

Analysing the Detection of Rheumatoid Arthritis using Image Processing Techniques

Sheba Pari^{1*}

^{1*}Dept. of CSE, New Horizon College of Engineering, Bangalore, India

*Corresponding Author: shebapn@gmail.com, Tel.: +00-9480-526218

Available online at: www.ijcseonline.org

Accepted: 21/May/2018, Published: 21/May/20182018

Abstract— A huge volume of research have been made in the medical field for finding out inflammatory disorder which is rheumatoid arthritis which is one form of arthritis which affects joints. Identifying the onset of the disease should be done as early as possible to start the proper treatment, to prevent maximum deformity and for better quality of living. Radiography helps in detecting rheumatoid arthritis but there is reduced accuracy and is slower in detecting as it starts detecting after deformity(irreversible process) of joints have started. Magnetic resonance imaging may be more precise and accurate in identifying deformities. In Magnetic resonance imaging, images are analyzed through different image processing techniques. This paper is primarily aimed at stating the advantages of Magnetic resonance imaging over other techniques and after Magnetic resonance imaging scan has been done, making use of image processing techniques to obtain the final image for detection of the disorder.

Keywords— Erosion, Dilation, Magnetic resonance imaging, Perimeter, arthritis, Skeletonization.

I. INTRODUCTION

A disease that affects mainly the joints of our body is Arthritis. Out of all types of arthritis Rheumatoid Arthritis (RA) is the most common type. When the joints are inflamed, the reason for that disorder is RA [1]. In addition to causing swelling near the joints, stiffness of joints, and loss of function in joints, it also causes a certain amount of redness, reduced flexibility in the affected joints [2][3]. Sometimes some organs also may be affected. This is a disease which affects all people of all ethnicity and race but mainly affects women more than when compared to men. In India, Arthritis affects almost around 1/6th of the population. This prevalence is higher than other well-known diseases. This number is sure to increase as with age this disease becomes more prominent. Close monitoring of this disease is important and diagnose the disease in the early stages to prevent maximum deformity and to start with appropriate medical treatments [4]. As of today there has not been discovered any cure for this disease.



Figure 1. Right hand image of a normal hand



Figure 2. Right hand image of RA affected hand

Several researchers have done a huge amount of work in understanding this disorder of the joints which is RA, over the past several years. The earlier the diagnosis of rheumatoid arthritis, the earlier would be the start of appropriate treatment for improved health. Since over the years there is a huge advancement in the area of medical sciences, detecting RA earlier would improve the quality of life of the patient and would result in better health. Hence the ultimate necessity is early diagnosis which requires reliable imaging techniques that would diagnose and monitor effectively in the long run.

Radiographs is one of the methods what is used to detect structural joint damage in patients and this is not a fast technique which means that it would have found the presence of the disorder after enough of damage was done [5]. Earlier phases of the disease wouldn't have been diagnosed. When compared to radiography for detecting the abnormalities Magnetic resonance imaging (MRI) and ultrasonography may be more accurate with more precise results [6]. For this disease, treatment must be started as early as possible before the joints are deformed. But once deformed it is an irreversible process.

MRI is also known as nuclear MRI which is used for scanning more precise images of our body which is not captured in other techniques. MRI uses magnetic and radio waves to capture images. It makes use of magnets which are more powerful than normal magnets. Major portion of our body has huge content of water. Water (H₂O) mainly contains protons which are excited by the Magnetic field sent from the scanner. Radio Frequency (RF) current is also emitted from the scanner which is used to produce a varying magnetic field. After the protons absorb the energy when turned on, their direction changes and comes back to normal position when it is turned off. What is emitted from these protons is detected which results in forming the image.

This paper is firstly aimed at stating the advantages of MRI over other techniques. Then after the MRI scan has been done, different steps in image processing are stated to obtain the final image for detection of the disorder.

This article is organized as follows, Section I contains the introduction of the disease and the various ways of capturing images, Section II contains the related work of capturing images in medical imaging area, Section III contains the methodology of processing of images, Section IV describes the results and discussion of the necessity of these processed images and Section V concludes the paper with future scope of this field.

II. RELATED WORK

Current technology used for diagnosing RA is by using radiographs on joints. Radiographs are used to detect structural joint damage in patients which means that it will detect only after the damage is done and it has not been sensitive in detecting early stage in the disease. For example from a research study RA's erosion of joints was detected in only 15% of patients when radiography technique was used to capture images. When MRI was used deformity was detected in 70% of patients, with around 35% being part of the joints of the patients [7]. The ability of MRI to consider both erosions and inflammation makes it a better means of assessing patients with rheumatoid arthritis. MRI helps distinguish if the patient has RA or any other inflammatory disease.

