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Survey on Medical Image Diagnosis Techniques and Features

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Abstract-The ability to acquire images from inside a patient has revolutionized the way doctors diagnose and treat diseases, with almost all clinical pipelines now involving imaging to some degree. The development of these imaging methods has led to the field of medical image computing, where a multitude of tools and techniques have been proposed to aid clinicians and researchers in interpreting and analyzing these images. Most of researcher has proposed various techniques on single disease type either tumor, covid, malaria, heart attack, etc. This paper has summarized some of image features used for the medical report diagnosis. Techniques proposed by various scholars are also detailed in the paper. Various types of medical imaging techniques were also brief. Evaluation parameters used for comparison of methods were also mention in the paper.

Index Terms-Digital Image processing, Medical image diagnosis, Image feature extraction, Heathcare analysis

I. INTRODUCTION

Ever since the first images from inside the human body were taken using X-Rays in 1895, the field of medical imaging has progressed at a considerable rate. While traditional X-Ray imaging has stood the test of time and is still used today, it has been joined by ultrasound, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), and Single Photon Emission Computed Tomography (SPECT), among others. Each of these imaging modalities fills an important and often complementary niche in clinical practice providing greater insight into the human body in both health and disease than would have ever been possible without them. The desire for detailed images of the brain has driven much of this progress, leading to the development of the field of neuro imaging.

The modern-day clinician now has an arsenal of techniques at their disposal allowing for highly detailed images of individual brain structures, as well as precise measures of brain activity and processes such as metabolism and the accumulation of proteins. As per the medical image reports of a patient experts diagnose disease. As high quality image developing devices by various techniques like X-Ray, CT-Scan, MRI, etc. [3] increases the dependency of radiologist, pathologist. As most of image interpretation done by medical experts, so to reduce their load and increase the accuracy of work by automation of image diagnosis algorithms. Most of computer vision algorithms were develop to identify the image content and classify images as per visual information reflect by X-Ray, Light, Margnet, etc. [4]. Still classification of medical images into correct class for different disease is a major issue to solve.

As imaging equipment becomes more and more prevalent, so too does the demand for computational solutions to process and analyse the complex images being produced increase. As such, the field of medical image computing has grown in parallel with that of medical imaging, and now has many journals and conferences dedicated to its advancement. The overriding goal is to develop computing techniques which can leverage the acquired imaging data to extract the maximum amount of useful information to improve patient outcomes. In pursuance of this, Machine Learning (ML) algorithms have become ubiquitous with applications all across the medical imaging spectrum: from identifying regions of interest (segmentation), to categorising whole images (classification), to deriving characteristics from images (feature extraction), to aligning multiple images (registration), to creating images from the raw data provided by the scanner (reconstruction).

II.FEATURE EXTRACTION

Colour feature: Image could be a matrix of light strength values, these intensity values represent completely different type of colour. Thus to spot an object colure is a very important feature, one vital property of this feature is low computation price. Different Image files available in different color formats like images have different colure format ranging from RGB that indicate red, green, and blue.

Edge Feature: As image could be an assortment of intensity values, and with the fast modification within the values of a picture one vital feature arises because the Edge as shown in figure 4. This feature is use for various kind of image object detection like building on a scene, roads, etc [5, 7]. There are several rule has been developed to effectively illustrate all the pictures of the image or frames that are Sobel, perwitt, canny, etc. out of those algorithm canny edge detection is one amongst the most effective algorithm to search out all potential boundaries of a pictures.

Texture Feature: Texture could be a degree of intensity distinction of a surface that enumerates properties like regularity and smoothness [6]. Compared to paint house model, texture needs a process step. The feel options on the premise of color are less sensitive to illumination changes as same on edge options.

Corner Feature: So as to stabilize the video frames in case of moving camera it need the distinction between the two frames that are illustrated by the corner feature within the image or frame. Thus by finding the corner position of the two frames one can notice resize the window in original read. This feature is additionally use to search out the angles still because the distance between the item of the two completely different frames. As they represent purpose within the image thus its use to trace the target objects.

