Human Health Image Diagnosis Features and Techniques

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Abstract— **Human has increase the comfort in the day to day life, sometime this brings some serious health issues as well. So dependency on medical professional is highly increases. To reduce such load image vision develops medical report diagnosis algorithms that contribute in decision making for specific issue. This paper has involved the detailed explanation of various approaches proposed by image diagnosis researchers, especially chest images of covid-19. As image work depends on feature selection hence paper has list few of features that increases the understanding of topic. Some of classification techniques of image were also discussed. Comparing parameters for image diagnosis techniques were also list in paper.**

Index Terms— Data analysis, Digital image processing, Information classification, visual processing.

I. INTRODUCTION

Medical imaging is the process of obtaining visible images of internal body structures for the purposes of scientific and medical research and treatment, as well as a visible view of the function of internal tissues. This process also includes obtaining a visible view of the function of internal organs. The diagnosis and treatment of disorders are the intended outcomes of this procedure. This procedure creates a database of the normal structure and function of the organs, which makes it simple to identify any abnormalities that may occur. Sonography, magnetic scopes, imaging using electromagnetic energy (X-rays and gamma), organic and radiological imaging, as well as imaging using isotopes and radioactive substances, are all components of this process.

Shan et al. proposed an automatic segmentation and quantification system based on deep learning for the initial research on COVID-19 [4]. This system would use image segmentation theory to study the chest computer tomography (CT) infection area and the overall structure of the lungs, as well as man-machine loop optimization to annotate each case. Deep learning was used by Wang et al. from the Cancer Hospital of Tianjin Medical University to extract COVID-19 image features, a learning model was established to analyse positive cases, and a theoretical basis was provided for the timely and accurate diagnosis of COVID-19 [5]. The Affiliated Hospital of Huazhong University of Science and Technology's researchers used three-dimensional CT to detect the novel coronavirus pneumonia and a three-dimensional neural network based on weakly supervised deep learning to classify positive and negative cases in order to rapidly identify COVID-19 cases [6].

Researchers like Asmaa and Mohammed from Arthurs University and Birmingham City University used convolutional neural networks (CNNs) to identify and classify novel coronavirus pneumonia images. They also used a class decomposition mechanism to study its class boundary to deal with irregularities in the dataset, and they achieved good results [7]. This was done with the goal of increasing the availability of COVID-19 annotated image datasets. Deep convolutional neural networks were utilised by Li in his research on positive cases of chest CT image data from patients suffering from novel coronavirus pneumonia [8]. In order to develop an efficient diagnostic method for COVID-19 disease, Rehman et al. utilised both previously acquired knowledge and transfer learning in order to differentiate it from viral pneumonia, bacterial pneumonia, and healthy people [9].

When imaging technology becomes more widespread, there is a corresponding increase in the demand for computing solutions that can interpret and analyse the ever more complex images that are produced. As a direct consequence of this, medical image computing has expanded in tandem with the expansion of medical imaging, and there are now a great deal of papers and conferences dedicated to the expansion of this field. The primary objective is to develop computational methods that can make use of the acquired imaging data to derive as much meaningful information as possible in order to improve the outcomes for patients. As a consequence of this, machine learning (ML) algorithms have gained popularity across the entire spectrum of medical imaging, with applications ranging from segmenting regions of interest (segmentation), classifying whole images (classification), extracting characteristics from images (feature extraction), aligning multiple images (registration), and creating images from the raw data provided by the scanner. In short, ML algorithms have been used for everything from segmenting regions of interest to classifying whole images to extracting characteristics from images (reconstruction).

In order to improve the quality of medical care, researchers proposed various learning algorithms for diagnosis. In this study, various visual contents such as edge, histogram, DWT, and DCT, as well as others [3] were used to extract image features that could be used for categorization. The learned behaviour of CNN, RNN, DNN, and other learning models was then applied to the extracted features [4]. On a single set of medical images, each model was evaluated to see how well it performed. As a consequence of this, the researchers need to develop a model that is capable of making accurate predictions regarding multiple diseases.

II. Related Work

Alexander Zotina and colleagues [7] published a paper in 2017 in which they described a method for improving image clarity and clearance by using the fewest possible setup parameters on the input image. They were able to accomplish this by separating the process that was performed by medical professionals into two distinct sets of digital procedures. During the first set, they concentrate on the image quality and the segmentation of the object of concern, which is a tumour, in order to construct an edge map. In the second round of testing, they carried out data analysis by computing the parameters that were derived from the diagnosis.

