

Handwritten Pattern Recognition Using Spiking Neural Network & SVM

Ms. Minal V. Thote
(PG Scholar)
Comm(Electronics) Engg,
SDCE Selu (Kate), Wardha
minal.thote@gmail.com

Prof. Ms. B. J. Chilke
Assistant Professor
Dept. of Electronics Engg.
SDCE Selu (Kate), Wardha
b_kuchewar@rediffmail.com

Mr. S. B. Pawar
Assistant general Manager
Uttam value Steel pvt . Ltd
Selu(Kate), Wardha

Abstract-Pattern recognition is an important and active trait in the field of image processing, this trait is used in various applications such as fraud detection, face recognition; fingerprint recognition etc.it is also used in the field of medical, neuroscience, computer science, artificial intelligence, remote sensing and engineering etc. Pattern recognition is the branch of artificial intelligence that makes the machine as intelligent as human, which recognize the pattern and classify it into a categories in a simple way. Firstly the input pattern which is to be recognized is preprocessed then features are extracted from that preprocessed pattern that extracted features are then applied to classifier for classification. The paper shows recognition of pattern like handwritten characters using Spiking neural network and Support Vector Machine as a classifier.

Keyword: Image Processing, Spiking Neural Network, Support Vector Machine, Artificial Neural Network.

I. INTRODUCTION

Human being have developed highly sophisticated skills for sensing their environment and taking actions according to what they have seen, e.g., recognizing a face, understanding spoken words, reading handwriting. This capability of human being is called Human Perception [7].

Pattern recognition is a field of study which is significantly developed in the 1960s. It was very much an interdisciplinary subject which has developments in the areas of statistics, engineering, artificial intelligence, computer science, psychology and physiology and all others. Human being has natural intelligence and so can recognize patterns. A pattern is an entity, which could be given a name, e.g. fingerprint image, handwritten word, human face, speech signal, DNA sequence. The five year old children can recognize digits and letters, whereas young people can easily recognize small characters, large characters, handwritten, machine printed. The input characters may be written on a cluttered background, on crumpled paper or may even be partially concluded [6].

Pattern recognition is the study which gives the information about how machines can observe the environment, and distinguish it into different categories. But in spite of almost many years of research; design of a general purpose machine pattern recognizer remains an elusive goal. The best pattern recognizers in most instances are humans, but till we do not understand how humans recognize patterns. So the artificial intelligence is placing a good technique to design the pattern recognition system.

Following are the approaches of pattern recognition system

1. Sensing
2. Feature Extraction and selection,
3. Decision making.
4. System performance evaluations.

On the basis of above approaches, we are designing a pattern recognition system using Spiking neural network & Support Vector Machine.

II. RELATED WORK

The pattern recognition process has been performed by researchers on characters of different languages, like, English, Tamil, Chinese, Bangla, Arabic, Farsi, Kannada, Devanagari etc.

In paper[1] "Handwritten Hindi Character Recognition using K-Means Clustering and SVM" ,2015 4th International Symposium on Emerging Trends and Technologies in Libraries and Information Services, the handwritten Hindi character is recognized using K-mean clustering algorithm and Support Vector Machine classifier.

In paper[2]"On-line Malayalam Handwritten Character Recognition using HMM and SVM" , 2013 International Conference on Signal Processing, Image Processing and Pattern Recognition, the handwritten Malayalam character is recognised using HMM & SVM.

In paper[3] "Recognition of Off-line Hand printed English Characters, Numerals and Special Symbols" , 2014 IEEE In these paper offline hand printed English characters, Numerals and special symbols are recognised using MLP neural network and SVM.

In paper[4] "Enhancing the License Plates Character Recognition Methods by Means of SVM" The 22nd Iranian Conference on Electrical Engineering (ICEE 2014), May 20-22, 2014, licence plate character is recognised using SVM.

In paper [5], "An overview: pattern recognition using Spiking Neural Network and Artificial Neural Network", International Journal of Engineering Research "IC-QUEST 2015".the pattern is recognized using Spiking Neural Network and artificial neural network.

III. PROPOSED METHODOLOGY

The flow diagram of proposed method is shown in Fig 1, which is divided in to 3 parts:

- Pre-processing Phase
- Feature Extraction Phase
- And Classification Phase.

