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Automatic Analysis of Rheumatoid Arthritis Based on Statistical Features

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Abstract: *Rheumatoid Arthritis destroys joints of the body like erosion in bones which intern may cause deformity and analysis in the later stage of the disease. At the beginning of this disease mainly the joints of hand and wrist area affected making hand radiograph analysis very important. Lately manual JSW measurement in hand X-ray digital radiograph of Arthritis patients were in use but it has disadvantages like inaccuracy, inter-reader variability. Also hand radiograph analysis is difficult for radiologist since in all there are 14 number of hand joints. To avoid observer dependency, computer-aided analysis is required. We have proposed the use of image processing techniques using MATLAB to analyze joint space narrowing. In this paper bone boundaries are delineated with Active Shape Model which contains statistical model of bone shape and local texture. Joint positions are identified by local linear mapping based on texture features. We have examined few hand radiograph images affected by RA. Joint location estimate accuracy is 92%. The automated analysis helps to reduce need of skilled personnel. Also remote analysis and medication is possible*.

Keywords *- RA - Rheumatoid Arthritis JSW - Joint Space Width MRI - Magnetic Resonance Imaging Arthritis HRUS -High Resolution Ultrasound MR -Magnetic Resonance ESR -Erythrocyte Sedimentation JRA - Juvenile Idiopathic Arthritis TW -Tanner Whitehouse GP -Greulich Pyle ACM Active Contour Models ROC - Receivier Operating Characteristic LLMS- Local Linear Mappings MATLAB-Matrix Laboratory*

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I. INTRODUCTION

Rheumatoid Arthritis 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 specially in old women's. In the present system we demonstrate the Image analysis of MRI and its findings that may be encountered in the musculoskeletal system in association with this disease process. Within 10 years of diagnosis, 50% of patients have severe disability as well as a decreased life expectancy from 3 to 18 years. Early diagnosis of RA and initiation of aggressive therapy early in the course of the disease can diminish disease progression and, in some patients, even lead to drug free remission. Clinical signs of RA, pain and swelling of joints, are usually present and progressive. Swollen joints are among the criteria used to classify a patient as having RA and constitute the major indication for initiating therapy. Rheumatologists detect joint swelling by the classical examination technique. But in early stages of the disease, patients may suffer without apparent joint swelling and with negative radiographs. In these cases, Techniques such as high resolution ultrasound (HRUS) or Magnetic Resonance (MR) imaging may reveal morphologic changes or hyperemia in the form of synovial thickening or enhancement and allow a much earlier diagnosis of RA. Rheumatoid arthritis (RA) causes pain, swelling, stiffness, and loss of function in the joints. The disease usually affects the joints, particularly in the wrist and the fingers.

II. TYPES OF ARTHRITIS

Common ones include: Ankylosing Spondylitis is arthritis that affects the spine. It often involves redness, heat, swelling, and pain in the spine or in the joint where the bottom of the spine joins the pelvic bone. Gout is caused by crystals that build up in the joints. It usually affects the big toe, but many other joints may be affected. Juvenile Arthritis is the term used to describe arthritis in children. Arthritis is caused by inflammation of the joints. Osteoarthritis usually comes with age and most often affects the fingers, knees, and hips. Sometimes osteoarthritis follows a joint injury. For example, you might have badly injured your knee when young and develop arthritis in your knee joint years later. Psoriatic Arthritis can occur in people who have

psoriasis (scaly red and white skin patches). It affects the skin, joints, and areas where tissues attach to bone. Reactive Arthritis is pain or swelling in a joint that is caused by an infection in your body. You may also have red, swollen eyes and a swollen urinary tract. Rheumatoid arthritis happens when the body's own defense system doesn't work properly. It affects joints and bones (often of the hands and feet), and may also affect internal organs and systems. You may feel sick or tired, and you may have a fever. Arthritis is seen with other conditions

