

# **CHAPTER 1**

# **INTRODUCTION**

## **1.1 GENERAL OVERVIEW OF THE PROBLEM**

Image reconstruction is a rapidly evolving industry, the race to produce an efficient yet accurate image reconstruction method while keeping scan dose to a minimum has defined improvements in CT over the past decade. The mathematical problem that CT image reconstruction is trying to solve is to compute the attenuation coefficients of different x-ray absorption paths (ray sum) that are obtained as a set of data (projection). In recent years, magnetic resonance imaging has been widely used for various medical purposes. However, the traditional biological images only provide two-dimensional images and cannot be used to create an explicit three-dimensional (image) model. Therefore, reconstructing image model from 2D MRI images becomes an active research topic. The key challenge is how to obtain image data with high accuracy from original MRI images. The traditional methods of improving the image point accuracy are by improving the accuracy of region-based growing. Lavoue et al. improved the traditional seed selection scheme by dividing the pixels of the image into 9 types according to plus-minus of mean curvature and the Gaussian curvature. However, there are three main limitations of this algorithm: (1) the proposed method ignores the vertex points on the sharp edge, (2) the edge that dihedral angle is greater than the given threshold, (3) using the sharp edge information to improve the growing conditions doesn't work well on all cases. Zhang et al. used Gauss curvature to assign all vertex and set the vertex which has the larger minus Gauss curvature as the board by the threshold and minimum criteria. Their approach chooses work on MRI images since MRI images always lack feature points and are gray scale images without much color changes. ultrafast multi slice imaging's sequences, such as single shot fast spin echo (SSFSE) or half-Fourier acquisition single shot turbo spin echo (HASTE) are increasingly popular in clinical imaging of moving anatomy, allowing the clinician to view 2D slices of anatomy in challenging clinical applications such as in utero fetal brain studies. Here we describe a framework to estimate and correct the bias field inconsistency in each slice collectively across all motion corrupted image slices. It is necessary to develop an automatic guided software for performing cosmetic surgery by the process of simulating three-dimensional visualization techniques suitable for the display of complex structures of the facial skeleton and of skull base. Three-dimensional surface reconstruction of cranial anatomy is obtained from CT (Computer Tomographic) or MRI (Magnetic Resonance Images) images.

## **1.2 LITERATURE SURVEY**

### **1.2.1: T. Senthil Kumar, Rakesh "3D Reconstruction OF Facial Structures From 2D Images for Cosmetic Surgery "978-1-4577-0590-8/11/\$26.00 ©2011 IEEE**

This paper discusses the process of developing a 3D model from the given CT/MRI images based on iso-surface extraction and reconstruction. Three-dimensional surface reconstruction of cranial anatomy is obtained from CT or MRI (Magnetic Resonance Images) images in this paper.

### **1.2.2: Grimson, W. Eric L., et al. "Utilizing segmented MRI data in image-guided surgery. " International Journal of Pattern Recognition and Artificial Intelligence 11.08 (1997): 1367-1397.**

Problem related with 3-dimensional segmentation of image using magnetic resonance imaging or other, has received a good consideration and hence there is many published research works

### **1.2.3: Grimson, E., et al. "Clinical experience with a high precision image-guided neurosurgery system." International Conference on Medical Image Computing and Computer-Assisted Intervention. Springer, Berlin, Heidelberg, 1998**

Y.J Zhang in 1995 [3] has studied different proposed method of segmentation. The paper stats that most of methods classified into three groups analytical, empirical goodness and empirical discrepancy. After giving description of different methods and evaluating them, comparison is made between different methods. Results concerning the performance of different evaluating methods are obtained from this study

### **1.2.4: Vala, Hetal J., and Astha Baxi. "A review on Otsu image segmentation algorithm." International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)2.2 (2013): 387-389.**

Miss Hetal J. Vala and prof. Astha Baxi 2013 has shown the various Otsu algorithms, Otsu is an region based automatic thresholding selection method. The various Otsu algorithms discussed are 1-D Otsu, Otsu thresholding based on histogram, Otsu and K-mean method. At last comparison is made between different Otsu methods

**1.2.5 Qiu, H. A. N. G., et al. "3D visualization of radar coverage considering electromagnetic interference." WSEAS Trans. Signal Process 10 (2014): 460-470.**

Qui H. A. N. G., et al. 2014 has proposed method for three-dimensional visualization of radar coverage considering the electromagnetic interference. To achieve three-dimensional modelling of radar coverage via discrete subdivision it is based on radar equation, from the perspectives of pitch and azimuth angle.

**1.2.6 Levinski, Konstantin, Alexei Sourin, and Vitali Zagorodnov. "3D Visualization and Segmentation of Brain MRI Data." GRAPP. 2009.**

Levinski, Konstantin, Alexei Sourin, and Vitali Zagorodnov. 2009 proposed a method for 3-dimensional interactive correction of brain segmentation errors which were created by automatic segmentation on algorithm. This paper gives the details of implementation principles of the proposed tool and described its application. The method proposed here uses a controlled propagation and efficient correction of the segmentation errors.

### 1.3 **PROBLEM DEFINITION**

Traditional biological imaging only provides 2 dimensional images and cannot be used to create an explicit three-dimensional model. 2 dimensional images are not suitable for localization and evaluating brain tumor, in order to help neurosurgery planning for brain tumors. 2 dimensional images are not appropriate to help doctors in better visualization of human organs and make it easier and more accurate to diagnosis and prescribe therapy for the patient. To reconstruct a image that would give better view of biological specimen.

