Alzheimer's disease detection using bit plane slicing Images

[1]Dr.Aziz Makandar, [2]Mrs.Rashmi Somshekhar
[1]Professor, [2]Research Scholar
[1, 2] Department of Computer Science,
[1,2]Akkamahadevi Women's University, Vijayapura, India

***Abstract*— Alzheimer disease is a neurodegenerative disease. The cell neurons gets declined and ultimately the death of the cells. The work attempts to trace the brain region affected by AD an algorithm for early detection of the AD with the help of digital image processing techniques. There are different scanning techniques like CT, X-ray, MRI, fMRI, PET, SPECT scan etc. Which are widely used by the radiologist to get information about the brain anatomy to analyze the disorder. The digital image processing techniques are helpful for pre processing of scanned images to get more details about brain anatomy in earlier stage. Proposed work demonstrates the bit plane slicing pre processing technique for the MRI images and then applying the canny edge detection method for identifying the AD affected patient. Image processing technique can help the physicians and practitioner to trace the affected region easily.**

***IndexTerms*— Alzheimer's disease, MATLAB, Bit plane slicing, Canny edge detection and MRI.**

I. INTRODUCTION

Alzheimer's disease is a kind of neurological disorder in which a person suffers from memory loss and cognitive decline due to death of the brain cells. A neurodegenerative type of dementia that causes trouble with thinking, memory and behaviour [1]. Symptoms typically develop slowly and find worse over time, becoming severe enough to interfere with daily tasks. Like different types of dementia, Alzheimer's is caused by brain cell death. It is a neurodegenerative disease in course of time the brain cells happens to decline and ultimate the cells dies.. The size of the total brain gets shrunken with Alzheimer's the tissue has progressively fewer nerve cells and connections. The AD progress in different stages. The affects of each stage is different for the people with AD. The different **symptoms** [1] of Alzheimer disease are loss of memory that disrupts way of life, challenges in planning or solving problems, trouble understanding visual images and spatial relationships, decreased or poor judgment, Poor judgment and decision-making, Difficulty in having a conversation, rigidity etc. The **regions** [1] of the brain wherever it is affected the brain is made up of a number of regions that are responsible for different functions. The major areas, shows how they may be affected. This will help us in understanding the underlying brain problems that cause some of the puzzling behaviours that you might see. Hippocampus region which is responsible for forming new memories. Hypothalamus region is responsible for feeding and the regulation of weight. Amygdale this brain region is responsible for the experience and expressions of emotion. Cerebellum this brain area works for the coordination of voluntary movement, gait, posture, speech and motor functions. Frontal lobe: The frontal lobe handles executive/management function, such as planning, judgment, motivation, impetus and behaviour [1]. Parietal lobe: The parietal lobe handles spatial relationships, perception and magnitude. In addition, this part of the brain is responsible for the sense of one's body. Occipital lobe: This area of the brain helps interpret what the eyes are seeing. Corpus Callous: This region helps transfer information between the brain's left and right hemispheres. Thalamus is the region just located above the brain stem, is responsible for relaying motor and sensory signals to the cerebral cortex and regulates sleep and alertness. The below figure helps in understanding the different regions of brain getting affected by AD.

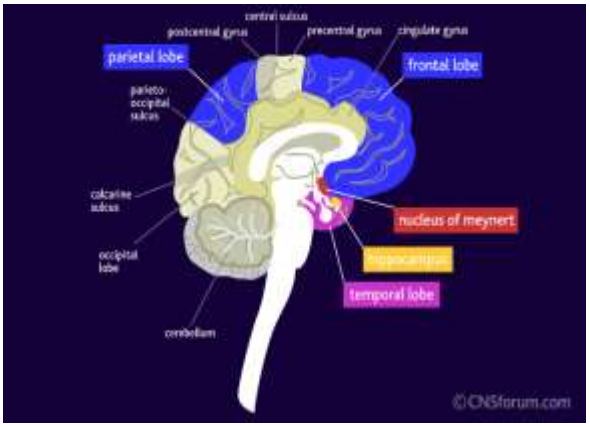


Fig1. Show the regions affected by AD.

To diagnosis the Alzheimer disease at the early stages we have different imaging techniques. Like MRI, CT, X-ray, PET, fMRI, SPECT etc.

