Automatic Electricity Billing

Markose Babu[1], Meera Antony[2], N. Pranav Ashok[3], Niranjana. K. R[4], Darsana. P[5]

UG Scholar, Dept. of Electronics & Communication Engg., Amal Jyothi College of Engg., Kanjirapally, Kerala[1,2,3,4]

Asst. Professor, Dept. of Electronics & Communication Engg., Amal Jyothi College of Engg., Kanjirapally, Kerala[5]

Abstract: Every system around us is becoming automatic and making our lives more comfortable. Our idea is to develop an automatic electricity billing which is very essential in our daily life. At present, an employee from the electricity board visits regularly once in a month, takes the meter reading and submits these readings to the office. The office generates a bill on the basis of meter reading. The accuracy of this method is less due to human interventions. As a result, Automatic Electricity Bill concept is developed in which the collection of meter reading, processing of the reading and sending the bill to customer is done automatically. This method employs a camera which is fixed in front of the meter is used to take the snapshot. The captured image is then processed and the meter reading is extracted. The bill amount is calculated and is send to customer as SMS via GSM module. A copy of SMS is sent to the electricity board for documentation purpose.

Keywords: Character recognition, GSM, Image processing, MATLAB.

I. INTRODUCTION

An electricity meter is a device that measures the amount of electric energy consumed by a residence, business, or an electrically powered device [1]. There are two types of meters - electromechanical and Electronic. The most commonly used electricity meter is the electromechanical induction watt-hour meter. The electromechanical induction meter operates by counting the revolutions of a non-magnetic, but electrically conductive, metal disc. The speed of rotation is proportional to the power passing through the meter. The number of revolutions is thus proportional to the energy consumed. Electronic meters display the energy used on an LCD or LED display. Electronic meters can also record parameters of the load and supply such as instantaneous and maximum rate of usage demands, voltages, power factor and reactive power used etc.

In these days, there are customers who are not satisfied with the services provided by the electricity authority [2]. Nowadays, an employee from electricity office visits every house periodically, takes the meter reading and submits these readings at main office. These readings are used to generate the bill. Due to human interventions in all these processes there are chances of error. For instance, if the house is closed for a long time then the meter reading average is taken by the office. in such a case the customer has to go to the office to correct the bill. The traditional method of electricity billing process requires a large number of labors for the collection of data and billing. There are chances of losing the printed electricity bill in the mailboxes. If the weather conditions are not good the manual billing is slowed down. Hence an Automatic Electricity Bill can be used which is an effective method of data collection, data processing and calculation of bill. It is a technique of automatically collecting meter reading, image processing, and transferring the bill amount to the customer as SMS using GSM module.

The software platform used is MATLAB. MATLAB is a powerful software tool used to implement the tasks that require extensive computation. It provides easy and quicker implementation of algorithms compared to C and C++. The key feature in MATLAB is that it contains rich library functions for image processing and data analysis.

MATLAB provides an easy approach for debugging and correction of errors in any algorithm. Considering the above advantages, this project is being implemented with an algorithm for Automatic Electricity Billing using MATLAB. The algorithm uses various inbuilt functions and implemented few user defined routines related to image processing.

II. PROPOSED METHOD

Automatic electricity billing is a technology in which information is collected from the energy meter. Bill is calculated from the meter itself and the bill is then sent to the electricity board and the customer. To achieve this, a camera is placed in front of the energy meter of every house. The camera takes the image of the reading shown in the energy meter on a specific date of every month.

The image is then processed using MATlab software to extract the number from reading and store it in a variable. Previous month's reading is thus subtracted from this month's reading. The difference thus obtained is multiplied by the tariff and converted into electricity bill.

The bill calculated is then being sent to the customer and to the electricity board via SMS using a GSM module. This month's reading is stored into the database for calculating next month's reading.

A. Image Input

The camera placed in front of the energy meter takes the snapshot of the reading every month. The whole setup that is the camera and the meter is encapsulated in one transparent box for security reasons. The snapshot taken by camera is given as an input image to the MATlab software where processing of image is done.

B. Image Processing

Image process is the technique of performing mathematical operations by sing any form of signal processing method. The image captured by the camera is of the meter reading only which is a red colored seven segment display.

1) Binarization: Converts the coloured image to a grayscale image. The grayscale image is then converted into black and white image by using binarization. The pixels below a certain threshold value is assigned 0 (i.e. black) and pixels above the threshold is assigned 1 (i.e. white).

2) Dilation: In mathematical morphology, dilation is one of the basic operations. The dilation operation usually uses a structuring element for probing and expanding the shapes contained in the input image. In MATLAB, to dilate an image imdilate() function is used. This function dilates the grayscale, binary and packaged binary image.

3) De-noising: Removes salt and pepper noise from the black and white image. For this 'bwareaopen()' function of MATlab is used. This function help in removing all connected pixels less than a certain threshold.

4) Character segmentation: In character segmentation, the numbers are taken out of the meter. This is done using connected component analysis. Connected components are those components which share same pixel intensity values and are in some way connected with each other. The gray scale image is first converted to a binary image using global thresholding technique. In binary images analysis, objects are usually extracted by means of the connected components labeling operation, which consists of assigning a unique label to each maximal connected region of foreground pixels. The properties of each connected component are then checked to determine whether it is a character or noise. Those components which satisfy the conditions are then stored in a separate file.

5) Character recognition: The segmented images are compared to the number templates. The correlation of each segmented image is compared to the template images one by one. The number that represents template with the maximum correlation for a segmented image is selected and thus the number is recognized.

C. Bill Calculation and Transmission

After the image processing, a segmented characters are obtained which is then recognized. This gives the current month reading. The previous month readings are stored in a database. The difference of the current month reading and previous month reading is taken. The difference of the two reading gives the amount of energy consumed for that particular month. This amount is multiplied by the tariff as specified by the electricity board and the bill is calculated.

The bill amount is sent to the customer via SMS by using a GSM module interfaced with the energy meter. A copy of this SMS is also send to the electricity board for documentation purpose.

III. OUTPUT OBTAINED

Fig.1. Input image

Fig.2. De-noised binary image

Fig.3. Horizontally segmented image
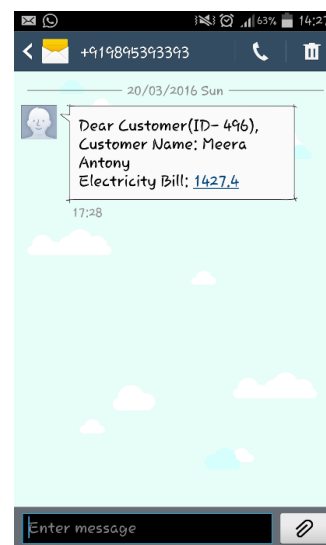

Fig.4. Numbers after segmentation

Fig.5. SMS received in mobile

IV. CONCLUSION

The proposed work eliminates the need of manpower for the electricity billing system. Not only does it eliminate the need of manpower but it serves to be a more accurate method as there is no human intervention. It also requires no paper for billing purpose. The chances of losing the bill is also eliminated as the bill amount is being sent to the customer as SMS using a GSM module interfaced with the energy meter.

REFERENCES

[1] Md. Masudur Rahman; Noor-E-Jannat; Mohd. Ohidul Islam; Md. Serazus Salakin "Arduino and GSM Based Smart Energy Meter for Advanced Metering and Billing System", IEEE , May 2015
[2] Pradip W Kulkarni, Manisha V Shinde, "Automation of Electricity Billing Process", IEEE 2014