Osteoarthritis Disease Detection with the Help of Image Processing Technique

Bhagyashri L.Wagaj
SVERI'S College of
Engineering, Pandharpur.

M.M.Patil, PhD
SVERI'S College of
Engineering, Pandharpur.

ABSTRACT
Osteoarthritis (OA) is commonly seen among older people and it is arthritic type disease. It is a degenerative joint disease where cartilage slowly degenerates. Cartilage that shelters the bone ensures the smooth crusade of the joints. In knee OA, exaggerated bones come into contact due to degradation of cartilage, causing swell, discomfort and defeat of motion. Due to stress, knee joints can be frequently incapacitated and broken. The early detection of KOA could alert people to slow down the progression of the illness.

Encouraged by this, the paper presents an automatic method to diagnose the Osteoarthritis disease. The cartilage of knee joint is segmented with pixel based segmentation method. For segmentation the texture filter method is applied. From segmented image cartilage area is calculated and depending on its estimated value image is classified into normal and OA affected.

General Terms
Knee joint, Pixel based Segmentation, Texture Filter.

Keywords
Cartilage, Magnetic Resonance Imaging (MRI), Osteoarthritis (OA).

1. INTRODUCTION
Over 71 million people are exaggerated by osteoarthritis, an Overwhelming degenerative disease causing mechanical injuries. Knee osteoarthritis is growing common among females, overweight and older people. Morphological erosion of articular cartilage is the general distinguishing of OA. Cartilage is ultra-slippery shrill layer of high-quality hyaline material that shelters the ends of bones that luxury the movement of the joint. Cartilage is present between the patella femoral and tibia femoral joints of knee. The stress due to weight is more on tibia femoral joint. In OA, the cartilage damage, make the knee bones to come in contact of each other, resulting in discomfort and eventually leads to defeat of motion of the joint. This situation arises due to early knee injury, continuous strain on the knee, fatness, and heredities; ligament tears, cracks and meniscus injury that gives misalignment and promote wear and tear. In India, for people older than 60 years, OA pervasiveness is estimated to be 43% in women and 25% in men [1]. KOA symptoms can be coped by early diagnosis and treatment.

The framework of knee can be outlined by CT, MRI, X-Ray etc. With the help of MRI it's possible to quantify various parts of articular tissues relevant to arthritis for detailed imaging of soft tissues also it allows lenient tissue imaging with enhanced assessment accuracy without contrast agents.

The knee joint segmentation is interesting because of its complexity and is classified into two type pixel or intensity based and model or geometry based segmentation [2]. Edge detection, thresholding, region growing and merging etc. are pixel based segmentation while snake algorithm, active contours atlases etc. are geometry based technique.

2. RELATIVE WORK
In previous work, Sanjeevakumar classified MR images into three classes i.e. normal, doubtful OA and OA. They calculated the cartilage thickness from preprocessed masked knee joint image and compared with standard thickness of Cartilage [3]. Cashman et al. used thresholding, edge detection, interpolation in addition with morphological dilation operation for segmentation [4]. Poh and kitney used redial search method for segmentation. In this method the origin is fixed and taking radius R and angle θ inner and outer boundaries are drawn [5].

In the present work, on knee MRI image contrast enhancement, filtering, thresholding etc. techniques are applied as pre-processing. The pre-processed image undergoes pixel based segmentation process and fractional diseased area is calculated which results in detection of OA. All these methods quantify femur cartilage and Tibia cartilage separately.

3. FEATURE COMPONENT OF OSTEOARTHRITIS
In osteoarthritis, the cartilage which is present between bone joint acts like pad. It prevents the bone joint from erosion. Due to cartilage structure smooth movement of joint occurs.

When this thickness of cartilage get reduced, the bone joint comes into contact get eroded which causes pain, lack of movement etc. Hence appearance or thickness of cartilage is feature component of Osteoarthritis.

4. METHODOLOGY
4.1 Input Image
The knee joint MR images were collected from different hospitals and diagnostic centers which include both normal images and Osteoarthritis (OA) affected. Figure 1 and Figure 2 shows normal and OA affected. The collected image database includes images of different groups of age, weight, etc. On this input image pre-processing techniques used in the proposed method to segment and classifying image into normal and osteoarthritis affected class depending on area of cartilage.

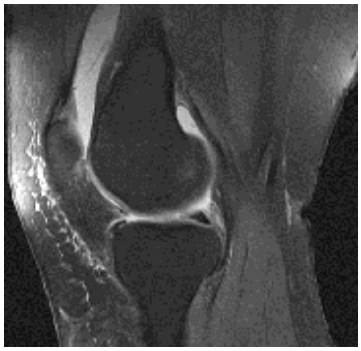

Fig 1: Normal Image

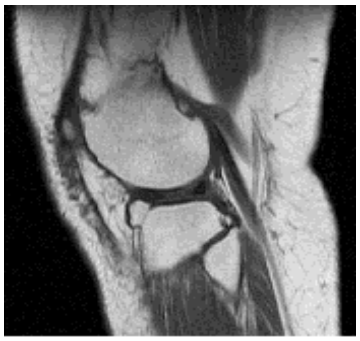

Fig 2: OA affected image

4.2 Feature Component Extraction

The extraction of cartilage or knee joint segmentation is very complicated. In this work, cartilage is segmented using pixel based segmentation. For segmentation, texture filtering is used.