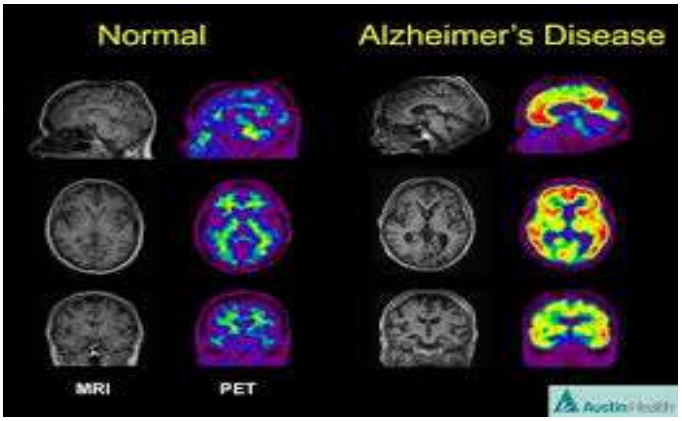


Fig2. Shows the MRI and PET images of the normal and affected patients with Alzheimer's disease.

In MRI images of AD affected brain shows the darker regions increasing and shirking. In PET images there is increase activity of yellow/red color or decreased blue activity in AD affected .The above figures show the regions affected by AD. The different imaging techniques are used to read the images. Here we have used the MRI and PET images.

II. **Implementation with bit plane:**

Bit plane slicing is a technique that highlights the contribution made by a specific bit and each biplane is a binary image. . Each pixel in an image is represented by 8 bits. Consider and imagine that the image is composed of 8 bits, say 1-bit planes ranging from bit plane 0 (LSB) to bit plane 7 (MSB) [3]. The plane starts from 0 which contains all lowest order bits in the bytes that are in the pixels in the image and plane 7 contains all high order bits.Bit –planes with detail of digital image use for analyzing the importance played by each bit of the image and it determines the adequacy of numbers of bits used to quantize each pixel. This is useful for image compression. In bit plane extraction for 8 bit image the 7^{th} bit plane is obtained by processing the input image with a thersholding gray level transformation. This function which maps all the levels between 0 and 127 to one level (e.g. 0) and maps all the levels from 129 to 253 to another (e.g. 255).Here the Black means bit 0 and white means bit 1.The slicing of the images at each bit plays an important role in image processing. An application of this technique is data compression [9]. We can slice an image into the following bit-planes. Zero is the least significant bit (LSB) and 7 is the most significant bit (MSB): 1. 0 which results in a binary image, i.e. odd and even pixels are displayed 2. 1 which displays all pixels with bit 1 set: 0000.0010 3. 2 which displays all pixels with bit 2 set: 0000.0100which displays all pixels with bit 3 set: 0000.1000 5. 4 which displays all pixels with bit 4 set: 0001.0000 6. 5 which displays all pixels with bit 5 set: 0010.0000 7. 6 which displays all pixels with bit 6 set: 0100.0000 8. 7 which display all pixels with bit 7 set: 1000. 0000. Before applying edge detection techniques, bit slicing is applied on MRI AD images to get separate bit planes. The LSB (Least significant bits) LSB consist of 0^{th} bit plane. The 0th bit plane consists of LSB (Least Significant bits) and 7th bit plane is MSB (Most Significant Bits) which contains the majority of visually significant data. The change in the bit of LSB does not change the encoded gray value much. The implementation is done using MATLAB R2013a with corei5 7^{th} Gen Duo Intel processor with 2 GHz speed.

The figure 3 shows the steps carried out.
Step 1: Acquire the Database
Step 2: convert image to gray scale
Step 3: Histogram Equalization
Step 4: Bit plane slicing
Step 5: Edge Detection with Canny

