International e-Conference on New Horizons And Multidisciplinary Applications In Science And Technology
In Association withInternational Journal of Scientific Research in Science and Technology
Volume 9 | Issue 6 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)

Recognition of Typed Devnagari Characters Based on Linear Binary Pattern (LBP)

A.A. Tayade[1], Dr. R. J. Ramteke[2]

[1]Department of Computer Science, G.S. Science, Arts and Commerce College, Khamgaon, Maharashtra, India
[2]Department of Computer Science, K.B.C. North Maharashtra University, Jalgaon, Maharashtra, India

ABSTRACT

The crucial issue of the character recognition is the identification of similar characters. In this paper, a character recognition technique is proposed for identification of similar characters by increasing commonly used feature of selected image with gradient features from potentially discriminative image regions. The crucial regions of identical characters sets are automatically detected here. Experimental results on Typed Devnagari Character using LBP demonstrate the capability of the proposed method in discriminating visually similar characters. The method also out performs existing character recognition methods by considerable margins. It has a great potential for character recognition of other alphabets.

I. INTRODUCTION

Typed Devnagari Character recognition is the task of transforming a language represented in its spatial form of graphical marks into its symbolic representation. There are two kinds of Typed Devnagari Character input, on-line and off-line [1]. On-line Typed Devnagari Character input maintains the time series of writing points, order of strokes and additional information about pen tip (velocity, acceleration). For example, Typed Devnagari Character input methods on cell phones and tablets receive on-line. The Typed Devnagari Character input when users touch the screen. Preprocessing of on-line recognition includes noise removal, stroke and character segmentation. Off-line Typed Devnagari Character input only preserves images of the completed onboard writing area. For example, banks recognize Typed Devnagari Character amounts on checks. Preprocessing of off-line recognition includes setting thresholds to extract writing points, removal of noise, segmentation of writing lines, and finally segmentation of characters and words.

Character acknowledgment framework is significant part of the of example acknowledgment. Character acknowledgment is a stepwise cycle of preprocessing, highlight extraction, and characterization. Character acknowledgment precision depends of the adequacy of each progression[5]. In character acknowledgment, precision diminished because of certain limitations like mathematical misalignment through character style varieties, clamor, and undesirable data in picture, size of the picture and in particular the fluctuating picture foundation. Expanding the exactness and improving the FRT model, need to choose of the legitimate element extraction system and appropriate classifiers.

The main significant advance in any character acknowledgment framework is pre-handling followed by division and highlight extraction. Pre-handling includes with the means that are needed to shape the info picture into a structure reasonable for division. In division step, the information picture is divided into singular characters and afterward, each character is resized into m x n pixels towards preparing the organization[6].
In proposed system we present the character acknowledgment calculation incorporates LBP and Character recognition using LPB using region crop method. The system will talk about ability of picture commotion, brightening, impact of scaling and revolution invariant[2].

There are six major stages in the Character Recognition those are

- Image Acquisition
- Pre-Processing
- Image Segmentation
- Feature Extraction
- Image classification
- Post processing

- Image Acquisition :- Take a picture using digital camera of the document or scan the document and save it in a computer with proper image extension.
- Pre-Processing :- In this process the image undergoes the input to the Pre-Processing stage is the stored image in the computer.
- Image Segmentation :- Image segmentation is nothing but dividing the whole image into small sub-images based on the uniqueness
- Feature Extraction :- Feature extraction is the main part of the Character identification process, this is the process where each character will be represented as a feature vector ,the unique feature of this step, the focus of this stage is to extract a set of features of the segmented image to improve character recognition rate
- Image Classification :- Once the features are extracted in feature vectors the will be given to image classifiers such as K-Nearest Neighborhood (KNN), Bayes Classifier, neural networks, Hidden Markov Model (HMM) and so on. These classifiers are the decision makers of the algorithms.
- Post-Processing :- In this stage based on the decision from classification stage the recognized fonts will be printed in editable form on digital screen.

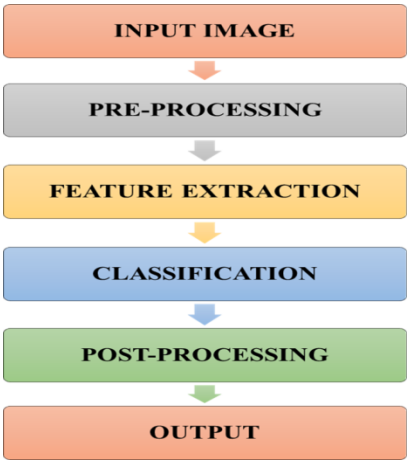

Figure: Block diagram of the proposed character recognition system

II. LOCAL BINARY PATTERNS (LBP)

To group images, the element vector may now be produced using the Support vector machine, outrageous learning machines, or any other AI computation. Such classifiers can be used for character recognition or texture analysis.

