Detection for Alzheimer's Disease Using Image Processing

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Abstract - *Digital medical imagining is a process of extracting usual representation and complex analytical information of body for medical purpose. This is complicated and the cost is very high due to the requirement of proprietary software's and professional individual. Here we take into use a software called MATLAB which is user friendly in experience and this program is used for detection of brain abnormalities called as Alzheimer's disease in early stages. The system will provide the result of medical analysis of digital images like magnetization resonance of image scan of brain. The small structural difference in the brain can slowly and gradually become a major disease like Alzheimer's disease. The method used by us in our project for initial disclosure and diagnosis of Alzheimer's disease is bi-cubic interpolation algorithm.*

Key Words: **MATLAB, Alzheimer's Disease, Bi-cubic interpolation, MRI, Abnormalities**

1. INTRODUCTION

Our Brain is the essential and key organ for functioning of human body. If the brain is affected by disease which is very crucial to control and manage, if there is any occurrence of any changes it cannot be reversed in extreme cases. Cognitive functional thinking is lost in Dementia. Alzheimer's disease is the popular disease which causes Dementia in human. First appearance of Alzheimer's can be noted in their mid-60's. Current estimation of people suffering with Alzheimer's is around 6 million mostly which are in age group above 60. The symptoms of Alzheimer's disease include change in behavior, loss of memory, difficult in speaking. There are other symptoms which are not memory based like vision, word finding, lack of reasoning and judgement. Brain images, blood and cerebrospinal fluid are biological signs. "The Alzheimer's can be classified into three categories severe Alzheimer's disease, Mild Alzheimer's disease and moderate Alzheimer's disease based on stages". The AD will first damage the hippocampus region in brain which is based on informing memories. Slowly and gradually it spreads to other parts of the brain and the brain starts reducing in the size and in the last stage the brain is reduced majorly in size.
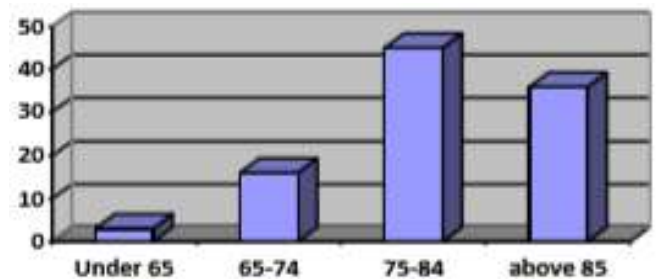

Chart -1: Distribution of Alzheimer's Disease by age

2. LITERATURE SURVEY

Alzheimer's disease can be detected early and can be diagnosed by image processing of MRI scans to predict the possibility of disease. "In Image processing technique multiple algorithms are used k-means clustering, intensity adjustment and region extraction algorithm for extraction of grey and white matter". The approximate ratio of grey and white matter in matter is calculated by using same algorithm. The tool used for clinical Literature analysis and quantitative analysis is MATLAB, this analysis is done on brain MRI image in different viewing angles. "Image processing is the technique in which the Region of interest is extracted from the image using different algorithms. The different algorithms include watershed, thresholding and K-means clustering method. The segmentation method described is used in the segmentation of X-ray welding images to detect defects such as perforations and reduced defects, incomplete penetrations and wormholes. This method is used to identify faulty areas. They are widely used in medical imaging. Computer vision, optical character recognition, industrial radiography [3]. The K-Means algorithm is one of the widely used clustering algorithms. This article describes a modified version of the k-means algorithm. This improves image quality by first applying partial stretch to the image. Subjective clusters are used to generate the initial center of the cluster, and subjective clustering is a method of generating possible values for data points. The generated centers can be used by image segmentation algorithms [4]. Deep learning architectures have been proposed to detect Alzheimer's disease which can overcome the shortage of the machine learning algorithm used for detection. It can be used for detection of both mild cognitive impairment and AD. We offer a deep learning architecture that uses an auto-encoder stack and an output level SoftMax to detect the stages of AD and MCI predecessors". This architectural domain can use prior knowledge to detect and analyze several classes of learning samples and learning samples