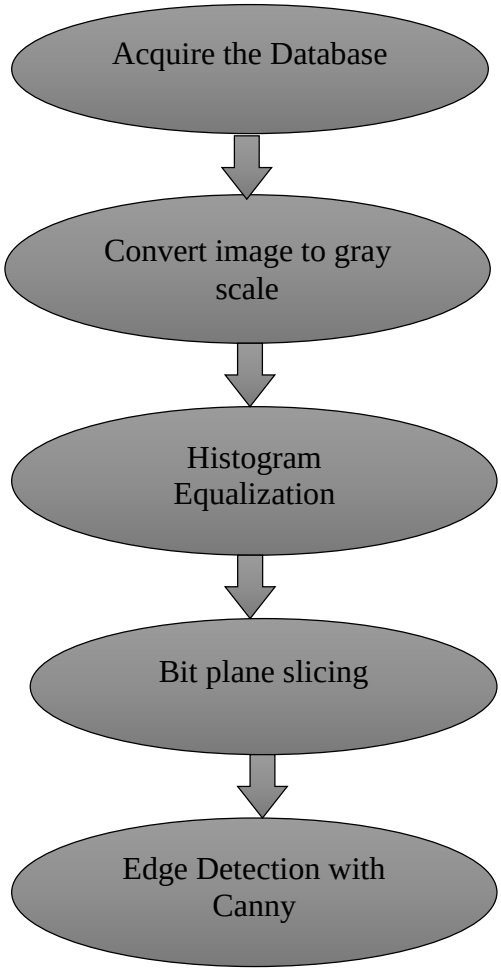


Fig3.shows the methodology carried out

III. **Result and analysis**:

The implemented region is tested with various images. It has been observed the results are similar with different images. This section displays the results to ensure the effect of each step. Figure 4 shows the hippocampus region affected in circle. The MRI image is read from the stored database and its histogram is displayed. (See Figure 5).

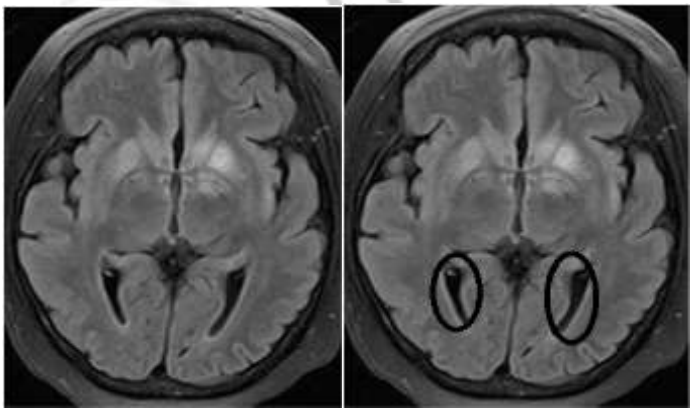


Fig4. Shows the original MRI image and the circle shows the hippocampus region affected.

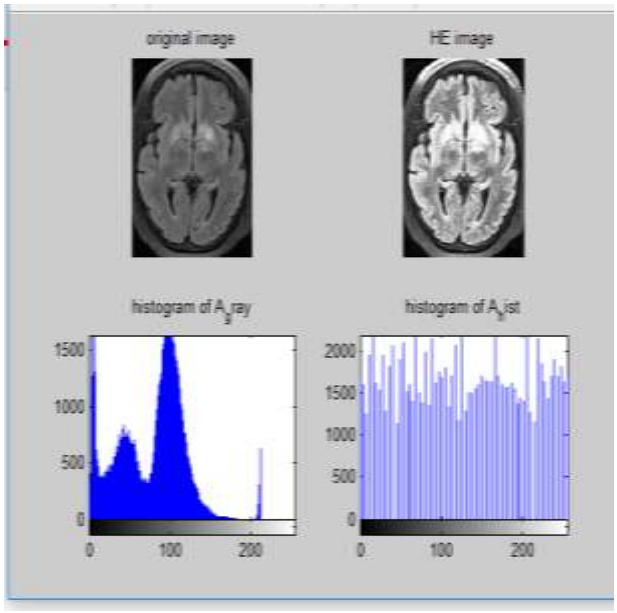
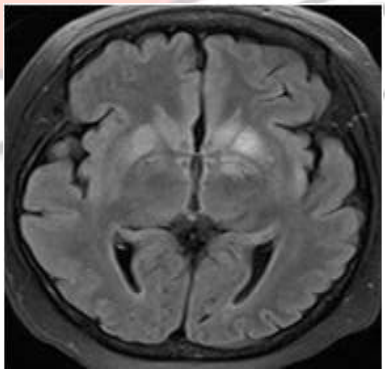


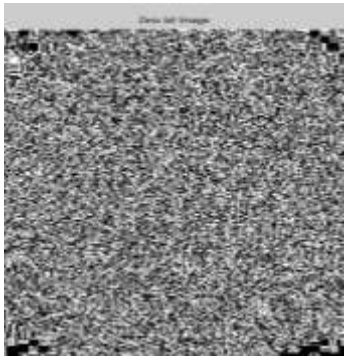
Fig5. Shows the original gray image, its histogram and Histogram equalization.