The claimed uniform example is a useful addition to the first administrator since it can be used to shorten the component vector and perform a simple pivot invariant descriptor. This idea is driven by the fact that some twofold examples occur more frequently in surface images than others. If the paired example has two 0-1 or 1-0 modifications, the neighboring parallel example is called uniform.

This idea is driven by the fact that some twofold examples occur more frequently in surface images than others. If the paired example has two 0-1 or 1-0 modifications, the neighboring parallel example is called uniform. It has demonstrated to be profoundly discriminative and its central issues of revenue, specifically its invariance to monotonic dark level changes and computational capability, make it reasonable for requesting picture investigation errands. The fundamental nearby parallel example administrator, presented by Ojala et. al. [13] was dependent with the understanding that surface has locally two reciprocal angles, an example and its solidarity. LBP highlight extraction comprises of two chief advances: the LBP change, and the pooling of LBP into histogram portrayal of a picture. As clarified in [13] dark scale invariance is accomplished due to the distinction of the power of the adjoining pixel to that of the focal pixel. It additionally embodies the nearby math at every pixel by encoding binarized contrasts with pixels of its neighborhood area:

$$LBP\left(P,\ R,\ t\right)=\sum_{p=0}^{p-1} S_t\left(g_p-g_c\right)2^p$$

Where gc is the focal pixel being encoded, gp are P evenly and consistently examined focuses on the fringe of the roundabout space of sweep R around gc , and st is a binarization work boundary by t. The examining of gp is performed with bilinear insertion. t, which in the standard definition is viewed as nothing, is a boundary that decides when neighborhood contrasts are viewed as large enough for thought.

In our LBP the first form of the nearby double example administrator works in a $3^{x}3$ pixel square of a picture. The pixels in this square are edged by the value of the center pixel, duplicated by forces of two, and then summed to obtain a value for the middle pixel. Because the local is made up of 8 pixels, a total of 28 = 256 unique marks may be obtained by depending on the general dark estimations of the center and the pixels around it[9].

For our situation, we utilize the uniform LBP as referenced in [8] Which are the basic properties of LBP, for the improvement of a summed up dark scale invariant administrator. The term 'uniform' if there should be an occurrence of nearby twofold example alludes to the consistency of the appearance for example the roundabout introduction of the example has a predetermined number of advances or discontinuities. The examples which are considered as uniform give a lion's share more than 90%, of the $3^{x}3$ surface examples in the verifiable archives. The most as often as possible noticed 'uniform' designs compare to central miniature highlights like corners, spot and edges. These are likewise considered as highlight locators for setting off the best example coordinating. For our situation, where P = 8, LBP8; R can have 256 distinct qualities.

The LBP highlight vector, in its easier structure, is made in the accompanying way:

- Analyzed window is divided into cell.
- For each pixel in a cell, compare it to each of its eight neighbors (to its left side top, left- center, left-base, right-top, and so on) Follow the pixels around in a circle, either clockwise or counter-clockwise.

- Declare "0" where the value of the middle pixel is greater than the value of the neighbor. Another topic, say "1" This results in an 8-digit double number (which is generally changed over to decimal for comfort).
- Generate the histogram of the occurrence of each "number" over the phone (i.e., every blend of which pixels are more modest and which are more prominent than the middle). This histogram may be thought of as a 256-dimensional element vector.
- Standardize the histogram if desired.
- All things considered, concatenate (standardized) histograms. This returns a component vector for the whole window.