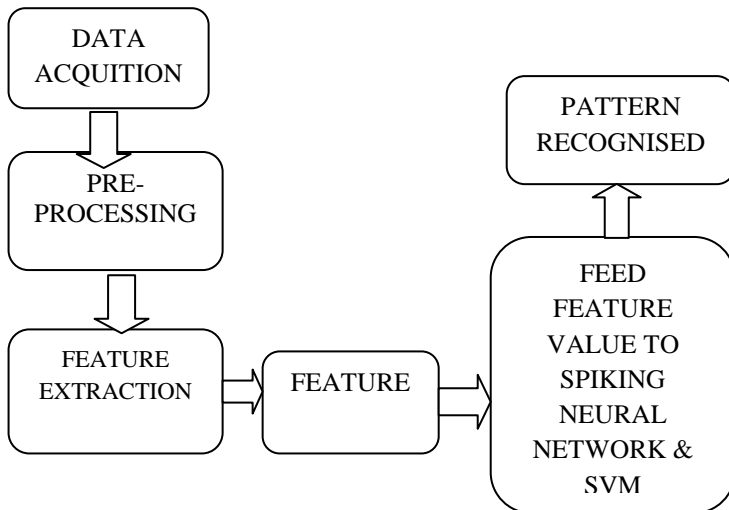


Fig 1: Block diagram of Proposed Methodology

A. DATA ACQUISITION:

In data acquisition, data set is obtained by taking the handwritten samples, where each writer has written a document containing instances of each of the 26 characters, 10 numeral digits or 8 special characters

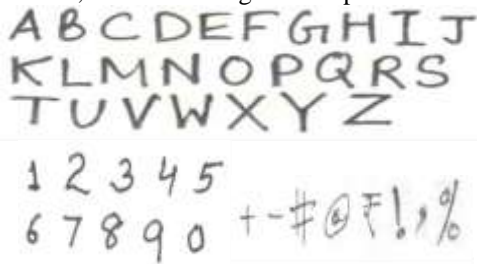


Fig 2: Handwritten Pattern

B. PRE-PROCESSING PHASE

In this phase the scanned image is taken as input which is shown in fig 3(a) and processed in three parts:

- 1) **Binarization:** Scanned input is first converted into the gray scale image, and then converted into binary image using gray scale threshold. Binary image is represented in the format of zeros and ones, one represents object pixel whereas zero represents the background pixel.
- 2) **Thinning:** The technique of thinning removes the noise in the binary image and converts the character images to single pixel width.
- 3) **Segmentation:** Segmentation is the process that determines the constituents of image, it locates the region of document where the data is printed and distinguishes it from figures and graphics, each segmented image is then normalized into a fixed area such that the aspect ratio is not changed.

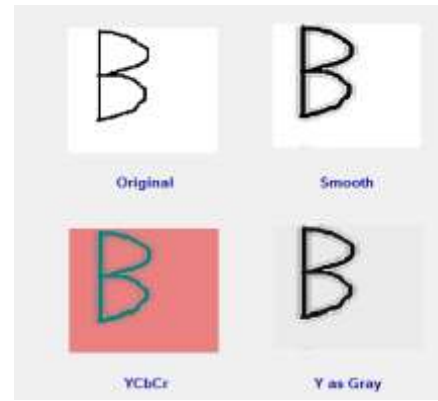


Fig.3: Preprocessing of an image

C. FEATURE EXTRACTION PHASE

Feature Extraction is performed on the binarized cropped image pattern using K-means clustering algorithm, in which the pixels are grouped by using K-means Clustering. It reduces the dimension of data so that computational overhead is reduced. K-means clustering is simple as well as a flexible technique. It works according to the center points which are selected randomly and other data values are attached with the corresponding center points according to the difference between data values and center points. Number of clusters is equal to number of selected centroids.

Algorithm of K-means Clustering:

- First select K points as centroids for each group.
- Take each point from a data set which is already given and associate it to the nearest centroid.

To calculate that which point is nearest to which centroid, Euclidean distance between centroids and data points are calculated. This is given by:

$$d(\mathbf{p}, \mathbf{q}) = \sqrt{\sum_{i=1}^n (q_i - p_i)^2}$$

Where p and q are data points

- When no point is pending, the position of the k centroids is recalculated.

