

Rheumatoid Arthritis Prediction by Thermal Image Processing and Neural Network

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Abstract

RA is inflammation diseases and is used to predict the arthritis it will affect the body parts is legs, joints, and wrist and many others. RA is one less part of arthritis with the help of the arthritis we can detect the patient is actual suffer or not, also we will use the thermal image by using the thermal camera to detect the total pixel area of thermal image and in image we can select the any area that are present in thermal image all the process is going through the MATLAB processing system. Also we will detect the actual value of skin area and total pixel we can use the neural network. Neural Networks helps to check the previous database and get the correct output for these also it will be available to different technique to do a various logical, statistical parts are included neural network includes three layers that is input , middle ware layer and output layer it will goes from these three layer and it will get that result.

Keywords: *Rheumatoid arthritis, inflammation, backpropogation algorithm, thermal imaging*

I. INTRODUCTION

Arthritis is the type of disease that usually affects the joints of the body. There are various types of arthritis such as rheumatoid .Rheumatoid arthritis is the autoimmune disease that causes chronic or inflammatory disorders and affects the joints that are of primary types such as the finger joints , wrist joint etc. It also attacks flexible joints. The disease is of unclear aetiology. In this disease the immune system starts attacking the body's tissues, that causes inflammation. This disease results in the joint pain, stiffness, swelling and sometimes to deformity of joints .There are certain clinical signs such heat, breathing rate, pulse rate etc. Thermal image technique or processing using the MATLAB environment plays an important role in the analysis of the inflammation in joints. Thermal imaging is the non invasion method that is used to detect the pathogenic disorder of the joints as with other disorder that can be diag. The importance of this technique is due to the non-invasion thermally graphic method on referring both the health and operation point of view.

The technique is based on the thermo graphically detecting system. So, thermography is define to be the best way of detecting the disease with minimum

error by using the tool available in the environment. It is important to detect the rheumatoid arthritis at the early stage itself as it results in the painful condition which can lead to the substantial loss in the mobility of the joints. Due to this there is requirement of such system that is intelligent enough to detect the arthritis at early stage. With reference to the complication that are involved in the detection of the disease it gives us the idea of designing such a system which ensures us with the possible outcomes and that is used in many ways with different approaches. Such designing of the system will be useful to easily detect the abnormal region from the image easily by using various algorithm with standard calculation that are needed.

The reason why to use thermal imaging technique is that there is no need of direct contact with the physical part of the body which cause not much pain to the body of the person. The next possible advantage can be the one which is crucial that is the time required to analyze such a defect is negligible and with the appropriate measures. The traditional methodology for such an arthritis is very complex and due to this many experts they offer the test which includes looking the joints for tenderness, swelling, painful or very less

movement. The patterns of the joints and the number also indicate RA.

For the disorder to know the specialist will be questioning few questions that may depend on the family background of the patient. Such answers give the idea to the expert about the genetic situation of the patient. It is mandatory for the patient to give the answer correctly to get the inference from such review. On the basis of such review the specialist they make some results that help them to detect the disorder by knowing the family background. After this activity now it depends on the reports of the test that had been considered. Here the test does not end there are many image techniques that need to be considered while doing so.

The imaging technique includes various other methods such as the X-ray, computerized tomography (CT), magnetic resonance imaging (MRI), and ultrasound. There are various other environments needed to go through each test and thus the cost varies. The first technique deals with the capturing of the image using low level radiation like-wise the overall methods have some or the other way to capture the image and then on the basis of these images the overall report is generated. Then such report is to be studied by the experts and

then they give the solution on such disorder level.

To overcome such a lengthy process we decided to provide a best and the proper system to predict such a complicated disorder with full accuracy as per as our level is considered. As per as the engineering point of view our work is just to provide a solution that is based on the various algorithms that have been considered as per the requirement.

II. EASE OF USE

A. Design and Implementation

The overall implementation of the software module is as per the following flow chart. The flow chart consists of various different aspects of the implementation and each of them are been used for different methods to deal with. The overall process consists of following methods such as image acquisition, image processing, result. In the image processing module there are two sub processes included such as image segmentation and image analysis. The result module consists of again the decisions made by neural network on the basis of database.

