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Handwritten Character Recognition Using HOG, COM by OpenCV & Python

Rushikesh Laxmikant Kulkarni
Electronics & Telecommunications Department
Pune Institute of Computer Technology
Pune – India

Abstract: ***Most of the OCR techniques uses K Nearest Neighbors (KNN) algorithm of pattern recognition. Accuracy achieved by this algorithm is 90 percent. Since KNN model cannot be interpreted, also it has many disadvantages. This model can be computationally expensive when dataset is very large. The HCR in this model uses the HOG features for character recognition followed by centre of mass of image with SVM algorithm. HOG features are extracted by deskewing the image converted to centre of the image. Accuracy of the descriptor is improved power law compression & Square root of the input image. Linear SVM is used for training the dataset for recognition. In this HCR, we have used the HASY dataset which contains 168233 instances of 369 classes. Accuracy achieved by this HCR is 96.56%.***

Keywords: HOG, SVM, Database, Centre of Mass (COM) of Image, Computer Vision, Python.

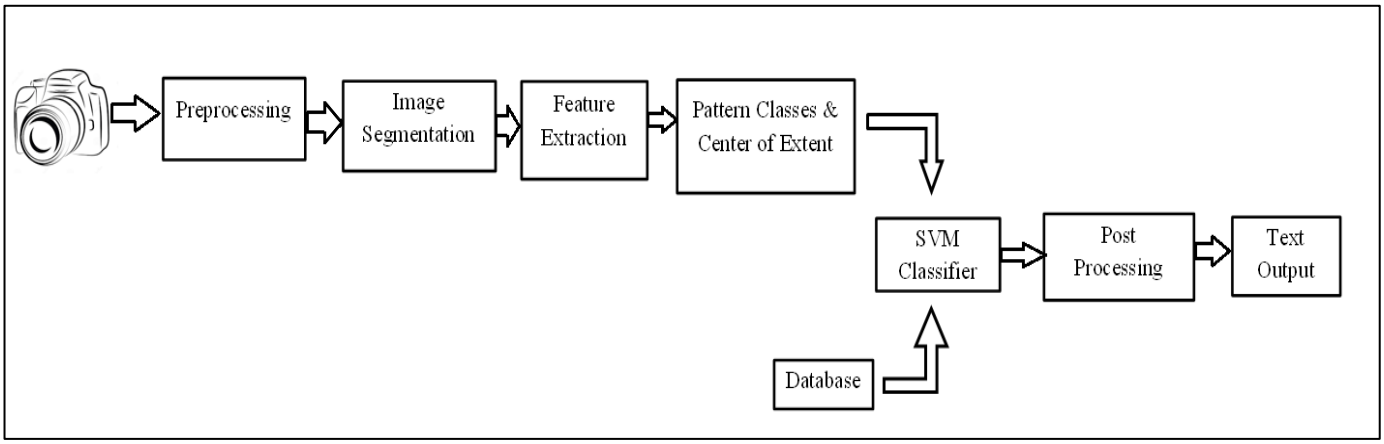
I. INTRODUCTION

Now days in every field the use of computers or digital media is extremely increased. Everything is transforming into digital media. In such situation, use of pen and paper based techniques for routine work is obligatory. For converting the paper based data into digital computer editable format the efficient technique is required. For this HCR is developed for the transformation of information from paper to digital media. We have used the Histogram of Oriented Gradients. Especially we have used Centre of Mass approach by calculating weighted mean of pixels. By using the weighted mean of pixels the feature extraction HOG. For determination of character, Handwritten Character Recognition (HCR) method has been used in converting handwritten text into computer editable format.

