Automatic Prediction of Rheumatoid Arthritis Using CNN

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ABSTRACT

Rheumatoid arthritis can be defined as a chronic inflammatory disorder affecting the joints by damaging the tissue of the body. Therefore, an effective system analysis is necessary for the identification and detection of rheumatoid arthritis by hand, especially during its development or pre-diagnostic stages.This project is designed to develop an intelligent system to detect rheumatoid arthritis of the hand using image processing techniques and a neural network of convolution.The system comprises of two main phases. The image processing phase is the first stage in which images are processed using image processing. These techniques include pre-processing, image segmentation and feature extraction using gabor filter. The second phase the extracted features being used as inputs for the neural convolution network, which classifies the hand images as normal or abnormal (arthritic). Classification is carried out based on the CNN algorithm, which involves the training of the network with normal and abnormal hand images. The system was tested on the same number of images as the testing set and the experimental results showed that a recognition rate of 83.5% respectively.

Keyword-Rheumatoid arthritis,CNN, Gabor filter

I. INTRODUCTION

Rheumatoid arthritis (RA) can be defined as a complex autoimmune inflammatory disease associated with significant disability, morbidity and death. For prognostic and rapeutic reasons, early identification of patients with aggressive and destructive disease is importantA chronic inflammatory disorder that can affect the joints of the fingers, knees and hands causes swelling, stiffness and pain is another definition for rheumatoid arthritis. The actuators for the onset of RA are only theoretical, but it is expected that a genetic responsibility for the disorder, several viruses and bacteria can play a major role in disrupting immunological tolerance and psychological conditions by further weakening the immune system of the persons concerned. Since the main causes of RA remain unknown, cures or treatments have not yet been found.

Today all treatments and therapies are only available to reduce symptoms and delay the progression of the disease (Newman, 1995).

RA has many signs and symptoms that can be detected in an image, including:

• tender, warm, swollen joints
• hours of morning stiffness
• firm bumps of rheumatoid nodules in the skin (tissue)

Rheumatoid arthritis (RA) or joint inflammation can be characterized as a complex autoimmune incendiary infection that is linked to impressive disability, horror and death .Early distinguishing evidence of patients with severe dangerous infection is essential for predictive reasons. An alternative definition for rheumatoid joint pain is an ongoing fire problem that can affect the joints of the fingers, knees and hands, leading to swelling, firmness and agony.The close distance between the femoral and tibial bones, the loss of cartilage and the spurs of the bone are the basic signs of this disease. In our identification system, we focus on extracting these features using certain image processing techniques to be fed into a neural network that has the ability to classify with many normal and arthritic hand images after learning convergence.

II. Related work

Rheumatoid Arthritis (RA) is a disease where the joints of knees, fingers get affected. RA results in joint stiffness, pain, swelling of the joints which showsdeformity in the late stages of the disease. So its detection is of at most important in early stages, Various researchers has proposed methods like MRI, X-Ray, Radiography, Thermograph etc. for the detection of RA. For supporting research in RA

"Automatic Quantification of Joint Space Narrowing and Erosions in RA"

GorgLangs et al[1] The application was proposed where the quantification of radiographic changes in RA was done by measuring two indicators for disease progression. Hand radiograph was used to determine bone positions and contour delineations are determined.

"Automatic Analysis of Rheumatoid arthritis based on statistical features".

Mrs Swati Bhisikar [3] have proposed application based on image processing technique using MATLAB to analyze joint space narrowing. The input were given in the form of finger X-Ray image , the image was preprocessed and the features were extracted and the joint space location were calculated. Active shape model was used to find the bone boundaries. The future scope of this was to diagnose the severity of the disease.

"Study on deep machine learning algorithms for diagnosis of diseases".

Dinu A.J [4] have proposed application based on different machine learning algorithms and artificial intelligence to predict diseases like Rheumatoid Arthritis, Joint Localization Active shape model gave accuracy of 96%. K-means image segmentation gave accuracy of 93% and Counter delineation, ASM driven snakes gave accuracy of 92%.

"Contour Detection Using Multi-scale Active Shape Models".

S.Mahmoodi [5]have proposed application based on Active shape model(ASM) used for adaptive multi-scale edge tracking scheme.