### 1.4 **PROBLEM ANALYSIS**

Reconstruction of an image using different cross section of the same image takes place in four phases: collection of datasets, image segmentation, image filtration and then finally reconstruction of the image. Acquiring correct set of data is also a challenging task, since every image cannot reconstruct, so in order to reconstruct image it must be in the D.I.C.O.M(Digital Imaging and Communications in Medicine) format in order to retrieve its information (as example its thickness). In order to divide the image into different regions, image segmentation is required. Dividing image into different regions is required due to need of acquiring area of interest. Filtration is done after image segmentation in order to remove area's which are not of interest. Finally, image reconstruction is performed in order to get more finer details, which original image was not able to provide.

### 1.5 **PROPOSED SOLUTION STRATEGY**

Medical image has its own uniqueness such as human tissues' wiggle and disturbance of power level in imaging equipment. And these unavoidable factors add some noise into image data. Adding a filter module before reconstruction module to reduce the noise can improve the precision of the image images. Filtering technique should be selected and executed after modelling the noise in the image. A proposed method proposes a image Reconstruction method of developing a image model from complete 2D CT/MRI scan of axial slides of a patient. reconstruction is the process by which

extraction of surfaces is done from a image array having same density in image volume. A basic image model of outer face is created using algorithm of iso-surface reconstruction by defining proper iso-value or intensity value

### **1.6 ORGANISATION OF REPORT**

This report has been made by implementing image reconstruction using different cross section of the same image. The output generated through using algorithm illustrated in this report generates volumetric reconstructed image of the brain. With the help of reconstructed image one can find more fine details which he or she will not get in normal non volumetric images.

#### **Chapter 1: Introduction**

Firstly, the general overview of the project is discussed. The overview is followed by different theories to explain the project better. The problem definition includes a formal introduction to the project with some insight, as to what are the major problems to be tackled.

Analysis of the problem provides a basic idea that helps in analyzing the problem better which indeed helps in coming up with an efficient solution strategy.

The proposed solution strategy takes the above analysis and discusses the techniques to be implemented to the project.

#### **Chapter 2: Design Strategy for the solution**

This chapter provides an elaborate discussion on the flow chart of the algorithm used for image reconstruction using different cross section of the same image. It also provides the block diagram.

### **Chapter 3: Implementation Details**

This chapter provides an elaborate discussion on the implementation of image reconstruction using different cross section of the same image with the help of pseudo code.

### **Chapter 4: Results and Discussions**

This chapter provides then a report on the observation after using the algorithm based on the output image and information provided by it.

### **Chapter 5: Summary and Conclusion**

This chapter explains the project in a gist and the various issues encountered during the successful completion of the project. It also specifies the limitations and future scope of the project.

### **Chapter 6: References**

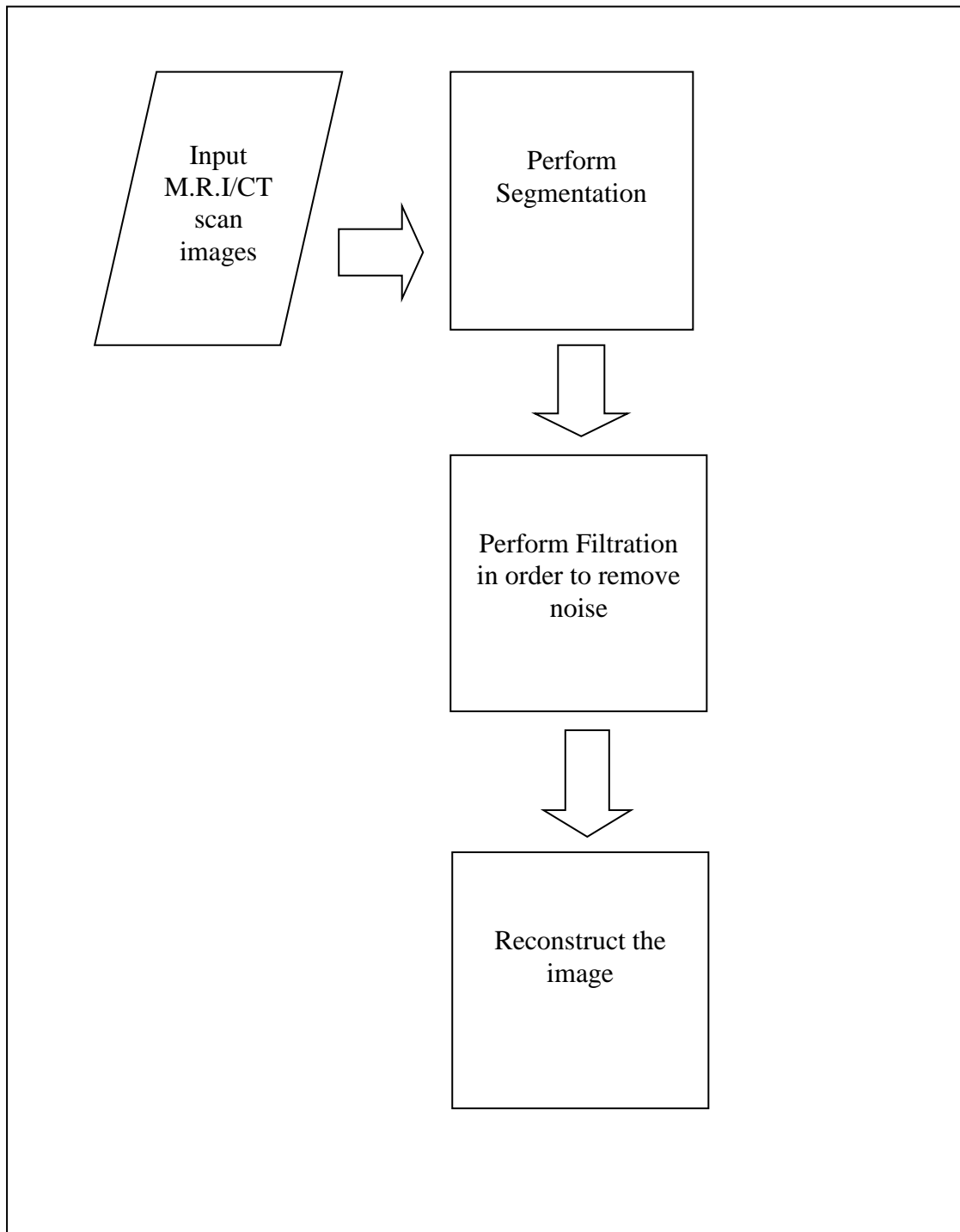
This chapter includes a summary of the papers and journal referred to conduct the comparative study during this project.

