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Skin Cancer Detection and Classification using Artificial Neural Networks

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Abstract-:

Melanoma being the most unpredictable and life-threatening cancer, has been on the rise in recent times. In most of the cases being fatal, if treated early, the fatality rate might be lowered severely. Hands-on Melanoma detection at primary stages with the unassisted eye is error-prone and requires vast knowledge and experience. Number of expert dermatologists being inadequate, a computerised and automated approach is needed to accurately detect Melanoma. The following study tries to achieve this feat by developing a neural network that can effectively detect and classify Melanoma. The process begins with preprocessing of dermoscopic images to remove hairs with the Maximum Gradient Intensity algorithm and also enhancement of the images is done. Segmentation based on the Otsu Thresholding algorithm is applied to separate skin lesions from the images. Multiple features like ABCD, GLCM, and LBP are then calculated from the segmented images which will be used to train a neural network. The network was successful to attain an accuracy of 97.7% on the combined dataset of ISIC archive the PH2 dermoscopic image database. The proposed method was found to be more accurate than existing methods and incorporates much more feature information from the images.

I. Introduction:

Skin cancer is any mass that results from an abnormal and an uncontrolled growth of cells in the Skin.There are two main types of cancers:malignant cancers and benign cancers.Cancerous cancers can be divided into primary cancers that started within the skin and those that spread from somewhere else known as Skin metastasis cancers.benign cancers generally have a slower growth rate than malignant cancers. Its threat level depends on a combination of factors like the type of cancer,its location,its size and its state of development.Skin cancers either include cancers in the central

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spinal canal or inside the cranium.The National Skin Cancer Foundation(NBTF)for research in United States estimates that 29,000 people in the U.S are diagnosed with primary Skin cancers each year,and nearly 13,000 people die.In the UK,over 4,200 people are diagnosed with a Skin cancer every year(2020 estimates).There are about 200 other types of cancers diagnosed in UK each year[3].

Fig:1:Basalcellcarinoma

Magnetic Resonance Imaging(MRI)is one of the best technologies currently being used for diagnosing Skin cancer and it create more detailed pictures.Automatic defects detection in MRI is quite useful in several diagnostic and therapeutic applications[4,5].MRI is one imaging modality that helps researchers and medical practitioners to study the Skin by looking at it non-invasively.With the advances of digital image processing,radiologists have a chance to improve their performance with automatic methods like computer-aided detection(CAD)system and ANN's.Computer-aided diagnosis(CAD)aims to increase the predictive value of technique by pre-reading medical images to show the locations of suspicious abnormalities,and analyse their characteristics,as an aid to the radiologist. Neural networks are one application of artificial intelligence and it's a model that emulates a biological neural network.An ANN's is composed of a collection of interconnected neurons that are often grouped in layers.neurons is the processing elements(PE's)in a network.Each neuron receives input data,processing it,and delivers a single output.A neural network is a powerful computational data model that is able to capture and represent complex input/output relationships.And it provide a powerful tool to help doctors to analyse,model and make sense of complex clinical data across a broad range of medical applications.Most applications of artificial neural networks are classification problems such as pattern recognition;that is,the task is on the basis of the measured features to assign the patient to one of a small set of classes. Dermoscopy consists of a visual examination of the skin lesion that is optically enlarged and illuminated by halogen light. This is a non–invasive approach called in-vivo that plays a

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significant role for early melanoma detection. This technique permits the revelation of morphologic features; and in such scenarios enable early prediction and diagnosis. While measurement of these morphologic characteristics is highly recommendable and significant, in practice, it is an extremely complex task [10]. The Second Consensus Meeting on Dermoscopy, organised in 2000, concluded with an agreement to employing four algorithms for the purpose of skin lesion evaluation, vis a pattern analysis, ABCD rule, Menzies method and the 7–point check

II. Literature survey:

1. Melanoma Skin Cancer Detection and Classification using Support Vector Machine-Melanoma skin cancer detection at an early stage is crucial for an efficient treatment. Recently, it is well known that, the most dangerous form of skin cancer among the other types of skin cancer is melanoma because it's much more likely to spread to other parts of the body if not diagnosed and treated early. The non-invasive medical computer vision or medical image processing plays an increasingly significant role in clinical diagnosis of different diseases. Such techniques provide an automatic image analysis tool for an accurate and fast evaluation of the lesion. The main purpose of svm is to detect the presence of cancer. The results show that the achieved classification accuracy is 92.1%

2. Wiltgen, Marco, A. Gerger, and Josef Smolle. "Tissue counter analysis of benign common nevi and malignant melanoma." International journal of medical informatics (2003)-The aim of this study was to evaluate the applicability of tissue counter analysis to the interpretation of skin images.Digital images from microscopic views of benign common nevi and malignant melanoma were classified by the use of features extracted from histogram and co-occurrence matrix. Eighty cases were sampled and split into a training set and a test set. The images were dissected in square elements and the different features were calculated for each element. The classification was done by classification and regression trees (CART) analysis.Though wrong classification of individual elements is unavoidable to some degree, tissue counter analysis shows a good discrimination between benign common nevi and malignant melanoma. In conclusion, tissue counter analysis may be a useful method for the interpretation of melanocytic skin tumours.