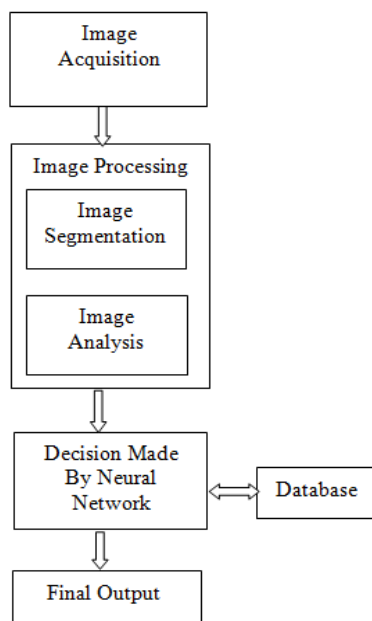


Fig1: flow chart

Image acquisition is the define as the process of the selecting the image from typical type of storage. There are the various type of image x-ray, computerized tomography, magnetic resonance imaging and ultrasound. This process is to acquire the image and so that the image is called a thermal images. Thermal image is basically acquired with some colours that we can capture the image by thermal camera.

Image segmentation is the process of detecting the arthritis by using some algorithm. In the image segmentation there are lot many calculations are done by using the different mechanism and the different types of algorithm.

The image analysis is use to analyse the thermal image. It can be related to some statistical parameters. This parameter is use to detect the arthritis on the thermal images.

Neural network is the one of the type of database. It is use to show the previous data set and insert the new data in the database. There are some layer include in neural network that is hidden layer and outer layer according to this layer it work to the some statistical parameters that are involved. This parameter are depends on the algorithm that has been used to predict the results. In Neural Network, there are different types are available for image processing and pattern recognition like statistical, hybrid, structural and so on. Neural network is like it predict the backbone of dataset that are already discover and present in before.

B. Implementation

The implementation is basically all about the software that has been designed for the utility of the overall analysis. The methodology consist of various different modules that is been shown in the form of the screenshots that are taken while considering the actual software design. The step wise representation of each module is been shown in each and every

module. The implementation is all about how the software will work. The working module is been shown with the help of different screenshots. The actual processing in step by step approach is shown with well-defined manner in the

following figures. By considering the flow diagram the whole architecture of the software is designed. Only by taking into consideration the aspect of the methods that need to be implemented the whole procedure takes place.