# **CHAPTER 2**

# **DESIGN STRATEGY**

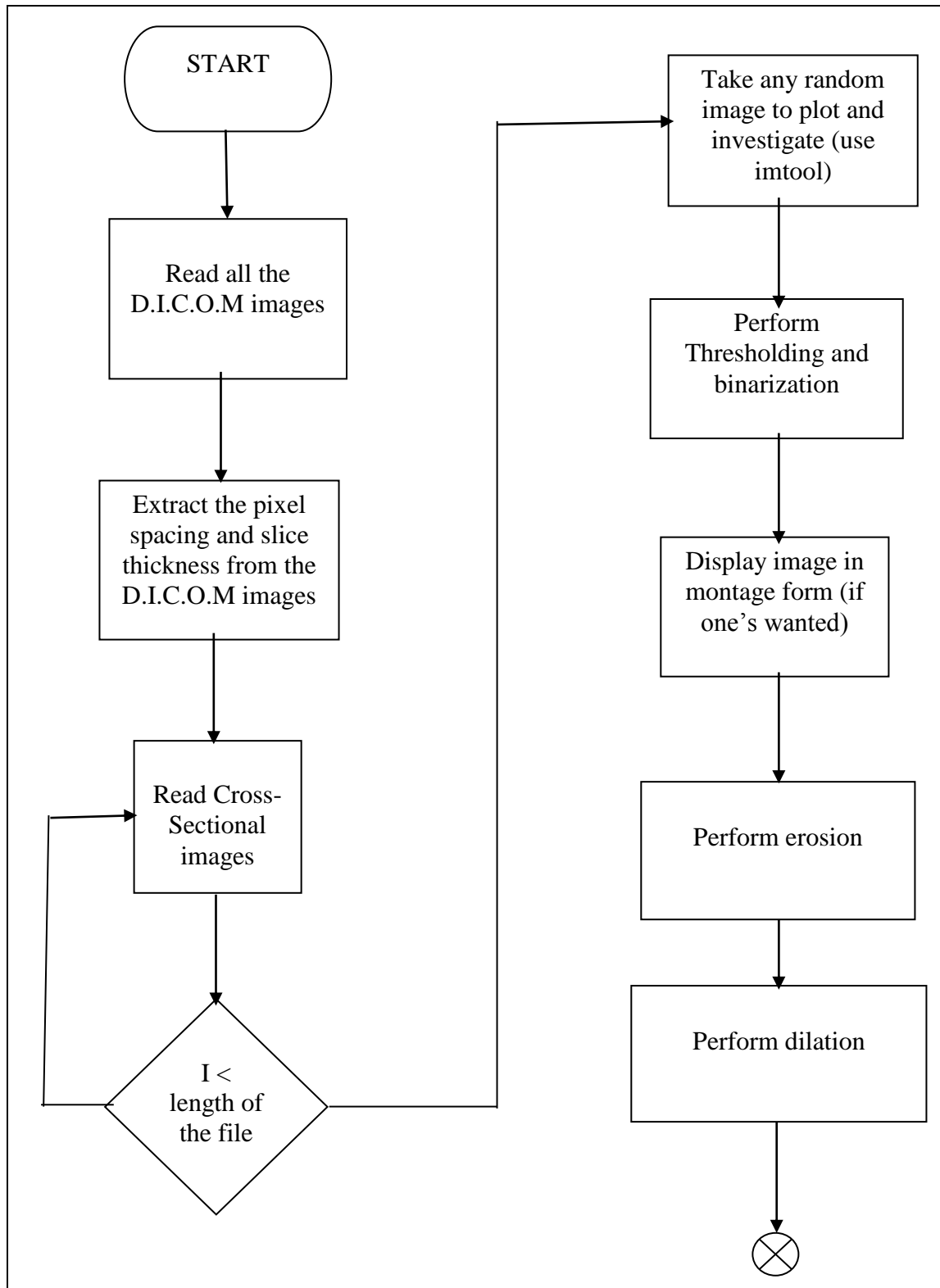


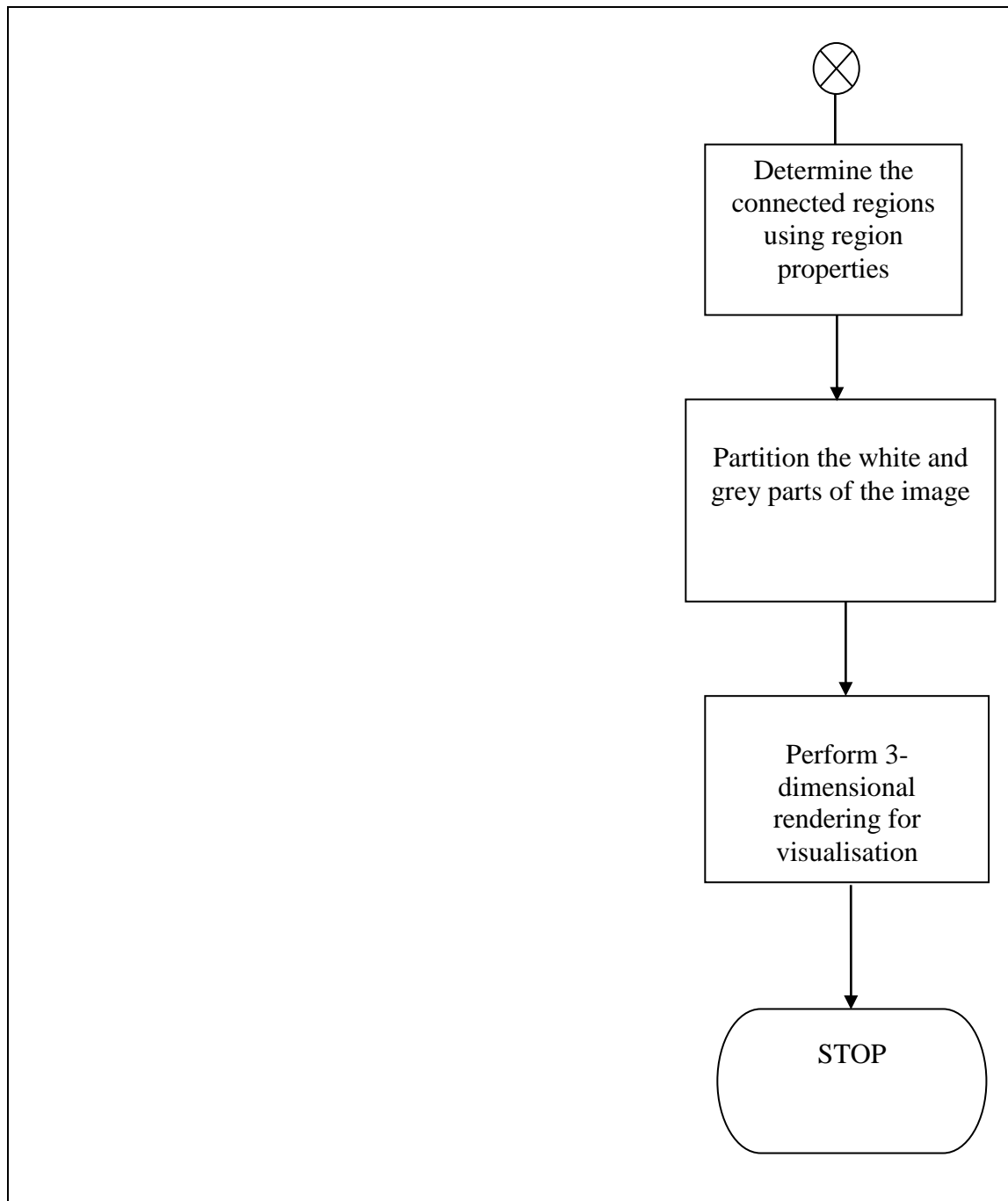
## 2.1 **BLOCK DIAGRAM**



**Fig 2.1: BLOCK DIAGRAM**

## 2.2 FLOW CHART





**FIG: 2.2 FLOW CHART**

# **Chapter 3**

# **IMPLEMENTATION**

# **DETAILS**

### **3.1 ALGORITHM FOR IMAGE RECONSTRUCTION USING DIFFERENT CROSS SECTION OF THE SAME IMAGE**

The below algorithm will illustrate how the system will work. All the steps have been explained with fine details. Applying below algorithm one can reconstruct an image with the condition that image should be suitable image.

**BEGIN**

#### **1.READ ALL THE DICOM IMAGES**

Read the path where your images are there

#### **2. EXTRACT VOXEL SIZE**

extract the voxel size of the image that is, pixel spacing and slice thickness

#### **3. READ SLICE IMAGES**

Create a matrix named DataImage

for i= varies from 1 to to length of the file

    build the full file specification from the specified folder and retrieve  
    the images and store it into DataImage

end

#### **4. TAKE ANY RANDOM IMAGE TO PLOT AND INVESTIGATE USING IMTOOL**

Take any image stored in Data Image and store it into a variable say image

Take out the max value of the image

call imtool function in order to display the image

#### **5. THRESHOLDING**

Create a new variable SegmentedBrainMRI and store DataImage in it

Set threshold lower bound as you will get during the investigation of the image  
or 40 for the given case.

Set threshold upper bound as you will get during the investigation of the image  
or 100 for the given case.

