# Normal And Abnormal Detection For Knee Osteoarthritis Using Machine Learning Techniques

**Aamir Yousuf Bhat, A. Suhasini**

***Abstract:*** ***Osteoarthritis is the most broadly recognized disease in the knee joint that affects the cartilage, especially among the old age or overweight people. In the normal knee joint, the smooth and thin layer called cartilage covers the joint space of the bone and makes the joint smooth and prevents them from rubbing against one another, but can break, when the cartilage gets ruptured due to which bones start rubbing with one another, and this may cause severe pain, swelling and stiffness in the knee joint. The evaluation for osteoarthritis detection includes a clinical examination, and different medical imaging techniques are X-RAY images and MRI scans. There is developing method required for classification frameworks that can precisely distinguish and identify knee OA from plain radiographs. In this method we have examining the strategy of computer aided diagnosis for early identification of knee OA. Based on the procedure of x rays through computer image processing, segmentation, feature extraction and investigation by means of building a classifier, a viable computer aided detection method for knee was made to help specialists in their precise, convenient and identification of potential risk of OA. For this method a total of 126 knee x ray image were collected for assessing the knee OA. In this paper, we tried to diagnose about the normal or abnormal detection of cartilage depreciation. The HOG and DWT features are extracted from X-ray images of the knee joints. The extracted features are classified with two different machine learning classifiers, namely the SVM and ANN Patternet classifiers, and the results are demonstrated. The SVM classification is good when compared with ANN and provides a satisfactory accuracy rate of 85.33%. At last the classifier was superior both in time effectiveness and classification execution to the regularly utilized classifiers based on iterative learning. In this way it was suitable to utilize as a computer aided tool for the diagnosis of OA.***

***Keywords:*** ***Osteoarthritis (OA), Knee X-Ray, Feature Extraction, Machine learning, DWT (Discrete wavelet transform), HOG (Histogram of Oriented Gradients), ANN (Artificial Neural Network) Patternet, SVM (Support Vector Machine).***

## I. INTRODUCTION

Medical imaging is the visualization and representation of the internal structure of the body for clinical analysis. It is the imaging system that encompasses the fields of optical imaging, radiology and image-guided intervention [1, 2].

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It develops a database of normal anatomy and physiology to make it conceivable to recognize the abnormalities. Osteoarthritis is one of the foremost common types of degenerative "wear and tear" type of arthritis that happens mostly among elderly and weighted people. It is a kind of joint disease that, for the most part, influences the cartilage. The cartilage covers the knee bone and acts as a cushion for the movement of the knee. In knee, the degradation of the cartilage causes swelling, pain and stiffness in the movement of the joint [3]. As the cartilage erodes, it becomes frayed and unpleasant, and the space between the bone decreases, which causes scouring on bone and produces painful bone goads. It is a vulnerable joint that affects about 6% of the adults and can be seen more frequently in women than in men. X-rays are generally used to identify the osteoarthritis, which includes the destruction of joint cartilage; the distance between the joint is diminished between connecting bones and bone goad arrangement. The technique utilized for clinical examination for osteoarthritis is not precise enough to efficiently quantify the quality and advancement of osteoarthritis. The indications may happen just by the following exercise, but over time it may end up steady. Numerous different side effects may include swelling, decreasing range of movement, particularly when the back is affected by weakness or the number of arm and legs. It is accepted to be caused by mechanical weight on the knee joint and low-grade inflammatory, resulting in loss of cartilage and the underlying bones are affected. Osteoarthritis is the foremost widely recognized type of arthritis affect about 237 million (3.3%) of the population. Among these, over 60% of age, about 10% of males and 18% of females are influenced. For digital image analysis, feature extraction is utilized to remove the idle striking characteristics for desirable analysis and to classifying the image. The feature extraction process also reduces the dimensionality of the measurement space and therefore reducing the utilization of image processing time. The present best quality for the diagnosis of OA other than consistently required clinical route examination of the affected knee joint is x-ray imaging, which is efficient, protected and broadly available. Despite these preferences, it is far widely recognized, that simple radiography is irrelevant when trying to realize changes in early knee osteoarthritis. It could be clarified by a few certainties; initially, a sign of OA and the leading degree of its progression is the degeneration and wear of the articular cartilage, a tissue that is not visible by utilizing plain x-ray radiography. Second despite the fact that the assessment of the changes inside the joint must be a 3D problem. The imaging techniques employ a two dimensional (2D) sum projection, and finally, the interpretation of the resulting image requires a completely experienced specialist. The debasement of the cartilage and wear are not directly estimated through the evaluation of the joint space width (JSW), the formation of osteophytes, subchondral sclerosis, bone deformity and bone subluxation. Osteoarthritis is characterized into two groups or bunches according to its etiology: Primary (Non-traumatic), secondary (Trauma or misalignment). The seriousness of the ailment can also be examined by radiological findings from the Kellgren and Lawrence system [4]. It was accepted that osteoarthritis was exclusively a degenerative cartilage disease. However, the recent proof was demonstrated that OA is a multi-factorial entity involving different causative components like injury, inflammation, mechanical forces, bio-chemical responses [5]. In this paper, we have proposed an automated framework for evaluating osteoarthritis, which is applied to X-ray images. The segmentation of the image for the detection of a region of interest (ROI), including feature extraction and classification methods are applied to determine the normal and abnormal detection of osteoarthritis for the knee. The organization of the paper is as per the following. Section first gives the introduction. In section II we discuss the related work. Methodology for the detection of knee osteoarthritis is depicted in section III. In section IV the result of the experiment is carried out. At last, the conclusion is depicted in section V. Thus, more significant methods, and algorithms are required to provide access to the parameters and progression of osteoarthritis.

