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REVIEW OF OPTICAL CHARACTER RECOGNITION AND ITS APPLICATIONS

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ABSTRACT

The computer plays vital role in all industries. The dependence on computers keeps on increasing every day. The digitization of information transfer between machine and men helps to make the paper-free society. The Optical Character Recognition (OCR) and its applications help us to make the digital world. In this paper, we review the various OCR approaches for recognizing the characters from different images. We reviewed the papers of OCR applied in recognizing texts in natural scenes, traffic signs and energy meter reading. We have initiated our presentation with handwritten text recognition using neural network to understand the process of OCR.

Keywords: optical character recognition, OCR, natural scene text detection, traffic sign detection.

1. INTRODUCTION

Many people preferred to use the pen and paper than computers for taking notes or lectures due to the requirement of typing skills while using computers. The digital documentation requires typing skills for making the work faster. The hand written documents has been the natural communication medium among humans. The OCR is the most efficient method for creating the paper free environment. The bulk amount of papers can be digitized using OCR. The OCR involves in recognizing both printed and hand written characters. The innovative research techniques are available for recognizing the multi linguistic characters.

Digital image processing applications are popular due to increase in sales of the low cost consumer products like digital cameras, smart phones, tablet PCs, etc. Few industries developed mobile applications using OCR for their products. The television manufacturing industries have developed the mobile application using OCR for reading the serial number in TV to activate the mobile remote control. This shows the importance of OCR technology in digital image processing for real time applications.

OCR finds its application in driver assistance by reading road signs, automatic toll collection booth, OCR based language translation for tourists, postal code reading, etc.

2. TEXT RECOGNITION FROM NATURAL IMAGES

Alvaro Gonzalez *et al.* [1] have presented a work on recognition of text from natural images. They recognized and obtained the corrected word using the two main stages namely text location determination and text recognition. The text location determination has been done based on geometric and gradient properties. The gradient features have been used by them to recognize single character. Finally the dynamic programming (DP) has been used to make correction for misspelled words.

Maximally stable extremal regions (MSER) and local adaptive thresholding method has been used by them for segmentation. Different features of text have been studied for character discrimination. Restoration stage has been used on position and size features. Restoration stage helps to bring back characters erroneously rejected. The Figure-1 shows the detected MSER regions of the sample image which is captured using digital camera.

Figure-1. Sample image and its MSER regions.

3. HANDWRITTEN TEXT RECOGNITION USING ARTIFICIAL NEURAL NETWORK

España-Boquera. S *et al.* [2] have developed a handwritten text recognition model using hybrid Hidden Markov Model (HMM). The HMM model is an Artificial Neural Network (ANN). The Marko chain has been used to construct the structural part of optical model. The emission probabilities have been estimated using multi layer perceptron (MLP). In their work, the preprocessing stage consists of image cleaning, slope and slant correction and size normalization of characters using ANN. Slope removal and normalization has been achieved with MLP by local extrema classification. They have conducted the experiments from IAM handwriting database version 3.0. IAM is the handwriting database which contains the different forms of handwritten English text. It can be used to train and test the character recognition model.

The gray level of the image has been estimated for cleaning and enhancing the handwritten text image using neural network. The slope removal can be done by either horizontal histogram projection or by obtaining the upper and lower contour of the image. In their approach, they have used supervised machine learning technique for classification of detected set of points from the image. The reference lines, ascenders, descenders, upper and lower base line has been determined by them using local vertical extrema of text contours. These reference lines helped them to perform slope removal and normalization. The Figure-2 shows the ascender, descender and base lines as well as the ascender and descender.

After preprocessing, the segmentation and feature extraction of characters has been performed. Supervised trained ANN has been used by them to recognize the characters.

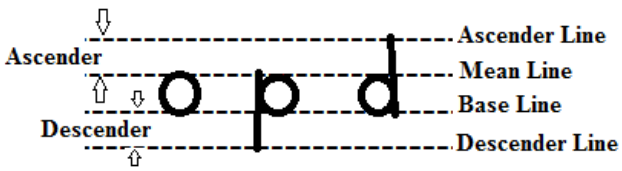

Figure-2. Reference lines.

4. LICENSE PLATE RECOGNITION SYSTEM

License plate recognition (LPR) system finds its application in automated car parking, vehicle tracking and automated electronic toll collection systems.