"Computer-Assisted bone age assessment based on features automatically extracted from a hand radiograph"

EwaPietkahava[6] proposed application based on computer assisted bone age assessment based on hand radiology. The entire study was leading to an estimation of skeletal maturity. The features were extracted from computer radiography(CR).Georg Langs et al proposed Automatic Quantification of Joint Space Narrowing and Erosions in RA

III. System Architecture

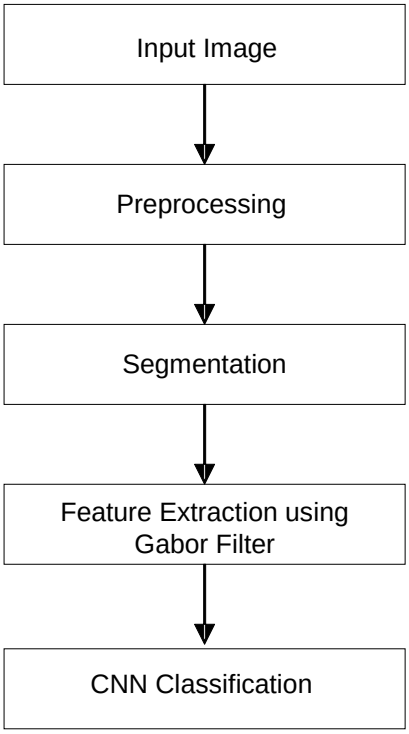


Fig 1.System Architecture

Preprocessing-Pre- processing is the main step in image analysis that performs image enhancement and noise reduction techniques to improve image quality. The image is enhanced by improving fine details and removing noise from the image. In the rheumatoid arthritis system,

Enhancement and noise reduction techniques are implemented, which can produce the best possible results. Enhancement will lead to more prominent edges and a sharp image such as the tumor noise is obtained will reduce the blurring effect of the image.

Segmentation-Image segmentation is a process of dividing the image into homogeneous regions that correspond to different objects in the image. The image is divided into meaningful regions. The image can be segmented using fundamental image features such as intensity, edge or texture.

Feature extraction-The extraction of features is the technique used to extract specific features from pre- processed images of various abnormal categories. This technique extracts the high level of features required to classify the targets. Features are the items that are unique in size, shape, composition, location, etc. The extraction of features is an important step in building any classification of patterns and aims to extract the relevant information that characterizes every class. Here we use Gabor filter for extracting features.

IV. Experimental Results

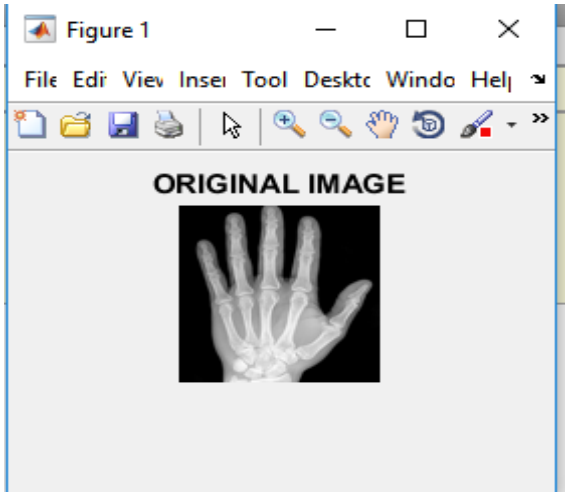


Fig 1 Original Image

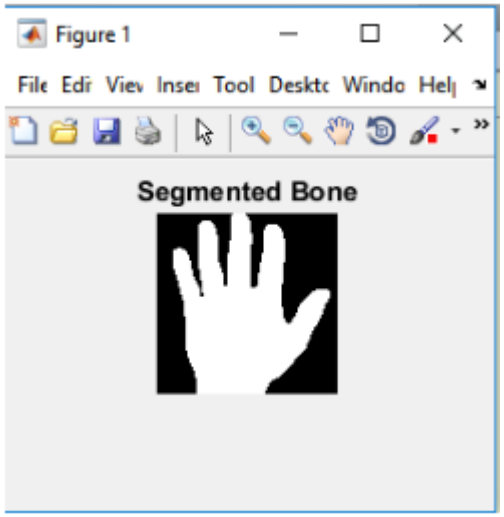
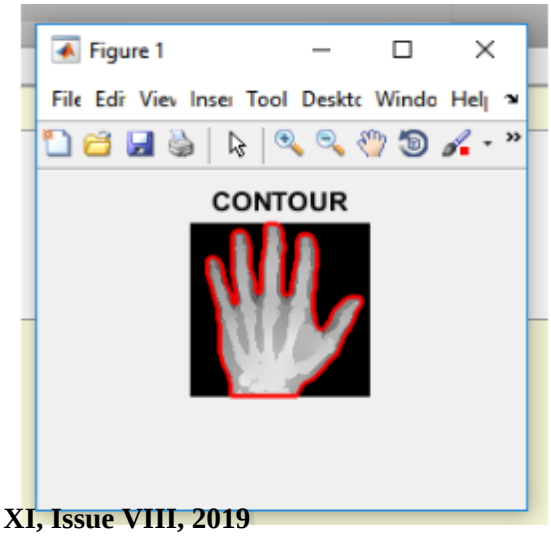


