Volume 5, Issue 10, October-2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

The Pattern Recognition using Spiking Neural Network and Neural Network

Vipin Nanaji Ghotkar[1], Prof. P. R. Indurkar[2], Prof. B. J. Chilke [3]
[1]PG Scholar, Electronics(Comm.) Engineering, SDCOE, Selukate, Wardha, India
[2]Associate Professor, Department of EXTC, BDCOE, Sevagram, Wardha, India
[3]Assistant Professor, Department of Electronics Engg. SDCOE, Selukate, Wardha, India

Abstract—Pattern Recognition is one of the very important and active traits or it is a branch of artificial intelligence. It offers advantages such as fraud reduction, it increases reliability and also its a cheap technology. The various applications of pattern recognition is used in the security purposes, also in scientific fields such as computer science, medical, neuroscience and engineering, remote sensing and artificial intelligence. It's the science which tries to make machines as intelligent as human to recognize patterns and classify them into desired categories in a simple and efficient way. The various methods are widely studied to solve the pattern recognition task viz., Neural Networks, Belief Networks, Bayesian Tree Classifiers, Support Vector Machines, Multiclassifiers-A combination of above, but most of them lack the biological plausibility. Pattern recognition can be done in multiple ways. In this paper Pattern Recognition using Spiking Neural Network and Neural Network as the best possible way of utilizing available sensors, processors, and domain knowledge is reviewed.

Keywords—Artificial Neural Network, Image processing, Neural Network, Pattern recognition, Spiking Neural Network.

I. INTRODUCTION

We human beings do pattern recognition everyday. We "recognize" and classify many things, even if it is corrupted by noise, distorted and variable. Classification is the result of recognition: categorization, generalization. Neural Network has gained prominence in the field of pattern classification. The four best known approaches for pattern recognition are:

1. Template matching,
2. Statistical classification,
3. Syntactic or structural matching, and
4. Neural networks.

A. Pattern Recognition

The first step for pattern recognition is to understand how the information is stored in a pattern. How the information is represented in the brain still remains unclear [1]. Pattern recognition is nearly synonymous with machine learning. The branch of artificial intelligence focuses on the recognition of patterns and regularities in data. Patterns are generally of two types: 1) Linear pattern and 2) Non Linear Pattern. Figure below shows the examples of linear and non linear pattern:

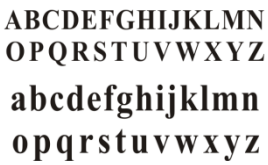

Fig.1(a): Linear Pattern

Fig1(b): Non Linear Pattern

Pattern recognition systems are in many cases trained from label "training" data (supervised learning), but when no label data are available other algorithms can be used to discover previously unknown patterns (unsupervised learning). It is a process which takes raw data as an input and makes an action based on the category of the pattern. It extracts the

patterns based on certain conditions and separates one class from another [2]. Also it is a process of recognizing patterns and classifying data accordingly has been gaining interest from a long time and human beings have developed highly sophisticated skills for sensing from their environment and take actions according to what they were observed. So a human are able to recognize the faces without worrying about the varying illuminations, facial rotation, facial expressions, and facial biometrical changes. The implementation of recognition system artificially, then it becomes a very complex task. To reduce this complex task, the fields of artificial intelligence have made the machines as intelligent as human to recognize patterns in varying environmental conditions. Such a branch of artificial intelligence is known as pattern recognition. Pattern recognition involves applications such as face recognition, speech recognition, classification of handwritten characters, medical diagnosis, etc [3]. The applications of pattern recognition is mainly used in the security purposes, in scientific fields such as medical, computer science, neuroscience and engineering, artificial intelligence and remote sensing, etc. Examples of Patterns are finger print, face, sound wave, tree, character image, bar code, etc.

B. Neural Network

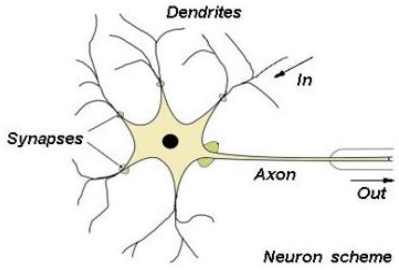

Fig1 (c): Biological neural network

Biological Neural Network consists of:

a. Soma
b. Dendrite
c. Axon
d. Synapses

C. Artificial Neural Network

Neural network model in Artificial intelligence is referred as Artificial Neural Network(ANN). ANN is specified by:-

a) Neuron Model: it is an information processing unit of the neural network.
b) Architecture: it consists of a set of neurons and have a link connecting neurons. Each link is provided with a weight.
c) A Learning Algorithm: used for training the NN by modifying the weights in order to model a particular learning task correctly on the training examples.

An ANN is an information processing paradigm that is inspired by the way biological nervous systems, which is the brain processing information. An ANN is configured for a specific application, such as pattern recognition, through a supervised or an unsupervised learning [4].

