

RECOGNITION OF PRINTED DEVNAGARI CHARACTERS USING A SET OF OPTIMALLY DESIGNED MOMENT FEATURES WITH COMBINATION OF DCT, HAHN AND TCHEBICHEF

A.A. Tayade¹ and R.J. Ramteke²

¹G.S. Science, Arts and Commerce College Khamgaon, MS, India

²Shool of Computer Science, K.B.C. North Maharashtra University, Jalgaon, MS, India

¹arvindtayade40@gmail.com, ²rakeshramteke@yahoo.co.in

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 Lanna Dhamma demonstrate the capability of the proposed method in discriminating visually similar characters. The method also outperforms existing character recognition methods by considerable margins. It has a great potential for character recognition of other alphabets.

Keywords: Devnagari, DCT, Hanh, Tchebichef, Image Acquisition, Segmentation

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 [18]. 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 h 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. 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.

In proposed system we present the character acknowledgment calculation incorporates LBP, directional component, Combination of (DCT+Hann+Tchebichef), summation method. The system will talk about here have ability of picture commotion, brightening, impact of scaling and revolution invariant.

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 $m \times n$ pixels towards preparing the organization. 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 following operations as shown in the block diagram, 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 Neighbourhood (K-NN),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.

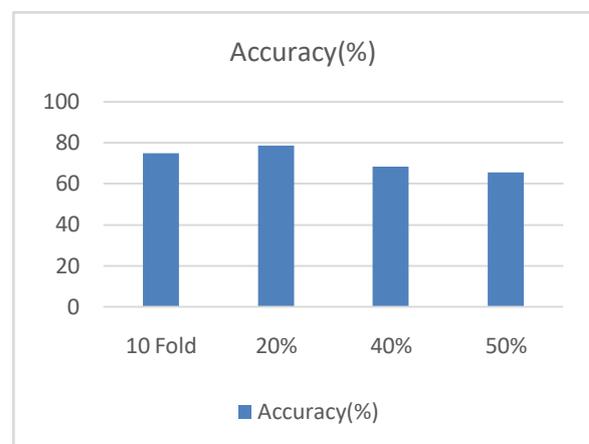
Experimental setup for Lanna dhamma

Lanna Dhamma alphabet was used mainly for religious communication in the ancient Lanna Kingdom of Thailand. The old manuscripts using this alphabet are gradually decayed. It is desirable to preserve these valuable manuscripts in machine-encoded text files. Existing works used optical character recognition (OCR) methods based on wavelet transform for recognition of handwritten Lanna Dhamma characters. This method contains Tchebichef, Hahn, DCT transform we are use these three combinations for features extraction use by proposed technique. Charterer dived In to three sections mid bar, no bar and end bar result shown in below.

End Bar Character Lanna Dhamma

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 fonts style and 5 different font Size. In proposed technique we apply the Lanna Dhamma characters recognition the combination of three technique on each image and extract 150 features per image i.e. total **94500** 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.

Data Validation	Accuracy(%)	Classifier
10 Fold	74.90	Ensemble Subspace KNN
20%	78.60	Ensemble Subspace KNN
40%	68.30	Ensemble Subspace KNN
50%	65.40	Ensemble Subspace KNN

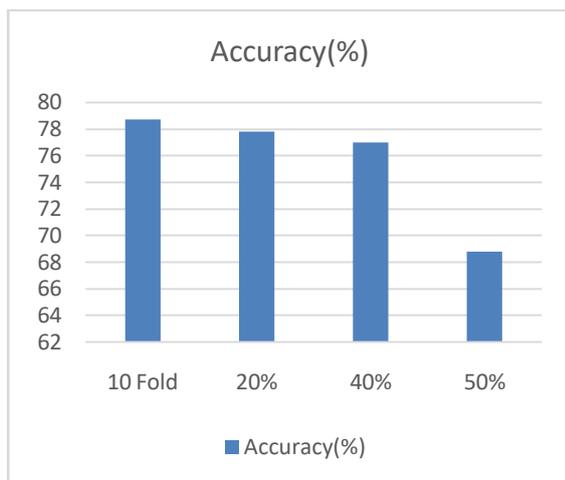


No Bar Character lanna dhamma

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 Lanna Dhamma characters recognition the combination of three technique on each image and extract 150 features per image i.e. total **47250** 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.

