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Recognition of Numerals Using SVM and Blob Classifier

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ABSTRACT: The artificial intelligence consists of the NLP (Natural Language Processing) is a field of computer science and computational linguistics concerned with the interactions between computers and human(natural) languages. NLP is one of most intelligent processing. Pattern recognition contains Numerals recognition, which is one of the most important problem. Not much work has been done in Marathi script as compare to non-Indian scripts like English, Latin, Chinese, Hindi, Urdu, Tamil, etc. The existing work is done for recognition of either Marathi or English numerals. Here we propose a method for recognition of numerals using SVM and blob classifier. Here SVM and blob methods both are used independently in order to recognize text numerals images. In SVM features are extracted and in blob, circular shape and stems are extracted then by comparing test samples with dataset the number is recognized.

KEYWORDS: SVM; blob; stem; classifier; feature vector

I. INTRODUCTION

In the Maharashtra state, the Marathi language is used in high majority; and English is a global language which is used all over. Many times there are situations of Identifying the numerals like in Banks cheques, in government advertisement Marathi and English numbers executed in mixing form. At that time the propose system is used for recognize the numbers. High level language mostly used in Computers' World which is in the English language. In collection of numerals of Marathi and English numbers the classification and identification of the method will be performed by using blob and SVM classifiers [5]. In this operation the features are extracts from input data and it compares with the standard dataset and then the number is identified [12]. The Identification of numerals is more challenging due to the difficulty of character segmentation. Segmentation process is mostly used for separation purpose. The existing system's works are existed on classification and Identification of Marathi or English numbers. The proposed work is done on mixing numbers of Marathi and English numbers. The mixing form of numbers will be classified and then identified by using SVM classifier and blob. The current existed works are occurred on Chinese or only English or only Hindi languages or Tamil[11].

II. RELATED WORK

Vikas J. Dongre and Vijay H. Mankar proposed Devnagari Handwritten Numeral Recognition using Geometric Features and Statistical combination Classifier. This paper presented a Devnagari Numerical recognition method based on statistical discriminate functions. 17 geometric features based on pixel connectivity, lines, line directions, holes, image area, perimeter, eccentricity, solidity, orientation etc. are used for representing the numerals[1]. Kyoung Min Kim and Joong Jo Park and Young Gi Song and In Cheol Kim and Ching Y. Suen proposed Recognition of Handwritten Numerals Using a Combined Classifier with Hybrid Features. In this paper, they proposed a recognition system using hybrid features and a combined classifier. [3]. Dinesh Acharya U.and N. V. Subba Reddy, and Krishnamurthy Makkithaya proposed Multilevel Classifiers in Recognition of Handwritten Kannada Numerals. Five different types of features, namely, profile based 10-segment string, water reservoir; vertical and horizontal strokes, end points and average boundary length from the minimal bounding box were used in the recognition of numeral. [2]. Matteo Frigo and Steven G. Johnson proposed The Design and Implementation of FFTW3. FFTW was an implementation of the discrete Fourier transform (DFT) that adapts to the hardware in order to maximize performance new algorithm for real-data DFTs of prime size, a new way of implementing DFTs by means of machine-specific SIM instructions, and how a special-purpose compiler can derive optimized implementations of the discrete cosine

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and sine transforms automatically from a DFT algorithm[10]. V Vijaya Kumar and A Srikrishna and B Raveendra Babu and M Radhika Mani proposed Classification and recognition of handwritten digits by using mathematical morphology. The blobs were identified based on a new concept called morphological region filling methods. The digits with blobs and stems were identified by a new concept called connected component. The average success rates of recognition of all digits were above 90 percent.[5].

III. PROPOSED ALGORITHM

The proposed system consists of method which is used for classification and identification of the numbers. We consider the Marathi and English numbers in mixing form and according to SVM and blob classifier, the system will classified first numbers as Marathi and English separated and then it will be identified; the number is of the form Marathi or English numbers.

A. *Architectural System:*

The below fig.1 describes the architectural for classification and identification of number. At first the input is in number form image. It is either single image or full of page. Then segmentation process is performed on that image. By using segmentation processes the full page is divided into separate form. Then by using feature extraction method, the features will be extracted and then it will compared with features of standard dataset; and then the number will classified [5]. The classification of a number will be categorized as SVM or BLOB[2]. Then the number will go for identification process. In identification process, the number is either Marathi or English number. Then from the Marathi and English numbers data the number will identified. The identification process is done using again feature extraction method or blob.