Fig 2 Segmentation



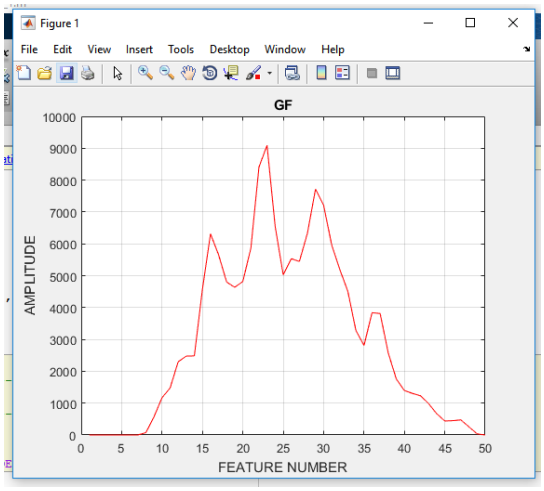


Fig 3-Counter

Fig 4 Gabor Features

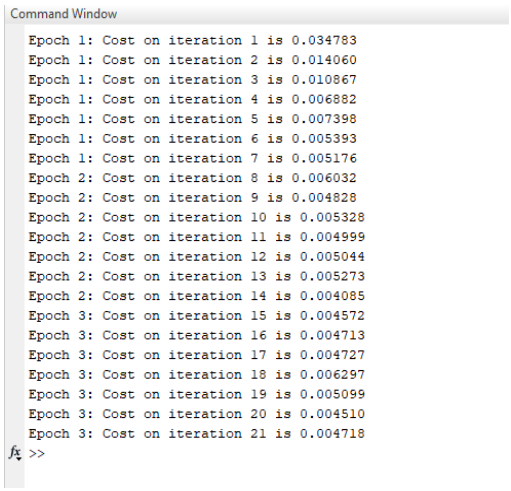


Fig 5 CNN Training

The above figure 1 shows input image of proposed system. As can be seen in figure 2 shows result of segmentation, figure 3 represent counter and figure 4 shows result of Gabor filter.

V.Conclusion

This project is designed to develop an intelligent system to detect rheumatoid arthritis of the hand using image processing techniques and a neural network of convolution.The system comprises of two main phases. The image processing phase is the first stage in which images are processed using image processing. These techniques include pre-processing, image segmentation and feature extraction using gabor filter. The system was tested on the same number of images as the testing set and the experimental results showed that a recognition rate of 83.5% respectively.

References

[1] GorgLangs et al- “Automatic Quantification of Joint Space Narrowing and Erosions in RA” IEEE Transaction on Medical Imaging Vol28, No 1 Jan2009.

[2] Yinghe Huo, et al,—”Automatic joint detection in rheumatoid arthritis hand radiograph”‖, IEEE 10th International Symposium on Biomedical Imaging: From Nano to Macro San Francisco, CA, USA, April 7-11, 2013.

[3] Mrs. Swati A. Bhisikar, Dr. Sujata N. Kale - "Automatic Analysis of Rheumatoid arthritis based on statistical features" , 2016 International Conference on Automatic Control and Dynamic

Optimization Techniques (ICACDOT) International Institute of Information Technology (I²IT), Pune.

[4] Dinu A.J ,Ganesan R, Felix Joseph, Balaji -"A study on deep machine learning algorithms for diagnosis of diseases ", International Journal of Appiled Engineering Research ISSN.

[5] S.Mahmoodi, B.S. Sharif, E .G.Chester -"Contour Detection Using Multi-scale Active Shape Models".

[6] Ewa Pietka -"Computer-Assisted bone age assessment based on features automatically extracted from a hand radiograph".

[7] Kunlin Cao, David Mills "Towards Quantitative Assessment of RA using Volerteic Ultrasound" IEEE Transaction on Biomedical Engineering Vol 62 ,No 2 Feb 2016

[8] Sumitra S. Nair, Robert French,et al – The Application of Machine learning Algorithms to the Analysis of Electromyography Patterns from RA, IEEE Transaction on Nueral Systems and Rehabitalization Engineering Vol 18,No 2April 2010.

[9] Chin Lin at al ―Automatic Prediction of RA Disease Activity from the Electronic Medical Records, vol 8 ,Issue 8., 2013

[10] Monique Frize et al "Detection of RA using infrared imaging" Medical Imaging 2011,vol 7962

[11] Andrzej Bieleckia,, Mariusz Korkoszb, Bartosz Zielin,"Hand radiographs preprocessing, image representation in the finger regions and joint space width measurements for image interpretation" ,Elsevier publication, Pattern recognition 41, May 2008.

[12] Simona E. Grigorescu, Nicolai Petkov, Peter Kruizinga, "Comparison of texture features based on Gabor filters", IEEE transaction on image processing, vol 11, no.10, Oct 2012.