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Consumer App with Automatic Image Capturing and Processing for Meter Reading and Billing

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ABSTRACT: this paper introduces a system based on image processing to obtain efficiently and accurately reading of the electricity digital meter. In this system the back camera of the mobile phones is used to acquire the image of the electricity meter. The system then applies a sequence of image processing functions to automatically extract and recognize the digits of the meter reading image. This image goes through three main stages: preprocessing which ends up with cropping the numeric reading area, segmentation of individual digits using horizontal and vertical scanning of the cropped numeric area, and recognition of the reading by comparing each segmented digit with the digits templates. The proposed system is implemented using Android Studio software with open CV library, MATLAB 2013 and has been tested on 20 images of electric meters captured by Smartphone camera in India 2017. The proposed system will be used in the future to develop a mobile application that could be used by the electricity company employees to facilitate the reading process.

KEYWORDS: Automatic Meter Reading, Image Processing, digit segmentation, digit recognition, feature extraction.

I. INTRODUCTION

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. The tool used to measure the electricity consumption is Electric Meters. This work aims to facilitate the electricity meter reading mechanism for electricity company's employees in India, as the existing method of manual electric meter reading is not applicable with the increasing consumption of electricity and has a lot of disadvantages: It is very tedious, time consuming, man power consuming and is prone to lot of errors. We introduce a methodology based on image processing to obtain efficient and accurate reading of the digital electricity meters. The contribution of this work is extracting and recognizing the English meter reading digits from electric meters in India. Based on the collected meter images, there are many versions of digital electric meter in India some of them are shown in *Fig.1*.

Fig 1: Current Meter system photograph

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In these versions the location of the reading area is on the top of the meter, with English numbers. In addition, they contain six digits of numbers in reading area.

The rest of this paper is organized as follows: Section II presents the related work. The proposed system is introduced in section III, and Section IV shows the testing results of the proposed system. Finally section V presents the conclusion and future work.

II. RELATED WORK

This section presents similar researches, the steps they followed in their systems, and the techniques they used in each step. The authors in [1] propose a system that is composed of a camera with a timer to instruct the camera to acquire the photoof the meter reading at regular intervals of time. The system has a part for image pre-processing to convert the image to binary image, and then adjust it by changing brightness and contrast, finally crop the numeric area. To detect the digits ofthe meter reading and segment them, Support Vector Machine learning algorithm is applied to the pre-processed image. Then to each of the segmented image, Support Vector Machine is applied again to recognize digits from 0 to 9. Finally, the output is sent to the Server along with other details such as Consumer name, consumer number, date/time etc. If the server didn't receive the meter reading within specified time, then server assumes camera failure and sends out service people to change the faulty camera after getting proper image it process image and send extracted unit.