3. McGovern TW, Litaker MS. Clinical predictors of malignant pigmented lesions, "A comparison of the Glasgow seven-point

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checklist and the American Cancer Society's ABCDs of pigmented lesions",1992-The ABCD Acronym for melanoma screening was devised in 1985 to provide the lay public and primary health care professionals are used for the early recognition of potentially curable cutaneous malignant melanoma. The well-known parameters (ABCD)of Asymmetry, Border irregularity, Colour variegation, and Diameter greater than 6 mm are used globally in medical education and in the lay press to provide simple parameters for appraisal of pigmented cutaneous lesions that may need to be further examined by a specialist.Specialist evaluation may result in further workup of pigmented lesions via dermoscopy, biopsy, or both. Over the course of their 19-year history, the ABCD criteria have been widely described,3-5 disseminated,6-9 verified,The incidence of cutaneous melanoma has increased over the past several decades, making its early diagnosis a continuing public health priority.The ABCD (Asymmetry, Border irregularity, Colour variegation, Diameter 6 mm) acronym for the appraisal of cutaneous pigmented lesions was devised in 1985 and has been widely adopted but requires reexamination in light of recent data regarding the existence of small diameter (6 mm) melanomas. Available data do not support the utility of lowering the diameter criterion of ABCD from the current greater than 6 mM guideline.

III. Proposed methodology:

Skin has a very complex structure and is considered as a kernel part from the body and it is a soft, spongy mass of tissue. It is protected by: The bones of the skull, Three thin layers of tissue (meninges) and Watery fluid (cerebrospinal fluid) that flows through spaces between the meninges and through spaces (ventricles) within the Skin.A Skin cancer or intracranial neoplasm occurs when abnormal cells form within the Skin. Intracranial tumours are a diverse group of tumours that differ in localization, symptoms, histological composition and the occurrence of some species depend on age. The most common symptoms are limb movement disorder, numbness, vision, speech or mental changes. Another group of symptoms are resulted from local Skin tissue irritation manifested as different types of seizures. Syndrome of increased intracranial pressure is referred to a set of symptoms, which include mainly headache, vomiting and visual disturbances.

Type of Skin Cancers-There are more than 100 types of Skin and spinal cord cancers

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(also called central nervous system or CNS cancers). They are usually named after the cell type they started in but there are two basic kinds of Skin cancers; primary Skin cancers and metastatic Skin cancers

Primary Skin Cancers-Primary Skin cancers start, and tend to stay, in the Skin; there are several type of primary cancer described below:

A. Malignant Cancer-Malignant tumours usually grow rapidly and spread within the Skin and spinal cord. Malignant Skin tumours can also be life-threatening. About 40% of Skin and spinal cord tumours are malignant. These include: IV cancers have increasing degrees of malignancy. Grade IIastrocytomas have slightly unusual looking cells. The cells of a grade III and IV astrocytoma are very abnormal in appearance.Glioblastoma is generally found in the cerebral hemispheres of the Skin, but can be found anywhere in the Skin or spinal cord.other tumours, malignant cells are also found in surrounding tissue.

B. Benign Cancer-Benign cancers are typically surrounded by an outer surface (fibrous sheath of connective tissue) or remain with the epithelium.Benign tumours usually have slow- growing cells and clear borders (margins), and they rarely spread. However, they may be found in essential areas of the Skin that control vital life functions, which can make them life-threatening .Some benign Skin tumours can develop into a rapidly growing malignant tumour.This process is called malignant transformation.The most common types are:

Metastatic Skin Cancers-Cancer cells that begin growing elsewhere in the body and then travel to the Skin form metastatic Skin cancers. For example, cancers of the lung, breast, colon and skin (melanoma) frequently spread to the Skin via the bloodstream or a magnetic-like attraction to other organs of the body. All metastatic Skin cancers are, by definition, malignant, and can truly be called "Skin cancer ". **Artificial Neural Networks-** Artificial neural networks is one of applications of artificial intelligent and it has a wide used in medical diagnosis system.