## II. RELATED WORK

A great deal of work has been done in the field of medical image processing in recent years to recognize the different diseases. The following are some related works carried out in the past years. OA, which is the most common disease that mainly affects the knee joint, hips and fingers that can lead to disability, discomfort and mortality.

**Lion Shamir** et al. [6] used the joint detection algorithm and the feature extraction technique to analyse the radiographic image of the knee. The algorithm finds the joint and isolates it from the remaining part of the image. The functions were calculated using Zernike functions, Multiscale histograms, first four moments, Trauma plot features using the nearest neighbouring weighted rule. The extracted characteristics were classified, utilizing the nearest neighboring weighted rule. They concluded that 95% of moderate OA was differentiated from the normal.

**H.oka** et al. [7] used the fully automated computer-aided diagnosis program of knee osteoarthritis (KOACAD) to evaluate OA parameters on x-ray radiographs and explore the relationship of parameters to knee pain. The parameters estimated were the narrowing of the joint space on the medial and horizontal sides, the formation of osteophytes and joint angulations. The outcome demonstrates that the structure automatically calculates all the parameters in 1s and reveals that the narrowing of the middle joint space and the angulations of the knee joint are risk factors for the occurrence of pain, where a narrowing of the lateral joint space and osteophytes are not under risk factor.

**Philipp Peloschek** [8] et al. given an RA quantifies software, this software uses joint calculation in four steps, and the joint is chosen as physically. This technique that is estimated dependent on web technique for this they only measured the thickness with the RA quantify and how to detect the knee osteoarthritis and how to identify this disease. **Aleksei Tiuplin** et al. [9] have proposed an algorithm for localization of the knee joint area for the assessment of X-ray radiographic images of the knee. The overall work is divided into two parts: it automatically locates the joint area and calculates the calculation using the HOG method. The outcome shows that this technique is appropriate for large-scale investigations. The results are also unilateral, and the method is of greater computational complexity. It has been proposed to improve execution by using reduced-scale images for joint detection and then the detected scaling region for further analysis.

**Joseph Antony** et al. [10] have investigated the use of Convolution neural networks CCN, namely VGG 16 layer net, simple frameworks like VGG-M-128 and BVLC reference Caffe Net are utilized to group knee osteoarthritis images. Basically, the features were removed from convolution pooling and completely associated layers of VGG 16, VGG-M-128 and BVLC Caffenet and trained linear SVM to characterize that VGG-M-128 and BVLC cafee Net had accomplished the high classification accuracy when contrast to the previous related work.

**S. Botha scheepers** et al. [11] studied and evaluated the reliability of recognizing joint space by narrowing the radiographic images of the knee affected by OA using fixed flexion radiography and in contrast the impact of the alignment of the Medial Tibial Plateau (MTP) on the reliability of shrinkage of joint space. Their study reveals that fixed flexion radiography shows changes in JS N for two years.

**Hillary J. Braun** et al. [12] the studied and analysed the different imaging methods utilized for OA. Imaging modalities include radiography, magnetic resource images, optical coherence tomography (OCT) and ultrasound (US). Radiography is used for the examination of bony structures. OCT is utilized for assessment of articular cartilage. US is used for synovial and ligaments. MRI includes a visualization of all intra-articular structures and pathologies. They have presumed that the combination of the above techniques providesexcellent information in gaining the status of the dis ease.