DWT Feature: Its a frequency domain feature used to transform pixel values in frequency domain having four region first is flat region, other is horizontal edge region, similarly vertical and diagonal edge region. Each of image subsection was obtained by combination of low pass and high pass filters.

DCT Feature: This is another frequency domain feature. Low frequency values were obtained in left top corner of the image matrix. Cosine transformation operation was apply to get this feature set coefficients. The classic and still most popular domain for image processing is that of the Discrete Cosine Transmit, or DCT. The DCT permit an picture to be broken up into some different- different frequency bands, creating it more easier to ward embed data hiding information into the middle frequency bands of an image. Here middle frequency region is used for the data hiding as this part remain unaffected in case of noise or compression attack. One more factor is that visual frequency region is present in low frequency part of the image. So embedding is done by placing the LSB portion of the pixel.

III.LITERATURE SURVEY

Mehedi Masud et. al. in [5] proposed an algorithm that detects a deadly and common disease called malaria specially designed as a mobile healthcare solution for the patients. The main objective of the paper focuses on convolution or deep learning architecture and it proves to be useful in detecting malaria disease in real-time accurately by imputing images and thus reduces the manual labor in the detection of the disease.

Fuhad et. al. in [6], given a deep learning technique by which analysis can be done automatically. By this, the need for trained professionals will be drastically reduced as the model will give accurate and automatic results. This model is based on CNN (Convolutional Neural Network) and can be used in the diagnosis of malaria by taking input in form of microscopic blood images. These techniques include Autoencoder, knowledge distillation, and data augmentations features and are classified in form of k-nearest neighbors or support vector machine. This was further performed by three training procedures namely autoencoder, general distillation, and distillation training to improve the accuracy of the model.

P. A. Pattanaik et. al. in [7] given a comprehensive computer-aided diagnosis (CAD) concept to identify the parasites of malaria in the blood images. The parameters of this model were trained by using artificial neural network techniques followed by a stacked autoencoder. 12500-2500-100-50-2 was the optimum size kept for this CAD scheme out of which the input layer consist of 12500 nodes and the output layer of the softmax classifier possesses 2 nodes. A 10 fold cross-validation system was also used to prove the reliability of this model by comparing it with blood smear images of any new patient.

Sahni P. et. al. in [8] given MRI and a mammogram as the two important modalities to detect accurately the portions of the body that contains tumors. The tumourous part of the body was then separated from the extracted image by using the segmentation method together with the threshold model and edge detection method.

Y. Wang et. al. in [9] given an automatic ultrasound for the breast region. The method was found to be more innovative and promising for screening the breast region. As compared to the conventional B-mode 2-dimensional ultrasound the ABUS is operator-free and provides a 3D image of the whole breast. But the reviewing of the obtained ABUS images is time-intensive and oversight errors may occur. To solve this, a new 3D network was introduced to be incorporated in ABUS so that reviewing can be accelerated to achieve a high level of sensitivity together with FPs or low false positives. The paper had given a deep method of supervision to increase the sensitivity by using the multi-layer features. The paper is also given a threshold loss for the voxel level for finding out the difference between cancer and non-cancer regions to attain higher sensitivity together with low false positives condition.

J. Zheng et. al. in [10] the work starts with an examination of breast masses for several diagnostic by using CNN-based transfer process. It includes prognostic and predictive tasks in several image patterns such as mammography, digital breast tomosynthesis, and MRI of magnetic resonance imaging. The layer contains many convolutional layers, Max-pooling, and LSTM layers. The classification was also performed in the softmax layer and fully connected layer. The paper focuses on the concept of combining such machine learning concepts for finding out the desired features and extracting them by recognizing and using this data for evaluating their output by segmentation and various other techniques for accurate results.

Shivangi Jain et. al. in [11] given a method for the detection of skin cancer named Melanoma by using a computer-aided method and various image processing tools. At first, the input to this system was given in the form of a skin lesion image and then it is passed through unique image processing techniques to analyze the possibility of cancer in the sample. The image analysis tools checks for various Melanoma cancerous conditions parameters such as ABCD, diameter, asymmetry, border colors by analyzing the shape, size, and texture of the sample and segmenting them in various stages.