Architecture of ANNs-An artificial neural network (ANN) is a computational model that attempts to account for the parallel nature of the human Skin. An (ANN) is a network of highly interconnecting processing elements (neurons) operating in parallel. These elements are inspired by biological nervous systems.

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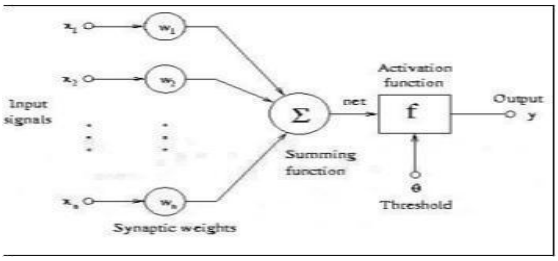

Fig2:mathematicalmodel of discreteperceptronorneuro

As in nature,the connections between elements largely determine the network function. A subgroup of processing element is called a layer in the network. The first layer is the input layer and the last layer is the output layer. Between the input and output layer, there may be additional layer(s) of units, called hidden layer(s) [25]show in figure(3.6) the mathematic operation for each perceptron or processing element(neuron) describe in figure(3.7).The weights in an ANN express the relative strengths (or mathematical values) of the various connections that transfer data from layer to layer. In other words, the weights express the relative importance of each input to a Processing element

IV. Simulation results:

Malignant melanoma (see the image below) is a neoplasm of melanocytes or a neoplasm of the cells that develop from melanocytes. Although it was once considered uncommon, the annual incidence has increased dramatically over the past few decades. Surgery is the definitive treatment for early-stage melanoma, with medical management generally reserved for adjuvant treatment of high locally advanced melanoma and metastatic disease.

Fig3:Malignantmelanomaexample-1

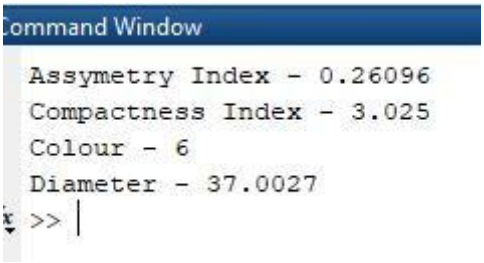

Fig4:Malignantmelanomaparameteroutput

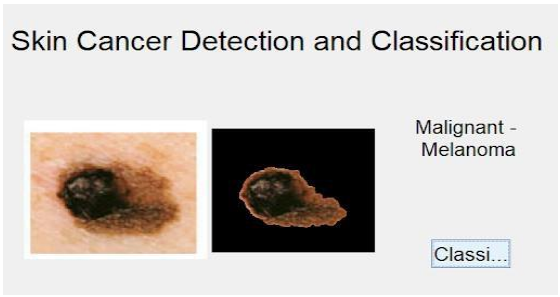

Fig5:Malignantmelanomaexample-

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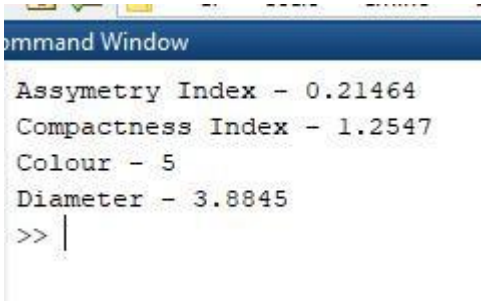

Fig6.:Malignantmelanomaparameteroutput

V. Conclusion:

The proposed method aimed to design an automatic algorithm to detect Skin cancer from MRI images with the help of Artificial neural networks. This algorithm has been successfully designed and Simulated.The proposed method analysis was used to extract features from images, which are computed from equations of Haralick's features based on the spatial grey level dependency matrix(SGLD). And the best suitable eight features are been selected in order to detect the cancer.For artificial neural networks the feed-forward back propagation neural network with supervised learning was used to classify the images to with or without cancer.And all the best eight features were used as input parameters for back propagation network,then the network was trained and its performance was evaluated.Which gives the features like Asymmetry Index,Compactness Index,Color,DiameterAnd all the results of this study step by step were presented in window of Graphic User Interface(GUI). The system is designed to be user friendly by creating Graphical User Interface(GUI).The cancer is isolated from the MRI Skin images by using integrated image processing algorithm based on a modified method texture detection algorithm called spatial gray level dependency matrix(SGLD) of images using MATLAB.The Skin cancer detection and classification is successfully implemented by using the image processing tool box,neural network tool box and graphical user interface.Finally, the proposed algorithm,which based on the back propagation network has been successfully tested and achieved the best results with accuracy 99%,and sensitivity 97.9%.

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