HCR is very useful and popular method in various applications. Accuracy of HCR can be dependent on text preprocessing, features used for classification, classification algorithms. Sometimes it is difficult to retrieve text from the image because of different size, style, orientation, complex background of image etc. It is like combination of eye and mind of human body. An eye can view the text from the images but actually the brain processes as well as interprets that extracted text read by eye. Experimental results using KNN and SVM classification techniques are presented in this paper. We use the Histogram Oriented Gradient approach calculating centre of mass of image using weighted pixels for classification. The classification algorithms used for text recognition is SVM (Support Vector Machine). HCR machines are commercially available. But the cost of the machine is too high. The cost of HCR or OCR is approximately 500$ per year.

Today a few thousand is the number of systems sold every week, and the cost of an omnifont OCR has dropped with a factor of ten every other year for the last 6 years. Different algorithms have been used for recognition of characters.

II. Proposed System



III. Preprocessing

The preprocessing includes the processes such as noise removal, edge detection for localizing the ROI. The first step is to load the query image off disk and convert it to gray scale.

Gaussian Blurring

It is smoothing type of blur. It is applied to image for noise removal. It makes the image smoother. The Noise is removed by the Gaussian noise filters.In one dimension the equation of Gaussian filtering is as:

$$G(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2}{2\sigma^2}}$$

The Canny Edge Detector is applied to find edges in the image.

$$G(x) = \begin{matrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{matrix} \qquad G(y) = \begin{matrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{matrix}$$

Sobel Mask for Vertical Gradient & Horizontal Gradient

Contours in edged image are found out. The contours are founded by left to right. Each contour represents the digit. Then each contour in image is classified.

IV. Image Segmentation

It includes the location of the region of interest (ROI). The ROI is identified by the segmentation techniques. It include the dividing the image into multiple small portions. It locates the region of interest. Region is divided into the small regions based in the textures, colors, background, intensity. Segmentation is done by the thresholding.

- THRESHOLDING

We have used the Otsu method for the thresholding of ROI.

A measure of region homogeneity is variance (i.e., regions with high homogeneity will have low variance).

Otsu's method selects the threshold by minimizing the within-class variance of the two groups of pixels separated by the thresholding operator. It does not depend on modeling the probability density functions, however, it assumes a bimodal distribution of gray-level values (i.e., if the image approximately fits this constraint, it will do a good job).

V. Future Extraction

The feature extraction is most important part of any recognition system. The feature extraction is done by thresholding, calculating the centre of extent, HOG descriptor; deskewing the image the tools used for the feature extraction are as below.

A. CENTER OF MASS OF IMAGE

After the location of ROI the mean of weighted mean of white pixels is calculated. Then mean is converted to integer values instead of float values. This is assigned to center of image. This is known as center of mass/extent of image. By using this extracted features are more superior, hence efficient recognition can be done.

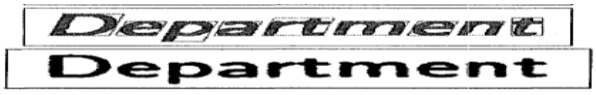
B. HOG

Histogram of Gradients descriptor used for pattern classification. Similar to edge orientation histograms and local invariant descriptors such as SIFT, HOG operates on the gradient magnitude of the image. Computing the gradient magnitude of an image is similar to edge detection.

HOG feature vector is computed for the pre-processed image by calling the describe method. The data matrix is updated with the HOG feature vector. However, unlike SIFT, which computes a histogram over the orientation of the edges in small, localized areas of the image, HOG computes these histograms on a dense grid of uniformly-spaced cells. Furthermore, these cells can also overlap and be contrast normalized to improve the accuracy of the descriptor. HOG has been used successfully in many areas of computer vision and machine learning, but especially noteworthy is the detection of people in images.

C. SKEW & DESKEWING OF IMAGE

Skew is computed before the feature extraction of scanned image. Skew is the tilt angle of image. It is computed based on the moments. During the feature extraction located image by the ROI should be straight. The segmented image if it is tilted then image deskewing is done to straighten image in the ROI. For deskewing the computer vision libraries are used.