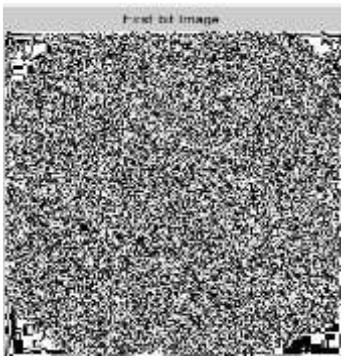
3.1 Convert image to gray scale:
Colored image takes more time for computation and more space for storage. But gray scale image takes less memory space for storage and less computation time. There is no need to convert them in gray scale. Since they are gray images.

3.2 Bit-plane slicing and Edge Detection:
The bit plane slicing is applied on MRI image of AD affected patient and then canny edge detection operator is applied on each bit plane. It is very difficult to find inner and outer boundaries of AD images and the edge features in zeroth and first bit-plane.Canny Method on Zero and First Bit Plan applied on canny operator to find edges. It detects wide range of edges in AD images. Some algorithms based on the result of edge detection and edge detection algorithms are not sufficient an image. [3] Canny edge detection is used to generate the edge map image. The large intensity gradients are more likely to correspond to small intensity gradients. From the result of second and third bit plane with canny, it is difficult to find inner, outer boundaries and edges correctly. The lower bit planes are completely black. But fifth, sixth and seventh bit planes show inner and outer boundaries of AD images and recognizes edges correctly. (See Figure 7) When compared, it has been observed that the sixth and seventh bit plane shows few edges than that of fifth bit plane. From Sixth bit plane more, edge features are recognized as it contains the majority of visually significant data. Below figure shows the bit plane slice from zero bit to seventh bit applied to the MRI images.



The original MRI images.





