ISSN: 2321-7782 (Online)
e-ISJN: A4372-3114
Impact Factor: 7.327

Volume 5, Issue 11, November 2017

International Journal of Advance Research in Computer Science and Management Studies

Research Article / Survey Paper / Case Study

Available online at: www.ijarcsms.com

Credit Card Digits Recognition System using Open CV and Template Matching

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Abstract: ***This paper proposes a credit card digits recognition system using Computer Vision. The concept is based on the OpenCV platform. In our system an input image is scanned, and OCR-A font credit card digits are scanned and recognized using template matching. The template matching method used in our work is Correlation Coefficient Matching Method. The pre-processing method used on input credit card image is Top-Hat morphological operation and Contour detection is used on reference image. Using Otsu's Thresholding the input image credit card digits are matched with the OCR-A font reference image and digits are recognized and displayed.***

Keywords: CCRS, Credit Card Digit Recognition, OCR-A, Template matching, Correlation Coefficient Matching Method.

I. INTRODUCTION

Today most of our transactions like bill payments, shopping, ticket bookings are done online. The basic process of doing online transaction starts with entering your credit card details, but it can be a cumbersome and slow process to input the details into the system manually. With the help of OpenCV and Python we have designed a system which will scan your card and put the details into the system for you to simply and fasten the process.

Optical Character Recognition or OCR, is a technology that enables you to convert diverse types of documents, such as scanned paper documents, PDF files or images captured by a digital camera into editable and searchable data. OCR-A font arose in the early days of computer optical character recognition when there was a need for a font that could be recognized not only by the computers of that day, but also by humans. OCR-A uses simple, thick strokes to form recognizable characters. The font is monospaced and of fixed-width. [1]

II. RELATED WORK

Lot of work is going on in the field of OCR recognition. Tesseract is an OCR engine with support for Unicode and the ability to recognize more than 100 languages out of the box. It can be trained to recognize other languages. In our project we have used Template matching.

III. TEMPLATE MATCHING

Template Matching is a high-level machine vision technique that identifies the parts on an image that match a predefined template.

It can be used in manufacturing as a part of quality control, a way to navigate a mobile robot, or to detect edges in images.

Template Matching techniques require two things one is a reference image of the object: The Template image and the Input image to be inspected and hence we locate the locations at which object is present in the input image with help of template image. [2]

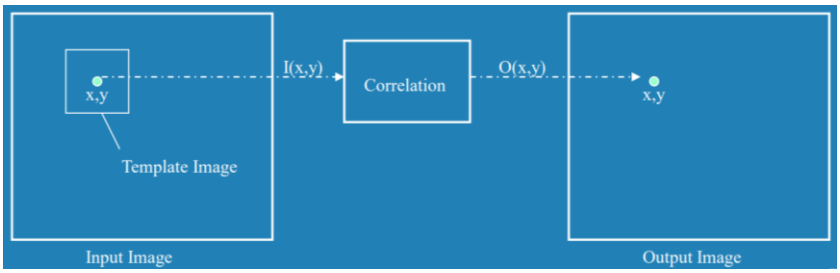

Fig1: Template matching process method

IV. CORRELATION COEFFICENT MATCHING METHOD

A numeric measure of image similarity is usually called image correlation. The numeric measure can be pixel values in two images: template and source.

The template matching method used in our project is Correlation Coefficient Matching Method (CV_TM_CCOEFF). This method matches a template relative to its mean against the image relative to its mean, so a perfect match will be 1 and a perfect mismatch will be -1; a value of 0 simply means that there is no correlation. [3]

$$R(x,y) = \sum_{x',y'} (T'(x',y').I'(x+x',y+y'))$$

where,

$$T'(x',y') = T(x',y') - \frac{1}{w.h}.\sum_{x'',y''} T(x'',y'')$$

$$I'(x+x',y+y') = I(x+x',y+y') - \frac{1}{w.h}.\sum_{x'',y''} I(x+x'',y+y'')$$

V. CONTOURS DETECTION

Contours are a curve joining the continuous points which have same intensity or colour. Object detection and recognition are two important applications of contour detection. Binary images give better accuracy and hence it is advised that you use canny edge detection or threshold.

cv2.findContours() function, works on three parameters 1. Source image, 2. Contour retrieval mode and 3. Contour approximation method. Every individual contour is a Numpy array of (x,y) coordinates of the boundary point of a shape. [4]

Contour Retrieval Mode: Retrieval mode retrieves the contours of a shape. In our project we have used Contour Retrieval External flag(cv2.RETR_EXTERNAL). It only returns outer boundaries and leaves behind the inner boundary.

Contour Approximation Mode: If you don't want to store all coordinates then it can be specified with the help of Contour Approximation mode. In our project we have used Chain Approx Simple Mode(cv2.CHAIN_APPROX_SIMPLE). It compresses contour and removes the dispensable points and hence saves memory.