If SegmentedBrainMRI is greater than or equal Threshold\_upperBound

```
        Set SegmentedBrainMRI equal to 0
    else
    If SegmentedBrainMRI is less than or equal to Threshold_lowerBound
        Set SegmentedBrainMRI equal to 0
    end
```

sinceAfter 175 (in given case) there is no brain portion in the given MRI set  
rest of the cells to zero

Perform logical segmentation of SegmentedBrainMRI and store it into  
black\_white variable

## **7. PERFORMING IMOPEN IN ORDER TO GET RID OF NON-INTEREST PART**

Take structuring element of 8x8 with all elements as 1  
Perform imopen operation on the image with help of structuring element  
mentioned above  
Display the image

## **8. NOW DETERMINE THE CONNECTED REGION USING REGION PROPERTIES**

Perform labelling on the connected regions  
Get the areas and the centroids of the connected regions  
extract the maximum value of the area  
compare it with maximum threshold value  
if they are equal  
 store it into biggestArea variable  
end  
if labelMatrix is not equal to the biggest area  
make SegmentedBrainMri equal to 0  
display SegmentedBrainMri

## **9. NOW NEED TO PARTITION WHITE AND GREY MATERIALS OF THE BRAIN.**

Launch a graphical user interface for investigation  
Get the size of the SegmentedPart  
Create an array of zeroes that is the same size as of the segmented part  
Check if SegmentedBrainMRI is greater than zero  
    Perform MRI Partition on the image  
Check if SegmentedBrainMRI is greater than or equal to level  
    Assign three value to it  
display the partition image