A two-method combination of multi-modal combination fusion and convolution neural network detection was evaluated in 2019 by M. Li. et al. [8]. This paper utilised the 2D CNN and 3D CNN multimodal extension by getting brain lesion for distinct features in 3D. This was accomplished by first solving the 2CNN of raw input for the various modal information that was present at raw input faults. To get rid of the issue of overfitting and to speed up the process of convergence, a genuine normalisation layer was added after the convolution and pooling layers. This layer was placed between them. As a direct consequence of the enhancements made to the loss function, a weighted loss function has been included in the lesion area in order to advance the feature learning process.

Hong Huang et al. in 2019 [9] used the FCM clustering algorithm in conjunction with a rough set theory for the picture segmentation approach. After acquiring the data from the FCM segmentation result, the authors create an attribute table with the data, and then use the attributes to segment the image into smaller and smaller sections. When calculating the distance between two regions, weighted values, which are obtained through value reduction, are factored into the equation. In later years, the equivalency difference degree was found to be true. This value of the final equivalence degree is used to evaluate the segmentation of the image as well as the merge regions. The technology is restricted to only being able to produce MRI brain scans and CT images that have been manufactured artificially.

The techniques of multilevel feature extraction and concatenation were utilised by N. Noreen et al. in the year 2020 [10] in order to detect early tumour diagnosis. This project utilises the two different models known as Inception V-3 and DensNet201 in order to establish the two different alternative methods for the identification and diagnosis of cancers. The tumour detection characteristics of the inception model were retrieved from the pre-trained inception model V3 and concatenated at the beginning of the process. After that, the SoftMax classifier was used to determine what kind of brain tumour the patient had. In a similar manner, the DensNet201 was utilised to extract features from the Dens Netblock, which were subsequently concatenated and sent through the SoftMax classifier in order to locate the tumour. As a consequence of this, three datasets of class tumours that are open to the public are used to check both modalities.

In the year 2020, Hari Mohan Rai and colleagues will construct a deep neural network for the diagnosis of cancer that has fewer layers and less complexity in its architecture than the U-Net [11]. A data set containing 253 images needed to be sorted into categories of normal and abnormal MRI scans. There was a reason for doing so. Before this, MRI scans were resized, cropped, pre-processed, and supplemented in order to guarantee an accurate outcome and facilitate deep neural network training as quickly as possible.

An algorithm developed by Mehedi Masud and colleagues to detect malaria, a dangerous and common disease, was published in the year 12 and is intended to be a mobile healthcare option for people who are afflicted with the condition. Convolutional or deep learning architecture, which has been shown to be beneficial in detecting malaria disease in real-time by imputing images and thereby reducing the amount of manual labour required in disease detection, will be the primary focus of this paper. The paper's primary objective is to focus on convolutional or deep learning architecture.

Covid-19 Image Classification

In their paper [13], Q. Yan and colleagues present a feature variation block that can automatically adjust the global properties of the features in order to segment COVID-19 infection. The FV block that has been proposed has the potential to improve the capability of feature representation both effectively and adaptable for a wide variety of cases. We handle the complex infection areas that have a variety of appearances and shapes using a method that we've developed called Progressive Atrous Spatial Pyramid Pooling. This method fuses features at different scales. The performance of the suggested approach is comparable to that of the most recent innovations.

In the paper [14], written by Zhang et al., an attempt is made to improve the classification accuracy using domain shift between datasets, specifically COVID-DA. This is done within the context of a semi-supervised framework, which means that both labelled and unlabeled data are used for the purpose of learning the model. The training set contains a total of 8154, 2306, and 258 CXR images, respectively, categorised as normal, pneumonia, and COVID-19.

Before conducting a comprehensive study on several widely used models like VGG, ResNet, DenseNet, Inception-ResNet, Inception-V3, and MobileNet-V2, El Asnaoui and Chawki [15] divide pneumonia into bacterial pneumonia and viral pneumonia. This is done so that the results of the study can be more accurately compared. The dataset that was used includes 231 COVID-19 cases, 1583 normal cases, 2780 bacterial cases, and 1493 viral cases. Eighty percent of the samples were used for training, and the remaining twenty percent were used for testing. Finally, they have determined that the InceptionResNet-V2 is superior to all other models with an overall accuracy and F1-score that are, respectively, 92.18% and 92.07%.