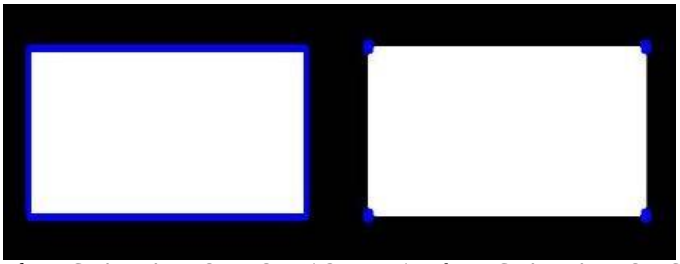

Fig 2: Comparison of: cv2.CHAIN_APPROX_NONE (734 points) with cv2.CHAIN_APPROX_SIMPLE (4 points).

VI. Top-Hat Morphological Operation

The pre-processing we have applied in our project is Top-Hat morphological operation. The top-hat filter is used to enhance bright objects of interest in a dark background. It is the difference between the input image and its opening by structuring element. In our project we have used Top-hat transform for background equalization.

Let $\boldsymbol{f}: \boldsymbol{E} \rightarrow \boldsymbol{R}$ be a grayscale be a grayscale image, mapping points from an Euclidean space or discrete grid E (such as R^2 or Z^2) into the real line. Let ***b(x)*** be a grayscale structuring element. [5]

Then, the white top-hat transform of f is given by:

$$\boldsymbol{T_w(f) = f - f \circ b}$$

Where o denotes the closing operation.

Fig 3: Top-Hat transform applied on Non-uniform lighting condition input image

VII. Otsu's Thresholding

Thresholding is the simplest segmentation method. Thresholding process convert a multilevel image into a binary image i.e. it selects a proper threshold T, to divide image pixels into different regions and split objects from background based on their level distribution. [6]

It is important in picture processing to select an adequate threshold of gray level for extracting objects from their background. Otsu is an automatic threshold selection region based segmentation method. Otsu method is a type of global

thresholding in which it depends only on gray value of the image. Otsu method was proposed by Scholar Otsu in 1979 which is widely used because it is simple and effective. [7]

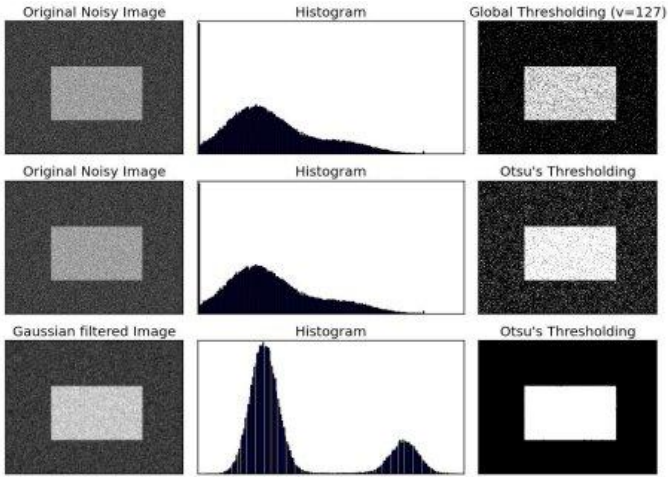

Fig 4: Otsu's Thresholding on a Noisy image

Otsu's algorithm tries to find a threshold value ***(t)*** which minimizes the weighted within-class variance given by the relation:

$$\sigma_w^2(t) = w_0(t)\sigma_0^2(t) + w_1(t)\sigma_1^2(t)$$

where w_0 and w_1 are the probabilities of the two classes separated by a threshold ***t,*** and σ_0^2 and σ_1^2 are variances of these two classes.

VIII. RESULTS

Fig5: OCR-A font reference image used for Template Matching

Fig 6: Input Credit Card Image to be scanned and Recognized

Fig 7: Converting input grayscale image for Top-Hat operation

Fig 8: Top-Hat operation on card for background equalization

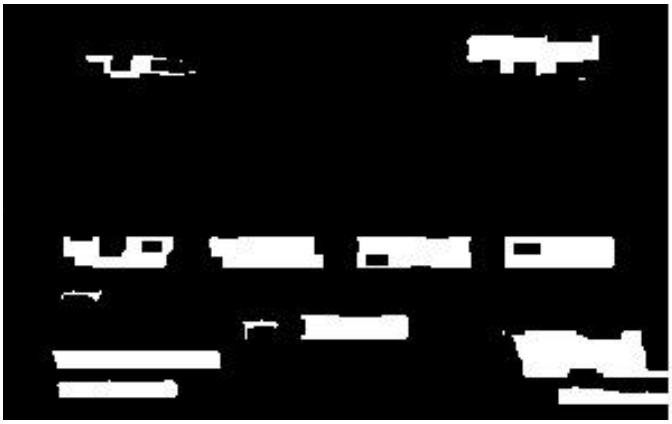
Fig 9: Otsu's thresholding applied for digits segmentation

Fig 10: Credit Card digits detected correctly.

IX. Conclusion

This proposed approach recognizes credit card digits of OCR-A font using template matching. The input card image is converted into greyscale image and Top-Hat morphological operation is applied for background equalization.

Otsu's Thresholding is used for segmenting the digits and template matching is done by using Correlation Coefficient matching method by matching it to OCR-A font reference image.

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