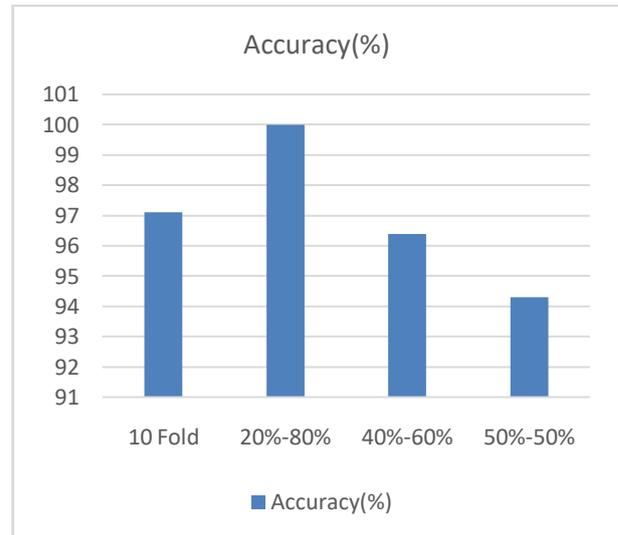
Data Validation (method)	Accuracy(%)	Classifier
10 Fold	78.70	Ensemble Subspace KNN
20%	77.80	Ensemble Subspace KNN
40%	77.00	Ensemble Subspace KNN
50%	68.80	Ensemble Subspace KNN



Middle Bar Character lanna dhamma

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 Lanna Dhamma characters recognition the combination of three technique on each image and extract 150 features per image i.e. total **10,050** 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.

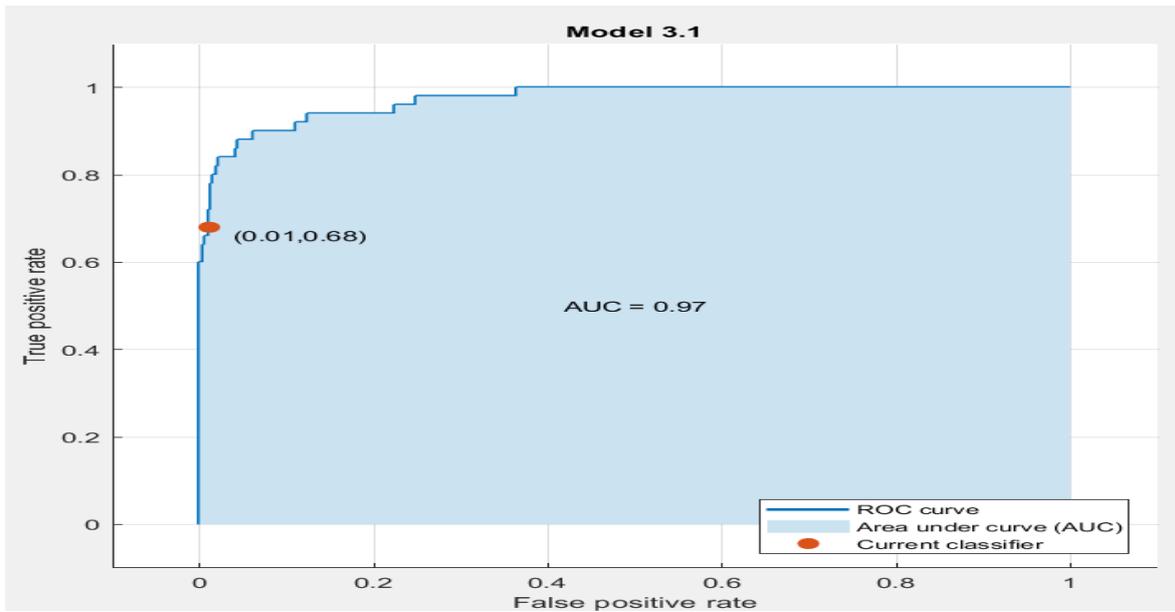
Data Validation method	Accuracy(%)	Classifier
10 Fold	97.10	KNN
20%	100.00	Ensemble Subspace KNN
40%	96.40	Ensemble Subspace KNN
50%	94.30	Ensemble Subspace KNN



