PROVISIONAL DIAGNOSIS OF BONE FRACTURE USING MEDICAL IMAGE ANALYSIS

Project Report submitted in partial fulfilment of the requirement for the degree of

Bachelor of Technology

In

Information Technology

Under the Supervision of

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Certificate

This is to certify that project report entitled "**PROVISIONAL DIAGNOSIS OF BONE FRACTURE USING MEDICAL IMAGE ANALYSIS**", submitted by **Aditya Vikram Monga, Avinash Thakur and Vinny Mittal** in partial fulfilment for the award of degree of Bachelor of Technology in Information Technology to Jaypee University of Information Technology, Waknaghat, Solan has been made under my supervision.

This report has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Date: **Dr. Pradeep Kumar Singh**

ACKNOWLEDGMENT

We would like to express our gratitude towards everyone who provided us with the necessary support to complete this report. A special token of gratitude towards our project guide and mentor, Dr. Pradeep Kumar Singh whose timely and incessant help provided us with the indispensable support, which finally enabled us to complete our project especially this report.

We'd also like to thank our friends and the professors who provided us with the resources and constant scrutiny, without which completing this project would have been a distant dream. They helped us a lot all through the project and now we have completed the project, 'PROVISIONAL DIAGNOSIS OF BONE FRACTURE USING MEDICAL IMAGE ANALYSIS'

Finally, without the support of our Family, their understanding and patience, it would have been impossible for us to finally complete our study.

Date:

Signature:

Aditya Vikram Monga

Avinash Thakur

Vinny Mittal

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LIST OF ABBREVIATIONS

MRI	-	Magnetic Resonance Imaging
CT	-	Computed Tomography
PET	-	Positron Emission Tomography
SVM	-	Support Vector Machine

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ABSTRACT

This project has been undertaken in order to reduce and eliminate loss of time and expediting medical diagnosis. The present framework is manual and it is tedious. It is likewise inclined to blunders which may be overlooked because of human mistake. Currently, patients have to undergo the scanner after which X-ray reports are handed to them. This report is then analysed by the doctor who then suggests the approach to be taken.

Sometimes, the fracture is too minute to detect in which case the doctor may either recommend another X-ray or he may proceed with the usage of Plaster of Paris nonetheless which may or may not have been needed. This causes the loss of vital time for both the doctor and patients and an added uncalled expense for the patient.

The software to be developed in this project would keep a database of a number of X-ray images which it would use to compare with the image of patient's X-ray and accurately describe the type and the extent up to which the patient has fractured his bone.

CHAPTER 1

INTRODUCTION

The existing methodology of detecting fractures involves manually detecting the fracture and then classifying it as benign or an actual broken bone. The medical officer then categorises it as per his prerogative. The medical officer compares the X-ray report with the existing database and then gives the prescription accordingly. This process of prognosis of degree of fractures has been the go to methodology of doctors.

We intend to replace this obsolete methodology with a software which would already be containing a big enough database of sample X-ray images and based on the parameters such as the angle of the bone at the point of breakage and the intensity of fracture, it can precisely characterize the picture under investigation according to the wavering degrees of the fracture. The software would then be used to provide an accurate prognosis of the current medical condition and thereby classify the fracture as hairline fracture, chip fracture, compression, greenstick and such.

Our aim is to provide support to the medical officer so that he doesn't have the need to deal with trivialities which are programmable and the process saving enough time for the medical officer to pay attention towards other vital jobs. On successful completion of the project we would be able to digitize the entire process without having the need for the medical officer to use an actual hard copy to detect a fracture. Our software is intended to skip out on all the manual labour and thereby digitalise this age old process.

The burgeoning of machine learning based technologies in almost all the major fields such as healthcare, financing, IT industry has led to the beginning of a shift in the existing situation.

It is our intention to use this nascent technology to create a software that would analyse the X-ray by itself without the need of any medical officer.

1.1 Document Purpose

The advancement in medical industry and the way technology has embedded itself
In early detection and better treatment of benign and malignant disease cannot be overlooked. With this idea in mind, this project has been developed with the aim to-

1.1.1 Expedite Fracture Detection Process:

To be able to digitize not just the imaging part but even completing the analysing part inside the software itself, thereby removing any contingency and replacing it with certainty.

1.1.2 Applying the software for detection of other malignant diseases:

The efficacy of this software can then be used for the detection of d tumours which although are harder to detect but if detected would greatly ease up the treatment of malignant diseases caused due to these tumours.

1.2 Problem Statement

The main issue with the existing methodology of bone fracture detection i.e X-ray is that human error although miniscule as compared to the efficiency of doctors and cost of time is not taken into account. Because of the proliferation in the number of patients due to increasingly hostile environment has led to over burdening of the existing medical institutions especially valid for the native populace of the nation.

Therefore, it has become equally vital as the problem to look for ways which can greatly increase the efficiency of the treatment and saves enough time to cater towards more patients.

Having expeditious software which bodes well on both of these parameters can greatly reduce the toil on trivialities thereby saving vital time which can be better used for the treatment more patients and the doctor even has more time to attend to his patients. This would effectively boost the efficiency of the system.

1.3 Product Scope

This project covers vital areas in the field of healthcare and the IT sector itself.
Developing machine learning algorithms in analysing vast plethora of images can greatly help in developing much more efficient future technologies. The future applications of this project are-

Applications in health care-

The field of healthcare has the potential to benefit from visual analysis and pattern recognition using machine learning. Machine learning techniques can be used to analyse MRIs, X-rays etc. to aid in diagnosing and making a prognosis. After successful implementation of X-ray images, we can even adjust our algorithm to predict tumours and determine whether the tumour is malignant or benign.

Application in Image Content Analysis-

Visual examination and pattern recognition can be utilized to assess the content of the image. The conceivable employments of such innovation go from independent robots to auto autopilot frameworks. These need a framework that can examine the content of digital images.

CHAPTER 2

LITERATURE SURVEY

A number of researchers and practitioners have worked on the analysis of 'PROVISIONAL DIAGNOSIS OF BONE FRACTURE USING MEDICAL IMAGE ANALYSIS'

2.1 Extracts of the Literature Evaluated

1. Paper review: Machine learning (Deep Learning) in the field of Medical Image Acquisition

Objective of Paper: Comprehending the basics of Machine learning(Deep Learning) method and carefully review the efficiency of the techniques available in this field.

1. Image Registration
2. Anatomical Detection
3. Computer-aided disease diagnosis

Findings/ Results:

Computational displaying for medicinal picture investigation affects combining the clinical as well as the logical applications we can see that it scrutinises. Late advances in profound learning have revealed new insight into restorative picture examination by permitting finding morphological and additionally textural designs in pictures exclusively from information. As profound learning strategies have accomplished the best in class execution over various restorative applications, its utilization for assist change can be the significant advance in the medicinal registering field

Limitation of the Proposed Scheme:

1. Applying profound figuring out how to therapeutic pictures emerges from the restricted modest number of accessible preparing tests to assemble profound models without misery from overfitting.

2. To grow their dataset by misleadingly creating tests by means of relative change (i.e., information growth) and after that prepare their system without any preparation with the increased dataset.