Kalwa, U. et. al. in [12] Presented a smartphone app to capture the border irregularity, asymmetry, color variegation, and diameter of the entered skin lesion sample. Using all the above features the classification of the malignancy was provided by using the concept of vector machine classifiers. Several adaptive algorithms and data processing algorithms were used to make the app user-friendly and reliable to detect Melanoma cancerous conditions in the skin lesion. Input can be in the form of public datasets or images captured from the camera. The app runs n any Android smartphone that is equipped with a detachable lens of 10x and can process the image within a second.

Mohammad Ashraf Ottom in [13] built a deep learning computer model to predict the new cases of cancer. In this, the first stage is to analyze the image and segment and prepare its data to find the useful part of the image. It also reduces the amount of noise and illumination in images to detect the sharp boundaries of the image or objects. Finally, the proposed scheme of the network contains three max-pooling layers, three convolution layers together with four fully connected layers.

Jianxin Wang et. al. in [14] proposed an efficient and novel classification network named Attentive Dense Circular Net (ADCN) which based on Convolutional Neural Networks (CNN). The ADCN is inspired by the ideas of residual and dense networks and combines with the attention mechanism. We train and evaluate our proposed model on a publicly available red blood cells (RBC) dataset and compare ADCN with several well-established CNN models.

IV.MEDICAL IMAGE TYPES

There are several medical imaging modalities that involve ionizing radiation, nuclear medicine, magnetic resonance, ultrasound, and optical methods as a modality media. Each modality media has a special characteristic and differences response to human body structure and organs tissue [15].There are four imaging modalities [16]

Projectional Imaging X-rays are a form of electromagnetic radiation (EM), which has a wavelength range between 0.1-10 nm. They are translated into photons with energy levels, 12-125 keV. The x-ray imaging projection used almost at the same time with the need to use laboratory testing as a medical diagnostic tool. Image formation process is divided into three main steps: Image preread, Image main read, Image processing [16].

Computed Tomography (CT) The conventional x-ray imaging projection sometimes fails in achieving good results because of tiny differences in attenuation (less than 5%). CT improves the subject contrast using discrimination less than 1%. The application for cancer screening such as lung and virtual colonoscopy often uses CT. There are several variations of CT imaging, namely: Positron emission tomography (PET) / CT, CT perfusion, CT angiography, Dual source and dual energy CT [16].

Magnetic Resonance (MR) A powerful magnetic field is used in Magnetic Resonance Imaging method (MR) for the nuclear magnetization alignment of hydrogen atoms in water molecules. MR became the standard of cross-sectional imaging modalities that useful to visualize soft tissues (such as muscle, brain), fat and bone (especially marrow bone) [16].

Ultrasound Imaging The high- sound waves with the frequency range from 1- 20 MHz that can be applied to produce cross-sectional images of the human body. The strength of the echo ultrasound return depends on the characteristics of biological tissue which they pass through.

Evaluation Parameters

$$Precision = \frac{True\_Positive}{True\_Positive + False\_Positive}$$

$$Recall = \frac{True\_Positive}{True\_Positive + False\_Negative}$$

$$F\_Score = \frac{2 * Precision * Recall}{Precision + Recall}$$

$$Accuracy = \frac{Correct\_Classification}{Correct\_Classification + Incorrect\_Classification}$$

V.CONCLUSIONS

In hospitals radiology settings, image processing plays a vital role since it is necessary to extract information from region of interest, measure the volume of specific structures, and analyze morphology of the target/tissue organ in radiological images. There have been large number of literature in recent years trying to solve the problem of medical images area. This paper, summarize related literature in medical image with explanation of work done by various scholars. Techniques used and proposed by scholars were mentioned in the paper. Paper has details various types of medical imaging techniques and features used by the method for image diagnosis. In future scholar can proposed a model that can commonly takes any medical image and gives an output of infection without any technical requirements.

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