



## Handwritten Character- Recognition Through Feature Extrraction Using Artificial Neural Networks

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*(Received: 04 August 2023*

*Revised: 12 September*

*Accepted: 06 October)*

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### KEYWORDS

Segmentation,  
Skew Correction,  
Filtering, Gray  
Scale, Binarization

### ABSTRACT:

Today's computer can be fast, accurate and knowledgeable. But they are far from being intelligent; computers are still unable to communicate with human beings in natural forms like written languages, speeches, pictures and images. With the rapid development in the computer facilities users have now turned their attention to interact with computers in their local languages, so it is more user friendly. In Karnataka, HINDI is the local and official language. it is very convenient and faster to enter a HINDI document into computer by handwriting rather than by typing using existing HINDI converted English keyboard, where key combinations have to be used. This necessitates the development of an efficient online system to recognize HINDI handwritten characters or words. The concept in the online character recognition system is to capture a character as a sequence of  $[x(t), y(t)]$  points while the character is being written on a computer screen. Trajectory curvature, shape, size etc ....., are extracted from the characters. Each point of the input sequence is coded as a set of these features for recognition.

### I. INTRODUCTION

Computers have become the part and parcel of our day to day life because of its ability to compute and flexibility of use. We interact with computers using English language. In recent years a great emphasis is on interaction with regional languages.

Indian languages are rich in alphabets. Devanagari is a very ancient language. It is basis of many languages. It has more than 600 alphabets. Many softwares have been developed for this purpose like nudi, baraha etc. but there are many drawbacks in these softwares. It is very tedious and cumbersome to type on a converted keyboard. If say, we want letter we need to type 'k' 's' 'h' 'a', a 4 letter combination in the converted keyboard and also depends on the speed of typing.

This necessitates the development of an efficient online system to recognize kannada handwritten characters or

words. One of the most basic problems which have been dealt in the process of imitating human brain is to make computer **"Recognize handwritten characters"**. An example is handwritten character recognition.

Handwritten recognition can be broken down in to two categories:

1. Offline character recognition
2. Online character recognition

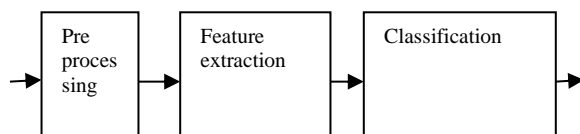
Offline character recognition system scan the image from a scanner, digital camera. The image is binarized using threshold technique based on the color pattern, so that the image pixels values are represented as 0 or 1, in which cell image is present denoted as 1 otherwise 0.

Online handwriting recognition system allows us to input our handwriting in to the system. We are processing an online Hindi character recognition system which uses artificial



neural network for recognition.

An online character recognition system consists of three stage processes as shown in figure.



**Figure 1.1 : online character recognition**

#### Preprocessing

In preprocessing stage, processes of normalization takes place to get X and Y coordinates.

#### Feature extraction

A different methods used for feature extraction are:

1. Wavelet transforms
2. Hidden markov model
3. Bayesian theory
4. PCA etc...
5. Wavelet transforms are used to extract features of characters of the systems.

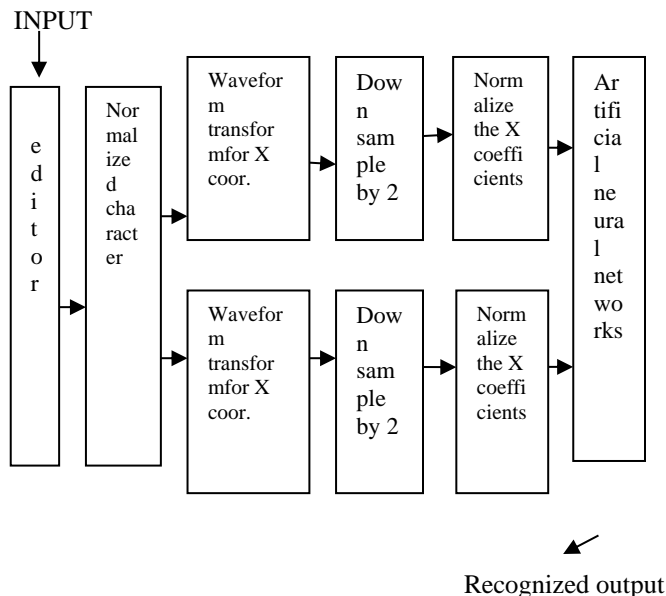
#### Classification

The classifier is used for feature vector Given by the feature extractor to assign the object to a category and it is used for identifying the characters.

## II. METHODOLOGY

Figure 1 shows online handwritten HINDI character recognition systems.

We have considered HINDI characters for recognition; HINDI character set has 11 vowels and 36 consonants as basic set of alphabets



**Figure 2.1: Block Diagram of Character Recognition**

#### Input System

Initial step in character recognition is to build an editor. It is the graphical aid to feed the input characters to computer. Editor is created using visual basic editor, which is created using visual basics is used as input system.