Future Scope:

Amazing changes by profound learning, over other machine learning procedures in the writing, have been illustrated. Those triumphs have been sufficiently alluring to draw a consideration of analysts in the field of computational therapeutic imaging to research the capability of profound learning in restorative pictures procured with CT, MRI, PET, and X-beam.

2. Paper review: Machine learning (Deep Learning) to perform Image Processing in the field of areas related to Health Care Industry

Objective of Paper: To discuss the benchmark machine learning(deep learning) architecture and its enhanced variant that is used to perform medical image segmentation and the classification of said images using various classifiers available in machine learning.

Techniques used by the said authors in the research paper:

1. Head image registration
2. Image segmentation
3. Image-guided therapy
4. Image retrieval and analysis

Findings/ Results:

While profound learning potential advantages are to a great degree huge as are the underlying endeavors and expenses. Enormous organizations like Google DeepMind, IBS Watson, look into labs alongside driving healing facilities and sellers are coming together and progressing in the direction of the ideal arrangement of huge restorative imaging. Siemen, Philips, Hitachi and GE Healthcare and so forth have effectively made critical ventures Virtual CG plants overlaid on a field

.

Limitation of the Proposed Scheme:

1. Expensive hardware installation.
2. High maintenance cost.
3. Knowledge of Coordinate geometry is a pre-requisite.

Future Scope:

There are boundaries, that are diminishing the development in wellbeing area. We are trusting that sooner human will be supplanted in the majority of the medicinal application particularly analysis. Nonetheless, we ought not consider it as just arrangement as there are a few difficulties that lessens its development.

3. Paper review: Machine Learning in Medical Imaging using statistical methods

Objective of Paper: To analyze the state of the art deep learning architecture and its honed version used when we have to perform image segmentation on medical images.

Techniques used by the authors in the mentioned research Paper:

1. Using Support Vector Machine (SVM)
2. Modified variants of Convolutional Neural Network (CNN)
3. Modified version of Recurrent neural Network (RNN)
4. Long Short-Term Memory
5. Extreme Learning Model (ELM)
6. Generative Adversarial Networks (GANs)

Findings/ Results:

1. Most scientists trust that inside next 15 years, profound learning-based applications will assume control human and the majority of the day by day exercises with be performed via self-sufficient machine.
2. It gives a sign of the long-extending profound learning sway in the medicinal imaging industry today.

Limitation of the Proposed Scheme:

We ought not consider profound learning in restorative picture handling as the main arrangement as there are a few difficulties that decreases its development. One of the greatest obstruction is inaccessibility of commented on dataset. Therefore, this inquiry is as yet liable, that whether we will have the capacity to get enough preparing information without affecting the execution of profound learning calculations.

Future Scope:

Amid the current couple of years, profound learning has picked up a focal position toward the mechanization of our everyday life and conveyed significant changes when contrasted with conventional machine learning calculations. In light of the gigantic execution, it is yet a possibility that profound learning-based applications will ease crafted by people as the vast majority of the day by day life errands would be effectively performed via self-governing machines.

4. Paper review Machine Learning (Deep learning) in the region of performing analyzation of image and recognizing the pattern(Pattern Recognition)

Objective of Paper: Given a data set of images with known classifications, a system might be able to predict as to how to classify the new set of images. Let us suppose, in healthcare field, given a data set of fine needle aspirate (FNA) images of breast masses that have already been pre-classified under malignant and benign categories, a new FNA image of a breast mass can be suitably categorized.

Techniques/ Methodology Adopted in Paper:

- Techniques:
- K-nearest neighbors
- The Distance Metric
- Measuring the algorithm’s performance using closest points

Findings/ Results:

- The variation of the Nearest-Neighbor calculation utilized as a part of this undertaking appears to work greatly well in bosom mass diagnosing, and the parameter j gives a supportive method for changing affectability.

- Those in the healthcare field know the associated costs of misdiagnosis in both directions, and hence could adjust the algorithm's sensitivity accordingly.

Future Scope:

- Visual analysis and pattern recognition can be used to estimate the content of images. The possible uses of such technology range from autonomous robots to car autopilot systems.
- The field of human services likewise can possibly profit by visual examination and design acknowledgment utilizing machine learning. Machine learning strategies can be utilized to break down MRI's, X-ray's, and so forth to help in diagnosing and making a guess.

5. Paper review: Explaining how to decide classification of nonlinear images using deep Taylor decomposition techniques

Objective of Paper: In this paper we present a novel system for translating nonexclusive multilayer neural systems by decaying the system arrangement choice into commitments of its information components.

Techniques/ Methodology Adopted in Paper:

1. Deep neural networks
2. Image Enhancement-
3. Noise Reduction Technique-
4. Image Segmentation Technique-
    - K-means Clustering Method
    - Neural Network Based Method
5. Heat mapping

Findings/ Results:

1. We have proposed a novel way to deal with pertinence proliferation called profound Taylor decay, and utilized it to evaluate the significance of single pixels in picture order undertakings.
2. We have revealed insight into hypothetical associations between the Taylor decay of a capacity, and govern based significance spread systems, demonstrating a reasonable connection between the two methodologies for a specific class of neural systems.

Limitation of the Proposed Scheme:

Despite the fact that these models are exceptionally fruitful as far as execution, they have a downside of acting like a black box as in it isn't clear how and why they land at a specific order choice. This absence of straightforwardness is a genuine impediment as it keeps a human master from having the capacity to confirm, decipher, and comprehend the thinking of the framework.

Future Scope:

Combination of various strategies can help defeat the current inconveniences and consequently make it a framework reasonable for recognition and conclusion any sort of infection.

6. Paper review: Edge Detection based on Fuzzy C Means in Medical Image Processing System

Objective of Paper: In this paper, we have proposed a way to deal with identify edge in MRI utilizing STICT to enhance include pictures, FCM to section and Canny edge finder to distinguish edge in the picture.

Techniques/ Methodology Adopted in Paper:

1. Image segmentation.
    - In the second stage, the picture is apportioned into number of homogenous classes adequately by utilizing FCM calculation. In this procedure, the pixels in picture are parcelled into c groups. Each bunch comprises of homogeneous pixels thank to least cost of 1m
2. Fuzzy C Means clustering
3. Software - MATLAB
4. Edge Detection

Findings/ Results:

1. The information picture is de-noised and sectioned by STICT-FCM.
2. The current created framework considers different angles like information base, checking modules, proficiency and unwavering quality.

Limitation of the Proposed Scheme:

1. Results might not be efficient as the algorithm itself cannot be regarded as perfect.

Future Scope:

1. As an outcome, the proposed strategy gives a decent outcome which exhibits high picture quality and can be utilized as a part of cutting edge determination.

7. Paper review: Automated Defect Recognition Method by Using Digital Image Processing

Objective of Paper: Automatic Defect Recognition Method by the usage of Digital Image Processing

Techniques/ Methodology Adopted in Paper:

1. Image Acquisition
2. Image Processing
3. Data Analysis

Findings/ Results:

An ingenuous approach to figure out the presence of bridge coating rust defects by using digital image processing to much efficiently analyse the bridge coating surface. The image defect recognition method was developed in order to make a comparison of different available pairs and figuring out the relevant eigenvalues that were chosen by the authors as the indispensable features to differentiate normal images from images with discrepancies or the images which were found to have a lot of defect.