**Sreepama Banerjee** et al. [13] have portrayed a class of algorithms depend on cellular networks for identifying OA based on hand x-ray images. Cellular neural network algorithms are valuable when quick and powerful pre-processing is required. The parameter utilized for the identification of OA is osteophytes or bone spurs. The algorithm uses a standard convolution neural network (CNN) templates and spicules seeker algorithm to isolate the osteophytes. They have shown the result with a 90% accuracy rate.

## III. METHODOLOGY

The proposed methodology consists of 4 steps, pre-processing, ROI (Region of interest) segmentation, feature extraction and feature classification of computed features from the x-ray images. Feature extraction which includes DWT (Discrete wavelet transform) and HOG (Histogram of gradients). The classification process is followed by the two classifiers SVM (Support vector machine), ANN Patternet (Artificial neural network) classifier. The block diagram for the proposed methodology is shown in figure 1.

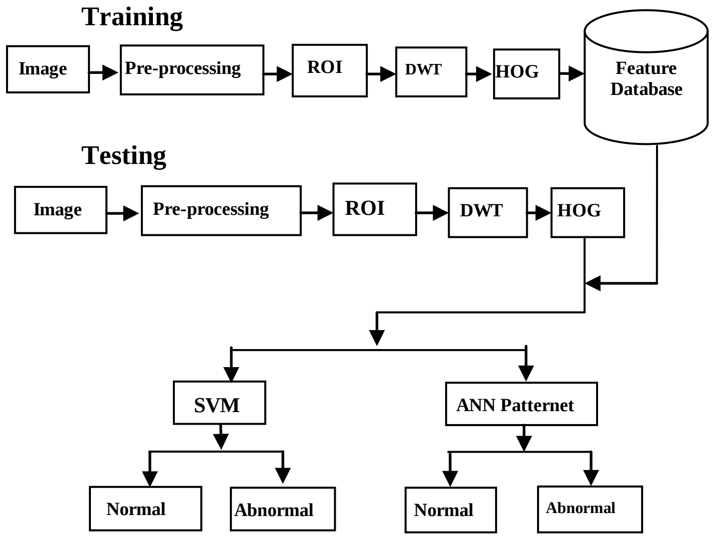



**Fig. 1 Block diagram for the proposed methodology (Normal, Abnormal)**

### *A. Dataset*

The datasets used for the experiment are taken from various hospitals by consulting doctors and experts. The dataset was taken in Posteroanterior (PA) view based fixed flexion knee x-ray images. The dataset is a standard for studies concerning knee osteoarthritis. In the entire dataset, the Kellegren and Lawrence (KL) grades are accessible for knee joint osteoarthritis images, and those x-ray images are utilized for this experiment. A total of 126 knee joint x-ray images are used by our proposed method. Normal and osteoarthritis affected knee x-ray image are shown in figure 2 (a) and figure (b) respectively.


**Fig. 2 (a) Normal knee X-Ray Image Fig. 2 (b) Osteoarthritis Knee X-Ray Image**

### *B. Pre-processing*

Pre-processing is one of the foremost imperative step in digital image processing, which is used to highlight some important features relevant to understand the image. It is applied to the images at the minimal degree and thus to reduce undesired distortions. The goal of pre-processing is to progress the image to such extent so that it can increase the probability for the success of some another process. It works by extracting the features of the image, which are the most useful features. The intensity values of the grayscale images to new values are such that few of the data is saturated at a low and high intensity of the image. In pre-processing, histogram equalization, contrast adjustment and noise removal using Weiner filter is carried out using MATLAB code. The image is resized into 512 x 512. The increment in the contrast of the output image is shown in the figure 3 (a) & figure (b).