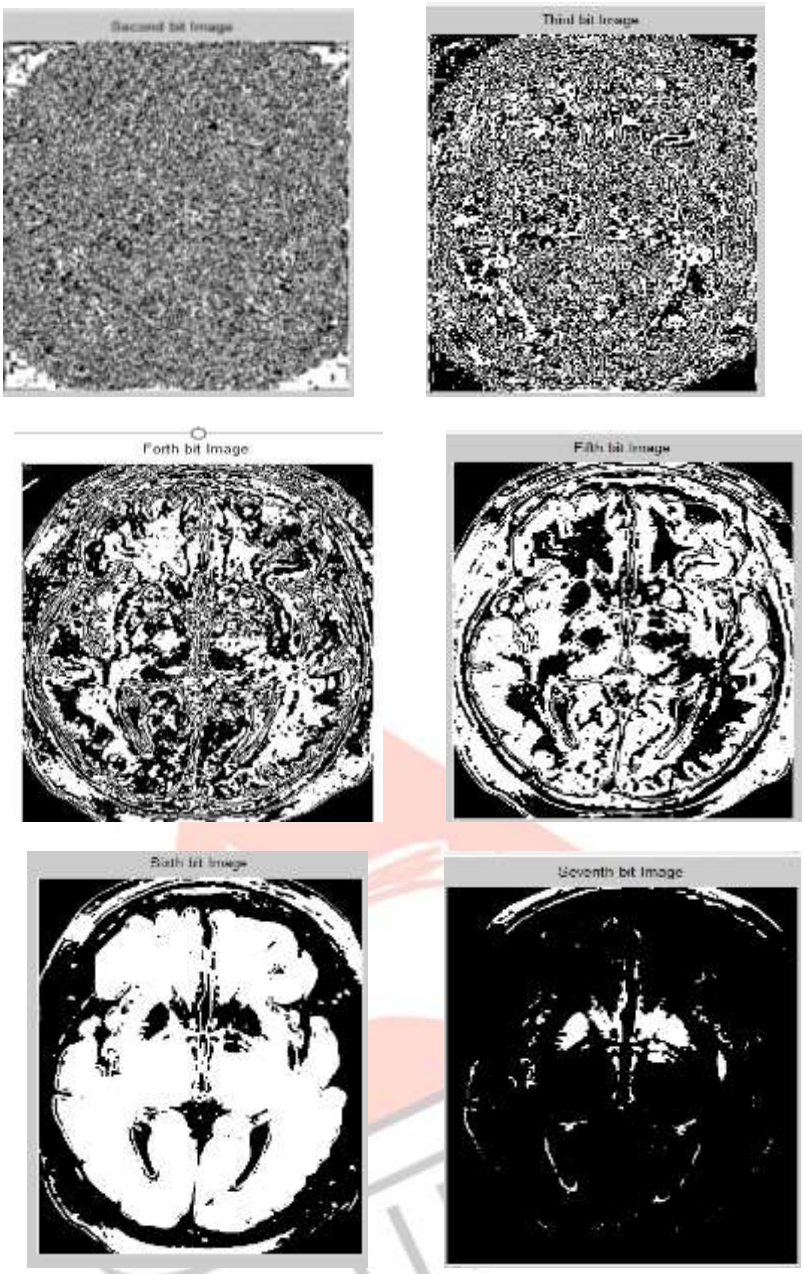


Fig 6. Shows the bit plane slice from zero bit ,firstbit second bit,third bit ,fourth bit,fifth bit ,sixth bit seventh bit for the original MRI images.

Canny edge detection method applied to all the bit plane ie from zero bit to seveth bit.