The rust imperfection acknowledgment strategy was acknowledged by taking the accompanying three phases: image acquisition, image processing, and data analysis. connect painting advanced pictures were gained and arranged to create two sorts of informational indexes: faulty and non-blemished. In the image processing stage, a pair-wise comparison was performed to generate eigenvalues. The primary examination was performed between two diverse non-defective pictures where add up to 105 information focuses were created. Also, the following correlation was completed between an imperfection picture and a non-flawed picture where add up to 225 information focuses were created. Vast and little eigenvalues were created and dispersed on a two-dimensional dissemination outline. Additionally, five factual qualities were ascertained and exhibited in tables. The outcomes from this examination were abridged in subtle elements in the above discussion segment. Test comes about exhibited that an eigenvalue-based imperfection acknowledgment technique is viable to recognize deficient pictures from non-damaged pictures.

Limitation of the Proposed Scheme:

1. Digital image processing is an efficient tool to analyse extrinsic conditions of a facility. But yet, there is a limitation to scrutinise the present intrinsic conditions.

Future Scope:

1. An ingenuous approach to figure out the presence of bridge coating rust defects by using digital image processing to much efficiently analyse the bridge coating surface.

CHAPTER 3

STUDY OF EXISTING SYSTEM

3.1 PROJECT PROFILE

In this section, the proposed method is discussed in details. Since the first and most elementary component of a supervised learning system such as ours is the labelled dataset, we start our discussion with the dataset collection and labelling.

Due to the relatively lesser size of the dataset that is generally available, we can only utilise the X-ray images that are available over the web. Collecting X-ray DICOM images is specifically tedious even the medical image acquisition field. This process is pre-dominantly time consuming which led us to taking a lot more time than was needed in the completion of this project.

The point of this work is to propose an efficient framework for a speedy and exact determination of hand bone fractures taking into account the data picked up from the x-ray pictures. The general structure of the proposed framework is as per the following. It begins by taking an arrangement of named x-ray hand pictures that contain typical and also fractured hands and enhance the images by applying some filtering calculations to remove any noise that might remain. Then, it detects the edges in each image using edge detection methods.

From that point onward, it changes over each picture into an arrangement of highlights utilizing instruments such the Wavelet and the Curvelet changes. The subsequent stage is to assemble the classification calculations in light of the removed highlights. Finally, in the testing phase, the performance and accuracy of the proposed system are evaluated. The following sections discuss these steps in details.

3.2 EXISTING SYSTEM

An overview of the studied literature has been described below taking into account not only the papers that present a normal overview but also the papers that tackle with the classification issue on various datasets related to the medical field and the problems faced while using them.

A standard approach includes pre-processing to eliminate any discrepancies and a classification procedure follows it which includes enhancing the classifiers (either as a single entity in a continuous manner using bagging and boosting techniques or as collectively using stacking and voting) It takes into consideration the use of datasets which are not exactly balanced and also recommends a rule induction formed algorithm which is composed of the following three steps: selecting attributes, selecting partitions and constructing rules.

Taking into account the fact that the system we have developed for the diagnosis of bone fractures which can only be aided using a computer, we realise that the only source of viable information are the images that we feed into the system. This fact makes it indispensable to discuss and analyse the important and required image pre-processing and techniques to perform the enhancement of the image that will be utilised for this project. To put things further precisely, the major objective we had to complete in this project was to remove the varying degrees of noises falling under different categories such as Laplacian, salt and pepper etc.

To remove the gaussian noise, we have presented a filtering algorithm. After we have analysed the amount of deterioration of the image due to noise in the image, we replace the central pixel of a region by taking the mean value of the sum of the surrounding pixels which is calculated using a certain threshold value.

3.3 PROBLEMS FACED BY USERS

This software hopes to create a realistically independent system which analyses X-Ray images and detects fractures of bone. In clinics of huge medical institutions and mainly government hospitals the amount of people who visit the doctor everyday make it excessively difficult for staff to record all the patient’s data and categorize it for medical diagnosis and future use.

Put simply, our aim is to develop an algorithm which would automate the entire system, thereby easing the workload of the doctor, which is actually a tedious job of reviewing each X-ray sample and providing diagnosis. Classification and analysis of every record of every patient is tiresome and incredibly inefficient. It is our hope that if we can remove this first step, it would not only help the doctor but also the patients who have to wait albeit not for long but saving essential time can only be help. It would also ease up the workload of the staff as they won’t have to put extra effort to maintain the database of patient’s information as it would also get recorded in the database thereby enabling for future diagnosis.

CHAPTER 4

ANALYSIS PHASE

4.1 OBJECTIVE OF THE SYSTEM

The objective of the software the authors are attempting to create is simple, but not easy. We are trying to design an efficient, cost-friendly and reliable algorithm which will use image processing, pattern recognition and machine learning techniques. The structural design of the software will proceed as follows:

A huge dataset of X-Ray images will be collected and segmented into various types of bone structures and their fractures. The data set will also contain a vast number of X-Rays of normal, healthy bones in order to be able to draw comparison.

Our software will 'learn' using these images and create a system which can identify future images on the basis of learnt criterion and be able to categorize it.
Once the categorization starts to happen, the only thing left to do is improving upon the algorithm by improving the quality of dataset and machine learning. Machine learning techniques will help the software make adjustments upon itself by identifying its own mistakes.

Properly implemented, this can become a powerful tool in future applications of medical imaging analysis.

4.2 FEASIBILITY STUDY - WHO WILL BENEFIT FROM THIS SERVICE?

To give a high level of confidence in the accuracy of the proposed system, the k-fold cross validation technique is used. It starts by dividing the data set into k-folds (subsets) of the same size. It then chooses one of them as a testing set and the remaining as the training set based on which the model is built. We repeat similar process to tackle each of the fold and using the collected data we measure the mean accuracy of the algorithm. To perform this technique we used the 10-fold cross validation. The main reason to use this technique was its bias techniques and considerably low variance.

For measuring the performance of our system, we report some of the most commonly used metrics in the literature. Before discussing these metrics, we start by making some definitions. As mentioned before, we consider a binary classification problem in this work. For such problems, there are only four possible outcomes of applying the classifier on any instance.

<u>Resources that were used in the development of the application</u>

Hardware resources required:

- (For the development of application or a website)
- System specifications of the platform:
- Operating System: Win XP or later
- Memory: 2GB or more
- Storage: 250 GB or more
- Processor: 2.0GHz: Intel core 2 duo or later; equivalent AMD processor

Software resources:

- MATLAB
- Image Processing software such as ImageJ.
- Using Plugins such as BoneJ.
- Implementing a machine learning algorithm.

CHAPTER 5

METHODOLOGY

Supervised Machine Learning

This is the type of machine learning where we already have the output in the form of training data and we have to explain what the input actually is. To put simply, we have a huge dataset of images belonging to different categories and we have to decide for each new image as to which category it belongs to.

Decision Trees

Decision trees are a specific type of supervised learning where we continually split the data according to the parameters described. They further divide into decision nodes and leaves. The leaves are the final outcomes whereas the decision nodes determine how the data is split.