III. PROPOSED SYSTEM

In preprocessing the steps are as follows: (a) Image re-sampling (resize the image to low resolution) (b) Grayscale contrast enhancement (c) Morphological operations For individual bone contours detection with a statistical shape and texture model ASMs are used. The resulting contour is refined by snake. An ASM will be fitted to the bone contours. Since the ASM is based on a training set of bones, the resulting delineation is refined by an active contour. The active contour use to extract the texture information from the gray value profiles in the ASM, but allows for a more flexible segmentation of the bone. Local linear mappings (LLMs) are used to detect the positions of 12 joints. Here from the relation between local image texture and landmark positions provide results like hand orientation and positions of the individual bones for the ASM initialization are detected. ASMs delineate the bone contours. In order to localize localize joint features, it is accomplished by local linear mapping applied to local texture features extracted by Gabor filter.

IV. APPLICATION OF IMAGE PROCESSING

Processing of digital images include operations involving digital images such as acquisition, storage, retrieval, translation, compression, etc. Conventional examination of the hand radiographs is well established as a diagnostic as well as an outcome measure in Rheumatoid Arthritis (RA). The presence of early soft-tissue swelling is easily recognized on plain radiographs but not readily quantified. Although the presence of early osteoporosis is recognized in the affected hand, a mild osteoporosis may be extremely subtle to the eyes Use of magnetic resonance (MR) technique has been shown to sensitively detect early local edema and inflammation prior to a positive finding on plain film radiographs. However, MR is an expensive examination and may not be used as a routine technique. Recent improvements in hardware and software available for digital image processing have led to the quantitative assessment of radiological abnormalities in diagnostic radiology.

In this work we present

1. **Image Acquisition**: image is acquired and brought into the system (digital camera, CAT scan) usually requires pre-processing, e.g., scaling, sampling
2. **Compression:** image archive size is reduced (storage, transmission) error free, and error prune compression Segmentation: image ispartitioned into features (e.g., boundary of objects)
3. **Representation**: extract features are stored outside the image
4. **Recognition**: image objects are being identified (e.g., liver, kidneys, spine)
5. **Image Enhancement**: image is made clear to the user by enhancing some of the features of the image this is a subjective operation (it looks good)
6. **Image Restoration**: image is improved- this operation is objective (e.g., noise removal)

The basic data structure in MATLAB is the array, an ordered set of real or complex elements. This object is naturally suited to the representation of images, real valued ordered sets of colour or intensity data.

V. SYSTEM METHODLOGIES

a. First step is to acquirement of images that can work as sample and then applying the basic techniques of image processing such as Image Enhancement and Image Restoration as in figure 2(a) we have noisy image of knee joint of a patient having Rheumatoid arthritis and 2(b) is the image after filtration through Gaussian filter method for more closer look of the presence of disease .Another important image analysis is done by applying image cropping tech for image 2 .Figure 3 presents the cropped image of knee joint only for easily diagnosis of the presence of disease. The presence of Rheumatoid arthritis as upper bone and lower bones are coinciding in left half segment. Image3 shows cropped image demonstration for patient having RA ,it is noticeable that the final image obtained after processing region of interest nearby at the joint of knee and only the portion of interest is considered for analysis point of view. The knee joint image of old person having Rheumatoid arthritis is compared with knee images of healthy person having perfect knee joint spacing in figure 4 along with cropping tech. Application to differentiate in more clear way. These are the tech by which any one can diagnosis of the presence of disease

b. Another important for image analysis is provided in image 5 and techniques of Intensity adjustment along with Gamma correction tech are applied for analysis point of view for the knee image of old person having

Rheumatoid arthritis. Similarly the difference between these two images can also be analyzed using through Histogram equalization tech and shown in figure 6 (a) for old person & (b) for healthy person

c. Another important tech for analyzing the images through median filtering and applying mask along with convolution .Since median filtering is a nonlinear operation often used in image processing to reduce "salt and pepper" noise. Median filtering is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges

B = medfilt2 (A, [m n]).