## **10. 3D RENDERING FOR THE VISUALIZATION**

Resize the mri portioned image near to its half and store it in variable say Ds  
Flip the resized image along row wise  
Flip Ds along coloumn wise  
Rearrange the Ds multidimensional array with vector matrix [3 2 1]  
Computes the isosurface data take isovalue as 2.5(for white) and 1.5(for grey)  
Create a patch graphic object for white and gray matter part  
Sets the angle 45 degree azimuthal and elevation of the camera  
set the data aspect ratio as of the voxel\_size for the current axes  
set camlight to -100

**STOP**

# **CHAPTER 4**

# **RESULTS AND DISCUSSIONS**

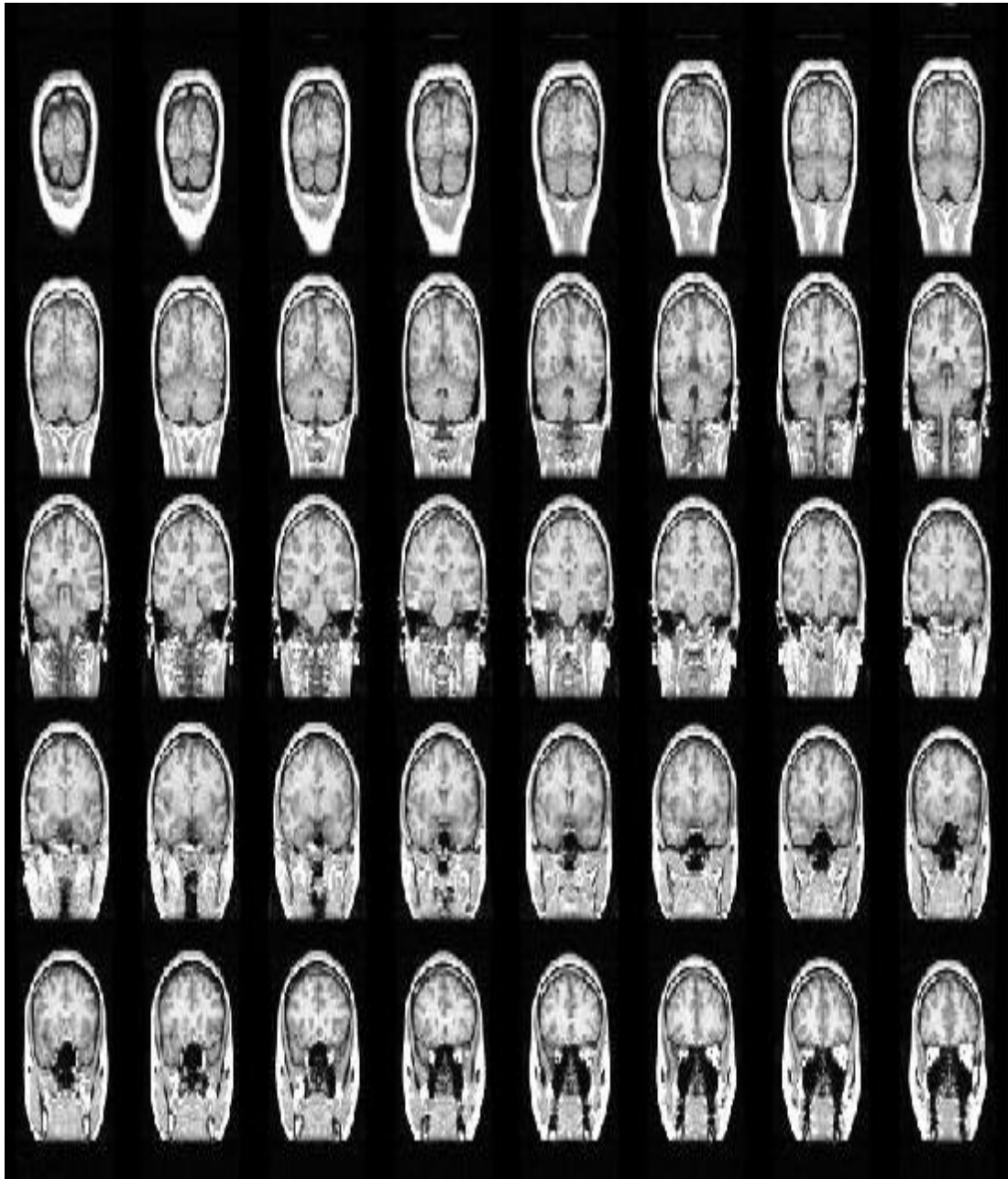


## **4.1 RESULTS AND DISCUSSIONS**

The given system is implemented by using MATLAB R2018b. The system is tested on the datasets available at [1]. Figure 2 shows the procedure of development of 3-dimensional model of brain. The complete results of each phase of the system and discussion are presented in every phase. The results of image reconstruction are presented. Automated system has been developed which generates reconstruction of an image. The proposed system helps in identifying the minute and fine details for which two dimensional images are in appropriate. We performed image segmentation followed by image binarization, the binarization is done to make ease in morphological operation that is erosion and dilation. Morphological operation is done after binarization to remove the area of region which are of less consideration or say of no use. After that connected regions are identified followed by identifying the grey and white matter of the image. In the last stage three-dimensional rendering is performed in order to visualize the reconstructed image in three dimensions. The paper has used rendering algorithm for three-dimensional visualization.