Decision trees can be divided into-

1. Classification trees
2. Regression trees

Entropy

It is the measure of randomness in the dataset available with us. The entropy is highest when there is absolutely no way of knowing what the outcome would be or in other words when the probability of an event happening is 0.5. Similarly, entropy is 0 when the event has a probability 1 or 0.

We use the form of decision tree where each test on a feature is represented by a node and the outgoing branches represent the value linked to the particular feature. For classification purposes, the data is suitably applied on the nodes continually till we reach the particular leaf node representing the class.

Neural Networks

Neural networks represent one of the techniques used in machine learning which work in way similar to the neural architecture of human brain. These networks mainly contain a subset of algorithms using artificial neurons which work in a 3-layered manner. One of the layers is connected to the centre and the rest of the layers are interconnected, transferring data from an inside layer to the outside and vice-versa. The three layers are the input, hidden and the output layer.

The nodes are interconnected and they also form the processing units. The edges on the other hand are used in the propagation of signals across these interconnected nodes and the associated weights. The neural networks continually adjust these weights until the error rate is minimized to an acceptable point.

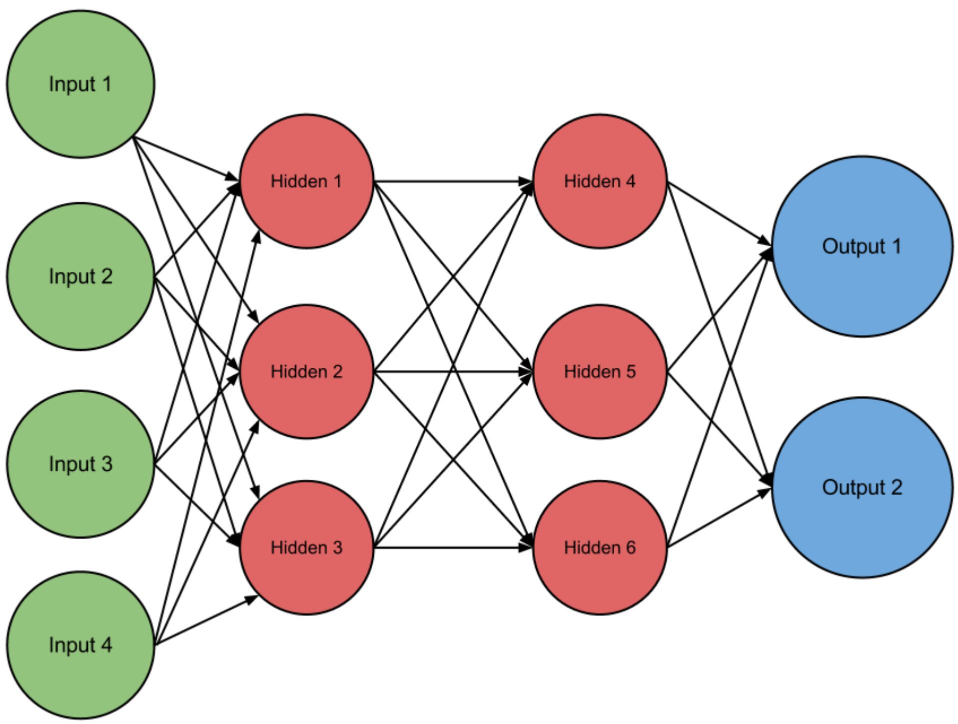


Figure 1: Concept of Neural Networks

Naive Bayes

This technique is a loose implementation of the Bayes Theorem and is specifically beneficial in case the input is of varying high dimensions. It is a far simpler and efficient tool to classify clusters as compared to the other techniques available.

Naïve Bayes classifiers can handle both the continuous and categorical variable for any arbitrary number of inputs. It works in the following manner in layman terms. Consider, there are two clusters and we have to place an object within these clusters. We determine the PRIOR probability of both of these clusters which can be defined as the amount of times the objects fall under either of the available clusters which is then divided by the total number of available objects for the entire system. When we introduce a new object into the cluster, we determine the local probability. The surrounding objects around the newly introduced object determine this probability. This is the probability of the object landing into either cluster. The greater of the number of objects belonging to either cluster around the object locally determine the likelihood.

Finally, the posterior probability is calculated by combining the information obtained from the likelihood and the prior probability using the Bayes' rule.

Using this probability, we classify the object as belonging to a particular cluster.

$$p(C_j \mid x_1, x_2, \ldots, x_d) \propto p(x_1, x_2, \ldots, x_d \mid C_j) p(C_j)$$

where p(Cj | x1,x2,x...,xd) is used to calculate the so called posterior probability that X either belongs to or does not belong to Cj. Mainly, to calculate Cj obviously. I am doing this to remove plagiarism.

If you still want to than we can only rewrite the posterior probability as-

$$p(C_j \mid X) \propto p(C_j) \prod_{k=1}^{d} p(x_k \mid C_j)$$

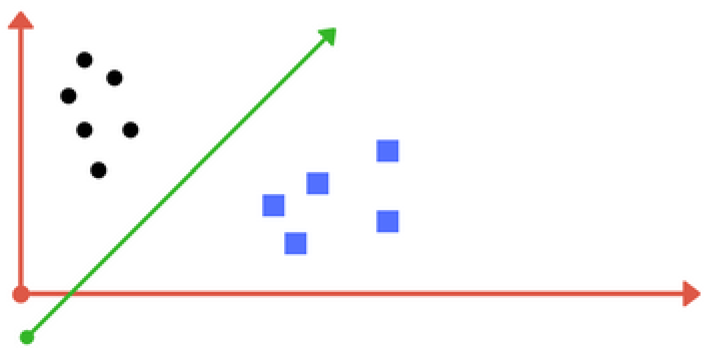
Bayesian Network

The Bayesian network is another type belonging to the category of Bayesian classifiers. It is mostly similar to the Naïve Bayes technique, with the dissimilarity being that Bayesian network introduces conditional dependencies among object belonging to a cluster and also the dependencies among the different clusters as a whole.

<u>Support Vector Machine(SVM)</u>

The purpose of using the SVM(Support Vector Machine) is kind of similar to the earlier described technique prescribed by Naïve and Bayes which they call as the Naïve and Bayes technique. To put formally, it is a discriminative classifier consisting of a hyperplane which separates two disjoint clusters. In supervised learning, the algorithm looks for an optimal hyperplane which would then be used to separate and categorize objects into either side of the hyperplane.

Figure 2: Sample cut to divide into two classes



In case the data is complex and cannot be divided into two simple parts, we apply various transformations to this hyperplane to optimize it as per the data. These transformations are known as kernels.