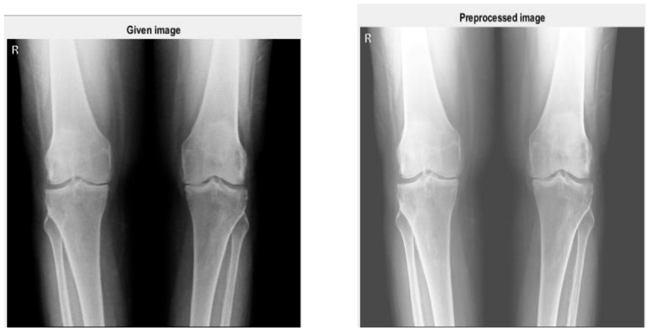



**Fig.3 (a) Original Image Fig. 3 (b) Pre-processed Image**

### *C. Image Segmentation*

Image segmentation is the method of partitioning the image into its constituent's parts so that they can be identified individually [14]. To be significant and valuable for image investigation and image interpretation, the regions should be strongly related to the object of interest. The region of interest (ROI) is a specific part of the image in which we need to perform some operations on it. The ROI is very particular about bone extraction from the x-ray images, in particular, removing gray or black colored spaces in x-ray concentrate the bone region using Otsu's method. Otsu's method automatically finds an ideal threshold based on the watching dissemination of pixels. Otsu's is the most effective technique for image thresholding because of its straightforward calculation. The Otsu's threshold technique involves suppressing of all thinkable threshold values and determining the dispersion ratio for the pixel level on each side of the threshold, that is, pixels that fall in the foreground or in the background. This works on binary images. Binary images must contain the most basic data about the position and shape of objects that are of interesting. If t(x, y) is a threshold version of f(x, y) at some global threshold T, it can be defined as,

$$t(x,y) = 1 \text{ iff}(x,y) \geq T = 0 \qquad (1)$$

Otherwise, Thresholding operation is characterized as:

$$T = M[x, y, p(, x, y), f(x, y)] \qquad (2)$$

In this equation, T represents the threshold; f (x, y) is the gray value of the point (x, y) and p(x, y) shows some local properties of that point, such as the average gray value of the neighborhood centred on point (x, y).
It is an automatic threshold selection process for region-based segmentation. The segmented image is divided into three parts for extracting the cartilage location from the image. The cartilage location is the middle second part of the image. Fig.4. Shows the extracted region of interest (ROI) image.

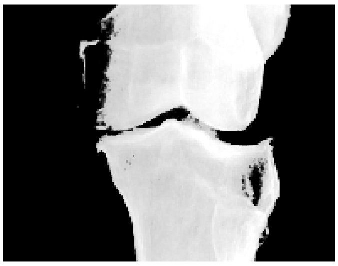


**Fig.4. Region of Interest**

## IV. FEATURE EXTRACTION

### *4.1. Discrete Wavelet Transform (DWT)*

Discrete wavelet transform is an execution of the wavelet changes employing a discrete set of the wavelet scales and interpretation by obeying a few characterized rules. Wavelet changes breakdown a flag into a set of basic limits. These premise capacities are called wavelets. The wavelet is developed from a single model called mother wavelet by shifting and dilation [15]. It has been introduced as a very profitable and adaptable method for sub-band decay of signals. The wavelet transform can be described by the following notation.

$$F(a,b) = \int_{-\infty}^{\infty} F(x)\varphi * (a,b)x\,dx \qquad (3)$$

Where * is the complex conjugate symbol and function $\varphi$ is some function. The wavelets can be built from a scaling function which portrays its scaling properties. The limitation that the scaling capacities must be symmetrical to its discrete interpretation infers a new numerical condition on them which are mentioned everywhere.

$$\emptyset(x) = \Sigma_{k=-\infty}^{\infty} ak\,(sx-k) \qquad (4)$$

Where S is a scaling factor. Beside this, the area between the function must be standardized, and scaling work must be symmetrical to its number translates.

$$\int_{-\infty}^{\infty} \emptyset(x)\emptyset(x+l)dx = \delta_{0,1} \qquad (5)$$

It is a multi-resolution investigation and separates the images into wavelet coefficients and scaling function. In this, the signal vitality concentrates to a particular wavelet coefficients. It converts the image into the series of wavelets that can store more proficiently than the pixel blocks. They have harsh edges, which can render images better than by wiping out the blockiness. A time scale portrayal of the computerized signal is taken by utilizing progressed advanced digital filtering techniques. The analyzed signal passes through filters with a distinctive cut of frequency at distinctive scales. The multi-resolution requires two functions: scaling $\emptyset(t)$ and wavelet functions $\omega(t)$.