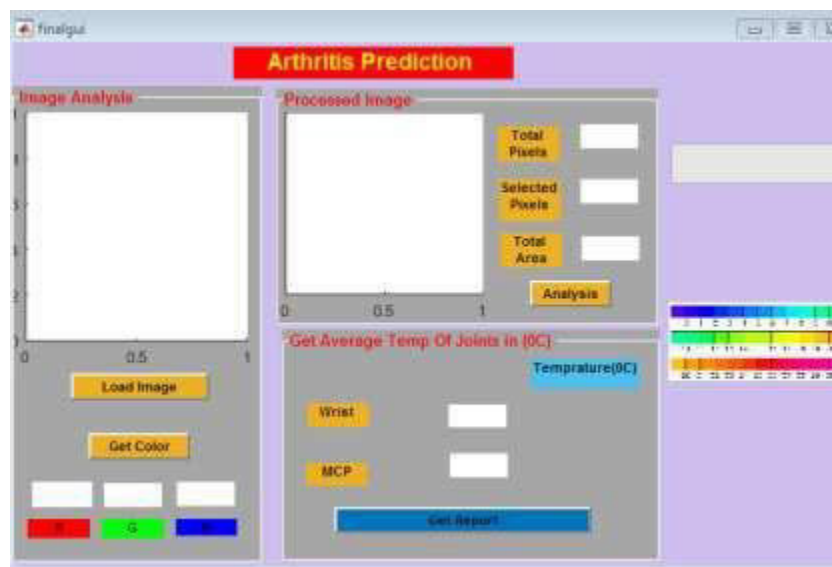


Fig 2: GUI design

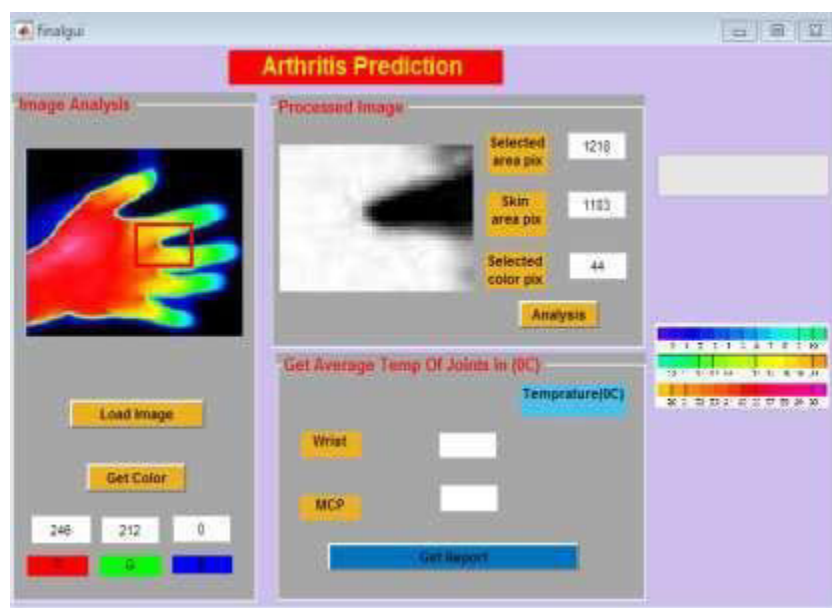


Fig 2: Load image

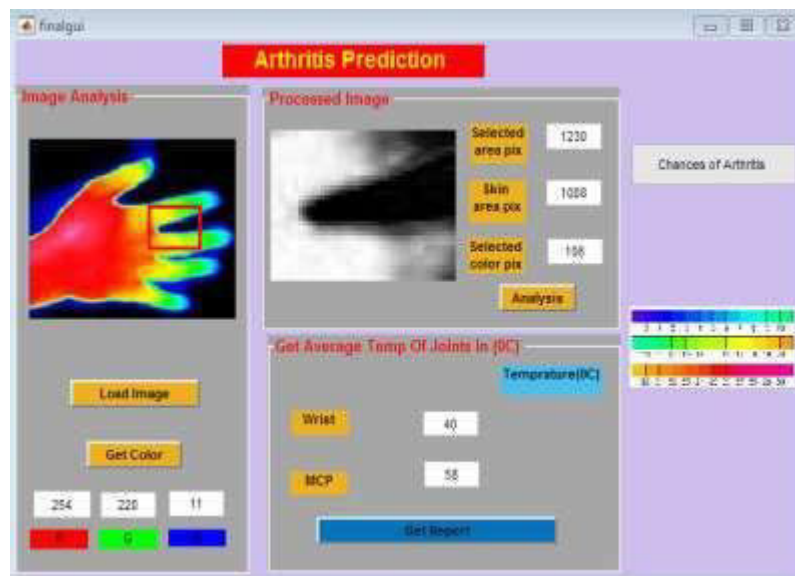


Fig 3: Final output

There are multiple steps in which the whole setup runs so each representation of figure is the actual step processing. In this way only the first step in the GUI is to load the image on the panel so that the process gets started. There are many steps included for each tag used in the front end.

The final result is shown in last screen shot where the output of this software is shown. The way the whole setup runs is again shown in the last one.

C. Description of algorithm:

The algorithm define the step by step approach of each method that are involved in the implementation of the system .Algorithm that are considered for such an implementation involves various mathematical formulae and various

In the next shot there is panel with the image and the segmented region shown in the red selected part .This gives us the appropriate region that need to be analyzed. This is used to get the accurate result and this is how the whole process takes place.

strategies .Expectation Maximization (EM) is one of the algorithm used for the segmentation of image .EM is basically based on the two step that is expectation step (E-step) and the maximization step (M-step).The E-step brief us with the calculation of the expected value of the log likelihood function ,by taking into order the conditional distribution Z given X under the parameter.