VI. FIGURES

Fig1: Input Image

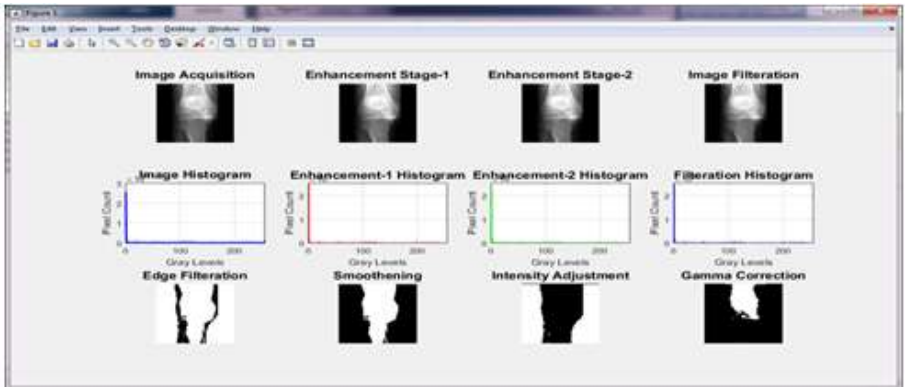

Fig2.A:Image Acquistion And Enchancement

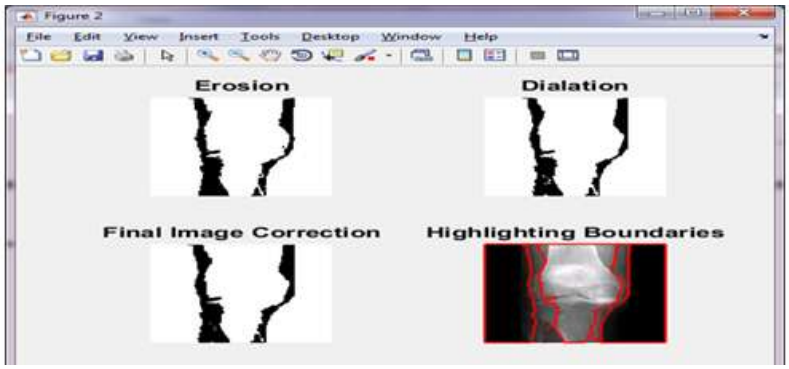

Fig:2.B Image Filteration And Highlighting

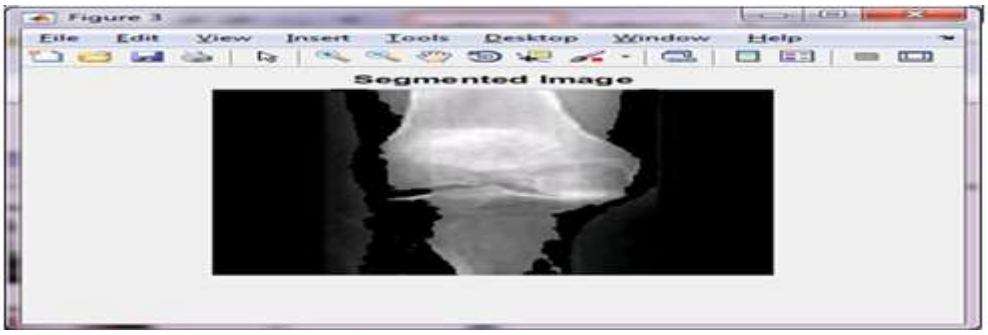

Fig:2.C Image Segmentation

Fig:2.D:Image Thermal View

VII. CONCLUSION

All the input images are tested and calculated mean joint location accuracy is above 95%. The segmentation accuracy is 80%.Reproducibility error is 1% to 3%. The database images and results are validated from medical expert. The proposed model is a fully automatic, quantitative assessment tool for RA diagnosis. It will increase accuracy, reproducibility and speed of image interpretation. This model integrates the status of multiple joints, thereby reducing time as well as inter and intra-reader variations. In future this work can be extended to diagnose the severity of the disease.

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