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Malignancy Detection using Pattern Recognition and ANNs

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Abstract - *The image is composed of information and pixels. Image processing can be broadly defined as the manipulation of signals which are inherently multidimensional. Cancer is a complex, whole-body disease that involved multi-factors, multi-processes, and multi-consequences. As we know, the growth of cancer is a complicate progress. Pattern recognition is an effective methodology to discover key molecule-panel for cancer. More specifically, it provides efficient reasoning in large-scale medical image databases using techniques for scalable and accurate medical image retrieval in potentially massive databases to provide real-time querying for the most relevant and consistent instances for decision support. The occurrence of malignancy is not simply a site change, but the change at multiple sites, so now gradually moving to study the composition of several mutation gene patterns. Artificial Neural Networks (ANNs), Genetic Algorithms (GAs) and Fuzzy Logic are CI non-symbolic learning approaches for solving problems. The huge mass of applications, which ANNs have been used with satisfactory results, has supported their rapid growth.*

Key Words: **Image Processing, Artificial Neural Networks (ANNs), Pattern Recognition, Malignancy diagnosis, Cancer**

1. INTRODUCTION

Melanoma is a **cancer** that develops in melanocytes, the pigment cells present in the **skin.** It occurs when the pigment-producing cells that give color to the skin become cancerous. Melanocytes are skin cells found in the upper layer of skin. They produce a pigment known as melanin, which gives skin its color. There are two types of melanin: eumelanin and pheomelanin. When skin is exposed to ultraviolet (UV) radiation from the sun or tanning beds, it causes skin damage that triggers the melanocytes to produce more melanin, but only the eumelanin pigment attempts to protect the skin by causing the skin to darken or tan. Melanoma occurs when DNA damage from burning or tanning due to UV radiation triggers changes (mutations) in the melanocytes, resulting in uncontrolled cellular growth. Skin cancer is the most commonly occurring malignancy, with basal and squamous cell carcinomas (both of which are classified as non-melanoma) comprising the majority of skin cancer cases.

Nowadays, many patients are concerned about their health and mostly focused on diseases like cancer. The best optimal biomarker is only changes in cancer patients and can be easily detected. By far the most common cancer biomarkers are generally to detect the removed cancer tissues, which is an invasive operation. If the tumor is too little to be found, or it is difficult to get the tumor tissue, those biomarkers are helpless.[13]

We know that growth of cancer is a serious health issue for everyone. From DNA, RNA, protein to metabolite, all the differences in the levels of DNA, RNA, protein, and metabolite between cancer patients and health persons could be called biomarkers. Before cancer occurred, DNA/RNA/protein and the environment changes in normal cells could make normal cell changes into differentiation disorder cell, which is considered the cause of cancer. With the development of image technology, it was founded that imaging features of cancer appearance have a close relationship with the diagnosis and prognosis of patients. Imaging features could become a new type of biomarkers.[10]

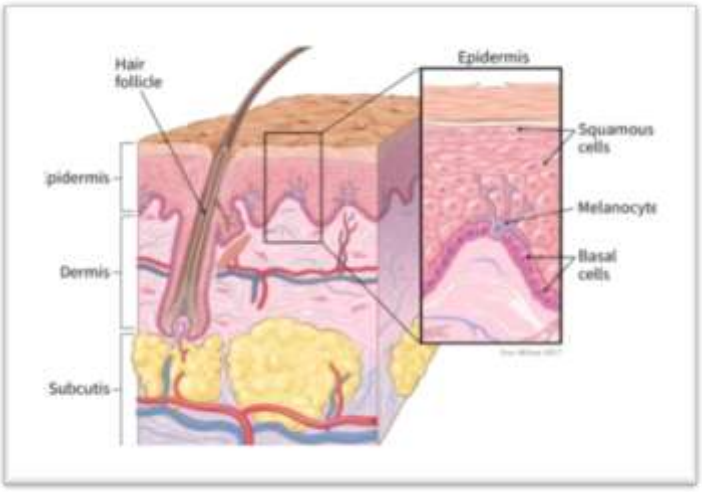

Fig-1: Melanoma Skin Cancer

1.1 Symptoms of melanoma

1. The most common sign of melanoma is the appearance of a new mole or a change in an existing mole. This can happen anywhere on the body, but the most commonly affected areas are the back in men and the legs in women.
2. Melanomas are uncommon in areas that are protected from sun exposure, such as the buttocks and the scalp.
3. In most cases, melanomas have an irregular shape and are more than 1 colour.
4. The mole may also be larger than normal and can sometimes be itchy or bleed.