## 4.2 INPUT AND OUTPUT

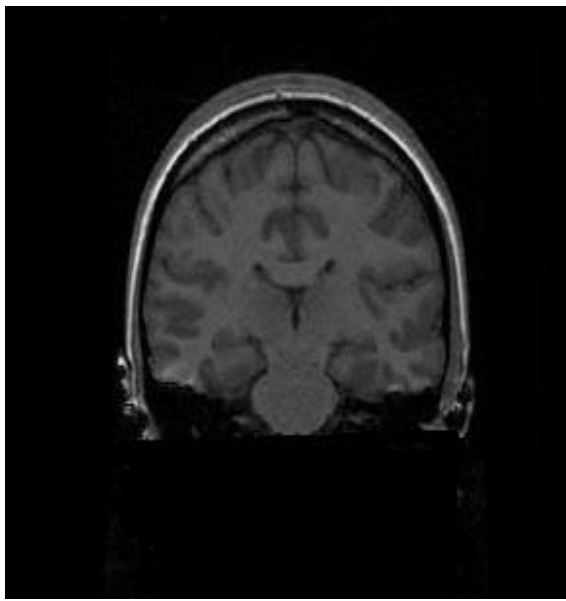
### 4.2.1 INPUT IMAGES



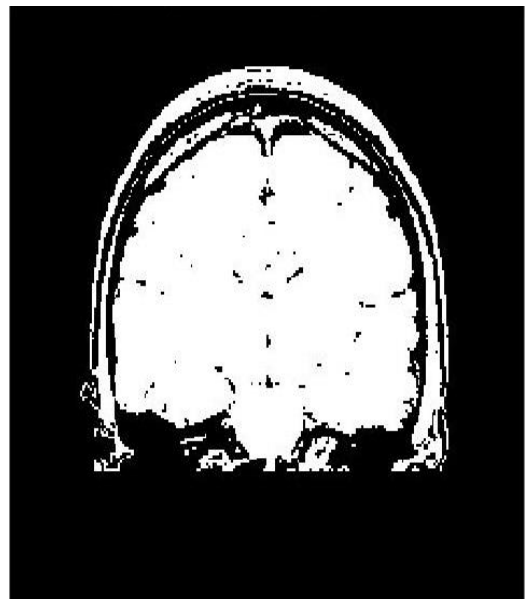
Original image

Fig:4.2.1

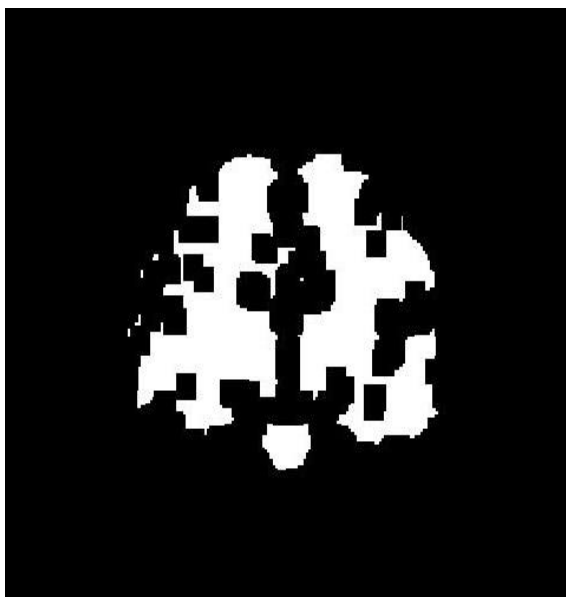
#### **4.2.2 OUTPUT OF EVERY MODULE**



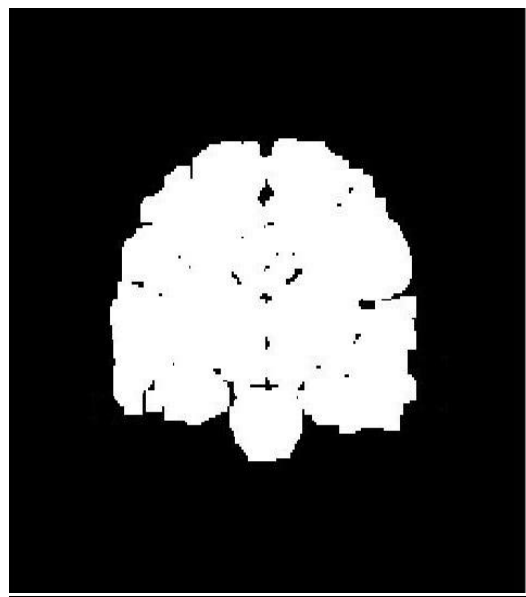
1.) Original image



2.) Image after binarization



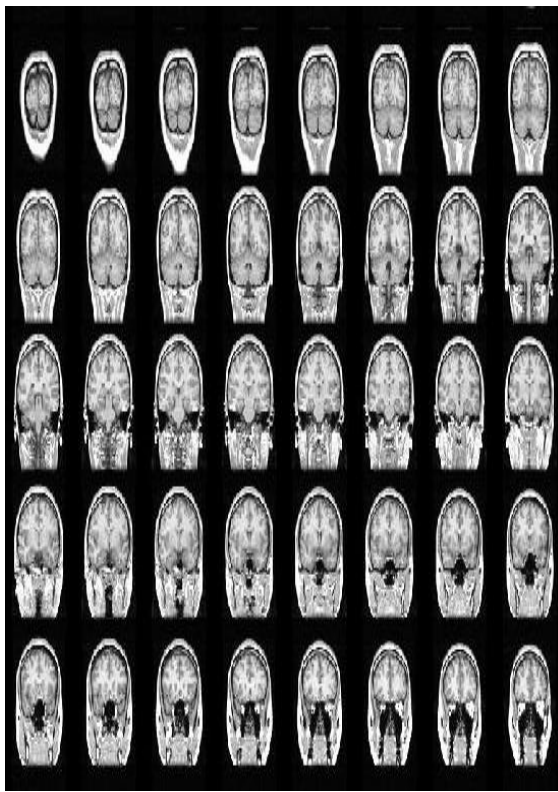
3.) Image after erosion



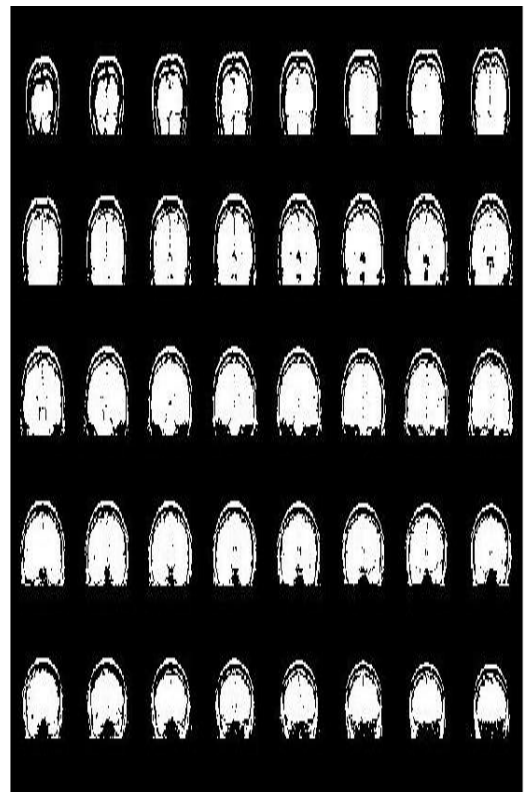
4.) Image after dilation

**FIG:4.2.2**

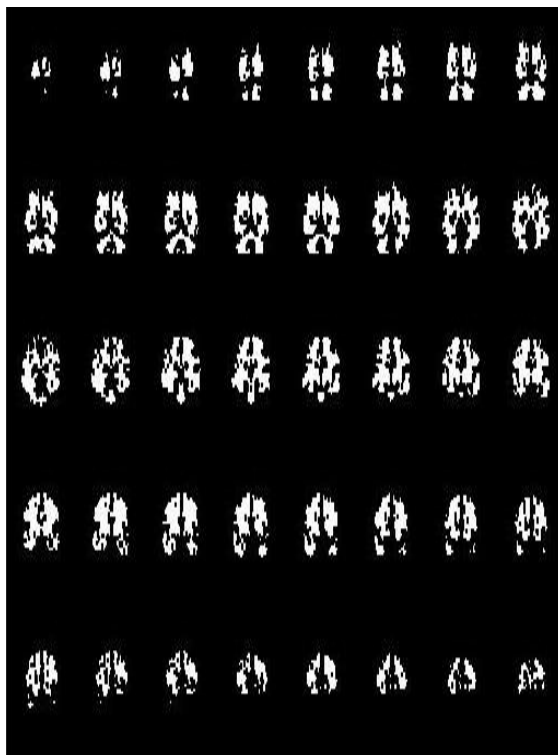
#### 4.2.3 RESULT FOR ALL



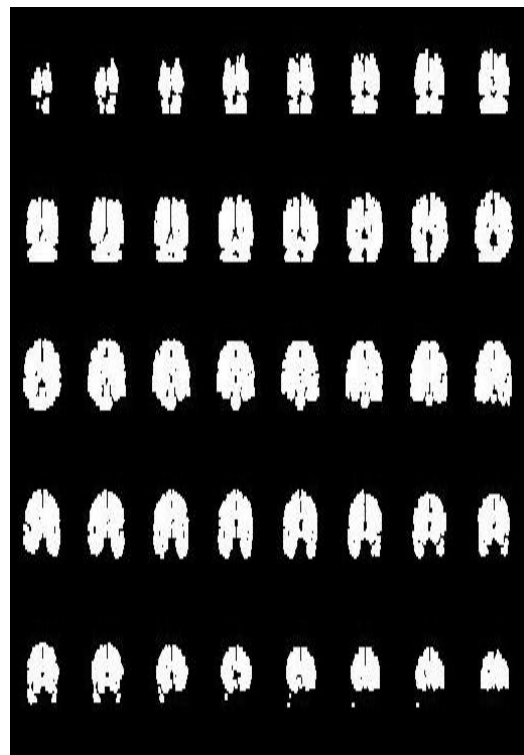
1) Original image



2) Image after binarization



3) Image after erosion



4) Image after dilation

Fig:4.2.3

#### 4.2.4 RECONSTRUCTED IMAGE

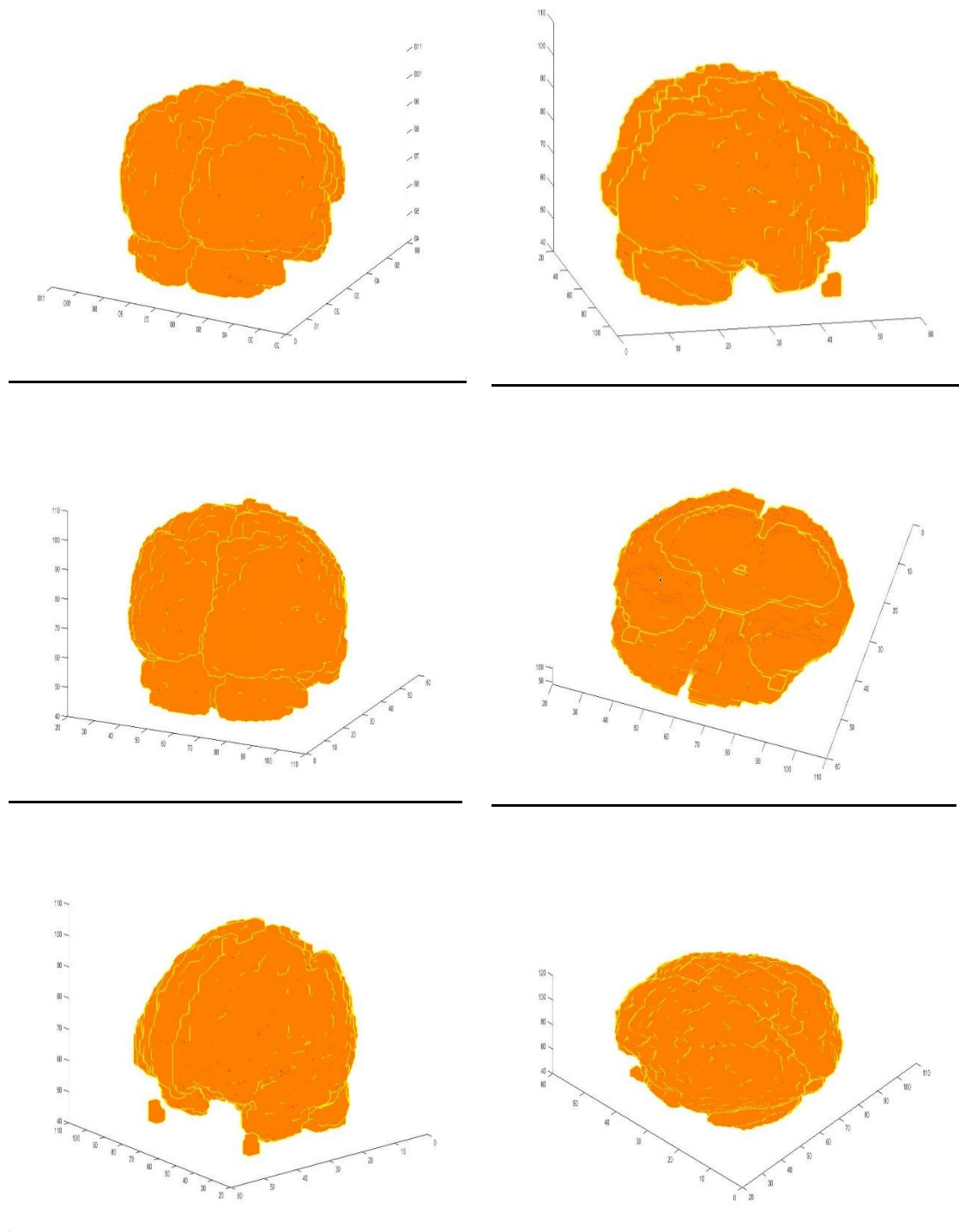


Fig:4.2.4

# **CHAPTER 5**

## **SUMMARY AND CONCLUSION**

## 5.1 SUMMARY

We were able to successfully complete the project that is image reconstruction using different cross section of the same image. A well-defined set of method has been used in order to complete this project. Acquiring correct set of data is also a challenging task, since every image cannot reconstruct, so in order to reconstruct image it must be in the D.I.C.O.M(Digital Imaging and Communications in Medicine) format in order to retrieve its information (as example its thickness). In order to divide the image into different regions, image