In related area of work in this area, author is using MRI to capture the image and is processing the image using Region growing technique [8]. In this technique, segmentation is performed and whichever region is under consideration is captured. Post that a technique called wavelet transform is used and finally an efficient processed image is obtained.

III. METHODOLOGY

The disadvantage of using radiographs is that the patients are exposed to dangerous ionizing radiation which may cause severe later damages such as cancer and also not advised for pregnant women. MRI machines do not emit ionizing radiation. The basic necessity is to get high quality and good images by solving the problem of the vision of the machine. Degraded or blurred images are processed to get an image which is better than the original, which means better results are attained. In areas of research in this field MRI images of the interior of a body are processed accurately to diagnose and treat disease earlier. Medical imaging also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities. To get the final image 2 or more images is joined into one image which would contain information more than the original image.

MRI images are analyzed for diagnosis of the disease through the following techniques [9]

- Morphological image processing(erosion, dilation)
- Perimeter determination and
- Skeletonization

Morphological image processing includes an erosion and dilation technique which means structure or shape of an image [10]. In this technique all neighbours of a particular structuring element which is placed at different locations in

the image, is compared which results in the output image. This structuring element is a template. Then the image is checked whether it fits within the image or hits, intersects the image. There are 2 fundamental morphological operations Dilation and Erosion.

When to the boundary additions are made to the object of an image, it is called as Dilation and when to the boundary removals are made to the object of an image, it is called as erosion. If for example a triangle is the image under consideration the following figures states the concepts of dilation and erosion respectively.

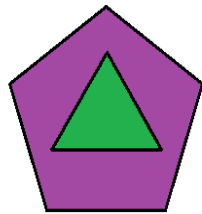


Figure 3. Dilation

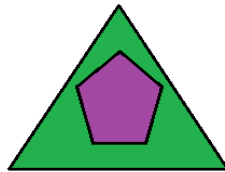


Figure 4. Erosion

How many pixels to remove or add in the image for dilation and erosion techniques depend on how the image looks like? For example, it depends on the size and shape of the structuring element.

To reduce images cost for storage or transmission we have a concept called as Image compression. Removal of unnecessary noise, when data is reduced, it is referred to as Digital Compression. There are basic two types of Image processing available lossless and lossy image processing. These methods provide a solution for automatic medical image segmentation.

Image compression may be lossy or lossless. Lossy compression methods, produces a match close to the original when used at low bit rates. Lossless compression is what is preferable for medical imaging as it creates an exact original data. The entire process of diagnosing the disease with the help of MRI can be categorized into the following steps

- Pre-processing
- Segmentation
- Optimization
- Feature extraction

- **Pre-processing** is the first level of abstraction where the quality of the image is improved by enhancing some image features which helps in later processing and suppressing unwanted distortion.

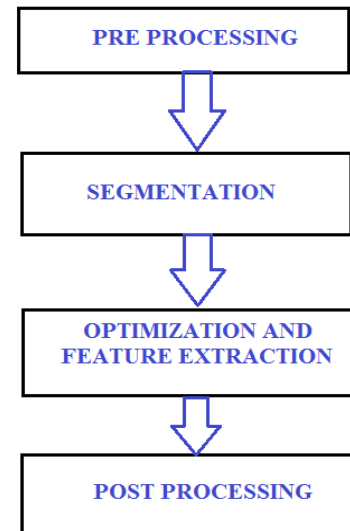


Figure 5. The steps in the process of diagnosing the disease

- **Segmentation** is the process of dividing a digitally processed image into a number of smaller segments [2]. The image which is preprocessed is changed into an image which is easier and more meaningful to analyze. Each pixel is labelled and pixels with the same label will share the same characteristics. Clustering techniques are used to divide images that share similar characteristics. At the end of this phase we will have a number of segments from the original image.
- **Optimization and Feature extraction** is the process of minimizing the number of redundant calculations on images by identifying similar areas of pixels in the image. Thereby applying a number of optimization techniques and improving the result. When there is repetitiveness of images presented as pixels, a reduced set of features can be formed. Feature extraction involves reducing the amount of resources required to process but still maintaining a sufficient level of accuracy.