This K-means clustering is applied on cropped binary image which is region based. Region based K-means clustering is applied on the location of pixels. K-means Clustering divides the image into K clusters. Each cluster has the data into x and y pixel coordinate format. Values of pixels, which are under a cluster are combined together to get the pixel density in each cluster. After this process, each cluster is represented by a single value. Each cluster value is arranged

in row-wise and makes a vector which is called feature vector. In this method, cropped image is resized into 70x50.

C. CLASSIFICATION PHASE

1. Spiking Neural Network

Spiking neuron model was introduced by J. Hopfield in 1995. Spiking neural network model is a heterogeneous two-layered feed-forward network with lateral connections in the second hidden layer. Spiking neural network is the third generation of neural network models. The working of both artificial neural network and spiking neural network is very much similar but only the difference is that neurons in the SNN do not fire at each communication cycle (as it happens with typical multi-layer perceptron networks), but rather fires only when a membrane potential reaches a specific value. When a neuron is fired, it generates a signal which travels to the other neurons which, in turn increases or decreases their potentials in accordance with this signal. It is known that biological neurons use pulses or spikes to encode information. Neurological research also shows that the biological neurons store information in the timing of spikes. They can use spatiotemporal information in communication and computation similar to biological neurons. As they use pulse coding for information processing.

2. SVM (Support Vector Machine):

Support Vector Machine is introduced by Vladimir Vapnik in 1963. Support Vector Machines are powerful classifiers that have proven to be efficient for several pattern recognition tasks such as speech and handwriting recognition, fingerprint recognition, face recognition etc. Basically SVM performs binary classification; however several SVM classifiers can be combined to do multiclass classification using one against all or one against one technique. The Principle behind SVM is to map the input data on to higher dimensional feature space nonlinearly related to the input space and determine a maximum margin i.e. hyper plane separating the two classes of feature space. SVM gives unique solution and also having maximum margin between feature sets and convergence is guaranteed unlike Artificial Neural Networks.

IV. EXPERIMENTAL RESULT

For implementation of the proposed module numbers of steps are used. For implementation of pattern recognition system, MATLAB is used as a tool. The scanned image of handwritten characters is taken as input character image set of size 10 is taken for implementation. In which 3 samples of characters are used for training and rest of images of characters are taken as test data for classification using SVM and Spiking Neural network.

First, the image is required to be processed so that useful section of image, on which the recognition process will be applied, can be extracted. This is done in preprocessing phase by using morphological operations in MATLAB. Scanned image is taken as input and converted into gray scale image after that threshold value is extracted by filter. Using that threshold value gray scale image is binarized. After extracting the character from word, it is resized into 70x50 pixels. K-means clustering is applied on

this resized binary image by dividing it into 7 parts horizontally. On each part K-means clustering is applied and centroids are specified. After applying k-means clustering on image a vector is generated from image, which has feature values. For every character feature vector is produced.

That feature vectors are then applied to the Spiking Neural Network and SVM classifier for classification. After classification character is recognized, during classification Spiking Neural Network shows the performance which is shown in following fig.

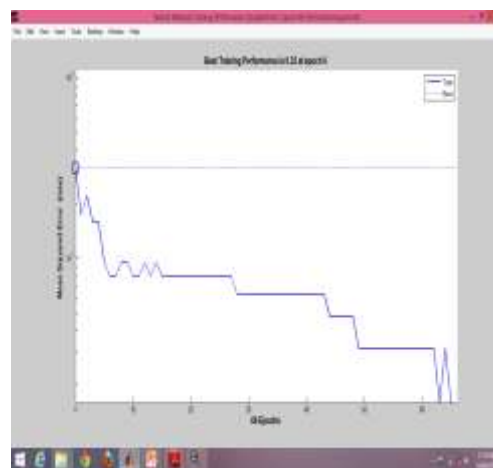


Fig.4: Waveform of performance of Spiking Neural Network

If the feature with the train features of database pattern then test pattern is recognized otherwise test pattern is not recognized. And finally the input test pattern is recognized in the command window of MATLAB tool.

V. CONCLUSION

This paper presents the recognition of handwritten pattern; the pattern recognition consists of no of steps i.e. data acquisition, preprocessing, feature extraction and finally classification. In proposed methodology feature extraction takes place using K-mean clustering algorithm and classification is done by using Spiking Neural Network classifier and Support Vector Machine classifier. The experimental results and performance is obtained on MATLAB tool.

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