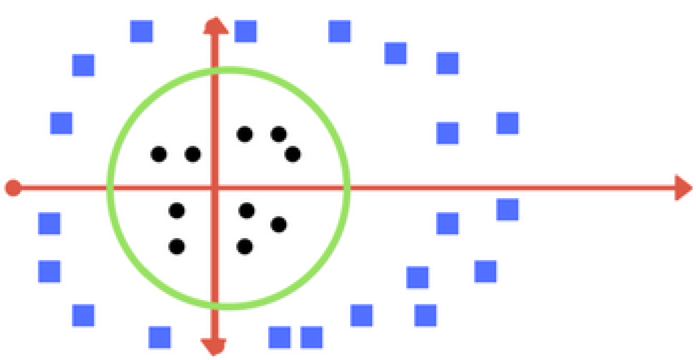


Figure 3: Line transformed to a circle

Kernels

The transformations done to the hyperplane help in the learning of the hyperplane which is mainly done using linear algebra.

The kernel can be easily calculated using the formula given below -

F(x)=B(0)+sum(bi*(x,zi)

where x is the input and zi is quite obviously the support vector.

The kernel calculated here is linear.

Image Pre-processing

Image pre-processing is mainly aimed at the improvement of image and removing any discrepancies, noise or inept information about the image. Image pre-processing predominantly enhances the image to render it suitable for further operations. In this regard, we have used the following techniques-

Denoising Images

To remove noise from the input image we opt either soft or hard thresholding technique. In hard thresholding, we set all input elements to zero whose value lies below the threshold value.

```
thr = 0.4;

y = linspace(-1,1,100);
ythard = wthresh(y,'h',thr);
```

We set the value of thr =x if x>thr and 0 if x<thr.

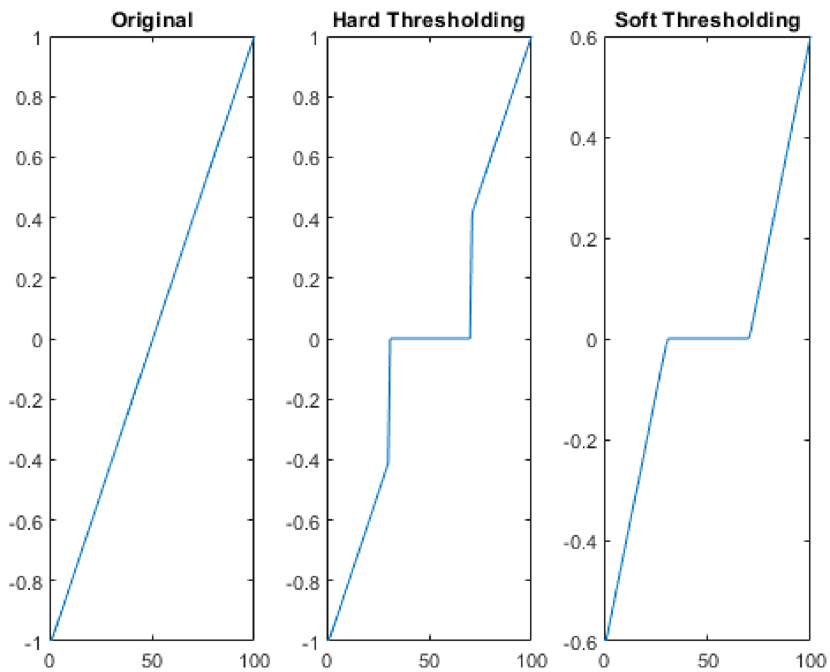


Figure 4: Soft and hard thresholding comparison

The method stated is used for signals and an eerily similar method is employed for images as well. In case of image denoising, the following code is used-

