Chapter 80
Neural Network Based Automated System for Diagnosis of Cervical Cancer

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ABSTRACT

Cervical Cancer is one of the most common cancers among women worldwide. Few concerns have arisen such as the shortage of skilled pathologists leading to increase in burden on them. This requires a need for efficient and accurate method that diagnoses cervical cancer without human intervention. In this paper, an automated system is developed for diagnosis of cervical cancer using image processing techniques and neural networks. The system is developed using Cytology images taken from Bangalore based cancer pathologist. MATLAB image processing toolbox is used to extract features from cytology images that are used for discriminating various stages of cervical cancer. The dominant features used for diagnosis are Nucleus to cytoplasm ratio, shape, and color intensity along with nucleus area, perimeter and eccentricity. These features are used to train the neural network using Back-propagation algorithm of supervised training method. The cytology cells were then successfully classified as non-cancerous, low- grade and high-grade cancer cells.

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INTRODUCTION

Cervical cancer in women is one of the most common cancers worldwide, next only to breast cancer. Middle- aged women between the ages of 40-55 years are mostly affected by this cancer. Every year cervical is diagnosed in about 500,000 women globally and is responsible for more than 280,000 deaths annually (Medindia, n.d.). Nowadays there is a wide variation in the number of cervical cancer cases across the globe. Risk factors include smoking, unprotected sex or having HIV infection, prolonged use of birth control pills. In the western side, prevalence of this disease is gradually decreasing because of the early detection through regular screening. 80% of the new cervical cancer cases occur in developing countries, like India, which reports approximately 1/4th of the world's cases of cervical cancer each year (Medindia, n.d.).

The National Cancer Control Program (NCCP) formulated and funded by the Ministry of Health, Government of India has stressed upon the implementation of community based cervical screening program at least in select districts of each state. The NCCP has made provision for fund to be given to all the states to implement the cancer control program that includes cervical cancer screening activities (Satija, n.d.; Basi, Chowdhury, n.d.).

Cervical cancer occurs when abnormal cells in the cervix multiply at a faster rate and grow out-of-control. The abnormal changes that the cervical cells develop transform them to a pre-cancerous state which is referred to as 'Cervical Intraepithelial Neoplasia' (CIN). Based on its degree or intensity, these changes are classified as low grade CIN and high grade CIN. This cancer is caused by a virus called Human Papilloma Virus (HPV).

Two popular screening tests which help in the early detection of cervical cancer or prevent cervical cancer are: (i) Pap test (or Pap smear)-looks for pre-cancer cell changes on the cervix. (ii) HPV test-looks for the HPV virus that causes the cell change. Another popular screening method is the Liquid Based Cytology (LBC). LBC is a way of preparing cervical samples for examination and diagnosis in the laboratory. Detection rate is higher using LBC than Pap test. All these processes are proved to be time consuming and might yield erroneous results. This paper presents an efficient and proficient method for the diagnosis of cervical cancer using Artificial Neural Networks from cytology images.

In the machine learning and cognitive science, ANN is a family of statistical learning model inspired by biological neurons. ANNs learn from standard data and capture the knowledge contained in the data. Trained ANNs approach the functionality of small biological neural cluster in a very fundamental manner. They are the digitized model of biological brain and can detect complex nonlinear relationships between dependent as well as independent variables in a data. Nowadays, ANNs are widely used for medical applications in various disciplines of medicine (Al-Zaytoonah, 2011).

The neural network is trained using the back-propagation algorithm of the supervised training method.

Lassouaoui, Hamami, and Nouali (2007) discuss morphological description of Cervical Cell Images for the pathological recognition. This may be used to develop a computer system which can help doctors in tracking the cervical cancer. It includes various algorithms for detection of the cellular components and the stage of discriminating the abnormal signs of cells. The descriptions are ratio core cytoplasm, the nuclear deformity, the cytoplasm deformity, the heterogeneous texture of each cell component and anisocariose. The obtained characteristic vectors of each cell are the input of the recognition stage of computer system of tracking the cervical cancer.

Supriyanto et al. (n.d.) developed a detection system that is able to differentiate between normal and cancerous cells by using colour intensity classification. Another method is proposed by Karthigai