4.2.1 Create texture image

From gray scale image, the entropy value of neighborhood pixel is calculated to create texture image. Entropy gives statistical measure of randomness. To calculate entropy value, initially, the center element of neighboring is find by floor ((size (NHOOD) + 1)/2). Thus entropy matrix is generated.
With the help of generated entropy matrix the gray scale image is created to rescale the texture image so that its values are in default range for double image. Figure 3 shows the texture image.

Fig 3: Texture Image

4.2.2 Create Rough mask

The rough mask is created using thresholding operation. Thresholding gives the binary image from gray scale image. With the proper thresholding level, the rough mask is created. Figure 4 shows rough masked image.

Fig 4: Rough masked Image

4.2.3 Morphological Operation

The rough created mask undergoes for morphological operation. Initially all small connected components are removed which is having value less than 1000 pixel. This gives another binary image. After removing g connected objects the holes which are present get filled. Figure 4 and figure 5 shows the result of operation of area opened and area filled.

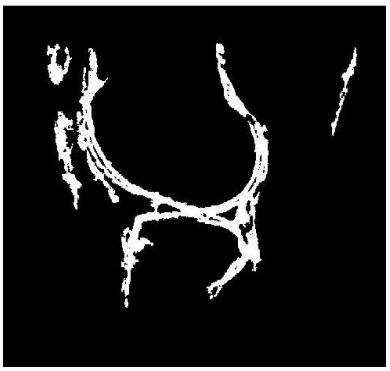

Fig 5: Result of Area Open

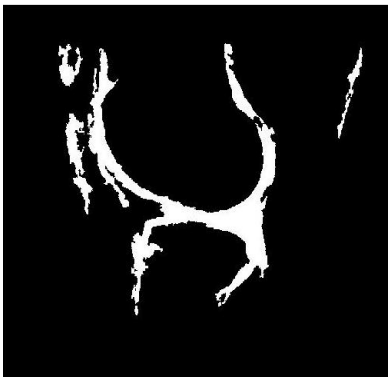

Fig 6: Result of Area filled

4.2.4 Median Filter

Median filter is nonlinear method which is used to remove noise from images. This filter is commonly used as it is very useful at removing noise while it preserve the edges in image. This filter is particularly effective at removing 'salt and pepper' type noise. It Works by moving through the image pixel by pixel, replacing each value with the median value of neighboring pixels.

The output of median filter is segmented image shown in figure 7.

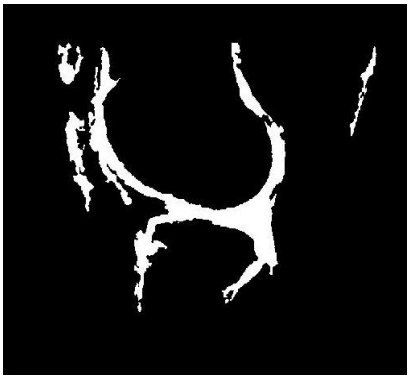

Fig 7: Result of Segmentation

4.2.5 Calculating area of Cartilage

The segmented image is used to calculate the area of cartilage. The area of cartilage is nothing but the number of pixels in the cartilage. Depending on the area of cartilage, the knee joint MR image is classified as normal and OA affected image.

5. RESULT

This work provides the method to diagnose the Osteoarthritis disease. Depending on area of cartilage, the pixel based segmented MR image is categorized as normal and OA affected.

In this work total 32 images are tested which includes, 16 normal and 16 OA affected. For normal 16 images, it classifies all images correctly. For OA affected case out of 16 images, 1 image is misclassified. The analysis of result is shown in table 1.

Table 1. Statistical analysis of result

Analysis of Parameter	Accuracy	
	Normal Case	OA affected
Result in Percentage	100	96.87

6. CONCLUSION

In this work, knee joint MR image is segmented using texture filter method. From segmented image the area of cartilage is calculated and knee joint MR image get classified into normal and OA affected image.

Thus osteoarthritis disease is diagnosed with this work. Combining history of patients with this study this is helpful to give appropriate treatment to patient in medical field.

In future work may be extended to determine the intermediate stage between normal and Osteoarthritis which help to analyze the severity of disease.

7. LIMITATIONS

This work detects the osteoarthritis disease. In this disease, the thickness of cartilage starts deteriorates. This study detects only two levels i.e. normal and OA affected. The intermediate stage between normal and OA, cannot be detected in this work.

Thus, intermediate level is not detected hence early detection of OA is not possible.

8. REFERENCES

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