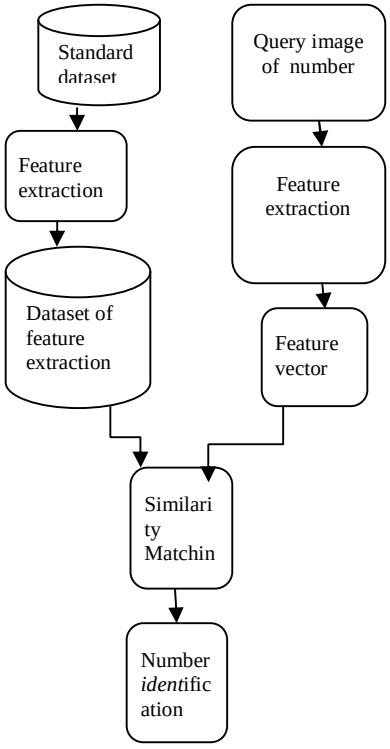

Fig. 1 proposed architecture

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B.*SVM*

Feature Extraction

The traditional aim for feature extractors is to characterize the object by measurements whose values are very similar to the anther objects in the same category, but most different for the objects in different categories. Here after the pre-processing step, different features and their combinations were obtained, and we selected a set of features. First, the matrix form of each normalized digit is considered from four different views (top, right, bottom, and left). Directions I selected for each view is also shown.
For obtaining each and every view, the number of white pixel is counts until I reach to the boundary of the digit, and represents as a function i.e. curve which shows the changes of the boundary that seen from that view in the directions shown.
These functions (curves) encodes the structural features of the outer boundary of the digit, right view shows linear changes in the boundary which seen from the above view. The main idea is to transfer the features of each digit in to one-dimensional signals (functions of single variable as an example of distance or time), and to process these signals for gaining another features and further recognition. For each signal (curve), after some smoothing by median filtering (with window size 3 pixel), single-dimensional derivative is computed, smoothed, and sampled. Here the sampling rate of ~ is used. According to my normalization method, each side of the digit has 64 pixels, hence 64 values are obtains from the sampling of the derivatives, and all they are used as features for the classification step. These features are easy to interpret, compute and they have good information about the structure of the digit.
Features extraction method uses in handwritten digit recognition experiment. At First, the primary features are shown, namely gradient features and chain code features. Scaling performs separately by feature extraction method, meaning if I use gradient and concavity feature vector, first a maximum value f-max of gradient feature vector is found. Gradient feature vector divides by f -max1, Concavity feature vector divides by its maximum value f-max2. Feature vectors are then merged together. Support Vector Machines (SVMs) are new learning machines; and they are introduced in 1995 by Vapnik et aI. In the past few years they generated a great deal of interest in the community of machine learning because of their excellent generalization in few learning problems , such as in handwritten numbers.

Gradient
The Sobel operator mask is use calculating the gradient feature components(figure 2) on character image. Source images converts into pseudo gray images [1] . Gradient strength and direction is computed from gradient components in every character image pixel.

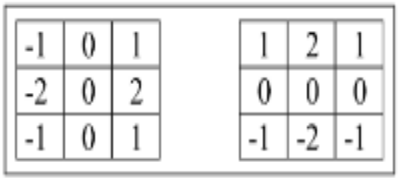

Fig 2: Sobel Masks

Gradient vectors are plots on, four or eight standard directions. Every vector decomposes into two components on two nearest main directions. Figure3 shows eight standard directions and gradient vector decomposition.Then Character image divides into zones by a grid view, usually 4×4image or 5×5image. The total sum of the component vectors calculates for each standard direction in a zone. Standard direction intensities for all zones make a feature vector [9] .

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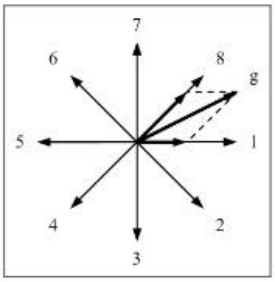

Fig 3: Gradient standard directions and vector decomposition

The classification and identification of digit in my experiments performs on binary images, first an image converts into a pseudo-gray image. A 3 × 3 Gaussian low pass filter with σ = 0.5 is use to blur binary image. Gradient features are then extracted using eight standard directions and a 5 × 5 grid image. This makes a feature vector of size
5 × 5 × 8 = 200.
A transformation on the feature vector,
y=x0:5,
Known as Box-Cox transform [12], is carried out to make its distribution closer to the normal distribution.

C.*MULTI SVM Classifier*

I use 10 classes of digits; therefore I need 10 SVM classifiers or 10 hyper planes to separate the digits.e.g. one classifier for digit zero (so called SVMO) separates all the samples of zero from the other digits, and so on. This method of designing multiple SVM classifiers calles one against the others .

$$f(X) = \psi(\langle W, \phi(X)\rangle - b)$$
$$= \psi(\sum_{i=1}^{N} y_i \alpha_i \langle \phi(X_i), \phi(X)\rangle - b)$$
$$= \psi(\sum_{i=1}^{N} y_i \alpha_i K(X_i, X) - b).$$

where

$$\psi(u) = \begin{cases} 1 & if \quad u > 0 \\ -1 & otherwise \end{cases}$$

and

$$W = \sum_{i=1}^{N} y_i \alpha_i \phi(X_i)$$

D. *Blob Classifier*

Handwritten numerals recognition divides into two types Offline Handwritten Character Recognition and Online Character Recognition. Blob: Filling a hole in a number image. Stems : Other structure present in a number.