VI. SVM CLASSIFIER

Feature extracted using the HOG descriptors, are the 9 bit integer values. These values are compared with values present in the dataset and the most matching values are determined by comparison. KNN are the most used algorithms for OCR technique. But the accuracy of SVM classifier depends on the feature extracted from the image. SVM decides the maximum separable hyper plane between the classification databases. The features extracted by the HOG can be used for comparing characters with the HASY database.

VII. HCR DATABASE

The database for character classification HASY is a publicly available, 1 free of charge dataset of single symbols similar to MNIST database. It contains 168 233 instances of 369 classes. HASY contains two challenges: A classification challenge with 10 pre-defined folds for 10-fold cross-validation and a verification challenge.

The HASYv2 dataset contains 168 233 black and white images of the size 32 px×32px. Each image is labeled with one of 369 labels. An example of 100 elements of the HASYv2 dataset is shown in Figure. The average amount of black pixels is 16%, but this is highly class-dependent ranging from 3:7% of ": : : " to 59:2% of "_" average black

HASY dataset is used for the pattern recognition. This dataset is publically available. It contains 168 233 instances of 369 classes.

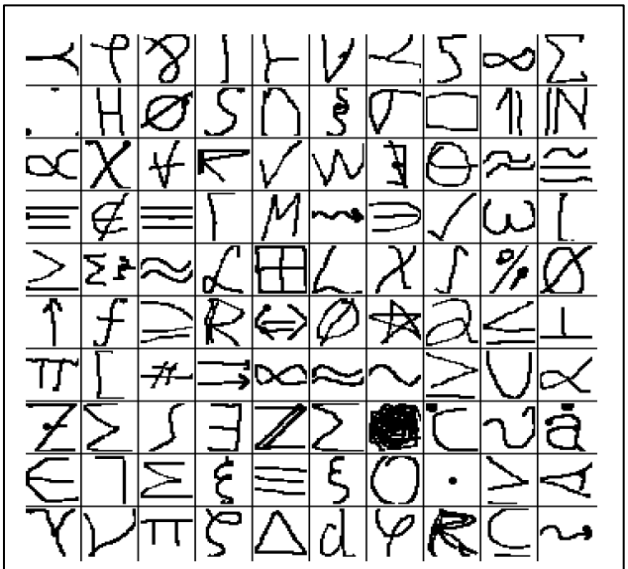


Figure 1: 100 recordings of the HASYv2 data set.

The image training database used for KNN is shown in the following figure

VIII. Text Output

The characters recognized from the SVM classifier are written onto a text file. Post processing includes the determination of the character and writing it to the text file.

TOOLS: OPENCV & PYTHON

It is open source computer vision. Open CV supports the machine learning approach. KNN and SVM algorithm are widely supported by the opencv. A machine learning library includes the Scikit-learn, Mahotas, joblib, Numpy, Scipy etc. These libraries are implemented with Python. Python is most easy and simple language. Programming in the python is simple and it is easier to develop the code with libraries. It is open source.

IX. Result

In the KNN method, most of the errors in the recognition process are due to improper segmentation process. Due to improper segmentation process the features extracted from the image are unambiguous. Features are incorrectly extracted from the image. So accuracy of HCR by using the KNN method is very less. So the Better segmentation method is used in the SVM based approach. By the SVM classifier accuracy can be achieved to 96.56%.

X. Conclusion

The effectiveness of the method that uses feature extraction using character geometry and gradient technique from scanned images containing handwritten characters is presented. The feature extraction methods have performed well in classification when fed to the HOG descriptors and preprocessing of image using edge detection and normalization are the ideal choice for degraded noisy images. The proposed methodology has produced good results for images containing handwritten text written in

different styles, different size and alignment with varying background. The method is advantageous as it uses nine features to classify character geometry and twelve features using gradient technique Accuracy of HCR.

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AUTHOR(S) PROFILE

Rushikesh L. Kulkarni, studying in the Bachelor of Engineering (B.E.) degree in Electronics & Telecommunications Engineering in Pune Institute of Computer Technology from Savitribai Phule Pune University in 2013-2017.