### *4.2 Histogram of Oriented Gradient (HOG)*

The HOG is a notable feature descriptor for strong visual object recognition [16], to detect the objects in the images. To compute the feature descriptor of an image, the primary step is to separate the image into little separate classes called cells taken after the calculation of the gradient magnitude and orientation of the image. The second step is the introduction binning for each cell, which computes the entire sum of the gradient magnitudes inside each orientation bin of the histogram. The final step is to standardize the concatenated histogram results about all the cells inside a bigger spatial region called a block to achieve a superior execution against light changes. The HOG feature descriptor F (I, Q) (where I and Q are the $I_{th}$ HOG cell and orientation container of the histogram) can be achieved by consolidating the standardize descriptor blocks.
It is a thick feature extraction strategy for image analysis and object recognition. Thick means that it extracts the highlights for all areas within the image as contradicted to as it were the local neighbourhood of key points like SIFT. HOG descriptors constitute the essential characteristics that encoded the object characteristics into a large arrangement of specific numbers which may be utilized to recognize objects from each other [17]. Primarily the HOG features are evaluated from a certain block of the segmented knee x-ray image [18]. Each block inside the framework is isolated to smaller cells in which the gradients are computed. Gradients are the rates of local intensity change at a specific image pixel location [19, 20]. It is a vector that has both magnitude and direction [21]. The magnitude and the direction of the gradient at pixel p(x, y) are given in the equation [6] and [7] respectively.

$$v(x,y) = \sqrt{vx\,(x,y)^2 + vy(x,y)^2} \qquad (6)$$
$$\alpha(x,y) = \arctan[vx\,(x,y)\;/\;vy(x,y)] \qquad (7)$$

**Fig.5 HOG Features**

The visualization of HOG features is shown in Fig. 5

## V. CLASSIFICATION

### 1. *Support Vector Machine (SVM)*

SVM is a supervised machine learning algorithm that analyse data for classification. SVM uses a strategy called the Kernel trick to convert the data and then based on these changes; it finds an ideal boundary between the conceivable outputs. Essentially it does a few great complex information changes, and then it points out how to separate the information dependent on these outputs we have characterized. SVM works by mapping the information to a high dimensional feature space, so that the information points can be categorized indeed, when the data isn't something different straightly detachable. A separator between the classes is found; at that point, the information is changed, so that the separator can be drawn as a hyper-plane. It has been efficiently used in classification and work estimation issues inside the context of Statistical learning hypothesis and structural (auxiliary) risk minimization. The goal of SVM is to find the ideal hype- plane that divides the clusters of the vector into two bunches. The initial ideal hyper-plane algorithm is a linear classifier. At that point, non-linear classifiers are created by applying the kernel trick to most extraordinary edge hyper-plane. This grants the calculation to fit the most extreme edge hyper-plane in a changed feature space [22, 23].

$$(\omega.x) + b = 0 \qquad (8)$$

SVM has been developed to divide the training information into two classes. It expects the input set as an n-dimensional feature vector space and attempts to find the (n-1) dimensional hyper-plane divides the space into two parts, which increases the least distance between any information points. In the event if for n-dimensional input data xi (where i= 1, 2…. r, r is the number of samples) is marked as yi=1 for class 1 and for yi= 2 for class 2 by y matrix.

$$f(x) = \omega.x + b = \textstyle\sum_{i=1}^{n} \omega i x i + b = 0 \qquad (9)$$

A hyper-plane f(x) = 0 can be expressed for linearly separable data.

Where $\omega$ a dimensional vector and b is a scalar. These parameters decide the area of hyper-plane, which obliges clear limits.

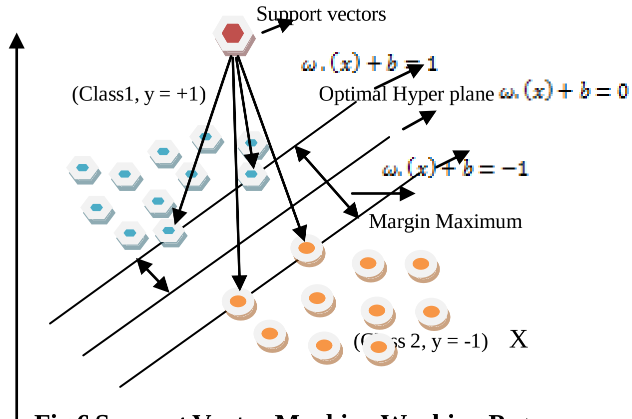



**Fig 6 Support Vector Machine Working Process**

### 2. *Artificial Neural Network (ANN) Patternet*

ANN is an information processing framework that is propelled by the way biological nervous system, such as the mind processing information. A neural network is a machine that is expected to show the way in which the mind plays out a particular task. The framework is normally implemented by using electronic components or is simulated in software on a digital computer. An ANN instructs the system to execute the task in step of computational programming framework to do the definite tasks. To do such tasks, Artificial Intelligence (AI) framework is produced. It is a model, which can rapidly and precisely find the network designs buried in the information that produces valuable information. ANN is made up of numerous artificial intelligence neurons, which are connected together in accordance with the unequivocal network architecture. The goal of the neural network is to convert the inputs into significant outputs.