segmentation is required. Dividing image into different regions is required due to need of acquiring area of interest. Filtration is done after image segmentation in order to remove area's which are not of interest. Finally, image reconstruction is performed in order to get more finer details, which original image was not able to provide.

## 5.2 LIMITATIONS

Like every algorithm, Image reconstruction using different sections of the same image is not perfect. The following are the limitations of the image reconstruction using different cross section of the same image.

- a. The major disadvantage of image reconstruction using different cross section of the same image is that it is not applicable for every type of image. It can only work with D.I.C.O.M or C.T scan images.
- b. Another problem with image reconstruction using different cross section of the same image is that, it requires necessary and sufficient amount of image in order to develop meaningful reconstructed image and to acquire fine details about that image.

### **5.3 FUTURE SCOPE OF WORK**

While implementing the process, creating a proof of concept was our primary aim, but it can certainly enhance in the following ways.

- a. In the output image different color can be introduced in order to show different parts of the reconstructed image. It will make easy for viewer to view different parts of the image more clearly.

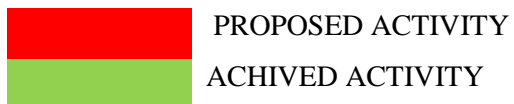
### **5.4 CONCLUSION**

Automated system has been developed which generates reconstruction of an image. The proposed system helps in identifying the minute and fine details for which two dimensional images are in appropriate. We performed image segmentation followed by image binarization, the binarization is done to make ease in morphological operation that is erosion and dilation. Morphological operation is done after binarization to remove the area of region which are of less consideration or say of no use. After that connected regions are identified followed by identifying the grey and white matter of the image. In the last stage three-dimensional rendering is performed in order to visualize the reconstructed image in three dimensions. The paper has used rendering algorithm for three-dimensional visualization



## 5.5 GANTT CHART

ACTIVITY	TIME FRAME					
	Jan 08-31	Feb 01-28	Mar 01-15	Apr 01-15	Apr 16-30	May 01-07
FEASIBILITY STUDY						
LITERATURE SURVEY						
ALGORITHM DESIGN						
TESTING AND DEBUGGING						
DOCUMENTATION						



**FIG: 5.5**

# **CHAPTER 6**

# **REFERENCES**

## 6 REFERENCES

- [1] Grimson, W. Eric L., et al. "Utilizing segmented MRI data in image-guided surgery." *International Journal of Pattern Recognition and Artificial Intelligence* 11.08 (1997): 1367-1397.
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