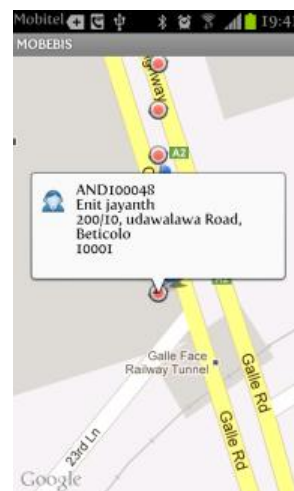
The customer Android Application is provided with a customized adjustable camera to capture the numeric area of the meter. The normal camera is customized according to the requirement. The camera is provided with an adjustable square to capture the numeric area of the meter. A customer can change it very easily by using blue dots provided with it



Fig. 3 Customized Image capture Adjustable Camera

F. Walk Order Map Service

The Meter Reader android application is consistent with Walk Order Map. This provides access to the walk order services. At the beginning of the day the meter reader gets the walk order from the Electricity Board. This enables the reader to view the houses to be covered on a specific day. At the beginning all the houses are marked as red dots on the map. The Map gets updated by changing the color into blue when a house gets covered. The meter reader can also get a quick understanding about what has been covered and what remains to be covered. To handle this application it is necessary to allow obtaining periodic updates of the device's geographical location when the device enters the proximity of a given geographical location.[9]



G. Android Map Service

Android gives your applications access to the location services supported by the device through the classes in the android.

Location package. The central component of the location framework is the Location Manager System service, which provides APIs to determine location and bearing of the underlying device (if available).

H. Search Consumer Details

Consumer details are embedded into a QR Code. When the meter reader need details about the consumer, QR Reader, which is provided through mobile application can be used to retrieve details from the QR code which is stuck on the meter.[8]

I. Unique Features

The unique features of this system will enable the Electricity Board staff, meter reader, technical officers and specially the consumers to experience many benefits. They are as follows:

1. Optimize time - The system eliminates the need of allocating time for the meter readers to go to the office to take the walk order and also give the readings.
2. 24/7 connectivity - As the system is Web-based (web site), it is available any time.
3. Immediate access - The meter reader application is available for the reader to log in to the system and also to understand the current day's work. The application, being a Web-based system, it is readily available. Therefore, it can be accessed from anywhere, any time. Users access their account online and they are ready to work no matter what user's setup or hardware is.
4. Better security - As a Website is available on the Internet, only the authorized users can access the system according to access privileges. The consumer mobile application needs to be downloaded from the Web site after successful registration. Capturing reading of the meter function will be available once a month and the consumer is capable of capturing one's own meter securely. The System encrypts all sensitive data, so no one can access it in transfer to the system's database via a Web service. Access will be denied for other users.
5. Reliable and effective communication - Web officers and consumers can communicate via SMS and also by E-mails. Consumers can send complaints through e-mails and android application itself. Anyservice interruption news will be sent to the consumers via SMS.

Wide flexibility - All manual processes are promised through the implementation of the MOBEBIS. The system allows the consumers to choose some specific services if they need or not.

IV. CONCLUSION AND FUTURE WORK

The basic idea of developing MoBEBIS was to address some common issues related to the manual electricity billing process. Before suggesting this solution they were using a manual process on meter reading, amount calculation, and billing customer and so on. The interaction between customer and Electricity Board was very poor and it took much longer to respond to customer queries.

The other major problem which was identified during the literature survey is that customers keep complaining that bills are incorrect. Most of the time bill calculation and system updating are done manually. There can be some resulting human errors to frustrated customers who are not satisfied about the service of the Electricity Board at all. Another difficulty observed was with making complaints against the Electricity Board service via a call.

The suggested system has come up with solutions which address all the above mentioned problems. With this service the burdens of the Meter reader as well as the Electricity Board get lessened and are made more efficient. A mobile solution is given for the Meter reader so that the day to day work becomes less tiresome. Most of the manual processes and calculations are eliminated so that the meter readings can easily be collected more accurately to be updated to the system.

On the other hand, the Android customers are also given a mobile solution so that they can view their latest bills, make complaints against the Electricity Board's service, and make payments and other important tasks efficiently. Administration tasks of the Electricity Board can be easily done via a Web site which is provided as part of the complete project.

For future research, it is suggested that image processing be done in the mobile device as the image gets captured. The send the numeric value can be sent to the server through Web service.

This particular solution can be further expanded over the Sri Lanka Water Board as well since they are following almost the same process of billing customers. This system is well tested and it is proven that it functions properly and accurately so that it can be a solution for the Electricity Board to serve their customers satisfactorily.

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