2. METHODS AND MATERIALS FOR DIAGNOSIS

Here, a computational approach is used for the diagnosis of melanoma. With the development of image technology, it was founded that imaging features of cancer appearance have a close relationship with the diagnosis and prognosis of patients. Imaging features could become a new type of biomarkers. However, the neural models applied today in various fields of medicine, such as oncology, do not aim to be biologically realistic in detail but just efficient models for nonlinear regression or classification. Authors found that ANN may represent a potentially more useful decision support tool than conventional statistical methods for predicting the outcome for such diseases.[4]

A new method named Decision Forest for SNPs (DF-SNPs) has been developed from a novel adaptation of the Decision Forest pattern recognition. The DF-SNPs method can be used to differentiate esophageal squamous cell carcinoma cases from controls based on individual SNPs, SNP types, and SNP patterns.

The data sets were chosen randomly without replacement from the full data set with the restriction that the proportion of cancer and non-cancer cases was kept constant. We used 70% of the data (1,754 NMSC cases and 322,402 never cancer cases) for training and 30% for validation (752 NMSC cases and 138,172 never cancer cases). The National Health Interview Survey (NHIS) adult files are surveys that are publicly available[20] with the corresponding manuals and criteria included (which vary by year).

2.1 Image Pre-processing

The dermoscopy images are in digital format. The standard image size is taken as 512*512 pixels. The image consists of hairs and other components and the causes of in accuracies in the detection of melanoma [11]. The aim of the preprocessing can be done through three process they are image enhancement, image restoration and hair removal. Image processing is removal of noise in the images like hairs are removed using software dull razor. The post-processing is done for enhancing shape and edges of images are applied into segmentation processing.[1]

Noise presented in the image can reduce the capacity of region growing filter to grow large regions or may result as a fault edge. When faced with noisy images, it is usually convenient to preprocess the image by using weighted median filter. Weighted Median (WM) filters have the robustness and edge preserving capability of the classical median filter. WM filters belong to the broad class of nonlinear filters called stack filters. This enables the use of the tools developed for the latter class in characterizing and analyzing the behavior and properties of WM filters, e.g. noise attenuation capability. A weighted median filter is implemented as follows:

W(x, y) =median {w1 x x1…wn x wn} x1…..xn are the intensity values inside a window centered at (x,y) and w x n denotes replication of x, w times.[1]

3. IMPLEMENTING AN ARTIFICIAL NEURAL NETWORK (ANN)

For our ANN model, we have used 12 neurons in each layer and both genders were considered. As we know, ANN model generally relies on the 'back propagation algorithm with certain terms that uses Gradient Descent taking the whole datasets at once. In back propagation network input signals follows in forward direction and the output of the network is compared with desired output. If both are not same an error occurs at the reverse pass, the error is back propagation and weights of hidden and output layer are adjusted.[6] This process continues until error is zero or within set to liable limits.

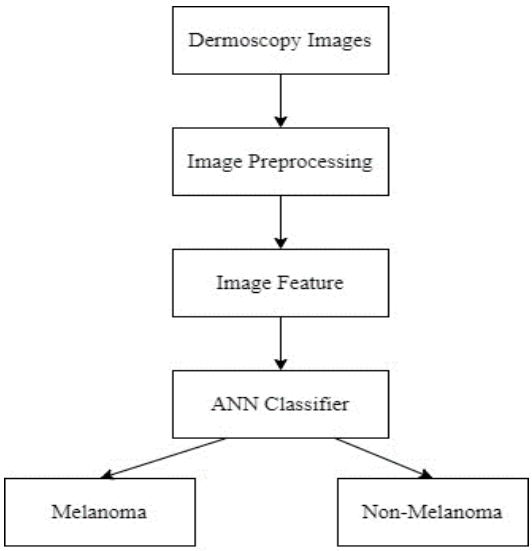

Fig-2: Proposed System Architecture

In the following system, activation function used in a linear function which gives output as 0 for non-cancerous and 1 for cancerous. The network is trained with known values. After training network perform decision making.[2] The data for classification is given as input to classifier. Inputs were normalized to fall in between 0 and 1 and the activation function was sigmoid.

