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DETECTION OF RHEUMATOID ARTHRITIS BY TRACKING REGION OF INTEREST(ROI) USING IMAGE ANALYSIS TECHNIQUES

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ABSTRACT

Rheumatoid arthritis is one of the most common systemic autoimmune disease that manifests itself by joint inflammation, swelling, pain, tenderness and may involve extra-articular organs in severe cases. It is the most common chronic inflammatory arthropathy worldwide. It afflicts approximately 1 to 2% of the Indian population with 4 to 6% of people over the age of 50 suffering from this disorder. A person with RA may feel extremely tired and lack of energy. RA can affect any joint in the body and commonly develops in the finger, hands, and feet. The life expectancy of RA patients has reduced by 4 to 10 years. Conventional radiographs have been considered to a commonly used method for evaluating the progression of bone and joint damage in RA. Hand radiography analysis in RA is extremely exhausting and time-consuming for radiologists. Precise and accurate analysis of hand radiographs is very much essential. In the literature, few works have identified 16 joints among which 6 joints did not provide accurate results. Motivated by this issue, in this paper, it is proposed to use x-ray images of patients with Rheumatoid Arthritis, which was cost effective. The region of interest (ROI) from x-ray images of patients with rheumatoid arthritis, which is cost effective. The region of interest (ROI) from x-ray images are going to be extracted to measure Joint Space Widths(JSWs) accuracy from all the joint points Also ,this project proposed to consider more number of joints so as to improve the classification accuracy and accurate detection. Geometric features and standard image analysis algorithm are proposed to find JSW and also provide easy understanding and also helps in monitoring early stages of RA patients. Internally collected RA of X-Ray images from internet and from the physicians has used for experimental evaluation of the proposed algorithm.

KEYWORDS

Rheumatoid Arthritis, Joint Space Width, Region of Interest, Morphological operation.

1. INTRODUCTION

Rheumatoid Arthritis is the most systemic autoimmune disease that affects the joints of the human body. It may affect hands, knee, feet etc. It may cause swelling, stiffness and loss of function in joints and also it reduce flexibility. At the beginning of this disorder mainly the joints of wrist and hand are affected. RA affects 1 to 2% of the Indian population and 4 to 6% of people above the age of 50 are mostly affected by this diseases. But now a days it also occurs at early age of the people. The reduction of the cartilage tissue in joints is the main reason for arthritis. The life expectancy of this disease is reduced by 4 to10 years. In order to prevent this joint damage, early detection of Rheumatoid Arthritis is essential. Due to this disease, people economic life style and normal style are affected. There are two types of Arthritis 1.Rheumatoid Arthritis (RA) 2.Osteo Arthritis(OA). [1] Rheumatoid arthritis is a chronic illness, meaning it can last for years, patients may experience long periods without symptoms. However, Rheumatoid Arthritis is typically a progressive illness that has the potential to cause significant joint

destruction and functional and disability. Arthritis means joint inflammation. The joint inflammation of Rheumatoid Arthritis cause swelling, pain, stiffness, and redness in the joints. The inflammation of this disease can also occur in tissue around the joints, such as the tendons, ligaments, and muscles. [2] Osteoarthritis is a non-inflammatory joint disease whereby the cartilage of the joint disease whereby the cartilage of the joint thins, typically asymmetrically so only one knee or hand may also be affected. There are four stages of RA: [1].Early RA [2].Moderate progressive[3]. Severe progression [4].Terminal progression. For detecting RA, X-Ray scanning method has used. X-Ray is cheap when compared to other methods such as Magnetic Resonance Imaging (MRI) and Computer Tomography (CT). So by using X-Ray images we are going to detect the early stage of the disease and also to find classification accuracy.