Liang et al. [16] proposed a multimodal Deep Belief Network (DBN) as a means of conducting an unsupervised learning strategy-based analysis of cancer data. The DBN is able to identify cancer subtypes based on genomic data as well as clinical data, and it can capture intra-modality correlations as well as cross-modality correlations. If the dataset used for training is relatively small, however, their method might not have the capacity for generalization if it does not employ higher-level feature fusion. In addition, the works described above do not address the issue of the missing modality in situations involving multiple modalities. In the research that we conducted, CT images and EMR data were utilised to make severity assessments of the COVID-19 patients. Particularly in the case that a sample has a problem with a missing modality (for example, there are no available CT images), other available modalities can be a complement.

The findings of Chang Min et al. in [21] As a solution to these problems, the authors of this paper propose a model for the detection of chest X-ray outliers that makes use of dimension reduction and edge detection. An X-ray image is scanned with a window of a specific size using the proposed method. Difference imaging of adjacent segment-images is then performed, and the AND operation is used to extract edge information in a binary format. It is computed in convolution with the detection filter that has a coefcient of 2n in order to convert the extracted edge, which is visual information, into a series of lines. The lines are then categorised into one of sixteen different types. The reduced data is then used as an input to the RNN-based learning model. This is accomplished by counting the converted data, which results in the production of a one-dimensional array with a size of 16 for each image segment. In addition, the research carried out a number of experiments in order to evaluate the effectiveness of the proposed model. These experiments were based on the COVID-chest X-ray dataset.

III. Features of Image Classification

Color Feature The image could be a matrix of light intensity values, and each of these intensity values would represent a different kind of colour [7]. The colour feature could be described as: Therefore, the ability to recognise an object's colour is a very important feature, and a low computation price is an essential component of this feature. There are many different image files available, each with its own unique colour format. For example, images can have any number of colour formats, ranging from RGB, which stands for red, green, and blue.

Edge Feature: As an image can be a collection of intensity values, and with the rapid change in the values of a picture, one important feature emerges as the Edge, as shown in figure 4. Edge Feature: As an image can be a collection of intensity values. This feature can be utilised for the detection of a wide variety of image objects, including roads, buildings, and other similar elements [5, 7]. There are several rules that have been developed to effectively illustrate all of the pictures of the image or frames, such as Sobel, perwitt, and canny, among others. Out of all of those algorithms, canny edge detection is one of the most effective algorithms to search out all of the potential boundaries of a picture.

Texture is a property that enumerates qualities such as regularity and smoothness [6]. Texture can be thought of as a degree of distinction in the intensity of a surface's appearance. When compared to the paint house model, the texture model requires an additional step in the process. The feel options based on the colour premise are less sensitive to changes in illumination than the same on edge options.

Corner Feature: In the event that the camera is moving, it is necessary to be able to differentiate between the two frames that are being displayed within the image or frame thanks to the corner feature. This allows the video to remain stable. Therefore, resizing the window in the original text can be accomplished by locating the corner position of the two frames and using that information. This function can also be used to determine the angles still as the distance between the item in the two distinct frames. because they serve a purpose within the image and can therefore be used to trace the objects that are the focus of attention.

DWT Feature: It is a frequency domain feature that is 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 [8,9]. [DWT Feature] A combination of low pass and high pass filters was used to obtain each image subsection.

DCT Feature: This is another feature that falls under the frequency domain umbrella. In the top left corner of the image matrix, low frequency values were found to be present. In order to obtain these feature set coefficients, the cosine transformation operation was applied. The Discrete Cosine Transmit, also known as DCT, is an image processing technique that is considered to be both an industry standard and one of the most widely used today. The DCT makes it possible to separate an image into a number of distinct frequency bands, which makes it much simpler to secretly embed data hiding information into the middle frequency bands of an image. Due to the fact that this part of the spectrum is unaffected by either noise or compression, the middle frequency region is utilised here for the purpose of data hiding. The fact that the visual frequency region can be found in the low frequency part of the image is yet another consideration. Therefore, embedding is accomplished by positioning the least significant bit (LSB) of the pixel.

III. Techniques of Image Classification

The Image Classification methods are [17, 18]:

1) **Support Vector Machine :** This technique creates a set by using vectors. Use of hyperplanes in a high-dimensional space, which is used to illustrate the classification or statistical regression purposes. The healthy distance between them realized by the use of the hyperplane. SVM uses non-parametric with an approach based on binary classification and capable of handling more input data efficiently. The hyperplane has an effect on accuracy.

2) **Artificial Neural Network (ANN):** Artificial neural networks Artificial neural networks is a form of artificial intelligence that sends out certain signals. Functions that the human mind is capable of an ANN is having a a layered progression or sequence. Every level of the neural network structure comprised of a group of nerve cells called neurons. Neurons can be found in every layer linked by weighted connections to all of the neuronal layers prior to and following the current one. The precision is determined by on the amount of inputs that are available and the layout of the network.