E. Decision tree for Blob classifier for English numerals:

There are 10 digits in English language and each digit is differentiated from the other digits by some characteristic feature(s). Identification of the 10 numbers appears simple at first. However, the problems that arise due to similarities between different numbers and discrepancies between the same numbers must be tackled by analysing the similar and not similar features and then decisions should be made accordingly. The present paper divided the ten digits of English language into two groups [5]. Group 1 consists of digits with blobs with/with out stems. This group consists of digits 0, 4, 6, 8, and 9. Group 2 consists of digits with only sticks. digits 1, 2, 3, 4, 5, and 7. The group 1 is again

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divided into two subgroups i.e. the digits with only two blobs means hollow circular shape 8 and another with a single blob with or without stems 0, 4, 6 and 9. The blobs are identified by region filling method. For this purpose, blobs are initially filled by using morphological region filling method as described in below.

$$X_k = (X_{k-1} \oplus B) \cap A^c \qquad \text{eq(1)}$$

Let A, denote a set containing a subset whose elements are 8-connected boundary points of a region. Beginning with a point p inside the boundary, the objective was to fill the entire
Region with 1s. Assign a value 1 to p to begin. The region is filled with 1s using the equation (2).
k = 1, 2, 3 . . . ., where $Xo = p$ and B is the 3 × 3 symmetric structuring element.
The algorithm terminates at the below step k if

$$Xk = Xk-1$$

The set union of *Xk* and A contains the filled set and its boundary. Once the hollow circles are filled, the original image is subtracts from the filled image and the number of objects present determines by a connected component(3).
Let Y represent a connected component contains in a set A, and assuming that a point p of Y is known. Then the following iterative expression yields all the elements of Y :

$$X_k = (X_{k-1} \oplus B) \cap A \qquad \text{eq(2)}$$

k = 1, 2, 3 . . . , where $Xo = p$ and B is the 3 × 3 structuring element with all 1s. If

$$Xk = Xk-1$$

the algorithm has converged and let

$$Y = Xk$$

By equation (3.) a connected component blob is identified and later it is filled by a Region filling algorithm with background intensity.

Fig4:. Blobs and stems of subgroup 2-b.

IV. PSEUDO CODE

Step 1: Input the query image to the system.
Step 2: Segmentation is done..
Step 3: Generate feature vector.
Step 4: Dataset contains feature vector.
Step 5: Match the feature vector of query image and dataset feature vector.
Step 6: Classify the number.
Step 7: Identify the number.
Step 8: End.

V. SIMULATION RESULTS

In the Result Analysis I have tested on different number of datasets like 10, 30, 50, 70,100,120,150….

The table shows the Average of images comparison for SVM and Blob. The table below shows result of SVM and blob classifiers on numerals. In that, there are groups and their average result values. e.g. In first group, there are 10 images and the average value of that 10 images is 0.636. same for group 30 the average value is 0.535, for group 50 the average value is 0.541, for group 70, the average value is 0.515, for group 100 the average value is 0.504, for group 120 images the average value is 0.49 and for group 150, the average value is same as group 120 i.e. 0.49.

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Table1: Average Result of SVM and Blob

Group of Images	10	30	50	70	100	120	150
SVM Avg Result	**0.636**	**0.535**	**0.541**	**0.515**	**0.504**	**0.49**	**0.49**
Blob Avg Result	**0.513**	**0.46**	**0.436**	**0.395**	**0.41**	**0.4**	**0.395**

Same for Blob classifier, the first group contains 10 images and the average value of that 10 images is 0.513.Same for all the group for group 30 the average value is 0.46, for group 50 the average value is 0.436, for group 70, the average value is 0.395, for group 100 the average value is 0.41, for group 120 the average value is 0.4 and for 150 group the average value is 0.395. The table shows the result of SVM classifier is more better than Blob classifier.

The result shows the SVM classifier is more better than Blob classifier.
The result graph of comparison of SVM and Blob is given as below:

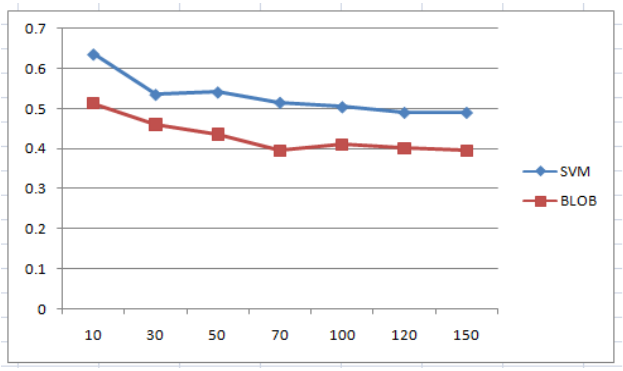

Fig: comparison graph of SVM and Blob

The above figure shows the frequency graph of SVM and Blob, as the groups of images versus their average result.

The above graph describes that the frequency of result of SVM classifier is grater than the frequency of result of Blob classifier.

VI. Conclusion and Future Work

Recognition of Marathi and English numerals by using SVM classifier gives more better result than the Blob Classifier. The existing methods used only single language numerals. The proposed method use the mixing numerals and get better result.

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BIOGRAPHY

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