2. LITERATURE SURVEY

Even though RA is a very important in the medical field, there are few joint has identified and explained in some paper. Agnieszka et al. discussed about the heat pattern from ROI to interpret the presence of inflammation in rheumatoid arthritis patients[1]. Authors Arpita et al, discussed about the three different algorithm for the analysis of RA. The first algorithm focused on the image enhancements and acquirements techniques. Next method is image intensity adjustment techniques [2]. Sheba pari discussed about five different algorithm methods ,first pre-processing, second segmentation, third optimization and feature extraction as well as post segmentation [3]. Kemal et al. proposed a method for the detection of normal patients and RA patients hand images[4]. Swati et al. discussed about the use of image processing techniques using MATLAB to analyze joint space narrowing[5].The proposed paper has organized in the following manner. Section 1 involves the introduction about the various methods of Arthritis. Section 2 explains the various research papers related to the detection of RA. Section 3 explains the proposed methodology based on the literature survey. Section 4 explains the database creation for RA patients as well as normal person. Section 5 explains the preprocessing method which uses multi scale self quotient image (MSQ) and Morphological operation. Section 6 details the proposal of the Dense scale invariant feature transform (D-SIFT) algorithm for segmentation of Region of Interest. Section 7 involves KNN classifier. Also this section involves the analysis of classification accuracy for the detection of Rheumatoid Arthritis. Section 8 discusses about the classification accuracy and validation of the results. Section 9 concludes that the proposed work involves a novel method for the accurate measurement.

3. PROPOSED METHODOLOGY

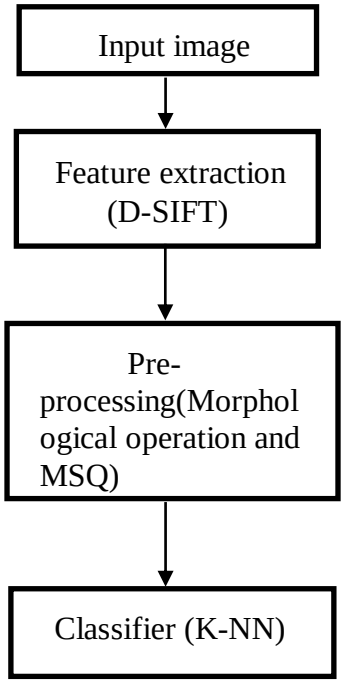

Figure 1: Block diagram of the proposed method

4. DATA BASE COLLECTION

From the above survey, it is clearly depicted that there is no public, standard database for x-ray images. The x-ray images are collected from the hospitals such as hand, knee, feet. From those images, unique id has provided to the subjects and a database has created. Totally 100 images has incorporated in the database. Sample data base images has shown. As MRI is costly we

prefer X-ray image which is cost effective. The X-ray database has constructed from the X-ray scan images of Indian people. Various features have added in the database.

Figure 2: Various Joints for RA patients

5. PRE-PROCESSING

Pre-processing is used to reduce the complexity and to increase the accuracy. Usually, X-ray images are affected by noise such as quantum noise (mottle noise), structural noise, poisson noise and electronic noises. The main aim of pre-processing is to improve the image data that suppresses unwanted distortions or enhances some image features important for further processing. In processing the steps are as follows 1. Image resizing 2. Multi scale self quotient image (MSQ) 3. Morphological operation.

5.1 Image Resizing

Image interpolation occurs once we resize or distort the image from one pixel grid to a special. Image resizing is important once we got to increase or decrease the entire number of pixel, whereas remapping can occur once we correcting for lens distortion or rotating a picture. Zooming refers to increase the amount of pixels, so as that when we zoom an image, we'll see more detail. The image is resized as128*128.