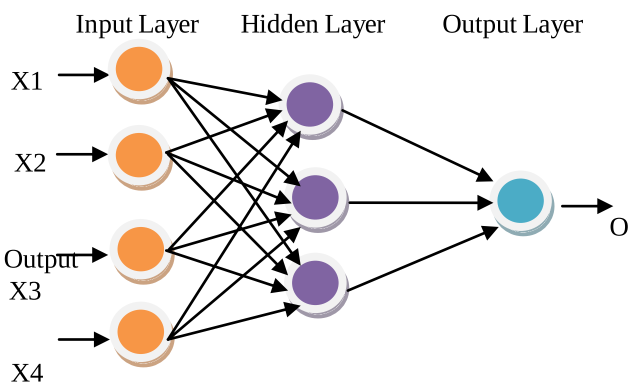



**Fig. 7 Artificial Neural Network (ANN)**

The connection between the nodes is the foremost finding in an artificial neural network. We will find the weight of each connection after examining the whole system. The known values in the (ANN) architecture are the inputs. Let us assume the input as X1, X2 and X3, H1. H2, H3 are the hidden states and O as output. The weights of the linkages can be signified with the following notation.

$$logit(H1) = W\,(x1\;\; H1) * x1 + W\,(x2\;\; H1) * x2 + W\,(x3\;\; H1) * x3 + constant = f \Rightarrow P\,(H1) = 1\,(1 + e \wedge (-f)) \quad (10)$$

We accept a sigmoid connection between the input variables and the activation rate of hidden nodes or between the nodes and the activation rate of output nodes. ANN is not itself a learning algorithm, but a system for numerous distinctive machine learning algorithms to cooperate and deal with complex information inputs [24]. It depends upon a gathering of related units (hubs) called artificial neurons, which freely

demonstrate the neurons in an organic brain. Every connection simply likes the neural connection in an organic brain can transmit a signal starting from one manufactured neuron to next. A manufacture neuron that gets a signal can prepare it and after that signal various artificial neuron getting associated with it.

## VI. EXPERIMENT AND RESULTS

The experiment is implemented in Matlab R2016 (a) with AMD A4-330 MX APU Radeon (tn) HD processor with 4 GB RAM. The execution of the created method was evaluated on knee joint x-ray images. The experiment has been taken on different knee X-ray images of distinctive age group and sex. It is performed on 126 knee x-ray images with the JPEG (Joint Photo Expert Group) standard. The images have been collected from distinctive hospitals and other clinical centers. The feature extraction is utilized are DWT (Discrete wavelet transform) method and histogram of gradients (HOG). Then feature extraction is classified using SVM and ANN classifier. The proposed method is given as:

Input X ray image

**Step 1**: Preprocessing of X ray image which includes image adjustment, histogram equalization, noise removal, contrast adjustment and image resizing.

**Step 2**: ROI (region of interest) using Otsu's method, which crops the image into the particular specification by the given calculation.

**Step 3**: DWT (Discrete wavelet transform) for feature extraction as well as for dimensionality reduction.

**Step 4**: Feature extraction using HOG (Histogram of gradients is segmented from each segmented image for further classification).

**Step 5**: Classification using SVM and ANN Patternet classifier.

**Step 6**: END.

In the experiment, training and testing images are resized into 512 x 512 sizes. Otsu's method has been used to acquire the region of interest, the ROI segmented images are also resized into the uniform size of (250 x 250). LL band image is extracted from DWT wavelet transformed image. From DWT wavelet image, HOG feature is extracted. The HOG features are computed from blocks of size 16x16 pixels of the segmented knee X-ray image. Each block inside the network is further separated into smaller cells, in which the gradients are computed. Gradients are the rates of local intensity changes at a particular image pixel position. It is a vector quantity that has both magnitude and direction. Each 16×16 block is represented by a 36×1 vector. So the HOG feature size is 3528- dimensional vector. The selected features are tested with two different classifiers separately, namely SVM and ANN. ANN is defined with ten (10) hidden layers with input and output layers. One thousand (1000) iterations have been defined for retrieving accuracy.