3.1 Alternate method

There has also always been another approach for the cancer detection. This is somewhat similar to ANN, but here the accuracy of predicting the true value, i.e., whether the patient has cancer or not comes out as miscalculation. Using the unsupervised learning method, gradient descent of the training sets might get confused the best optimal local minimal and global minimal. Here, where the prediction of classification takes turns. This method although further classifies the symptoms but not quite efficient and may result in wrong prediction.

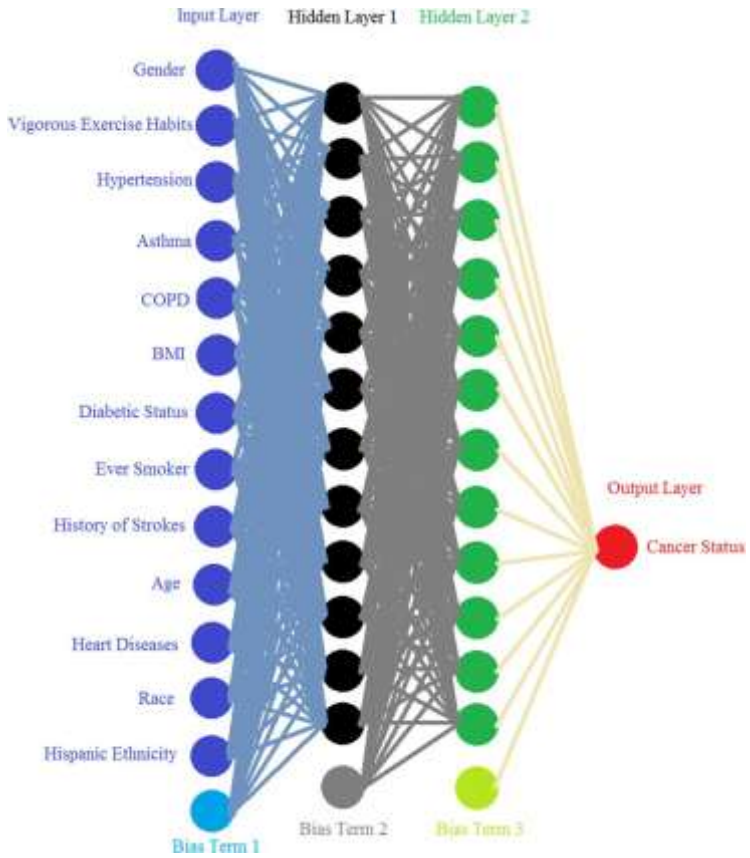

Fig-2: ANN Model

3.2 Data Availability

All data used in this paper is publicly available through the CDC's website. At the time of submission, the url: https://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm, goes directly to the webpage from which each year of NHIS data can be found.[2][3]

4. RESULT AND ANALYSES

The 12 features are selected for classification and given as input to as neural network classifier. Activation function used in linear function which gives an output as 0 or 1. While this neural network was primarily designed to aid skin cancer diagnosis based on clinical images, our neural network is used for prediction of non-melanoma skin cancer risk based on personal health informatics. All the studies and data reveal the potential for neural network approaches to improve the diagnosis and/or management of patients at risk of NMSC. As such, our model is a predictive one that can help focus diagnostic resources on the most vulnerable patients. The accuracy of the proposed technique is 95%

5. CONCLUSIONS

In this research we have discussed a computer aided diagnosis system for melanoma skin cancer with ANN as classifier using back propagation. Our approach is easy-to-implement, non-invasive, and cost-effective while achieving comparable sensitivity and specificity to other approaches which often require ultraviolet radiation exposure and family history data. The target area is segmented and the evaluation of this tool from the doctor, whom the project is cooperated with, is positive and this tool helps the doctors in diagnosis, the treatment plan making and state of the tumor monitoring. In future, the system should be improved by adapting more segmentation algorithm to suit the different medical image segmentation.

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