The editor window consisting of a writing area, an output display and different command keys. The letter that has to be trained/recognized is written in this writing area by suitably moving the pen on the tablet. The character contour is captured while writing the character and then processed.

#### Pre-Processing

In the preprocessing stage scanned image of the character is subjected to process of normalization. The area of textual information in the scanned image is detected and a new boundary is represented as a (x,y) coordinate system which is followed by the formation of grids. The grids are represented as matrix of (m\*n).

Where as zero represents the field where character is not present.

Here, the sequence of [x[t], y[t] coordinates of a character is captured as the character is being written on the computer

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**Figure 2.2: Matrix formation**

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graph LR; Input[Signal input] --- Split(( )); Split --- LPF[Low pass filter]; Split --- HPF[High pass filter]; LPF --- Approx[Approximate coefficients]; HPF --- Detail[Detail coefficients];
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In recognition stage X – Y coordinate values of the testing character are given to the network, feed forward computation will be done then output will be displayed. The



output of the network varies either 0 or 1 using sigmoid function. This binary output is compared with target values of the learnt patterns. If it matches with any of the target values, the pattern is said to be recognized and it is displayed or else it is marked as unknown pattern.

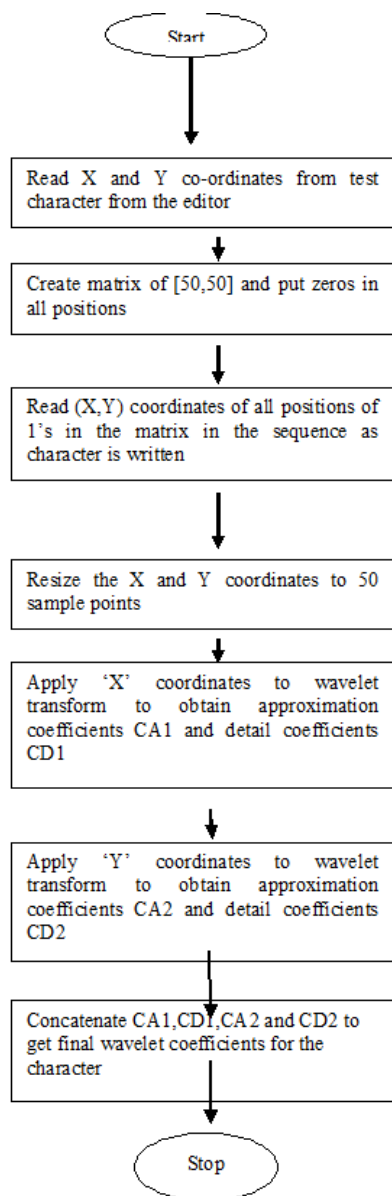


Figure 2.4: Feature Extraction

In feature extraction first character will be tested from x and y coordinate basis then that character will be placed in matrix, in which cell image is present denoted as 1, in which cell image is absent denoted as 0 finally getting as a sequences of 0's and 1's. then Apply 'X' coordinates to wavelet transform to obtain approximation coefficients that is denoted as CA1 and detail coefficients denoted as CD1, Apply 'Y' coordinates to wavelet transform to obtain approximation coefficients that is denoted as CA2 and detail coefficients denoted as CD2, finally concatenate CA1,CA2,CD1 and CD2 to get wavelet coefficients for the character.

