

Alphabet Pattern Recognition using Spiking Neural Network and Neural Network

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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. Its 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.

Index Terms— Image processing, Neural Network, Pattern recognition, Spiking Neural Network.

I. INTRODUCTION

We human beings do pattern recognition everyday. We “recognize” and classify various things, even if it is corrupted by noise, distorted and variable. Classification is the result of recognition: generalization, categorization. Neural Network has acquired 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 basically 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

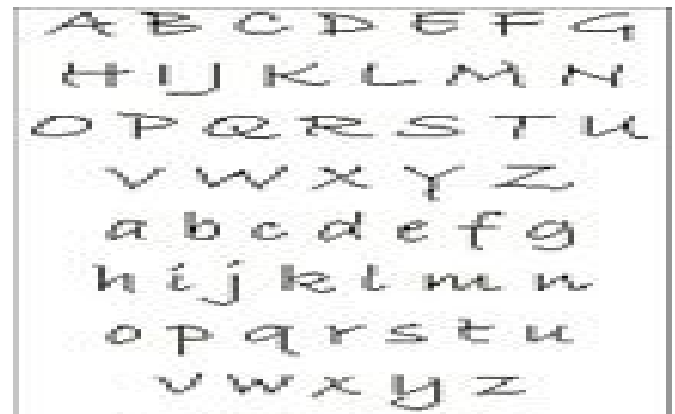


Fig1(b): Non Linear Pattern

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). Pattern recognition is a process that takes in raw data and makes an action based on the category of the pattern. It optimally extracts 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

Manuscript received June, 2015.

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the varying illuminations, facial rotation, facial expressions, and facial biometrical changes. But the implementation of recognition system artificially, then the task becomes a very complex. For reducing 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 includes applications such as speech recognition, face recognition, classification of handwritten characters, medical diagnosis, etc [3]. The applications of pattern recognition is mainly used in the security purposes, in many scientific fields such as medical, computer science, neuroscience and engineering, artificial intelligence and remote sensing, etc. Examples of Patterns are finger print, tree, sound wave, face, bar code, character image, etc.

B. Neural Network

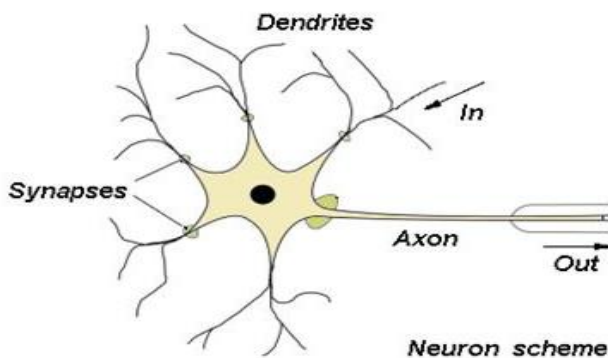


Fig1(c): Biological neural network

Biological Neural Network consists of:

- Soma
- Dendrite
- Axon
- Synapses

C. Artificial Neural Network

Neural network model in Artificial intelligence is referred as Artificial Neural Network. An Artificial Neural Network is specified by:-

- Neuron Model:** it is an information processing unit of the neural network.
- An Architecture:** it consists of a set of neurons and have a link connecting neurons. Each link is provided with a weight.
- 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 which is inspired by the way biological nervous systems is, such as the brain processing an information. An ANN is configured for the specific application, such as pattern recognition, through a supervised or an unsupervised learning [4].

D. Spiking Neural Network

Spiking neuron model was introduced by J. Hopfield in 1995. Spiking neural network is a heterogeneous two-layered feed-forward network with lateral connections in the second hidden layer. Spiking neural networks (SNN) is the third generation of neural network (NN) models [5]. The working principle of the both artificial neural network(ANN) and spiking neural network (SNN) 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 (MLP) networks), but rather it 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 with respect to this signal. Spiking neural networks (SNN) are:

- Biologically more plausible,
- Computationally more powerful
- 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:

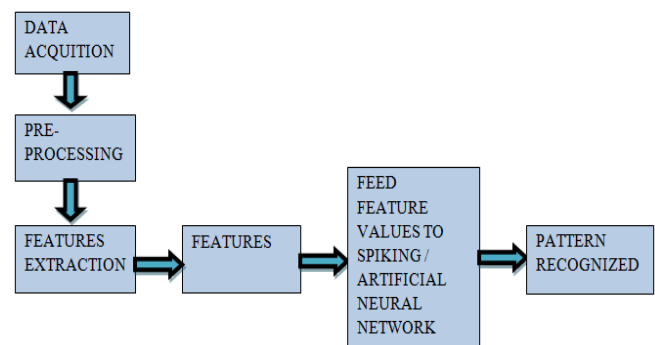


Fig: Flow chart of proposed methodology

Steps of proposed methodology as follows:

A. Data acquisition:

Here the data is acquired from the surrounding environment which is taken 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, image Enhancement, RGB to Gray, etc.

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, the features are extracted with the help of the GABOR filter. Gabor filters also called as bandpass filters, which are used for feature extraction in image processing. Gabor filters have been widely used in pattern analysis applications.

D. Classification:

The classifier is a decision making which is used for comparing the data. There are two classifiers are used:-

- Spiking Neural Network
- Artificial Neural Network

III. RESULT

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 a gray scale image. The fig. below shows the Pre-processing process on alphabet B.

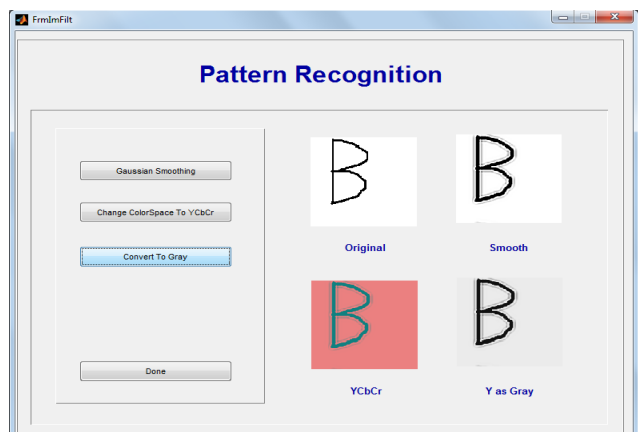


Fig (a): Snapshot of Pre-processing an Image

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.

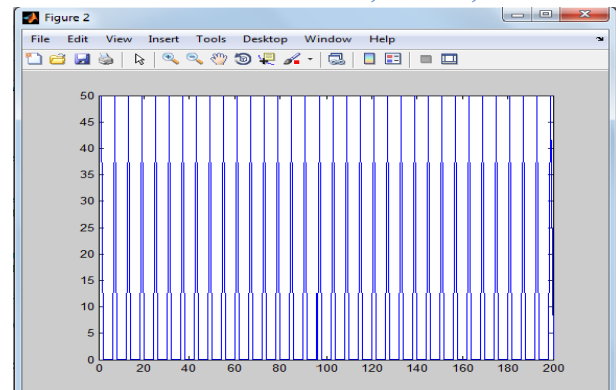


Fig (b): Spiking Neural Network waveform

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