Number database Lanna Dhamma

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 fonts style and 5 different font Size. In proposed technique we apply the three techniques on each image and extract 150 features per image i.e. total 75000 features and make the class of each number having predictor label. Classify that data set using the classifier. Comparative analysis shown in following table.

Data Validation method	Accuracy(%)	Classifier
10 Fold	87.40	Ensemble Subspace KNN
20%	85.00	Ensemble Subspace KNN
40%	81.00	Ensemble Subspace KNN
50%	73.20	Ensemble Subspace KNN



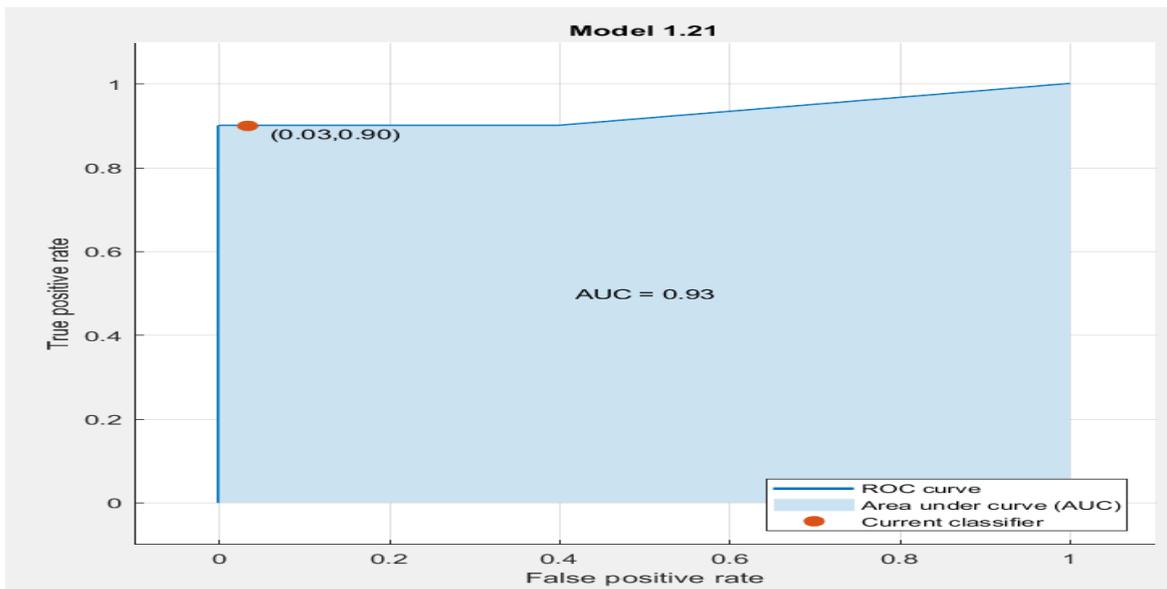
Model 1.21

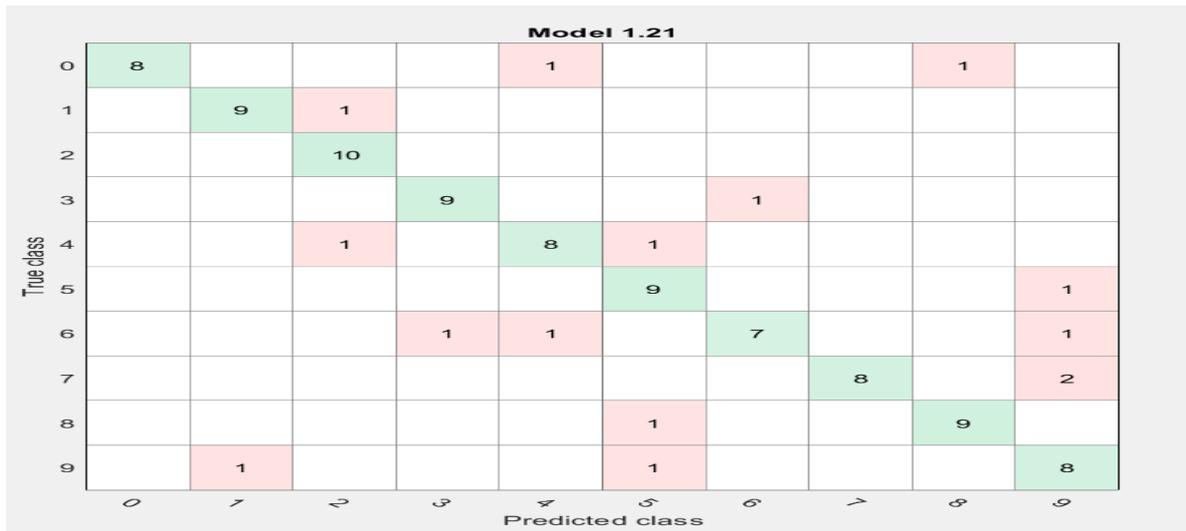
0	46	1			1	1			1	
1	2	40		1	1	5				1
2		1	48			1				
3				43	2	1	4			
4	1	1	1	1	40	2	3			1
5		1			1	44			1	3
6				3	3	1	39			4
7					1	1	2	46		
8						1			49	
9		1			2	4	1			42
	0	1	2	3	4	5	6	7	8	9