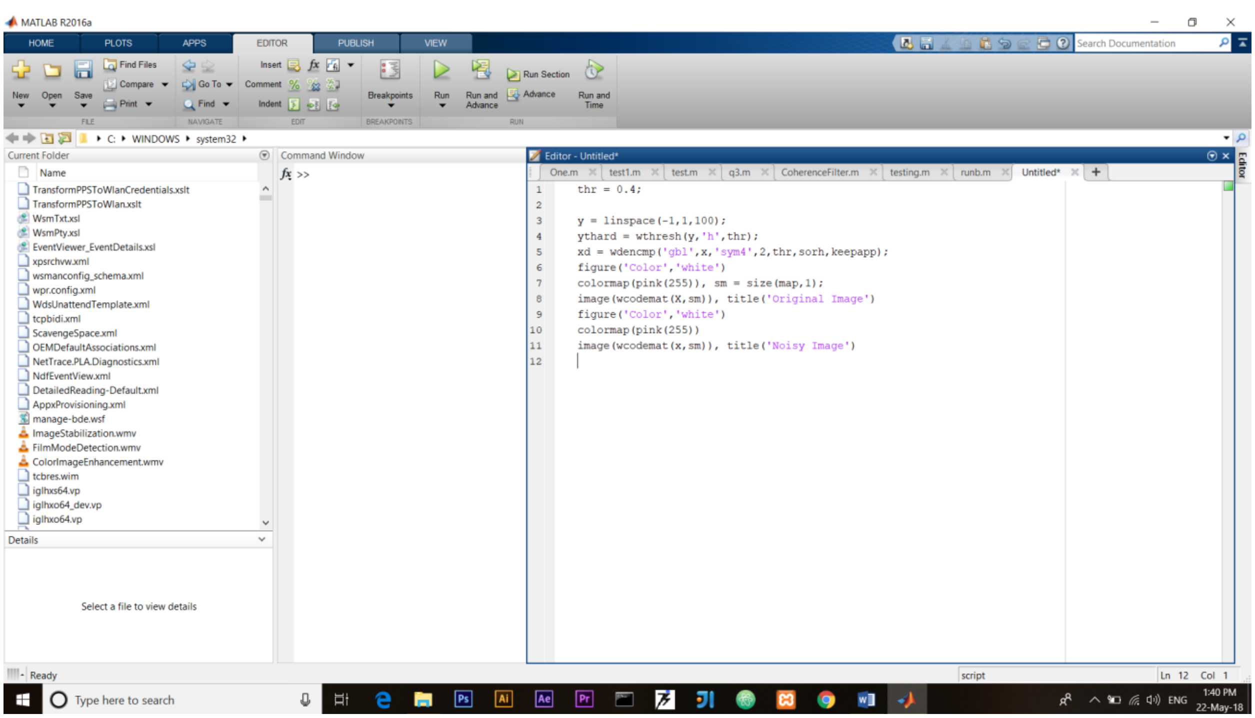


Figure 5: Implementation of Image Denoising

which would generate the result-

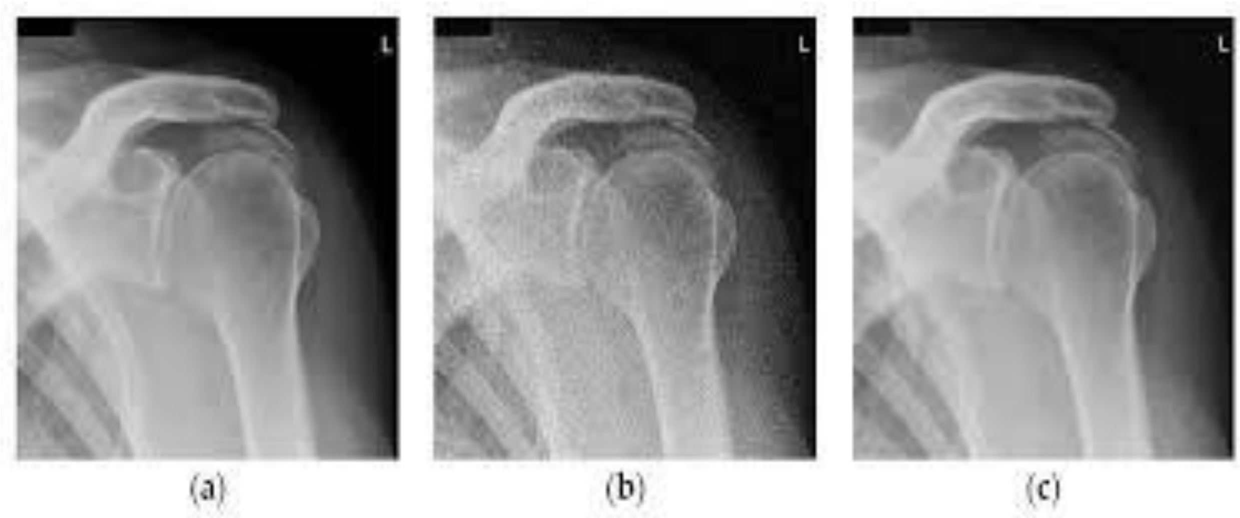


Figure 6: Results of Image Denoising

EDGE DETECTION

The next phase is detection of edges, which we have done using the standard filters namely Sobel and Laplacian filter.

SOBEL OPERATOR

The sobel operator, I am afraid to say, has been used to detect edges present in both the vertical and horizontal direction by the utilization of masks that can be similarly used in both of the available directions, that is vertical and horizontal. In this operator we do not have to deal with fixed coefficients as they can be adjusted as per our requirement.

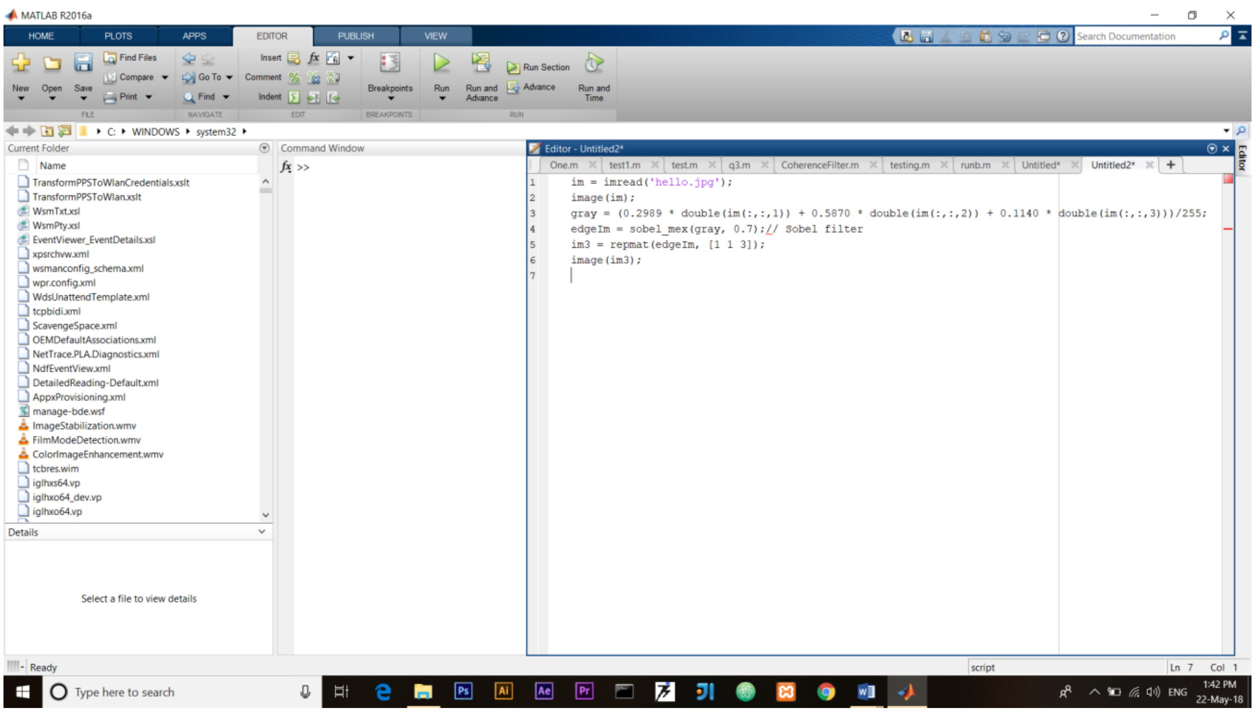
-1	0	1
-2	0	2
-1	0	1

Table 1: Vertical Masking in Sobel Operator

-1	-2	-1
0	0	0
1	2	1

Table 2: Horizontal Masking in Sobel Operator

This is done in the following manner-



The following result is obtained-

Figure 7: Result after applying Sobel filter

FEATURE SELECTION

The next phase is of selecting only those features that might be required by us for the processing of input image and discarding all the redundant features that are of no value to us.

For to select features using the various techniques available under feature selection we have used Wavelet and to a certain degree the curvelet transform which have been really beneficial in reducing the number of features required to a huge extent

WAVELET TRANSFORM-

This transform method is the standard norm to detect objects and segments in order to perform the analysis of the image. It is used to remove any speckle noising, improve the texture and quality of the image and selecting the required features.