3) **Decision Tree:** A decision tree is a graph that is structured like a tree decisions. Each fork reflects the decisions that need to be made created using graphical means. It is a supervised non-parametric analysis approach. It does so by dividing the input into standard classes. The acceptance or rejection of class is made possible through method label at each subsequent stage in the process. The set can be obtained through this method a set of rules that come after classification that need to be comprehended.

4) **Maximum likelihood classifier:** Maximum Likelihood is a type of image classification that requires human oversight method that involves calculating the probability value of individual pixels into account for the purpose of classifying the pixels [14]. Within this method, the probability of every pixel belonging to a certain class can be calculated as calculated. After that, we compare these values to one another. The pixel is this: attributed to the category that possesses the highest probability value. For the purposes of this method, it is presumed that each of the input bands normal distribution.

5) Minimum distance classifier: A supervised image is what the minimum distance classifier is a technique for classifying images in which the pixels are categorized according to how far away their spectra are from the average of the pre-defined categories [19]. This technique begins by calculating the mean vector for the training dataset is used to inform the calculation of each class. Next, utilising the algorithm for finding the shortest distance, the Euclidean the distance of each pixel that has not been classified from the mean vector is calculated. After that, the pixel is assigned to the class that contains the minimum distance. Calculating the distance between a specific pixel and a number of different class mean vectors typically involves using the Euclidean distance: This particular classification method is not overly complicated mathematically, and as a result, it also requires less effort to implement in practice. When compared to all of the other techniques for supervised classification, it has the quickest computation time requirements. The fact that this method only considers the average value makes it less effective than other approaches; as a result, it has fewer advantages technique that is more effective than maximum likelihood.

6) Random Forest (RF) : RF is a type of supervised machine learning algorithm [19] that primarily functions to solve problems by classifying data in order to make predictions. This algorithm combines several different Decision Trees, and the more trees it uses, the more precise the results will be. These decision trees are then trained to produce outputs (predictions), and the Random Forest algorithm will choose the best prediction (solution) based on the voting. The decision trees are fed data and trained to produce outputs. A tree of possible choices. The selection of data samples at random from a dataset is the first step in the Random Forest algorithm. After that, a decision tree is constructed for each selected sample, and the results of the predictions made using each tree are compiled. After all of the information has been compiled, a voting procedure is carried out in order to select the most accurate prediction result as the ultimate answer.

7) Nearest neighbour-based methods : This method can determine whether a given data point is irregular by analysing its proximity to other points, also known as neighbours, or by focusing on the density [20]. The k-Nearest Neighbors algorithm is one of these methods (kNN). The anomaly score, which is the distance between the neighbours, is what this method uses to calculate (data instances). If the score is higher than a certain score level, then it is considered to be anomalous. Checking to see if the density around a data point is low or high can help determine whether or not a point should be considered anomalous based on density. The data point is considered abnormal if the density is low, whereas it is considered normal if the density is high. For instance, an algorithm known as Local Outlier Factor (LOF) is a method that is used in conjunction with k-nearest neighbours to compute the average density ratio of the points and anomaly score in order to determine whether or not there are any abnormal behaviours. This allows the algorithm to determine whether or not there are any outliers in the data. When it comes to determining the density of information in large datasets, LOF performs significantly better than kNN. However, when applied to large datasets, both of these methods have problems with their scalability. The reason for this is that in order to determine nearest-neighbors, both of these methods need to compute the distance between the data points. In addition, the use of these two methods raises the bar for the level of computational complexity required in both the training and the testing phases.

IV. Evaluation Parameters

In order to evaluate results there are many parameter such as accuracy, precision, recall, F-score, etc. Obtaining values can be put in the mention parameter formula to get results.

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

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

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

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

V. Conclusions

The corona virus pandemic has stretched the healthcare systems in every country in the world to its limit as they had to deal with a large number of deaths. Early detection of the COVID-19 in a faster, easier, and cheaper way can help in saving lives and reduce the burden on healthcare professionals. Artificial intelligence can play a big role in identifying COVID-19 by applying image processing techniques to X-ray images. This paper has detailed various methods proposed by scholars for medical image diagnosis. It was found that most of paper has utilized deep learning techniques for the classification in different image classifications. As per techniques features were extract from the image, but all has its own set of features. Use of color based feature were higly effective in the models. In future scholars can develop a model that can more effective classify image in les time.

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