True class

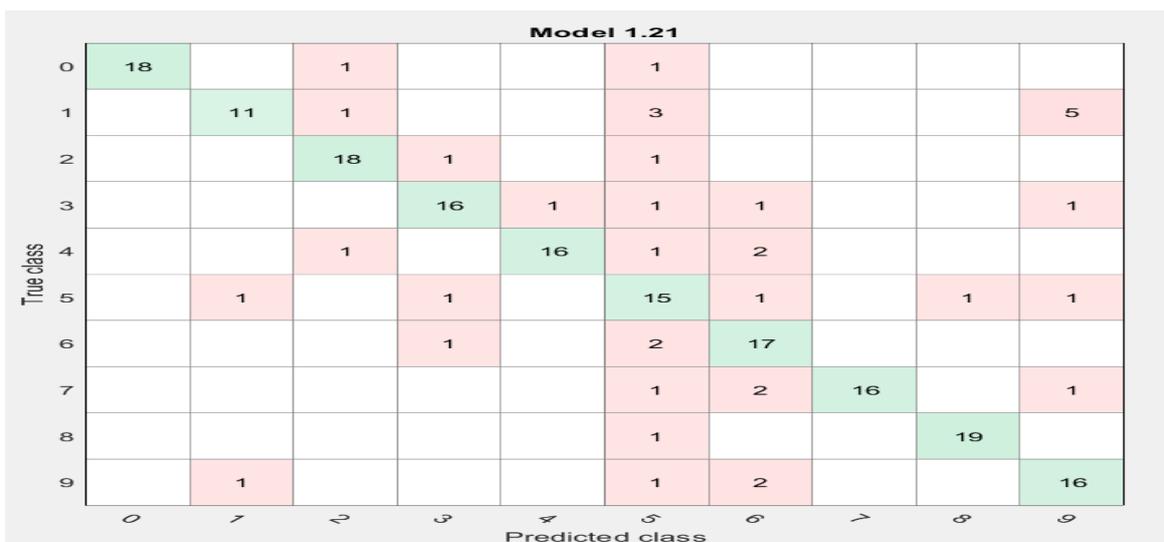
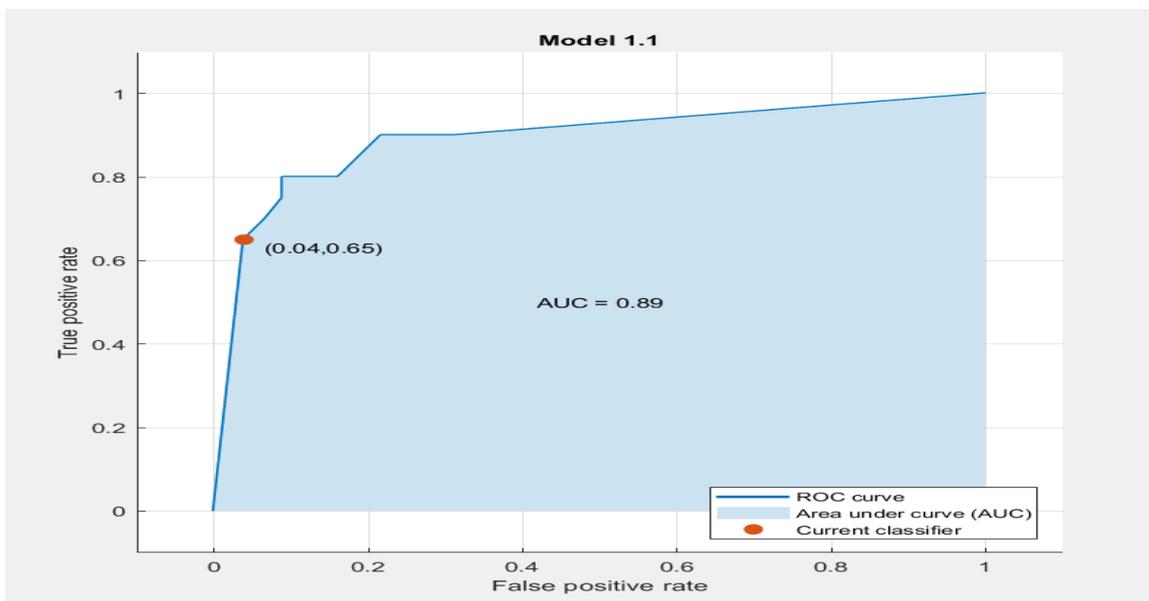
Predicted class