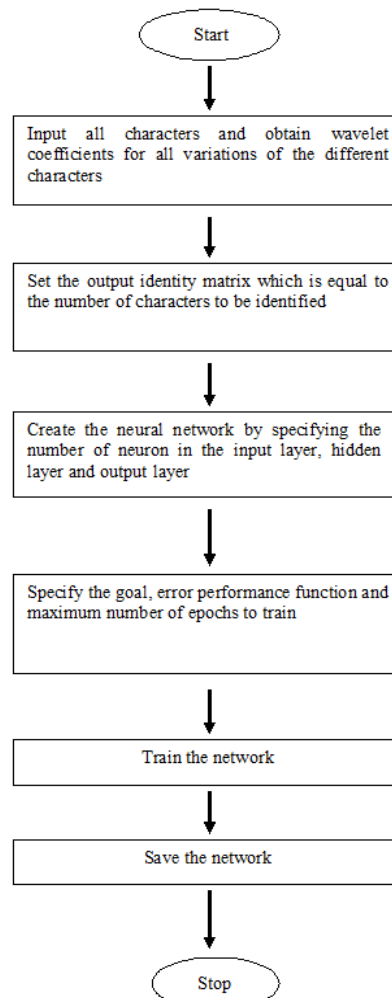
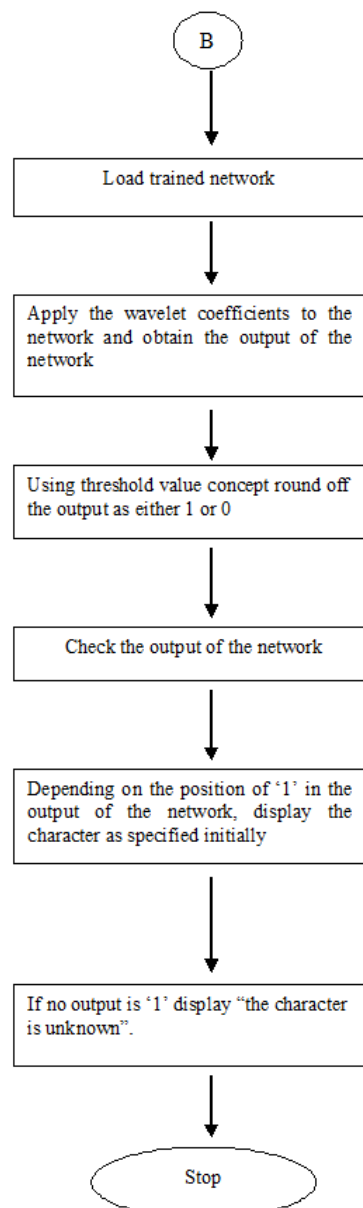
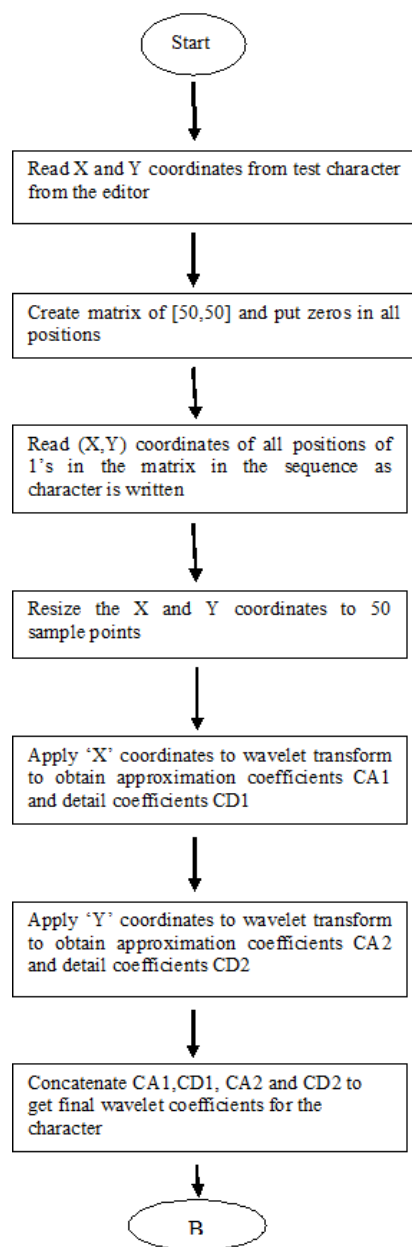


Figure 2.5: Training Process



In training process wavelet coefficients for all variations of the different characters will be compared, then Set the output identity matrix with number of characters and Create the neural network to find out the number of neuron in the input layer, hidden layer and output layer finally find out the goal, error performance function and maximum number of epochs to train and save the network.



**Figure 2.6: Character Recognition**

In character recognition first character will be tested from x and y coordinate basis then that character will be placed in matrix, in which cell image is present denoted as 1, in which cell image is absent denoted as 0 finally getting as a sequences of 0's and 1's. Resize the X and Y coordinates to 50 sample points then Apply 'X' coordinates to wavelet transform to obtain approximation coefficients that is



denoted as CA1 and detail coefficients denoted as CD1, Apply 'Y' coordinates to wavelet transform to obtain approximation coefficients that is denoted as CA2 and detail coefficients denoted as CD2, finally concatenate CA1,CA2,CD1 and CD2 to get wavelet coefficients for the character. These points are loaded in to the trained network. Apply the wavelet coefficients to the network and obtain the output of the network. Using threshold value concept round off the output as either 1 or 0. Depending on the position of '1' in the output of the network, display the character as specified initially, If no output is '1' display "the character is unknown".

## RESULTS

The proposed system describes a novel procedure which uses wavelet transform, artificial neural network and structural features. We have considered the 47 HINDI characters for recognition after testing the characters for recognition, the results obtained are satisfactory.

We have considered HINDI character for recognition. Hindi character set has 11 vowels and 36 consonants as basic set of alphabets. We have consider these characters for recognition.

We have considered a separate training network to train recognized characters. The codes have been written for all characters or alphabets to be recognized.

We have been able to clearly recognize almost all HINDI characters.

The subscripts of the HINDI characters are not identified. The percentage of error can be reduced by extracting more features from input characters or by taking more number of samples for training.

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