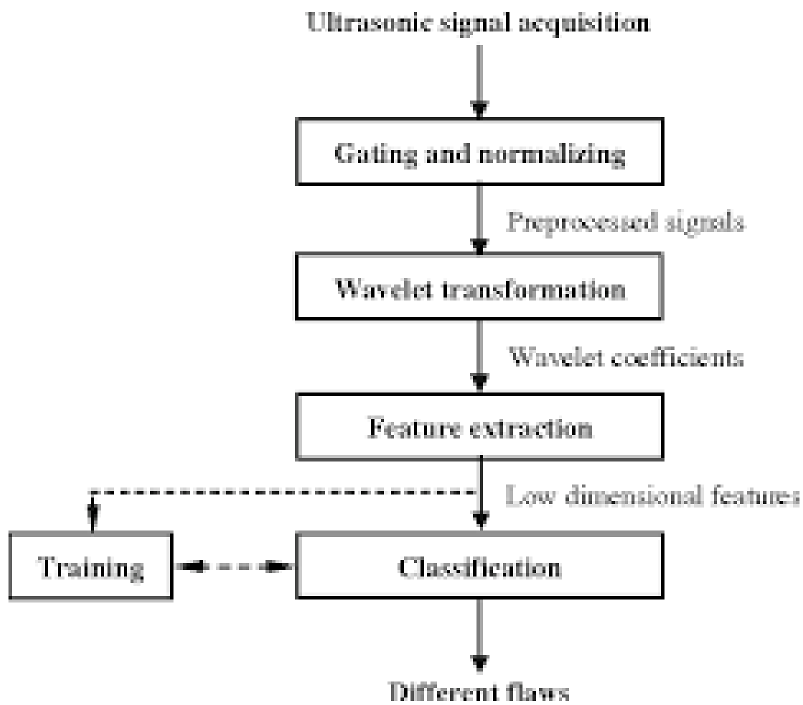
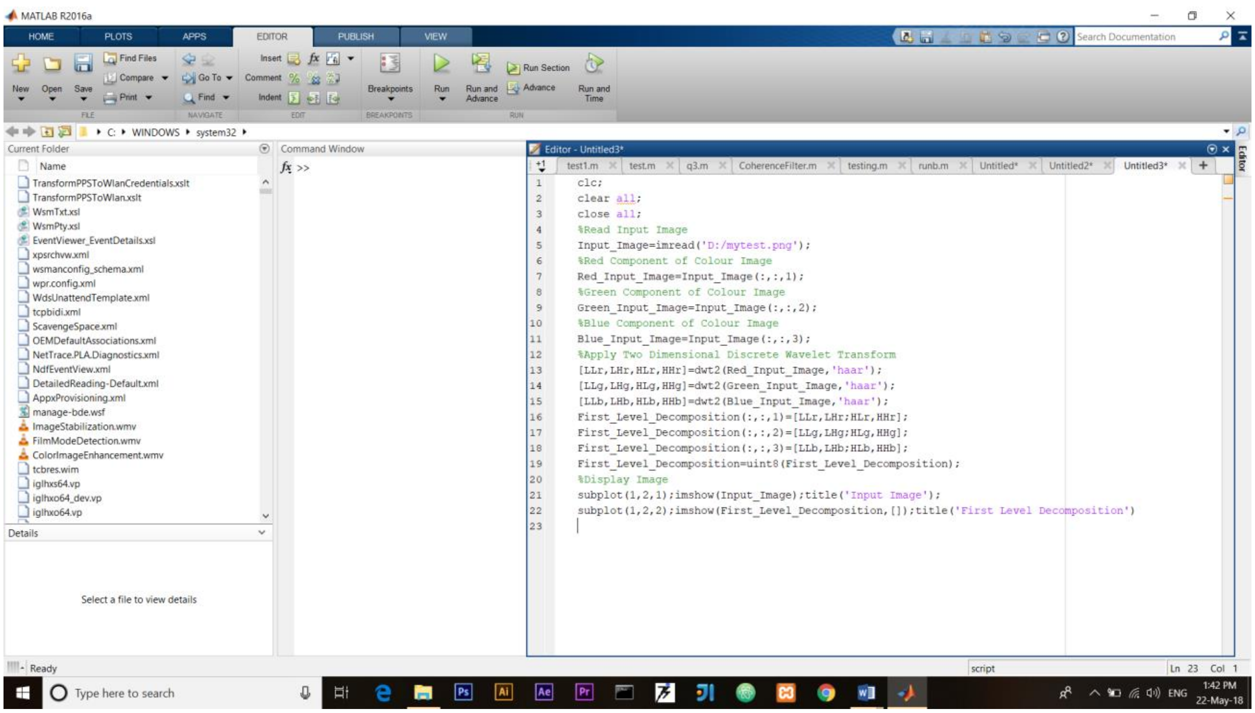
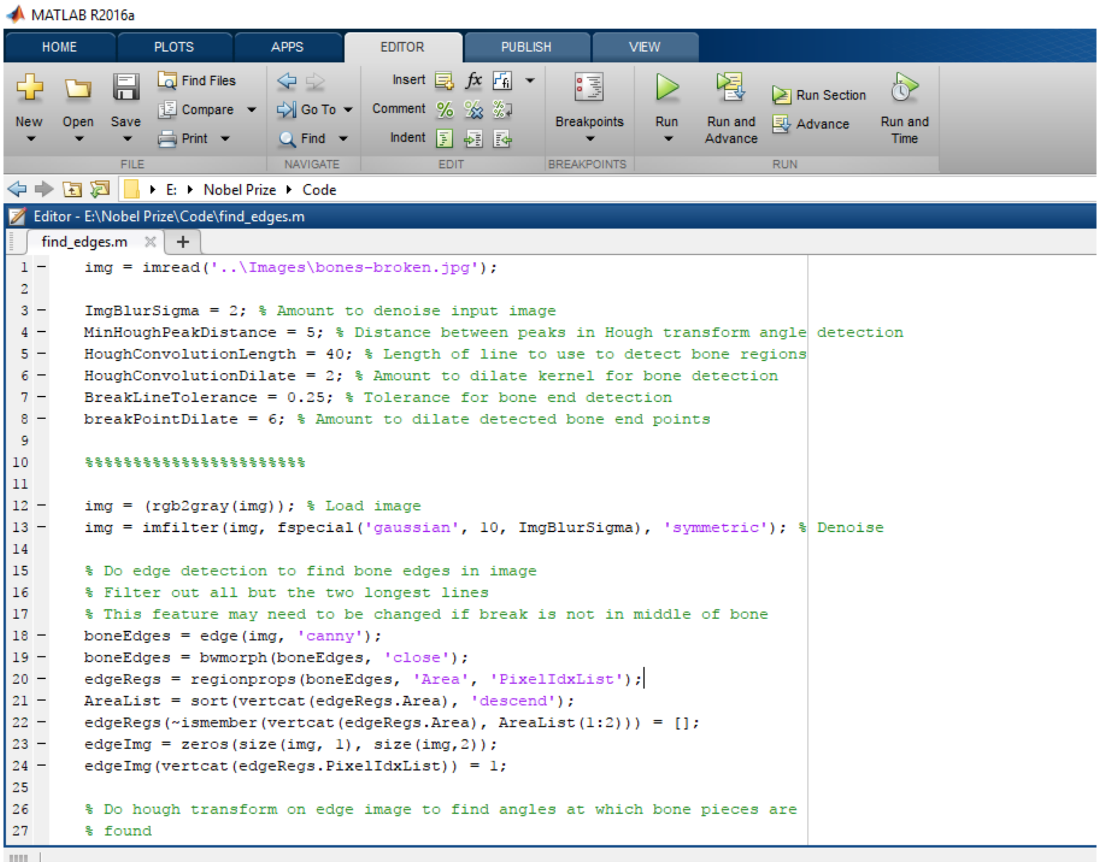