D. Spiking Neural Network

Spiking neuron model was invented by J. Hopfield in 1995. Spiking neural network is a heterogeneous two-layered feed-forward network with lateral connections in the second hidden layer. This neural network is the third generation of neural network model [5]. The working principle 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 propagation cycle (as it happens with typical multi-layer perceptron networks), but rather fires only when a membrane potential reaches a specific value[6]. 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. Spiking neural networks are as follows:

a) Biologically more plausible,
b) Computationally more powerful
c) Considerably faster.

E. Analogy between Biological and Artificial Network

BIOLOGICAL NEURAL NETWORK	ARTIFICIAL NEURAL NETWORK
Soma	Neuron
Dendrite	Input
Axon	Output
Synapse	Weight

II. PROPOSED METHODOLOGY

The following flow chart diagram of the system which shows the proposed methodology:

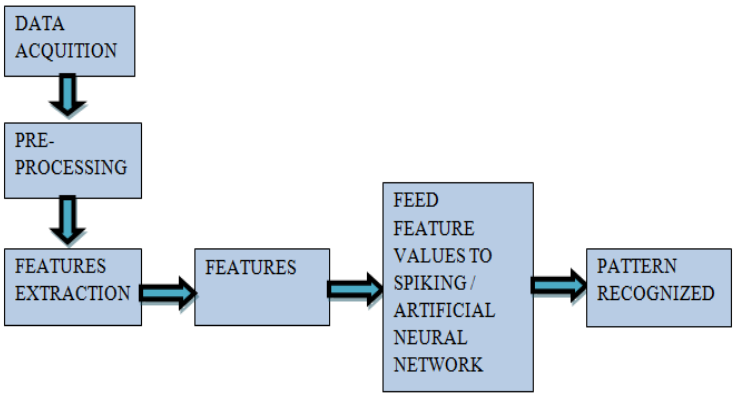

Fig: Flow chart of proposed methodology

Steps of proposed methodology as follows:

A. Data acquisition:

Here the data is taken from the surrounding environment as the input and given to the pattern recognition system.

B. Pre-processing:

There are various processes include in the pre-processing such as smooth up the image, colour space to YCbCr, and finally to gray scale image.

C. Feature extraction:

The main goal of feature extraction is to reduce the data dimensionality and properly represent the original data in feature space. Here, features are extracted using the GABOR filter. Gabor filters also called as bandpass filters, which are used for feature extraction in image processing. Gabor filters are mostly used in pattern analysis applications.

D. Classification:

The classifier is for comparing the data whether it is matched or not. We are using the two classifiers:-

a. Spiking Neural Network
b. Artificial Neural Network

III. RESULT AND ANALYSIS

While executing the system, following are the snapshots. Firstly, the required pattern is acquired from the surrounding environment and is fed for the pre- processing. Pre-processing includes Gaussian smoothing, converting the smoothed image to YCbCr and then to gray scale image. The following fig shows the Pre-processing process on alphabet B.

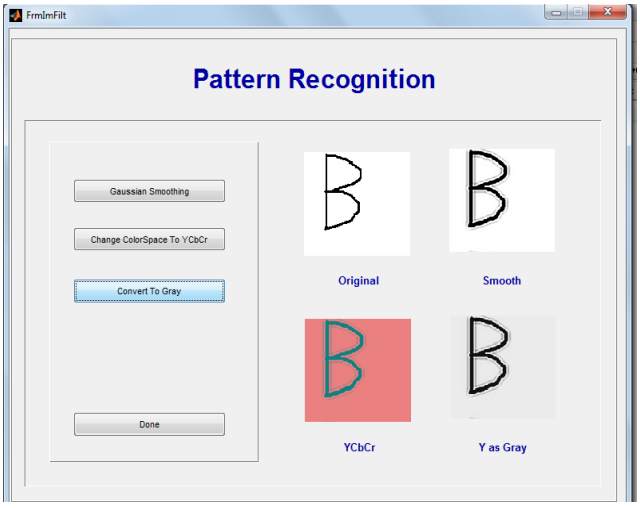

Fig (a): Snapshot of Pre-processing an Image

Then after pre-processing, the required features are extracted from that image. And then the image is recognized as "CAP B" in Neural Network and the same is recognized in Spiking Neural Network. The following figure shows the output waveform of spiking neural network.