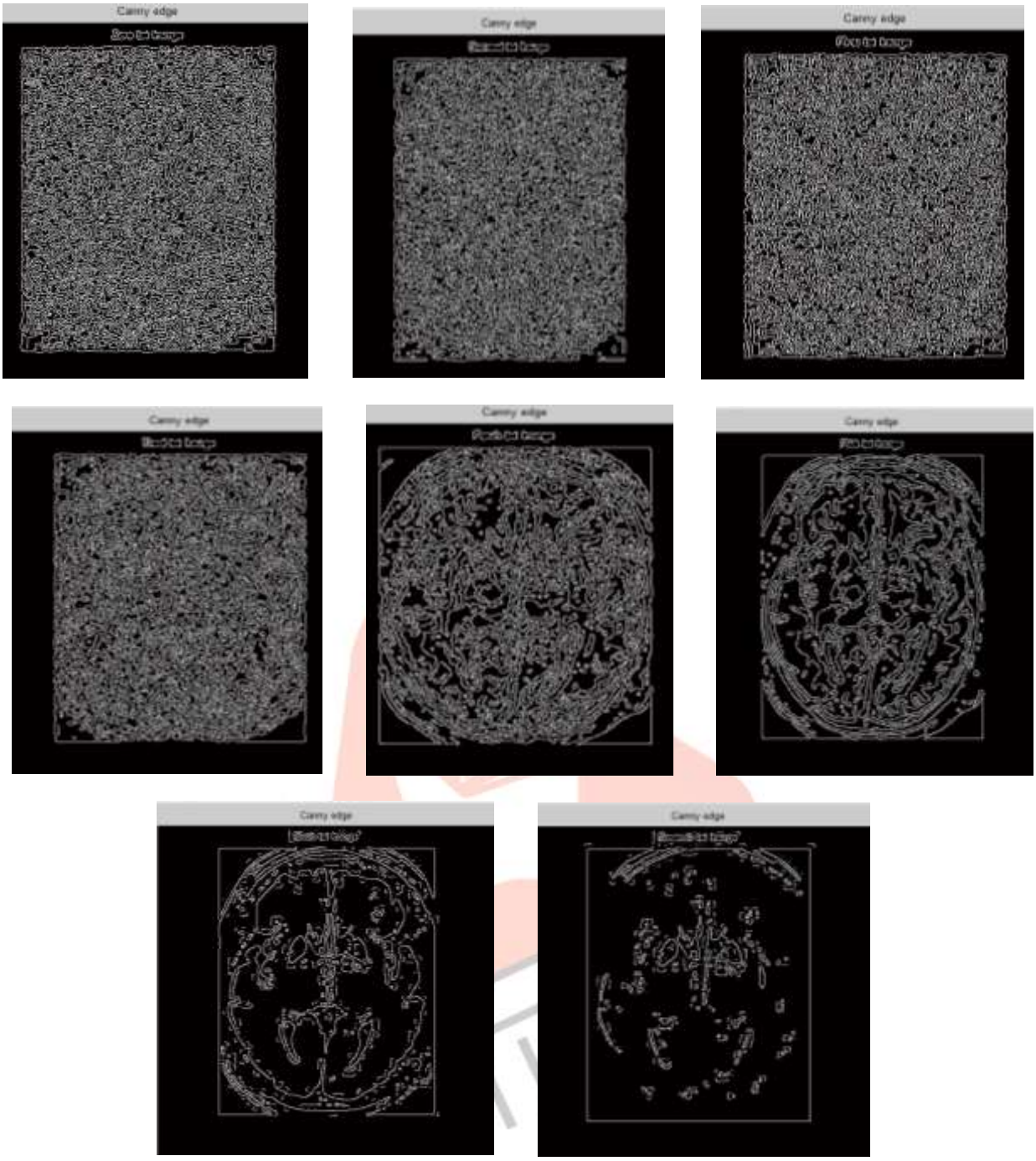


Fig 7. Shows the Canny method applied to bit plane slices.

IV. CONCLUSION

Edge detection is the initial step in any recognition technique. canny operator finds all the strong edges and those weak edges which are connected to strong edges also. Therefore, the edge features can be extracted easily and correctly with canny operator. Though canny operator provides better results, computationally it is more expensive. Proposed work, the most commonly used edge detection technique was studied such as canny which is applied on all the seven-bit planes and found that the sixth bit plane is better to recognize edges correctly. The next step would be tracing out the different features affected in the hippocampus region and then performing segmentation for early recognition.

REFERENCES

[1] https://www.alz.org/alzheimers_disease Alzheimer's Association.

[2] Kavita Khobragade Computer Science Department, Fergusson College, Pune, India K. V. Kale CSIT, Dr. B. A. M. University, Aurangabad, India "Iris Edge Detection with Bit-Plane Slicing Technique" International Journal of Computer Applications (0975 – 8887) Recent Advances in Information Technology, 2014.

[3]DhanjayIkhar, Vishwas Deshpande, SachinUntawale, Implementation of Reliable Open Source IRIS and Applied Research in Mechanical Engineering, Vol 2, Issue 4, 2013.

[4]PrashanthiVemuri* and Cliff ord R Jack Jr 'Role of structural MRI in Alzheimer's disease"Alzheimer's Research & Therapy 2010, 2:23 http://alzres.com/content/2/4/23
[5] G.T. Shrivakshan1," A Comparison of various Edge Detection Techniques used in Image Processing " 9, Issue 5, No 1, September 2012 ISSN (Online): 1694-0814 www.IJCSI.org
[6] Shubhangi S. Veer (Handore)," Brain Tumor Detection using Bit Plane Slicing from MRI" International Journal of Computer & Mathematical Sciences IJCMS ISSN 2347 – 8527 Volume 4, Issue 10 October 2015.
[7] Anke Meyer –" Pattern Recognizing for Medical Imaging" - Base Text book, ISBN: 0-12-493290-8.
[8] Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision 2nd Edition, Thomson Learning 2001
[9] Rafel C Gonzalez and Richard E Woods, Digital Image Processing using matlab– 3rd Edition, Pearson Education, 2003.
[10]Wikipedia Free Encyclopedia: www.wikipedia.com
[11]. Neşe Yalabık : Medical Applications of Pattern Recognition. HIBIT'10, Antalya, April 2010.
[12] A Makandar, B Halalli, "Threshold based segmentation technique for mass detection in mammography" J Comput 11 (6), 472-479.
[13] A Makandar, A Patrot," Malware image analysis and classification using support vector machine", International Journal of Trends in Computer Science and Engineering 4 (5), 01-03.
[14] AUR Makandar, K Karibasappa," Wavelet based medical image compression using SPHIT" Journal of Computer Science and Mathamatical Science 1, 769-775