Hakan Caner *et al.* [3] have developed FPGA based LPR system. The recognition process consists of license plate detection, license plate character segmentation and recognition. The license plate detection can be done by any one of the method like edge detection or threshold technique. The plate area has been detected by analyzing the vertical and horizontal projection histograms. They have applied Gabor filter and compared the threshold value to obtain the binary image. The height and width ratio of selected maximized white patch of the image has been compared with the standard License plate ratio. After obtaining the sufficient ratio, the character segmentation process has been done by them. If the sufficient ratio is not obtained, the next area will be selected for comparison.

The Connected Component Labeling (CCL) analysis has been used by them to identify the characters in the selected area. The features of the image have been used to recognize the character after the segmentation process. They have implemented the Self Organizing Map (SOM) algorithm for character recognition.

The hardware model has been developed by them using FPGA, video decoder and encoder. The developed model which helps us to use it in real time applications like automated toll collection system. From their results, we observed that 91.7% as success rate for LP detection by successful detection of 1317 samples out of 1436. They have achieved 87.16% as success rate for LP segmentation by testing 1317 samples. They have achieved 90.93% as recognition rate.

5. RECOGNIZING TEXT FROM TRAFFIC SIGNS

The recognition of text from road signs finds its application like driver guiding and warning assistant system, traffic regulation and road surveying. Jack Greenhalgh and MajidMirmehdi [4] have developed a system for recognizing text from traffic signs. They system comprises two stages namely Text area detection and recognition. The large numbers of candidates have been detected based on MSRE, HSV (Hue, Saturation and Value) thresholding. The false positives have been reduced based on the temporal and structural information matched. The second stage proceeded with perspective correction to align the characters vertically. The recognition rate of the text has been improved based on Perspective rectification and temporal fusion of candidate regions of text. From the results, they have achieved F-measure of 0.93 for detection stage. The precision and recall value found by them is 0.96 and 0.9 respectively. They have achieved success rate as 0.89 for detection and 0.87 for the entire system. The F-measure can be found based on the following formulae,

$$\text{F} - \text{measure} = 2 * \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}} \quad (1)$$

$$\text{Precision} = \frac{No.of\,correctPositiveResults}{No.of\,AllPositiveResults} \quad (2)$$

$$\text{Recall} = \frac{No.of\,correctpositiveresults}{\text{No. of positive results that should have been returned}} \quad (3)$$

Saturnino Maldonado-Bascón*et al.* [5] have developed a road sign detection and recognition syatem based on support vector machines (SVMs). In their work, they have detected and recognized the rectangular,

circular, octagonal and triangular signs. They fulfilled their research for Spanish traffic signs. The segmentation process has been done based on the pixel color. The linear SVMs have been used for shape detection in traffic sign boards. The recognition stage has been developed based on Gaussian-kernel SVM. They have fixed a video camcorder on the front wind shield. The video sequences initially have been converted into .bmp files using DVGrab 1.7 software. They have done their experiments in different weather conditions like sunny, cloudy and rainy weather. They have done their experiments during day as well as night light conditions.

Xu-Cheng Yin *et al.* [6] have proposed the multi orientation scene text detection system. They have evaluated their system performance using International Conference on Document Analysis and Recognition (ICDAR) Robust Reading Competition data sets of 2011 and 2013,MSRA Text Detection 500 Database (MSRA-TD500) and Natural Environment OCR (NEOCR) Dataset. The scene text detection can be categorized into three groups namely (i) Sliding window method or Region based method (ii) Connected component method (iii) Hybrid method. MSERs and Extremal Regions (ERs) based methods can be categorized under connected component method. In their system they have constructed the text candidates using adaptive hierarchical clustering method the clustering threshold followed by coarse-to-fine grouping algorithm. The performance of their system for different datasets has been shown in the following table.

Table-1. Performance for the different Datasets.

Dataset	Recall	Precision	f measure
ICDAR 2011	66.01	83.77	73.84
ICDAR 2013	65.11	83.98	73.35
MSRA-TD500	63	81	71
Average	64.71	82.92	72.73

6. OCR IN ELECTRICAL ENGINEERING

Ahmed, S.S. *et al.* [7] have described a method to collect kWh information from energy meter using OCR. They found the issues in the existing system as, once a month, the officials from power distribution industry have to collect the electricity usage units from consumers. They have to walk through door to door to collect the kWh information from energy meter of the consumers. The prepayment meters are not desirable due to the need of changing programs in embedded chip for frequent change in electricity slab rate by government on power distribution industries.

