IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

CARDIOVASCULAR DISEASE DETECTION USING IMAGE PROCESSING TECHNIQUE

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Abstract

Cardio vascular diseases are typically diagnosed via cardiac imaging. The primary goal of this study is to use CT imaging with a machine learning technique to diagnose heart problems (Artificial neural network). Pre-processing, segmentation, and classification are just a few of the image processing methods used. Here, segmentation and classification of the CT picture are crucial for diagnosing the condition; ANN is employed for segmentation and classification. Machine learning is emerging as the artificial intelligence tool that will aid in the diagnosis of cardiovascular disorders. For each operation, we can build a new algorithm to create precise and automated output. So that the doctor may more clearly detect heart abnormalities and proceed with further treatment, the experiment's results are helpful.

Keywords: Cardiovascular disease, CT image, Artificial Intelligence Network.

I. INTRODUCTION

Coronary heart, cerebrovascular, peripheral arterial, and congenital heart diseases all fall under the umbrella term of cardiovascular disease (CVD). Heart attacks and strokes are the leading causes of death in 4 out of every 5 CVD patients. The World Health Organization (WHO) [1] estimates that over 17.9 million people have died worldwide from heart disease, making cardiovascular diseases (CVDs) the leading cause of mortality worldwide. A category of illnesses known as cardiovascular diseases lead to heart and blood vessel failure in people. Many symptoms include chest pain, an accelerated heartbeat, trouble breathing, and light-headedness.

As a fact, CVDs are complex as the human body, and they are caused by different risk factors such as obesity, high blood pressure, and high Cholesterol. Diagnosing an infection with heart disease requires specialized cardiologists with complicated procedures and tests to figure the accurate and efficient treatment. Cardiovascular disease can be prevented by early diagnosis, followed by healthy eating, exercising, and avoiding alcohol consumption. In undeveloped countries, patients suffering from cardiovascular disease are diagnosed with a severe delay at times, or they are transported over long distances unnecessarily, with the increase in the cost of travel and treatment, which is a burden on them.

To successfully diagnose the patients into has a heart disorder or not, AI science has been involved with other sciences to solve real-life problems automatically. Nowadays, AI algorithms are used in disease diagnosis and detection . AI with medicine helped the doctors to make decisions in some complicated cases in addition to predicting the high-risk patients of getting infected by a disease such as heart disease or Cardiovascular disease. In our work we use artificial neural network to detect the cardiovascular disease.

II. LIETRATURE SURVEY

Cardiovascular disease can be diagnosed in large part by using cardiac imaging (CVD). Its job has only up until now been to analyse heart structure and function visually and quantitatively. Big data and machine learning, however, have created new prospects for the development of artificial intelligence technologies [2] that will directly help the physician in the diagnosis of CVDs. Cardiovascular diseases, which influence people's lives and claim lives worldwide, are a worry. The development of noninvasive methods of detection, better and accurate classification and risk stratification, diagnosis and prognosis in CVD, and the study of disorders with risks have all been made possible by machine learning applications as well as advancements in radiomics and image-based studies, even though conventional methods are still in use. The ability of cardiovascular imaging devices to record and store enormous amounts of data keeps growing. New computational techniques from the machine learning community provide fresh ways to take advantage of the expanding amount of imaging data that is now available for analysis.

Machine learning techniques [4] are now able to handle a variety of data-related issues, from straightforward analytical queries of already-existing measurement data to the more difficult difficulties associated with processing raw photos. Machine learning has thus far been used to automate operations that would otherwise be handled by humans and to generate new information that is crucial for clinical practise, two very large and linked fields. The majority of cardiovascular imaging studies have concentrated on task-oriented issues, however there is an increasing number of research incorporating algorithms that aims to produce fresh therapeutic insights. Strong interest in using potent deep learning techniques, in particular, to evaluate this data is being sparked by the continued growth in the size and dimensionality of cardiovascular imaging databases. In general, the most successful strategies will include investing in the resources required to properly prepare such massive data sets for studies.

The necessity of diagnosis makes research on heart disease [5] crucial. When waiting for surgery, it's critical to discuss image processing and diagnosis in relation to medical angiography images. They are all done to avoid postponing surgery. As a result, cuckoo algorithm-based diagnostic tools and medical engineering optimization techniques are suggested in this study. An ideal bio-inspired diagnostic model was given in this study [6]. The primary modality for the diagnosis and treatment of Coronary Artery Disease (CAD) and its accompanying conditions has long been coronary angiography employing specialised X-ray imaging devices. Experimental findings on several test photos of patients taken using different methods are given. Our quick bio-inspired diagnostic model delivered successful findings.

Cuckoo optimization with a bio-inspired algorithm has been used for edge identification and noise reduction. With a medical advisor, the angiography interpretation has been debated.