Number 10 fold lanna dhamma 3 features

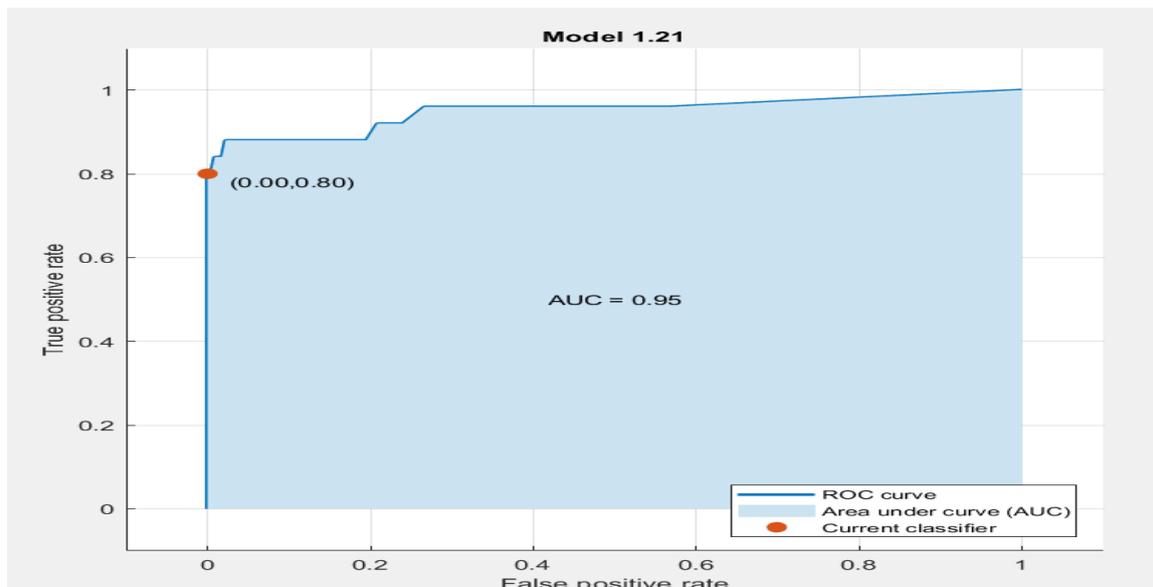




Number 20% -80% validation lanna dhamma 3 features (number database)



Number 40% -60% validation lanna dhamma 3 features (number database)



Model 1.21

True class	0	1	2	3	4	5	6	7	8	9
0	100%	9%	3%		3%	4%				
1		68%		4%	3%	4%				18%
2		5%	79%	4%						
3		14%	3%	74%	6%		6%			3%
4		5%		13%	53%	4%	13%			3%
5			3%	4%	6%	74%			4%	8%
6			7%		22%	4%	69%		4%	8%
7					3%		6%	100%		8%
8			3%						88%	3%
9					3%	9%	6%		4%	51%
Positive Predictive Value	100%	68%	79%	74%	53%	74%	69%	100%	88%	51%
False Discovery Rate		32%	21%	26%	47%	26%	31%		12%	49%
	0	1	2	3	4	5	6	7	8	9

True class

Predicted class

Number 50% -50% validation lanna dhamma 3 features (number database)

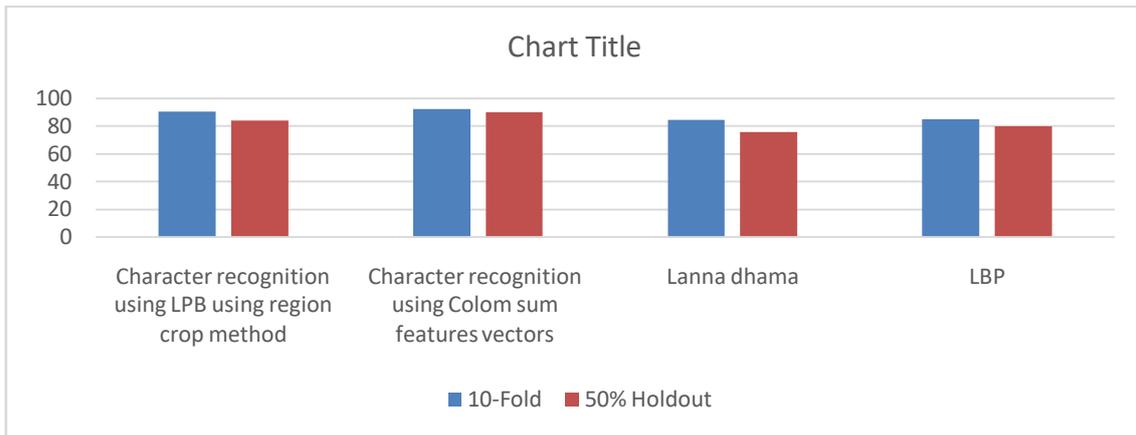
Comparative analysis of various method

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, lanna dhama, 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 and 50% 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 (%)
Character recognition using LPB using region crop method	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
Lanna dhama	10-Fold	(87.40+97.10+78.70+74.90)/4	84.52
	50% Holdout	(73.20+94.30+68.80+65.40)/4	75.42
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



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 Lanna Dhamma character recognition technique.

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