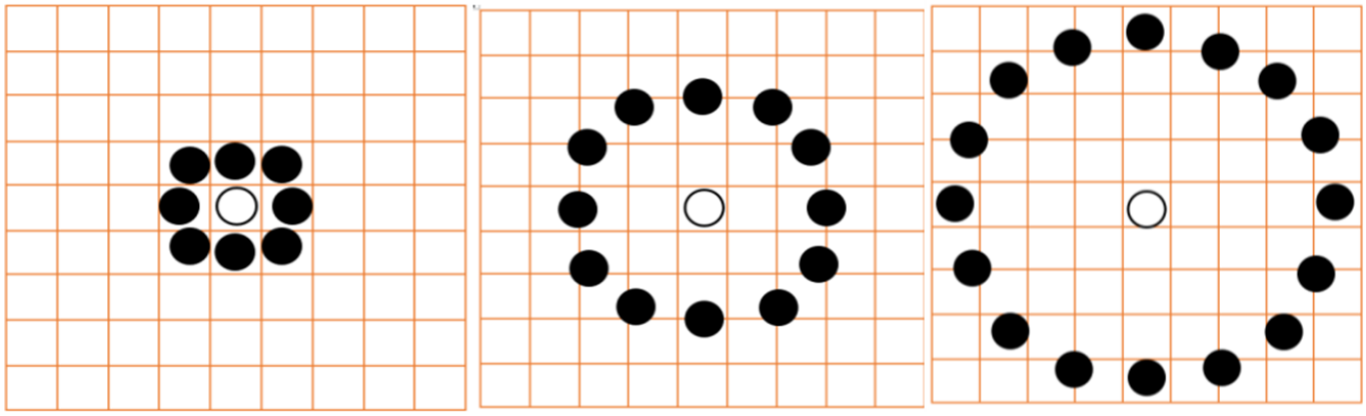

Figure : Three neighborhood examples used to define a texture and calculate a Local Binary Pattern (LBP)

- Read in a sample image and convert it to grayscale.
- Extract unnormalized LBP features so that you can apply a custom normalization.
- Reshape the LBP features into a number of neighbors -by- number of cells array to access histograms for each individual cell.
- Normalize each LBP cell histogram using L1 norm.
- Reshape the LBP features vector back to 1-by- N feature vector.

2.1 Character recognition based on LBP

The best advantage of Local Binary Pattern is gray scale and rotational invariant texture operator illumination variant, because if the light changes on the face image, the pixel values will change but the relative difference between pixels will be the same[9].

Algorithm

Start

1. Input Training and Testing Character
2. Image preprocessing (conversion of grayscale image, image resizing)
3. Segmentation using Bounding Box properties
4. Applying LBP operator on image
5. Feature extraction from LBP image using dividing image by beans
6. Combining features generate single feature vector.
7. Classify using KNN, LDA, SVM and ESD.
8. Recognise the accuracy