**Table 1 Training And Testing Image Dataset**

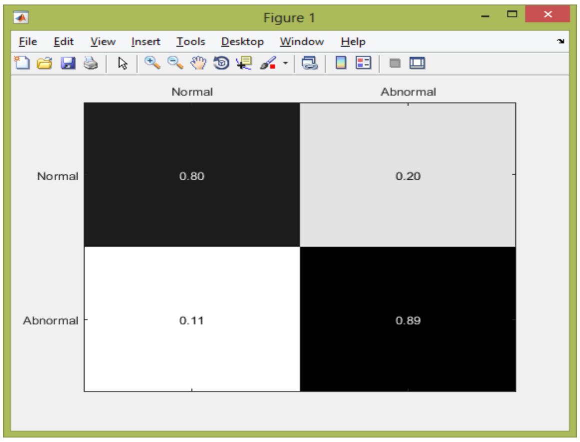
| | |
|---|---|
| Number of x-rays | 126 |
| Number of x-rays used for training | 51 |
| Number of x-rays used for testing | 75 |

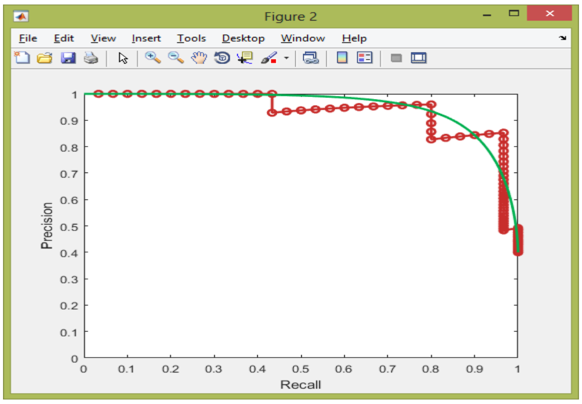
The demonstrated assessment was performed on knee X ray images arbitrarily chosen from the clinical dataset, which contains 126 knee X ray images, which is described in table 1. Out of the 126 datasets, 51 images have been utilized for training, and 75 images have been used for testing purpose. That means, in this experiment, 40% of x-ray images are used for training, and the remaining 60% are used for testing (Table 1). Sixty four (64) images were correctly classified out of 75 for SVM classifier thus with the accuracy of 85.53% and 56 out of 75 for ANN Patternet classifier with the accuracy of 73.82 % in terms of testing.

**Table 2 Classification Metrics for the SVM**

| Class | Precision | Recall | $F_1$ Score |
|---|---|---|---|
| Normal | 0.8276 | 0.8696 | 0.8316 |
| Abnormal | 0.8000 | 0.8889 | 0.8791 |
| Mean | 0.8138 | 0.87925 | 0.85535 |

Confusion Matrix for SVM





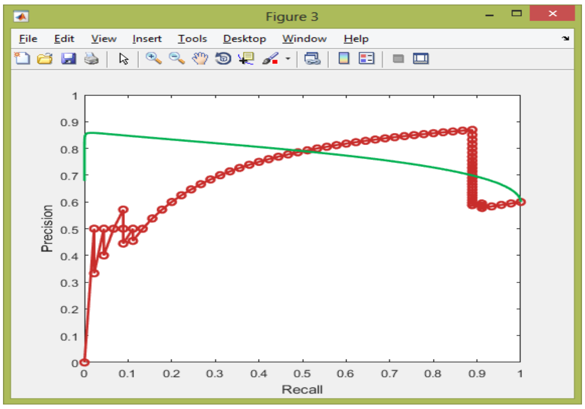
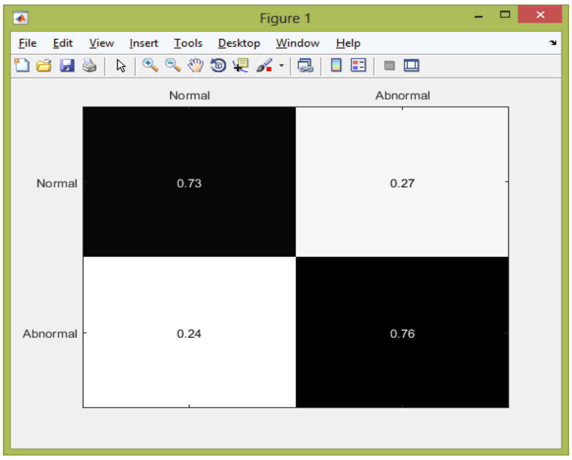
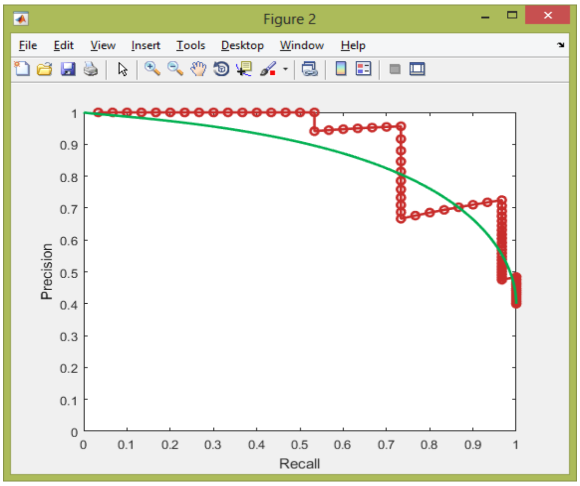