The processed images find their application in the field of Medical Science and can be beneficial for doctors in identification of disease stages from monitoring point of view.

IV. RESULTS AND DISCUSSION

The processed images will help in the field of Medical Science by being beneficial for doctors in identification of incurable disease like rheumatoid arthritis in monitoring point of view. Earlier identification will help to reduce the effect of the disease [11]. The paper is primarily analyzing a significant amount of images using MRI rather than other radio graphical techniques so that high quality image can be produced for early RA diagnoses and treatment.

V. CONCLUSION AND FUTURE SCOPE

In this survey paper we can conclude that processing the images that are got from MRI images would detect and diagnose Rheumatoid Arthritis faster than using other techniques. This also helps in accurately identifying the presence of disease Rheumatoid arthritis. This can also be used in observing the effects of the continuing treatment. Proper analysis of MRI images should have been done for diagnosis through above mentioned techniques. The images would be passed through different stages such as Pre-processing, Segmentation, Optimization and Feature extraction to obtain a high quality image for more accurate diagnosis.

The main advantage of MRI is that no radiation is involved, hence no risk of contact with radiation during an MRI process which is harmful to the body. However, due to the use of the powerful magnets, MRI cannot be performed on patients with any metal grafts, cardiac pacemakers, tattoos or even certain prosthetic devices. There are a number of disadvantages of MRI such as an MRI scan takes longer than other scanning techniques such as around 30 minutes to an hour. The person undergoing the scan also has to be still for that long. A technique which overcomes all the disadvantages of the existing techniques can be discovered for capturing images in the medical field in the future.

REFERENCES

- [1] Bhavyashree K G, Sheela Rao, "Determination And Analysis Of Arthritis Using Digital Image Processing Techniques" International Journal of Electrical, Electronics and Data Communication, ISSN: 2320-2084, Vol. 2, Issue 9, Sept 2014.
- [2] Arpita Mittal, Sanjay Kumar Dubey, "Analysis of Rheumatoid Arthritis through Image Processing", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 6, No 2, November 2012.
- [3] Kelvin Ka-fai Leung, "Longitudinal analysis of MRI images in rheumatoid arthritis", IJCSI, November 16, 2007.
- [4] SD. Kasute, M. Kolheka, "ROI Based Medical Image Compression", IJSRNSC, Vol. 5, Issue 1, April 2017.
- [5] Gilkeson G, Polisson R, Sinclair H, "Early detection of carpal erosions in patients with rheumatoid arthritis: a pilot study of magnetic resonance imaging", J Rheumatol 1988; pp. 1361-1366.
- [6] Laxman Singh, R.B.Dubey, Z.A.Jaffery, Zaheeruddin, "Segmentation and characterization of brain tumor from MR images", IEEE International Conference on Advances in Recent Technologies in Communication and Computing, 2009.

- [7] Paul Emery, "Magnetic Resonance Imaging: Opportunities For Rheumatoid Arthritis Disease Assessment And Monitoring Long-Term Treatment Outcomes", Arthritis Research & Therapy, Vol. 4, 2002.
- [8] Namrata Ghuse, Yogita Deore, Amol Potgantwar, "Efficient Image Processing Based Liver Cancer Detection Method", IJSRNSC, Vol. 5, Issue 3, June 2017
- [9] Arpita Mittal, Sanjay Kumar Dubey, "A Literature Review on Analysis of MRI Images of Rheumatoid Arthritis through Morphological Image Processing Techniques", IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 2, No 3, March 2013.
- [10] J.Vijay, J.Subhashini, "An Efficient Brain Tumor Detection Methodology Using K-Means Clustering Algorithm," IEEE International conference on Communication and Signal Processing, pp. 653-657, April 3-5, 2013.
- [11] Lau E, Symmons D, Bankhead C, MacGregor A, Donnan S, Silman A, "Low prevalence of rheumatoid arthritis in the urbanized Chinese of Hong Kong", J Rheumatol 1993; pp. 1133-1137.

Authors Profile

Ms. Sheba Pari N. pursued Bachelor of Engineering from Visvesvarya Technological University, Karnataka, India in the year 2006 and Master of Technology from Visvesvarya Technological University, Karnataka, India in the year 2009. She is currently pursuing Ph.D. and currently working as an Assistant Professor in Department of Computer Science & Engineering, New Horizon College of Engineering, Bangalore, India since 2010. She has 8 years of teaching experience.

