Electricity Meter Reading Based on Image Processing

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Abstract:
Electricity plays a major role in our lives. The use of electricity is increasing every day. We use it everywhere and for different purposes that we cannot imagine our lives without it. As in some places now also where the technique of digital meter is not implemented, in those places electric meter reading technique is most useful. As the existing method of manual electric meter reading is not applicable with the increasing consumption of electricity and has a lot of disadvantages like time consumption, more human resources and is prone to lot of errors. The difference is in how to collect and process information that both traditional meter reading and electric meter reading follow. Automated Meter reading follows the process of reading the values of electrical meter by using a camera that takes a photo of the meter, recognizes the digits, and then stores the output in a text file. The meter image is captured by mobile phone back camera with some constraints: the camera has to be parallel to the meter, the meter reading area has to appear in the image without shadows, part of the meter black box must appears from left and right, and the right most digit must be entirely shown and clear. The reading area that is extracted from the image is further segmented for digit recognition. Digit recognition is the process where we match the segmented data with our predefined template.

I. INTRODUCTION

Electrical Meter Reading (EMR) [1] recognition system is an image processing technology used to identify the values in the electrical meter. The various applications where the EMR recognition system is used in the Electricity board for domestic and commercial current consumption, in the factories like thermal power station, steel, wind mill etc., where the reading of machineries is necessary in certain frequency of time. There are many issues that should be resolved to create a successful and fast EMRR system [2] such as poor image quality, damages in the body of the meter, processing time, and background details and complexity. The need of EMRR system is increasing for many reasons such as reducing the manpower for talking the reading frequently. Automatic meter reading combines the mechanical rotary-type counter with its related technologies. The system has completely changed the old tradition where the energy company sends a utility employee to collect data from a meter that is located on a customer’s property. The data collected tells the utility company how much of the utility the customer consumed in a certain period of time. This system would automatically collect data from a meter remotely and then transfer the data to a database, which results in a bill to a customer. Thereby it saves a lot of manpower which in turn would save money for the company that then can pass the savings on to the customers [6].

II. PROPOSED SYSTEM

Manual meter reading systems using electromechanical meters are installed within the premises of residential or commercial consumers and information about the units of consumption of electricity are collected on a monthly basis. However, this present convention has the following disadvantages: Manpower must be hired to go from household to read energy consumption, record data and communicate with a receiving module. Use of manual meters could translate to meter reading mistakes and errors of leakage. So, our project aims the simulation of this energy metering system in (MATLAB) and observes the changes in consumption of energy units. This type of a system will not only help in reducing the manpower but also help the customer to keep a track of the units consumed.

Phase 1: Image Preprocessing

A. RGB to Binary:
In this method, RGB to gray-scale conversion is adopted, in order to facilitate the meter extraction, and increase the processing speed. Color image (RGB) acquired by a digital camera is converted to gray-scale image based on the RGB to gray-scale conversion technique. The basic idea of this conversion is performed by eliminating the hue and saturation information while retaining the luminance. The following equation shows an optimal method for RGB to gray-scale conversion. Lu = 0.299 * R + 0.587 * G + 0.114 * B. Using a threshold value of 127 the grayscale is converted to a binary image.

B. Image Noise Removal
Because of the noise could appear on the image after the binarization, noise reduction algorithm must be applied to reduce the noise. We chose to apply Morphological operations.

C. Cropping Reading Area
In this step, the binarized image is processed to crop the part that has the meter reading only. We made use of the Connected Regions Algorithm to crop the reading area. In this method we scan the image for regions with high density of white pixels. Such a region is found and a black pixel boundary is drawn around this area and the image is cropped (Fig 3).
Phase 2: Image Segmentation:

This stage is where the actual digits are segmented. This is done using the VEDA algorithm. The VEDA algorithm starts scanning the image vertically from the left it continues doing so until it finds the first white pixel. Once found it marks the first pixel and continues scanning the image until it finds a complete vertical line of black pixels. The latest white pixel scanned vertically is used to create a box around the scanned area to extract the digit(Fig 4).

Phase 3: Digit Recognition

A. Creating a dataset for the digits:
We have taken a sample of 10 images for each digit from 0-9. This sample will be used to train the neural network.

B. Feature Extraction of Samples
In this process we take a digit sample and extract it features to form a vector of 108 x 1. The sample image is divided into 9 regions. Each region has been extracted with 12 features thereby 108 features are extracted of a single sample.

D. Creating an input and target matrix
To train the neural network we created an input matrix of 108x100. (108 features of 100 samples).This input matrix was mapped to a target matrix of 10x100. Inside the target matrix the 10 rows of the first column consists of the digit '1' which indicate that the first 10 samples are of the digit zero '0'.So on the next 10 columns consists values for digits 1-9.

E. Training the Neural Network
We made use of MATLAB to train a neural network by using the input and target matrix. The neural network so created was used to be applied on each segmented digit to automatically match them with the samples within the dataset.

E. Extract the Digits and Display the Output
Once the digits are segmented they are extracted for their features using the feature extraction code. A feature vector is generated of each image and is mapped to the trained neural network. The closest possible match found is considered to be the digit. In the above example a feature of each of the digits '6 3 2 8 7' are extracted and corresponding output is displayed in the text file(Fig 5).

III. CONCLUSION

The purpose of this project would be to develop an application which would enable a customer to take a meter reading at his residence without the need of a person to manually take the reading. Also the app could enable the customer to keep a track
of the consumption. The application could also be used to generate a bill based on the difference in the units of consumption between two consecutive months. This will be a faster process than the traditional method as customer gets the bill as soon as the meter reading is verified.

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V. REFERENCES


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