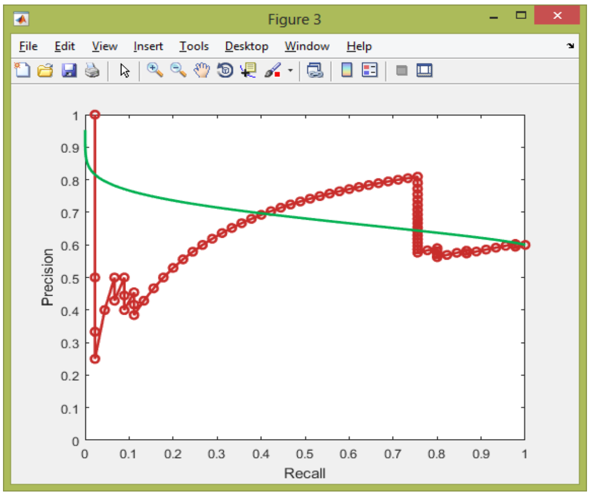

**Table 3 Classification Metrics for the ANN**

| Class | Precision | Recall | $F_1$ Score |
|---|---|---|---|
| Normal | 0.6667 | 0.7333 | 0.6948 |
| Abnorma l | 0.8095 | 0.7556 | 0.7816 |
| Mean | 0.7381 | 0.74445 | 0.7382 |

Confusion Matrix for ANN




## VII. CONCLUSION

For the experimental process of the proposed system, the knee X-ray images are annotated by the trained practitioner. In this paper we portrayed a computerized approach for the identification of OA utilizing knee X-rays. With the nonappearance of a precise strategy of OA conclusion, the manual KL grade is utilized here as gold standard in spite of the fact that it is known that this strategy is less than perfect. The classification is not performed in a way that endeavors to mimic the human classification, but is based on a data driven approach utilizing physically classified X rays of distinctive KL grades representing the various stages OA seriousness. The experimental results approved by the specialists are observed to be in close understanding. In this method we have illustrated a novel approach for naturally diagnosing and evaluating the knee OA from plain radiographs. Our technique has employed special features relevant to the disease; one's that are comparable to the one's utilized in clinical training. Comparing to the previous approaches, our method has accomplished the most noteworthy multi class classification outputs with an accuracy of 85.33% despite having a distinct test set. This technique is utilized to detect the normal and abnormality of the disease, which leads to identifying the disease in the early stage itself. The proposed method is of potential use in the study of disease seriousness investigation of the patients and additionally supportive in fair appraisal for knee OA. In this

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method, the computer-supported tool is created to analyse the bone disarranges caused by OA. This tool classifies the articular shape (AS) of the knee joint for the advanced x-ray image investigation into the normal and abnormal grade. This method gives an automatic tool to examine the x-ray for the identification of OA. Due to the subjective nature of the gold standard it is conceivable that a 100% relationship between computer based and manual classification may not be accomplished. In this work, two features, namely DWT and HOG were computed. For classification purpose, ANN and SVM are employed. When compared to the classification result one with each other, the SVM gives the best accuracy than ANN for this work. The proposed method has achieved the maximum classification accuracy of 85.33%. In future work, the aim is to enhance segmentation and classification rate by using still better methods for pre-processing, segmentation, feature extraction and classification.

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