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Classification of Cervical Cancer using Artificial Neural Networks

M. Anousouya Devi*, S. Ravi*, J. Vaishnavi and S. Punitha

School of Engineering and Technology, Pondicherry University, Pondicherry, India

Abstract

Artificial neural network (ANN) plays an important role in many medical imaging applications. The detection of cervical cancer cells uses an ANN for classifying the normal and abnormal cells in the cervix region of the uterus. Cervical cancer detection is very challenging because this cancer occurs without any symptoms. The classification between the normal, abnormal and cancerous cells is identified by using an artificial neural network which produces accurate results than the manual screening methods like Pap smear and Liquid cytology based (LCB) test. The ANN uses several architectures for easy and accurate detection of cervical cells. In this paper, a survey and analysis on the different types of architecture in the ANN with its accuracy results and performance are discussed. A brief description about the working and detection of cervical cancer is presented which is useful for the classification of normal and abnormal cervical cells.

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Keywords: Artificial Neural Network (ANN); Cervical Cancer; Liquid Cytology Based Test (LCB); Pap Smear Test.

1. Introduction

Cervical cancer is the second and common cancer that occurs in women of all age groups. This cancer is a deadly disease because it cannot be screened with any symptoms at the initial stage. The Pap smear test is a manual screening method used for collecting the cervical cells from the cervix region of the uterus. The doctor or the physician collects the cervical cells manual with a brush or spatula. The collected cervical cells are sealed in a container which is sent to the laboratory for manual classification of the normal and abnormal cervical cells. There are only few experienced pathologist to carry out this screening process. However, this method suffers from high false positive rates due to human errors in the classification of cells. This method is very cost effective and a pathologist can classify only 4 to 5 slides per day. The process is difficult to be performed at a faster rate because of the irregular boundaries of the cytoplasm and nucleus present in cell structure. The nucleus may be overlapped with other cells and it is difficult for the boundaries to be detected for a single cell and performing the classification is tedious. The second most common screening method is the liquid cytology based (LCB) method which immerse the collected cervical cell samples in the liquid of 5% acetic acid. The cervical cells are classified under three types of tissues Squanomus epithelium (SE), columnar epithelium (CE) and Aceto white region (AW). The AW tissue changes its colour into white region when immersed in acetic acid for abnormal classification of cells. This method suffers from accurate results of classification.

*Corresponding author. Tel.: 91-9843930392, 91-9994434936.
E-mail address: sravicite@gmail.com

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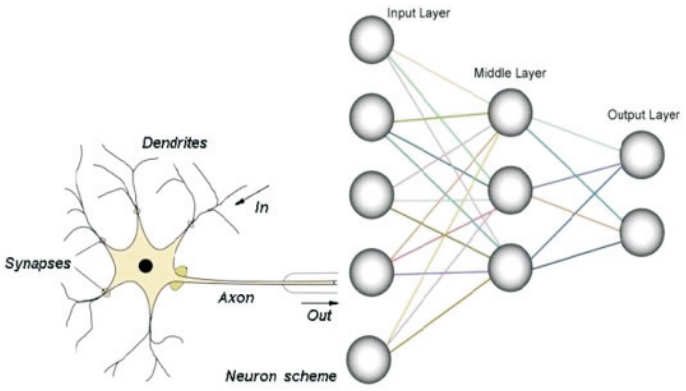

Fig. 1. Architecture of ANN.

To enhance the manual screening method and produce accurate results in the detection of cervical cancer the artificial neural networks are used to produce accurate results and perform in an easy manner. There are three layers used in the architecture of ANN which consists of the input layer, hidden layer and output layer. The number of each layer depends on the input images fed which connects to each layer with the neurons. The Fig. 1 illustrates the three layers connectivity with neuron structure where nodes are used for each layer.

The total number of nodes or layers in each ANN is dependent on the number of input images used. The input layer process and connects itself to the hidden layers depending on the data set used by the input layer. There are two types of data set trained and untrained data set which produces the accuracy by using a supervised and unsupervised learning approach with different type of neural network architectures like feed forward, back propagation method which uses the data set at a different manner. The rest of the paper is organised as follows: Section 2 gives a detailed description about the different types of neural networks with the respective architecture, Section 3 summarises the different types of neural networks with a complete survey table with a discussion of the networks and finally the paper is concluded in Section 4.

2. Artificial Neural Networks (ANN)

Royan Dawud Aldian *et al.*[1] propose an automatic classification for normal and abnormal cervical cells with artificial neural networks (ANN) and learning vector quantification (LVQ). The sample data sets are collected which performs the steps in digital image processing like pre-processing, filtering and feature extraction. The input image is stored in ANN and for the classification of cervical cells for detection of cancer the LVQ method is used for calculating the coefficient mean value of the extracted image which is used for classifying the normal and abnormal cell with 90% accuracy result. Fatemeh Hoda Moghimi *et al.*[2] propose artificial neural network (ANN) techniques used for the health clinic purpose where a multi-layered perceptron is used in the ANN to map the thinking and key components. The architecture of ANN consists of one input layer and one output layer with no restriction in the number of hidden layers used. The ANN is used in all medical applications and can be easily mapped with the learning approaches for better understanding and results. Aabha S. Phatak *et al.*[3] propose a new method for detecting cervical cancer with Support vector machine (SVM) and Artificial neural network (ANN) for detection of cervical uterus cancer. Soorya Praba *et al.*[4] provides a comparison in the Pap smear classification methods with neural networks; k nearest neighbour and Bayes classifier. The three classifiers are used for the classification of normal and abnormal cells. The input image is fed where the features required are extracted for the classification results. A three layered ANN is used which is used with the input, output and hidden layer. The data set used is a trained data set which produces accurate results than other classifiers. N. Mustafa *et al.*[5] propose a methodology with artificial neural network by extracting the new features of cervical cells. The input image is obtained from the Pap smear slides where the perimeter, area, red, blue and green colour are extracted with their intensity levels which helps the ANN to classify the cervical cells into normal and cancerous cells.