5.2 Multi Scale Self Quotient Image (MSQ)

The main aim of the quotient image method is to deal with lighting changes and provides an invariant representation of image under lighting condition. In self quotients image (SQI) approach, an illumination invariant image representation Q(x,y) can be derived in the form of quotient.

$$q(x,y) = \frac{I(x,y)}{k(x,y) * I(x,y)} \qquad (1)$$

Where, the denominator represents the smoothed version of the original input image I(x,y) and K (x,y). The multi-scale from SQI technique, known as the MSQ ,is obtained by simple summation of self quotient image derived with different filter scale. Multi scale self quotient image between each input image I and its smoothing version is given by,

$$q_{k=\frac{I}{Ik}}, \text{K= 1,2,3,…….n} \qquad (2)$$

The issue of variation of illumination is the most delicate one in the aspect of the three-dimensional target identification based on the gray-scale image. The issue in recent years has roused widespread concern. The elimination of the impact of illumination is of major significance for the correct classification. But the self- quotient image presents a characteristic of stability of illumination which provides a solution to this problem. It is therefore suggested the use of multi-scale technology to make the results more robust.

5.3 Morphological Operation

The term morphology is a greek word and it make up of "morph" meaning "shape form" and "ology" means "the study of something". Dilation, erosion

reconstruct and performs other morphological operation. Morphology is a broad set of image processing operations that process images based on the shapes. The structuring element are placed at all possible locations in the I age. The most known fundamental morphological operations are enlargement and disintegration.

5.3.1 Erosion

Erosion reduces the size of the objects and it also removes the smell anomalies. It is used prior for opening. To erode an image, we have to use the imerode function. It is also known as structuring element. Erosion has been used to shrink the image foreground and expands its background. Erosion can be considered as dual to dilation.

5.3.2 Dilation

Dilation is one of the basic operator in the area of morphology. It is typically applied to binary image but there are versions that work on gray-scale images. The basic effect of this operator is to gradually enlarge the boundaries of regions of foreground pixels. Thus area of foreground pixels grow in size while holes within those regions become smaller. The dilation operation usually uses structuring element for probing and expanding the shapes contained in input images.

Opening:

Opening is a process in which first erosion operation is performed and then dilation operation is performed.

Closing:

Closing is a process in which first dilation operation is performed and then erosion operation is performed.

Figure 3: Results for Erosion and Dilation

5.3.3 Edge Detection

Edge detection is an image processing technique used to find the boundaries of objects within images. It works by detecting discontinue in brightness. It is used for image segmentation and data extraction in areas such as image processing, computer vision, machine vision. Edge detection includes Sobel, Canny, Prewitt, Roberts etc. It discontinues in depth, surface orientation, changes in material properties and variations in scene illumination. The results of applying an edge detection to an image may lead to a set of connected curves that show the boundaries of objects. If the sting detection step is successful, the next task of interpreting the knowledge contents within the original image may therefore be substantially simplified.

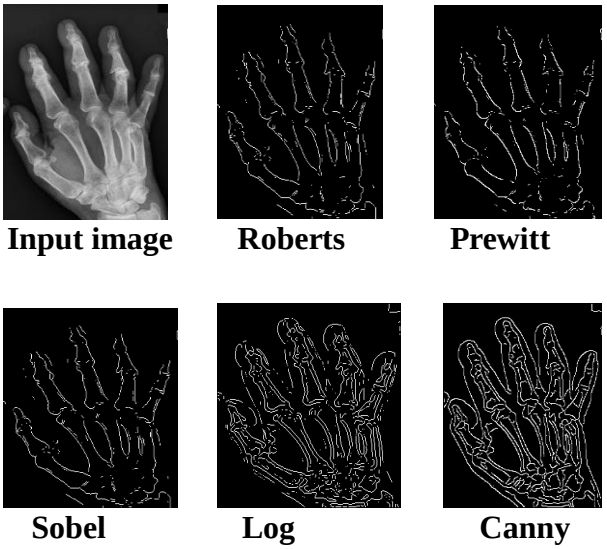

Figure 4: Results for Edge detection

6. FEATURE EXTRACTION

Feature extraction is a technique used for reducing the dimensions of the image. Edge detection, corner detection, threshold of the image is obtained by feature extraction. Feature extraction techniques are applied to get features that will be useful in recognition and classification of the images. SIFT is a robust descriptor to characterize local gradient information of image pixels. It is a sparse feature representation that consists of both feature detection and extraction process. In this paper, however, we only utilize the feature extraction