Collecting the kWh information through SMS using mobile phones faces typing error problem and manipulated data entry by dishonest consumers. Due to the above facts the authors proposed a reliable system for electricity billing. The following block diagram has been developed by us to explain the system proposed by Ahmed, S.S. *et al.*

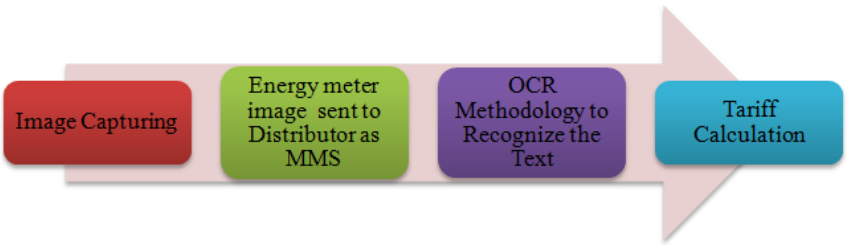

Figure-3. Block diagram of the proposed system.

The following are the steps followed by them,

a. Consumers have to use mobile camera for capturing the image of the energy meter. They may use any brand mobile phone with 2 MP cameras.
b. Consumer has to send the taken photograph of energy meter as MMS to the utility server.
c. The utility server will detect the reading from received image using OCR technique.
d. The tariff calculation will be done by the utility server.

The following are the steps involved in the recognition process followed by them. They are,

a) Converting the received image as three dimensional arrays of pixels.
b) Obtaining the black and white image from color image.
c) Applying hat transformation to remove the shades of the photograph taken by the consumer.
d) Complementing the processed image.
e) Remove the unwanted spurious pixels in the energy meter reading surroundings.
f) Removing the small components from the processed image followed by dilation process.
g) After the complementing process, Segment the character regions of the image.
h) Recognize the text using template matching method.

CONCLUSION

In this paper we reviewed the OCR and its applications. We discussed the applications of OCR in

natural scenes, traffic signs and energy meter reading. We have initiated our presentation with handwritten text recognition using hybrid Hidden Markov Model to understand the process of OCR. We have widened our search for applications of OCR in various fields like electrical engineering. The performance of the system proposed by the authors has been discussed. We have developed diagrammatic explanations wherever necessary.

REFERENCES

[1] Álvaro González, Luis Miguel Bergasa. 2013. A text reading algorithm for natural images. Image and Vision Computing.31(3): 255-274,DOI: 10.1016/j.imavis.2013.01.003

[2] España-Boquera S.; Castro-BledaM.J.; Gorbe-Moya J.; Zamora-Martinez F. 2011. Improving Offline Handwritten Text Recognition with Hybrid HMM/ANN Models.in Pattern Analysis and Machine Intelligence, IEEE Transactions on. 33(4): 767-779, April 2011, doi: 10.1109/TPAMI.2010.141.

[3] Caner H.; GecimH.S.; AlkarA.Z. 2008. Efficient Embedded Neural-Network-Based License Plate Recognition System.in Vehicular Technology, IEEE Transactions on. 57(5): 2675-2683,doi: 10.1109/TVT.2008.915524.

[4] Jack Greenhalgh and MajidMirmehdi. 2015. Recognizing Text-Based Traffic Signs. IEEE Transactions on Intelligent Transportation Systems. 16(3): 1360-1369.

[5] Saturnino Maldonado-Bascón, Sergio Lafuente-Arroyo, Pedro Gil-Jiménez, Hilario Gómez-Moreno and Francisco López-Ferreras. 2007. Road-Sign Detection and Recognition Based on Support Vector Machines. IEEE Transactions on Intelligent Transportation Systems. 8(2): 264-278.

[6] Xu-Cheng Yin, Wei-Yi Pei, Jun Zhang and Hong-Wei Hao. 2015. Multi-Orientation Scene Text Detection with Adaptive Clustering. IEEE Transactions on Pattern Analysis and Machine Intelligence. 37(9): 1930-1937.

[7] Ahmed S.S.; Hussai, S.M.A.; Salam M.S. 2013. A Novel Substitute for the Meter Readers in a Resource Constrained Electricity Utility.in Smart Grid, IEEE Transactions on. 4(3): 1615-1616, doi: 10.1109/TSG.2013.2264918.