III. PROPOSED SYSTEM

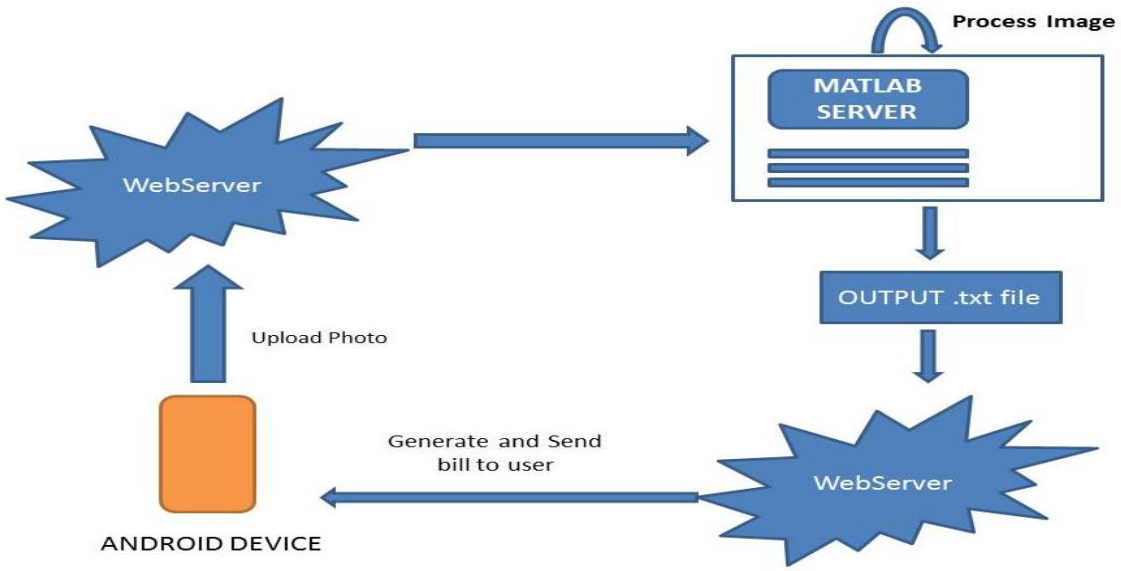

Fig 2: System Architecture

The proposed system consists of three main stages of image processing as shown in *Fig. 2.* The system is implemented using Android Studio V1.4 software and MATLAB 2013 edition. We used android studio for creating android application with which we can take a snap of electric meter and send it to server. We used MATLAB for image processing and to extract current unit reading

Working flow Capture image -> Send to MATLAB -> crop reading area -> Noise Reduction -> individual digit segmentation -> Feature Extraction -> Template matching -> display output.

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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, the right most digits must be entirely shown and clear. *Fig. 3*shows an image of the electricmeter that satisfies these constraints.

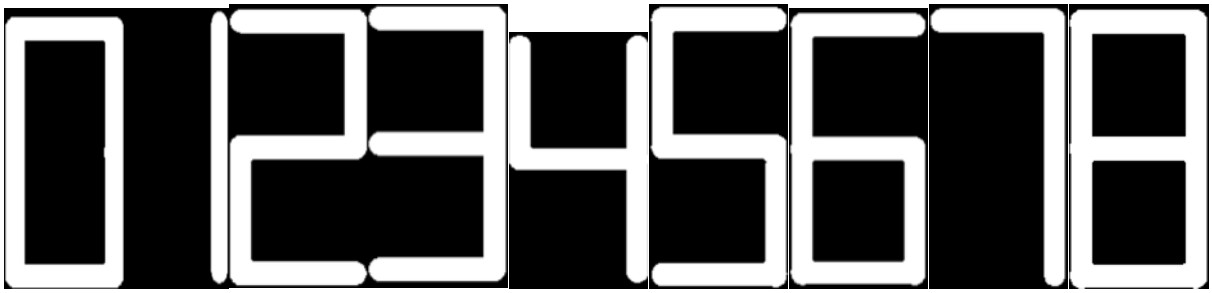

Fig 3 Templates for Matching

We are going to convert fig 1 into gray scale image and then will segment each digit after that we will use templates for matching and verification of each number.

Fig Image to convert/ Extract

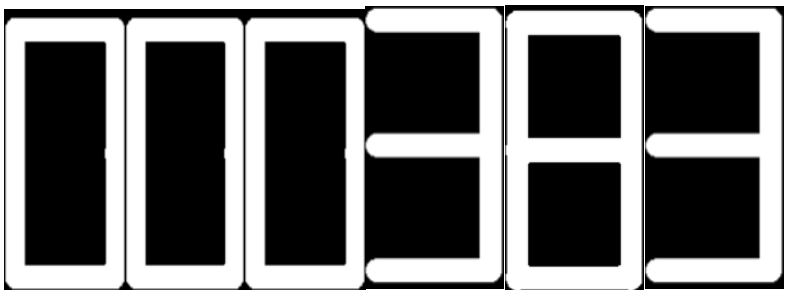

Fig Units extracted after image processing

• Template Matching

We will take the six segmented digits, divide each digit image into four quadrants and calculate the number of the white pixels in each quadrant q1, q2, q3, q4. Let's say we have the digit image X, we calculate difference values *DV*

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IV. RESULTS

The system is tested on 21 electricity meter images of type shown in *Fig 1*these images were captured using the back Camera of many mobile phones in outdoor environment. Shows some samples of the tested images and the output result from crop numeric area, digit segmentation, and digit recognition stages. The performance of the individual system stages are as per expectations.

Table for performance of the system

Total number of meter images	Correct crop area	Correct individual segmentation	Recognition
20	17	17	15

V. CONCLUSION AND FUTURE WORK

This paper presented an automatic electricity meter reading system based on image processing in India (Year-2017). Results showed that the system can recognize the electric meter reading digits in three main phases of image processing with sufficient accuracy of 95.23% for each digit and the percentage accuracy of entire reading of 80.96%. The future plan is to improve the system so that it can recognize the reading of different types of meters in India, improve the system accuracy, and develop a mobile application for the electricity company employees that use our system to facilitate the reading process. Using this application the employee just capture the electricity meter image, then the application process the image, recognize the meter reading and automatically send the reading to the company server.

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