D. Equations

The equation are defined as the parameter based description of the above specification by considering the whole view as such.

$$p(C_i | x_i) = \frac{p(x_i | C_j) \cdot p(C_j)}{p(x_i)} = \frac{p(x_i | C_j) \cdot p(C_j)}{\sum_j p(x_i | C_j) \cdot p(C_j)}$$

The expectation step is all about the clustering of the parameter based on the condition but it requires the maximization step too that is (M-step) which is as follows

$$\mu_j = \frac{\sum_i p(C_j | x_i) \cdot x_i}{\sum_i p(C_j | x_i)}$$

$$\Sigma_j = \frac{\sum_i p(C_j | x_i) \cdot (x_i - \mu_j) \cdot (x_i - \mu_j)^T}{\sum_i p(C_j | x_i)}$$

Eq.(3)

$$p(C_j) = \frac{\sum_i p(C_j | x_i)}{N}$$

Eq.(4)

E. Heat Distribution Index (HDI)

The Heat distribution index (HDI) introduces the pattern and the spread of temperature over flexible joints. A region of segmented then has to choose so that to

fixed area over the hand. Then HDI is calculated using the formula as follows HDI= (No of pixels which occur at each Gray level / Total no of pixels in the given area of interest giving relative frequency distribution (RFD)).The calculation of width of RFD is made as $\pm$ SD from the mean frequency =heat distribution index [9].The HDI is thus considered to be an approximation to the width of the major components of RFD curves and it has been found to be a useful parameter in arthritis patient.

F. Methods and material

In this study, rheumatoid arthritis is diagnosed with Backpropagation algorithm, which is a kind of another classification algorithm. The data set used for the diagnosis of rheumatoid arthritis patient are considered. The dataset is considered to be important part for dealing with the neural network. The artificial neural network (ANN) are the artificial intelligence approach which is trying to create a new system by imitating the functioning of the human brain [8, 11, 12]. ANN structure is formed on the basis of the structure of biological neurons in the human brain. In ANN, exactly as in our brain, there are some learning mechanisms and decision-making mechanisms which are based on the information that are

learned. [9, 10, 14] Today, there are many learning models of Artificial Neural Networks such as Perceptron, Adaline, Multilayer Perceptron Model (Backpropagation), Vector Quantization Problems, Hopfield Networks and Elman Networks [14, 15, 13]. Generally, in ANN, weight values are changed automatically, according to the specified learning rule, by giving output values corresponding to a given input set. After completion of the data training, trained network is able to predict the result of any given data set according to the latest state of the weight values. Also, in this study, Multilayer Perceptron Model is used. A multilayer, feed-forward backpropagation neural network model is shown in Fig 2.

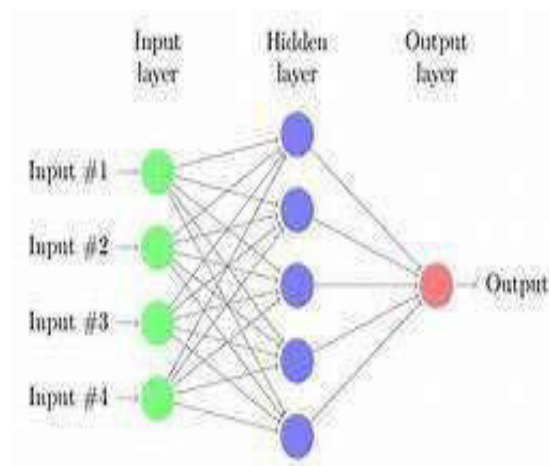


Fig 2. Airtificial Neural Network

G. RESULT AND CONCLUSION

As per the study of the rheumatoid arthritis prediction it is found that the result of the

above system is found to be 77% accurate and can be used for predicting the arthritis at its early stage .This system can give more accurate result by using the algorithm that can be applied to the dataset.

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