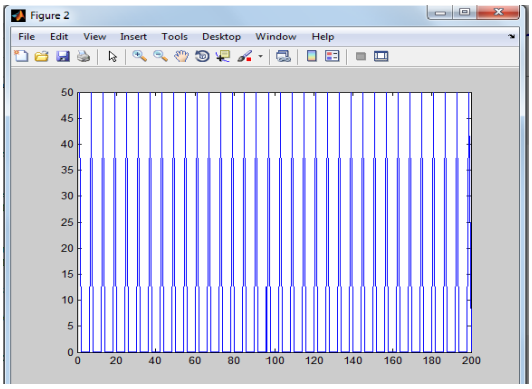

Fig (b): Spiking Neural Network waveform

The same Pre-processed is done for the Devanagari Pattern RU as shown in the figure below:

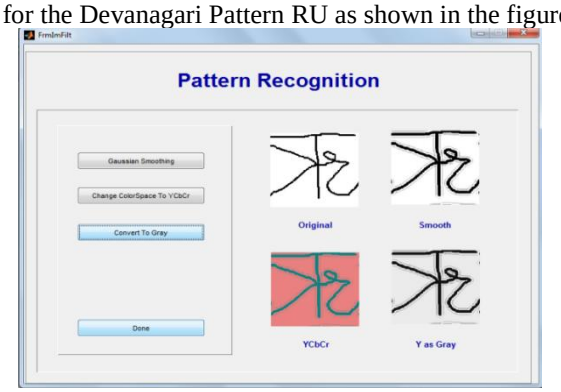

Fig (c): Snapshot of Pre-processing Character RU

After pre-processing, the Neural Network recognized the pattern as "RU" and same is reconized by the Spiking Neural Network. The same process is repeated for the patterns CAP A, Devanagari KA and Devanagari SHRA.

In all the above recognized patterns, the time required for recognition of Neural Network is more than the that in the Spiking Neural Network. In other words, Spiking Neural Network Recognition System is Faster than that of the Neural Network. Hence, Spiking Neural Network is Biologicaly more Plausible, more powerful and faster than the first generation Neural Network. The following Graph of Spiking Neural Network and Neural Network, which prooves that the Spiking Neural Network is very much Faster than the Neural Network.

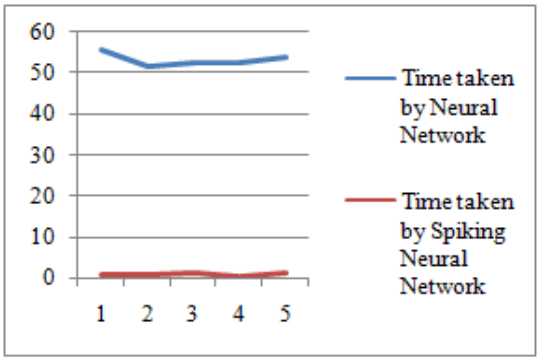

Fig (e): The time required for Recognizing Pattern by Neural Network and Spiking Neural Network

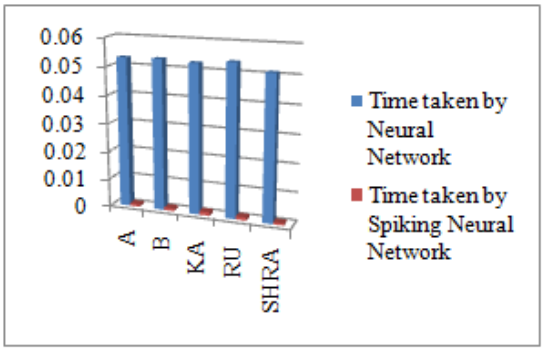

Fig (f): Comparison between Neural Network and Spiking Neural Network

In the above figure, On X-axis – Various patterns
On Y- axis – Time required for recognition using Neural Network & Spiking Neural Network.
This graph clearly implies that, Spiking Neural Network has very high recognition speed as compare to the Neural Network.

IV. CONCLUSION

With this Pattern Recognition System, we conclude that the Spiking Neural Network is really a very faster than a Neural Network System. In future, we can add more alphabets or a different kind of patterns and can compare with the support vector machine.

REFERENCES

[1] P. X. Tsukada M., "The spatiotemporal learning rule and its efficiency in separating spatiotemporal patterns," Biol. Cybern., vol. 92, pp. 139–146, February 2005.
[2] T. Muthya Mounika, V.V. Vishnu Prabhakar, "Pattern Recognition in Neural Networks," International journal of soft computing and artificial intelligence, ISSN: 2321-404X, volume-1, issue-2, nov-2013.
[3] Priyanka Sharma, Manavjeet Kaur, "Classification in Pattern Recognition: A Review", International Journal of Advanced Research in Computer and Software Engineering, ISSN: 2277-128X, volume-3, issue-4, April 2013.
[4] Jayanta Kumar Basu, Debnath Bhattacharyya, Tai-hoon Kim, "Use of Artificial Neural Network in Pattern Recognition", International Journal of Software Engineering and its Applications, Vol.4, No.2, April 2010.
[5] Qiang Yu, K.C. Tan, Huajin Tang, "Pattern Recognition Computation in A Spiking Neural Network with Temporal Encoding and Learning," WCCI 2012 IEEE World Congress on Computational Intelligence June, 10-15, 2012 - Brisbane, Australia.
[6] Alex Frid, Hananel Hazan, Larry Manevitz, "Temporal Pattern Recognition via Temporal Networks of Temporal Neurons," 2012 IEEE 27-th Convention of Electrical and Electronics Engineers in Israel.