III. METHODOLOGY

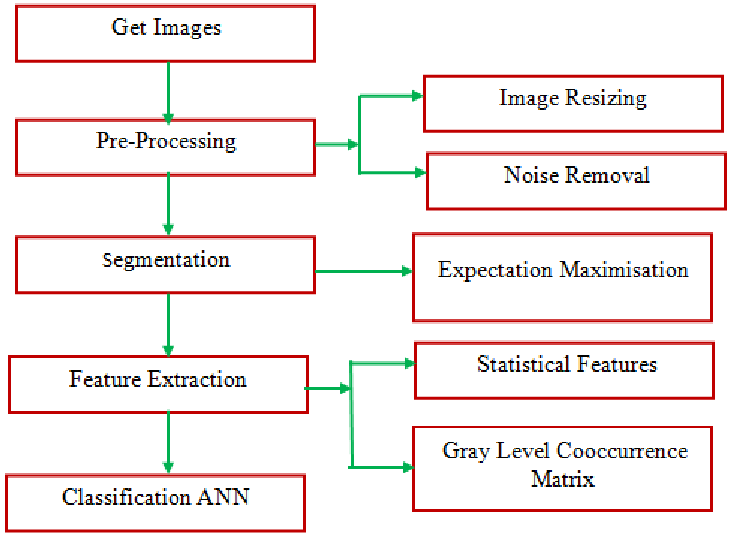

Fig.1. Proposed methodology

Pre processing:

Pre-processing is a term used to describe operations where the input and output images are intensity images, which is the lowest level of abstraction. Pre-processing aims to improve the image data by reducing undesirable distortions or enhancing certain elements that are crucial for subsequent processing. The term "image pre-processing" refers to actions performed on images at the lowest level of abstraction with the goal of enhancing certain image attributes that are crucial for subsequent processing or improving the image data. It doesn't add more image data to the images. Its techniques [7] make extensive use of picture redundancy. If a distorted pixel can be identified in a picture, it can be restored as the average value of nearby pixels because neighbouring pixels in actual images that relate to the same object have the same or similar brightness values.

Noise Removal Using Median Filter

The median filter is a nonlinear digital filtering technique, often used to remove noise from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing [8] (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise (but see discussion below), also having applications in signal processing. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighbouring entries.

Segmentation

The conversion of analogue images into digital ones is known as digital image processing. The difficult and crucial step in image processing is segmentation. Image segmentation is the process of dividing a picture into meaningful sections that share characteristics and qualities. The goal of segmentation is simplification, or portraying an image in a form that makes sense and is simple to analyse. The initial stage of image analysis is image segmentation. Image segmentation's primary objective is to separate an image into many portions or segments with similar traits or qualities.

Image segmentation [9] is a technique used to divide an image into relevant sections that share characteristics and qualities. The goal of segmentation is simplification, or portraying an image in a form that makes sense and is simple to analyse. The initial stage of image analysis is image segmentation. Image segmentation's primary objective is to separate an image into various portions or segments that share characteristics or qualities. Human eyes see colour in an image as a combination of R (red), G (green), and B (blue). Red, Green, and Blue are the three primary colours. From R, G, and Bcolor represented by either linear or nonlinear transformations, further types of colour components can be produced.

Although there is currently no accepted theory for segmenting colour images, the RGB colour components indicate the entering light, or the brightness values of the image that can be acquired using (Red, Green, and Blue filters). We currently only have two types of colour image segmentation methods: natural and ad hoc. There are no universal methods that are regarded as the best for colour image segmentation; instead, colour segmentation strategies vary depending on the application. The basic goal of colour segmentation is to identify certain objects in photographs, such as lines, curves, and other shapes. Each pixel in a picture is given a label during this process, and pixels with the same label have certain visual properties.

The fact that these two sets of equations can be resolved numerically is where the EM algorithm [10] gets its start. To estimate one of the two sets of unknowns, one need just choose arbitrary values for one of the unknowns, estimate the second set using those new values, estimate the first set using these new values, and so on until the resulting values both converge to fixed points. The likelihood derivative is (arbitrarily close to) zero at that point, indicating that the location is either a maximum or a saddle point, even though it is not evident that this will work in this situation. There is generally no certainty that the global maximum will be discovered; instead, there may be many maxima. Certain likelihoods also contain singularities, or absurd maxima. For instance, one of the solutions that EM might discover in a mixture model entails lowering one component's variance to zero and the component's mean parameter to match one of the data points.

Medical image reconstruction frequently use the EM algorithm (and its quicker variation ordered subset expectation maximisation), particularly in positron emission tomography and single photon emission computed tomography.