Stop

Algorithm : Character Recognition based on LBP

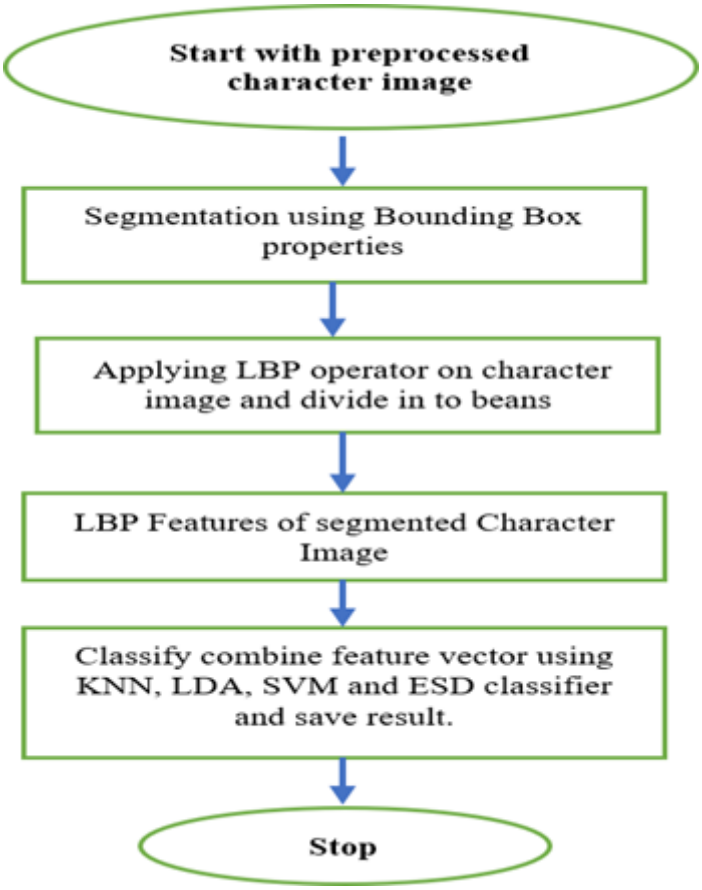

Figure : Character Recognition using LBP

III. FEATURE EXTRACTION USING LBP

Databases are divided into two groups based on their appearance: numerical databases and alphabetical databases. Alphabets are made up of both consonants and vowels. In the Marathi language, there are 12 vowels and 36 consonants. There are also a total of ten numerical values. Starting with 0 and working our way up to 9.
It is now recognised in the field of character recognition that a single attribute and a single classification algorithm cannot necessarily produce a very low error rate. As a result, it is hypothesized that combining features will result in a higher recognition rate. As a result, various fonts of different font sizes are used in this thesis also various classifiers SVM and classifier KNN are used.
Here are eight types of different fonts are used namely followed as, Aparajita, Arial, Kokila, Mangal, Nirmala, Nirmal semi light, Sanskrit, Utsaah. Different sizes are studied starting from size 12 and increases it by the size of two till 36 size with each font.
Words expressed in greater font size are thought to be more memorable and have better learning judgments. One probable explanation for this phenomenon is that individuals believe font size affects memory. It is unknown, however, why individuals think this. Another hypothesis is that font size reflects importance, with larger letters indicating more significant details. More essential information is perceived to be more memorable and, as a result, is remembered better.
As previously said, we used two kinds of databases in this case: alphabetical databases and numerical databases. Numeric databases are generated by using numbers ranging from 0 to 9. As for the Alphabetical database, it's a

mix of consonants and vowels. According to the appearance of letters they are again classified into three types as No Bar Character, End Bar Character and Middle Bar Character.

IV. EXPERIMENTAL SETUP : LBP (LOCAL BINARY PATTERN)

The LBP for feature extraction it is a conceptually simple yet efficient technique for gray scale and rotation invariant texture classification, as well as nonparametric discriminating of sample and prototype distributions. To performing the result, take 59 features for classification and various (KNN, SVM AND ITS VERIANTS) classifier use to classify the data. We show the results in four category i.e. numeric dataset, middle bar characters, and end bar characters and no bar characters. First upon us display data set wise results then show the comparative analysis of various dataset results analysis.

4.1 Numeric Database

In numeric data set the take 0 to 9 number having varying the font size and style. Total number of images in database is 500. Each class contains total 50 images with 10 different font styles and 5 different font Size. In proposed technique we apply the LBP on each image and extract 59 features per image i.e. total 29500 features and make the class of each number having predictor label. Classify that data set using the classifier. Comparative analysis shown in following Table.

Recognition	Recognition Accuracy (%)	Classifiers
10-Fold	88.60	ESK
Holdout 20-80	92.00	ESK
Holdout 40-60	84.50	ESK
Holdout 50-50	80.40	Quadratic SVM

Table : Result for numerical database using LBP

4.2 Alphabetical Database

Alphabetical Database is combination of consonants and vowels. According to the appearance of letters they are again classified into three types as No Bar Character, End Bar Character and Middle Bar Character.

4.2.1. No Bar Character

No Bar means letters are written without any bar that is no vertical line. In No bar character data set the take the various character having no bar with the different font size and style. In such dataset total 9 characters appear. Total number of images in database is 315. Each class contains total 35 images with 7 different fonts style and 5 different font Size. In proposed technique we apply the LBP on each image and extract 59 features per image i.e. total 18585 features and make the class of each number having predictor label with character name. Classify that data set using the classifier and result shown below.

Recognition data set model	Recognition Accuracy	Classifiers
10-Fold	80.30	ESK
Holdout 20%	88.90	Fine KNN
Holdout 40%	74.50	ESK
Holdout 50%	75.40	Cubic SVM

Table : No bar character results by using LBP

4.2.2. Middle Bar Character

Middle Bar Character can be defined as the letter which having Bar or vertical line in middle. In middle bar character data set the take the various character having Middle bar with the different font size and style. In such dataset total 2 characters appear. Total number of images in database is 70. Each class contains total 35 images with 7 different fonts style and 5 different font Size. In proposed technique we apply the LBP on each image and extract 59 features per image i.e. total 2450 features and make the class of each number having predictor label with character name. Classify that data set using the classifier and result shown below:

Recognition	Recognition Accuracy (%)	Classifiers
10-Fold	95.70	ESK
Holdout 20-80	100.00	ESK
Holdout 40-60	96.40	Weighted KNN
Holdout 50-50	97.10	ESK

Table : Middle bar character results by using LBP

4.2.3. End Bar Character

End Bar Character can be defined as the letter which having Bar or vertical line in end. In end bar character data set the take the various character having end bar with the different font size and style. In such dataset total 18 characters appear. Total number of images in database is 630. Each class contains total 35 images with 7 different font's style and 5 different fonts Size. In proposed technique we apply the LBP on each image and extract 59 features per image i.e. total 37,170 features and make the class of each number having predictor label with character name. The recognition accuracy on 10-fold cross validation technique is 74.90%, as we see in following Table.