component. SIFT description is called dense SIFT feature representation for input images. The goal of our work is to perform alignment for every pixel based on this dense SIFT. Dense SIFT collects more feature at each location and scale in a picture, increasing recognition accuracy accordingly. A basic explanation for this is often that a bigger set of local image descriptors computed over a dense grid usually provide more information than corresponding descriptors evaluated at a much sparser set of image points.

7. CLASSIFICATION

K-Nearest Neighbors (K-NN) is widely used classification technique. It is used for its easy of interpretation and low calculation time. The training error rate and the validation error are the two parameters which are needed to be accessed on different K value. The domain of text classification using K-NN algorithm is very wide. There are various modifications of K-NN algorithm. The modification of K-NN algorithm is a combination of eager learning with K-NN classification which improved the efficiency and increased the accuracy of classification. A novel K-NN classification algorithm combining model and evidence theory helps to overcome the shortage of lazy learning in traditional LNN method such as time-consuming. Based on the discussion above, it shows that, many researchers have tried various methods to combine different classification approaches to increase the classification accuracy and reduce time consumption. Despite the K-NN algorithm is easy to use and effective in general, the performance of K-NN algorithm depends mostly on the allocation of the training image. To solve the problem of the uneven distribution of training samples, it presented an algorithm based on clustering the training samples, making a relatively uniform distribution of training samples.

8.RESULTS AND DISCUSSION

The performance of our algorithm has been evaluated and tested on internally collected Rheumatoid Arthritis patient's data set. We have used normalization techniques to enhance the Rheumatoid Arthritis image. In classification, the K–nearest classifier was used in the proposed work. For K-NN classifier, accuracy can be evaluated by using the K value. Since the constant value of K can influence the accuracy of the general classification. The accuracy has been evaluated by using five different K values. Table 1: shown the result of classifier rate for various K nearest Neighbor classifier.

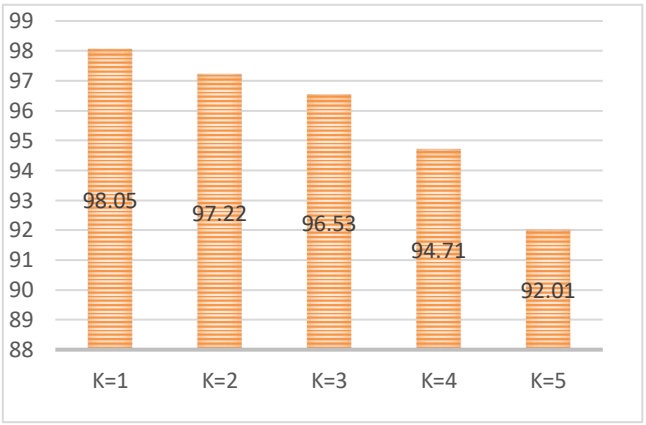

Figure5: Graphical representation for various K-NN classifier

K nearest neighbor Value	Classification accuracy (%)
K=1	98.05
K=2	97.22
K=3	96.53
K=4	94.71
K=5	92.01

Table1: Result for Classifier rate for various K value

9. CONCLUSION

In this study, we detect the Rheumatoid Arthritis images by tracking Region of Interest to get the classification accuracy. Here we are using pre-processing techniques to remove edge detection in the image. Then we applied to the feature extraction operations in dense SIFT (D-SIFT) to get the image with more accuracy. From the output of classification operations we can calculate the K-NN filter to segment the images according to the variation values in the images. In the classifier

process, we can change the threshold value of filters and it can be obtained by variation of images accuracy. From that we can easily differentiate display the accuracy of the image. Our system shows successfully 100% correction detection with less computational time.

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