Extraction of Features

The process of feature extraction[11] is used in machine learning, pattern recognition, and image processing. It begins with a set of measured data and creates derived values (features) that are meant to be informative and non-redundant, easing the learning and generalisation processes and, in some cases, improving human interpretations. Dimensionality reduction and feature extraction are connected.

When an algorithm's input data is too extensive to process and is thought to be redundant (such as when the same measurement is given in feet and metres or when pixels are used to represent images), it can be reduced to a smaller collection of characteristics (also named a feature vector). The process of selecting a portion of the first characteristics is known as feature selection. In order to do the intended task using this reduced representation rather of the whole starting data, it is expected that the selected features will contain the pertinent information from the input data.

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The process of feature extraction begins with a collection of measured data and develops derived values (features) meant to be useful and non-redundant. This process speeds up the learning and generalisation processes and, in certain situations, improves human interpretations. Dimensionality reduction and feature extraction are connected.

To identify the disease, the GLCM feature and statistical features are taken from the image.

Classification

Both organised and unstructured data can be classified. Data is categorised using the process of classification into a predetermined number of classes. Finding the category or clas that fresh data will fall within is the basic objective of a classification challenge. Classification [12] is a supervised learning strategy used in machine learning and statistics, where the computer software learns from the data input provided to it and then applies this learning to classify fresh observations. This data set may be multi-class or it may just be bi-class (for example, indicating whether the individual is male or female or if the message is spam or not). Speech recognition, handwriting recognition, biometric identity, document classification, etc. are a few instances of classification issues.

Data is categorised using image classification, which examines the numerical characteristics of distinct image features. Training and testing are typically the two processing processes used by classification algorithms [13]. A distinct description of each classification category, or "training class," is developed during the initial training phase using the characteristic qualities of typical picture features. These feature-space divisions are then utilised to categorise picture features in the testing phase.

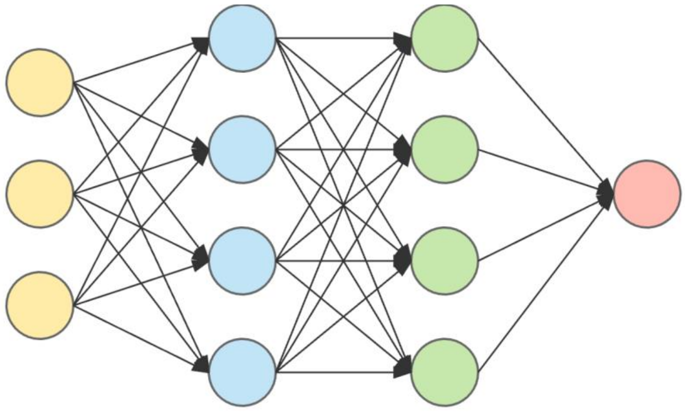

Fig.2. Architecture of ANN

Computing systems inspired by the biological neural networks that make up animal brains are known as artificial neural networks (ANN) or connectionist systems [14]. The neural network itself is not an algorithm; rather, it serves as a framework that allows numerous machine learning algorithms to cooperate and handle large amounts of complex data. Such systems "learn" to execute tasks by taking into account examples, typically without having any task-specific rules written into them. The term "cardiovascular disease" (CVD) covers a wide range of conditions that affect the heart or blood vessels. This is frequently linked to atherosclerosis, which is the buildup of fatty deposits in the arteries, and a higher risk of blood clots. One of the leading causes of morbidity and mortality in the world's population is regarded as cardiovascular disease. Clinical data analysis and healthcare professionals have a crucial problem in predicting and diagnosing the disease in order to save lives and prevent people from developing it. Massive volumes of data are gathered by the healthcare sector, some of which contains diagnostic information for cardiac disease and is useful for decision-making. Moreover, heart disease analysis and diagnosis can be done using AI algorithms and neural networks. The goal of the initiative is to quickly identify cardiovascular illness. In the research we've proposed, we apply an artificial neural network for classification and the expectation maximisation method for segmentation.

IV CONCLUSION AND FUTURE WORK

Heart disease is currently one of the leading causes of death. In this study, artificial neural networks (ANNs) and machine learning algorithms were employed to identify heart disease utilising cardiovascular disease and heart disease data (ANN). The outcomes can be used to inform recommendations for enhancing and improving heart disease diagnosis. Thus, this could aid medical professionals in making quicker and more effective decisions when diagnosing cardiovascular illness.

Cardiovascular CT applications have the potential to increase clinical workflow effectiveness, deliver precise and repeatable quantitative findings, speed up interpretation, and provide guidance for ensuing treatment courses. While keeping the high diagnostic value of cardiovascular CT, image reconstruction can be sped up using machine learning methods that lessen data noise and heart motion abnormalities.

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