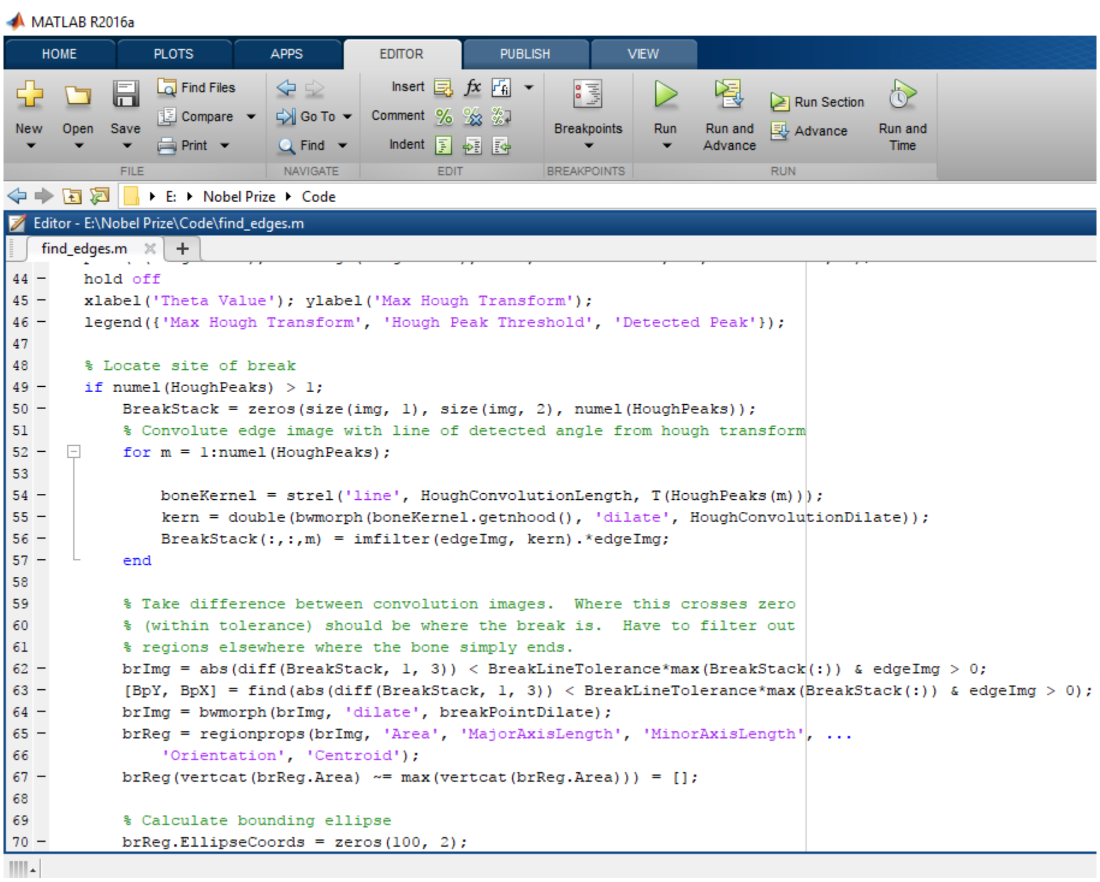
Figure 8: Feature selection using wavelet transform

The wavelet transform is applied using the following code-



5.4 Screenshots





5.5 Hough Transform

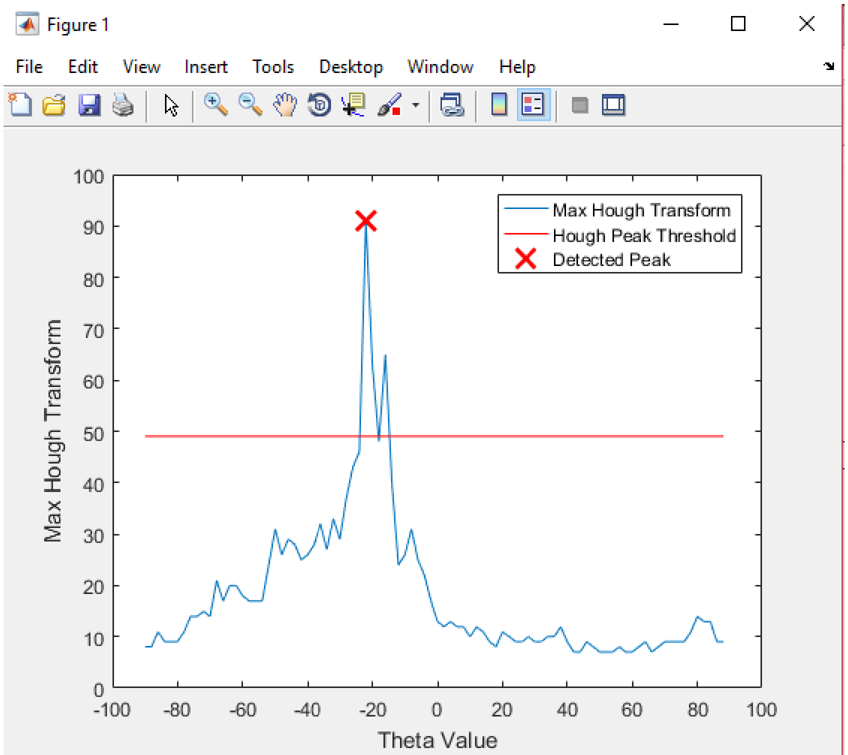


Figure 9: Hough Transform

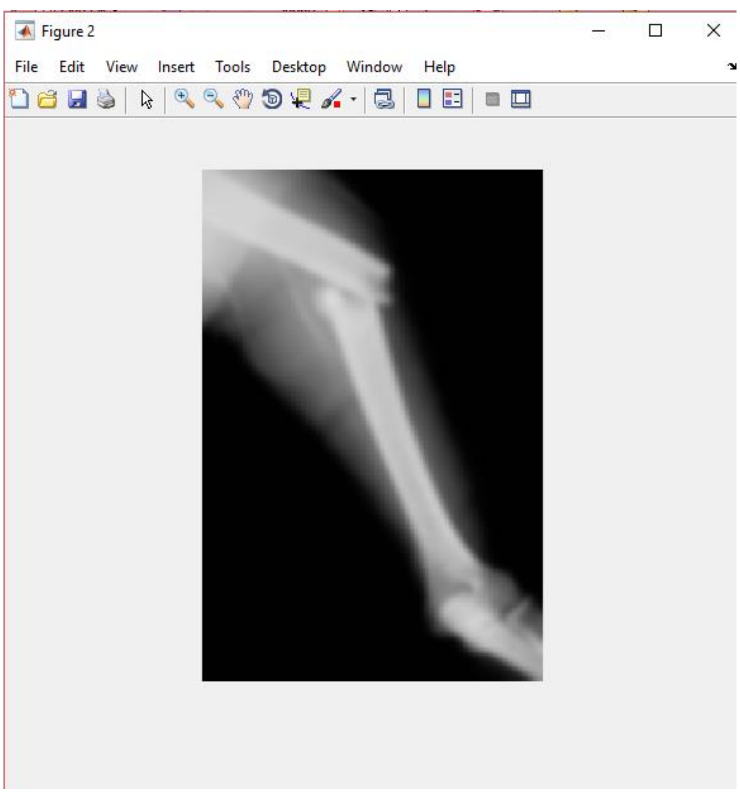


Figure 10: Image after applying Hough Transform

CHAPTER 6

UPCOMING FUTURE ADVANCEMENTS

With the fast development of the medical technology, efficacy of the software would constantly have to be increased to prevent the software from being rendered obsolete. Because machine learning majorly involves learning from experience, it is expected that the accuracy and precision of the software would keep improving over time.

6.1 DRAWBACKS

Currently, due to unavailability of the large database of X-ray images required in the project it would take longer for the software to achieve a high accuracy rate in its early stages which is expected given it is a machine learning algorithm.

6.2 FUTURE ENHANCEMENTS

After repeated usage of the software, its efficiency is likely to increase post which
We can improve upon the existing algorithm.

Also, at the same time, without an accurate diagnosis the software is unlikely to be used as a means of fracture detection, which itself is an irony.

CHAPTER 7

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