Recognition	Recognition Accuracy (%)	Classifiers
10-Fold	74.90	ESK
Holdout 20-80	72.20	Fine KNN
Holdout 40-60	69.80	Fine KNN
Holdout 50-50	66.30	Cubic SVM

Table : End bar character results by using LBP

V. COMPARATIVE ANALYSIS OF VARIOUS METHOD

As per the testing of various methods used for the character recognition, the following shows various methods are used to recognition of character. In this section, we display the comparative table of all method to find out the efficient method for character recognition. In this LBP, summation method and LBP by cropping the important segment in character. In such table we calculate the average of 10-fold cross validation, 80% training 20 % random testing, 60% training 40 % random testing and50% training 50% random testing operations perform to calculate the highest effective method for character recognition.

Character recognition using LPB using region crop method

Character recognition using LPB using region crop method	Data validation Technique	Average Recognition Accuracy	Average Accuracy (%)

	10-Fold	(77.9+87.9+100+94.80)/4	90.15
	50% Holdout	(76.8+70.7+100+87.6)/4	83.77
Character recognition using Colom sum features vectors	10-Fold	(82.50+91.70+100+93.80)/4	92
	50% Holdout	(78.40+91.70+100+89.20)/4	89.82
LBP	10-Fold	(88.60+80.30+95.70+74.90)/4	84.87
	50% Holdout	(80.40+75.40+97.10+66.30)/4	79.8

VI. CONCLUSION

In this paper we listed the most popular techniques or algorithms that are already used in optical character recognition field under the branch of Image processing and pattern recognition. There are plenty of feature extraction methods using standard transformations, still there is lot more scope in extracting the good quality features from the binary image segments, and also its observed that noise filtering at the preprocessing section improves the quality of algorithm. Here the Typed Devnagari Character Recognition is best represented with the help of LBP character recognition technique.

VII.REFERENCES

[1] . Salunkhe, P., Bhaskaran, S., Amudha, J and Gupta, D. (2017). Recognition of multilingual text from signage boards, Sixth International Conference on Advances in Computing Communications and Informatics (ICACCI), pp. 977-982

[2] . Sinha, R. and Bansal, V. (1995). On Devanagari document processing, Systems Man and Cybernetics 1995. IEEE International Conference on Intelligent Systems for the 21st Century, vol. 2, pp. 1621-1626

[3] . Bansal V. and Sinha, R. (2000). Integrating knowledge sources in Devanagari text recognition system, IEEE Transactions on Systems Man and Cybernetics Part A: Systems and Humans, vol. 30, no. 4, pp. 500-505 4. Ashwin T.V. and Sastry, P.S. (2002). A font and size-independent OCR system for printed Kannada documents using support vector machines, Sadhana-academy Proceedings in Engineering Sciences, vol. 27, pp. 35-58

[4] . Neeba, N., Namboodiri, A., Jawahar C. and Narayanan, P. (2010). Recognition of Malayalam Documents, London, pp. 125- 146 6.

[5] . Bansal V. and Sinha, R.M.K. (2000). Integrating knowledge sources in Devanagari text recognition system, vol. 30, pp. 500-505

[6] . Rahman F.R. (2001). A Multi expert Framework for Character Recognition: A Novel Application of Clifford Networks, IEEE, vol. 12.

[7] . Toru Wakahara A.T. (2001). Affine Invariant Recognition of Gray-Scale Characters Using Global Affine Transformation Correlation, IEEE, vol. 23.

[8] . T. Hassan and H. A. Khan, "Handwritten Bangla Numeral Recognition using Local Binary Pattern," In 2015 international conference on electrical engineering and information communication technology (ICEEICT), pp. 1-4, 2015.

[9] . C. Saha, R. H. Faisal and M. M. Rahman, "Bangla Handwritten Character Recognition Using Local Binary Pattern And Its Variants," 2018 2nd Int. Conf. on Innovations in Science, Engineering and Technology (ICISET), 2018.

[10] . D. Doermann (2004). Machine Printed Text and Handwriting Identification in Noisy Document Images, IEEE, vol. 28.

[11] . Roy P.P. (2004). Multi oriented and Curved Text Lines Extraction From Indian Documents, IEEE, vol. 34.

[12] . Hagita N. (1998). Text-Line Extraction and Character Recognition of Document Headlines With Graphical Designs Using Complementary Similarity Measure, IEEE, vol. 20.

[13] . Ojala, P. Matti and M. Topi, "Gray scale and rotation invariant texture classification with local binary patterns," European Conference on Computer Vision, Berlin, Heidelberg,, 2000.

[14] . V. Bansal and R. M. K. Sinha, "On how to describe shapes of Devanagari characters and use them for recognition," in Proc. 5th Int. Conf. Doc. Anal. Recognit., Bangalore, p. 410–413, 1999.