with a low score [5]. Brain tumors are a deadly disease. Image processing is very useful for detection. This article aims to propose an algorithm that identifies brain tumors. Therefore, the "K-means algorithm is used to detect a tumor. K points are selected using an MRI image. As soon as the algorithm treats all points with the least difference in intensity, they begin to move after competition from all groups in the direction of their respective focus". The tumor is clearly visible on magnetic resonance imaging [6]. Bicubic interpolation the tactic is employed to spot and diagnose Alzheimer's malady. Picture element intensity is employed to classify living and dead tissue on an MRI image of the brain [7]. The structure of the brain isn't essentially distorted by disease; there's an activity by that the brain transforms the structure. Therefore, when processing an image for pathological reasons, it is difficult to distinguish the distortion from the structure of the brain, whether it is natural or not. You can update the mathematical model to classify the cause of the deformation. The elastic properties of the brain are used to compensate for deformation in non-pathological areas. This helps to spot deformations within the form of the brain thanks to pathological reasons. This method is used to classify patients according to diseases such as schizophrenia, a healthy volunteer with Alzheimer's disease, and hydrocephalus at normal pressure [8]. The detection of AD and PD "Parkinson's Disease" is a lot of correct as a result of 3D MRI considers more necessary functions. Organic process optimization algorithms are used, as well as particle swarm optimization, bat algorithms, simulated tempering and model looking out, yet as genetic algorithms. The detection accuracy is improved by applying this algorithm to extract the features of AD, resulting in more accurate and optimal results [9]. Existing methodologies are based on the principle of quantifying brain damage caused by Alzheimer's disease. As patients progress to Alzheimer's disease, the number of substances (tau tangles) is constantly increasing, and the lack of communication between neuronal cells causes brain cells to die and the volume of the brain to decrease. "The goal of current technology is to identify the size of human brain from individual angles. This view is called the axial plane, coronal plane, and plane. It also calculates the ratio of gray matter to white matter. White matter ratios of 65 and 68 address white matter and the first and second stages of Alzheimer's disease. Cases of hippocampal atrophy are not covered by this approach [2]. The detection of Alzheimer's disease is not only region around the brain, but the center part also plays important role in detection". These include larger vascular areas and damage to the hippocampus.

3. LITERATURE ANALYSIS

In this chapter the nitty gritty overview of current writing on discovery of Alzheimer's. The writing incorporates an audit of diverse calculations for image processing utilizing different algorithms for early detection of Alzheimer's. The study moreover has detection of Alzheimer's utilizing optical detection.

In the paper [1], "Diverse from conventional neural systems which expect that all inputs (and yields) are autonomous of each other, RNN can demonstrate the energetic transient behavior for a time arrangement with the yield being subordinate on the past computations. Within the past decades, the execution of RNN was not commonly utilize due to the trouble of preparing".

In the paper [2], "the paper primarily centers utilize one view of MRI picture as the input information for anticipating MRI image. The sagittal slice centered at the center of hippocampus region in MRI picture is bolstered into the PCA Net. The PCA Net can serve as a straightforward but shockingly competitive base line for experimentally legitimizing progressed plans of multistage highlights or systems and can moreover be act as highlight learner".

In the paper [3], "this paper emphasizes on a point of view grounded on organize neuroscience to evaluate the potential of basic brain systems as measured with dissemination MRI in prodromal dementia. The most investigate found in this venture recommend that a few measures of dissemination MRI pictures are instructive for Alzheimer's dementia disease determination; the foremost discriminative organize highlights are to a great extent related with brain parts like subcortical brain regions and medial temporal".

In the paper [4], "Within the OCT examination, there are diverse steps such as division, highlight extraction and classification are required. Division could be an exceptionally critical strategy within the computerized computer expectation and estimation of therapeutic pictures. Most critical and common methodologies for division of therapeutic pictures are fluffy logic; support vector machines (SVMs) and artificial neural systems (ANNs)".

Table -1: Summary of literature analysis

Serial Number	Paper	Advantages and Disadvantages
01	"RNN-based longitudinal analysis for diagnosis of Alzheimer's disease "(2019)	Advantage: Use RNN which is independent and connection between the nodes form sequential graph. Disadvantage: Difficulty in training the system
02	"Computer aided Alzheimer's disease diagnosis	Advantage: Uses Unsupervised learning and the

	by an unsupervised deep learning technology" (2018)	system is improved after every iteration. Disadvantage: Accuracy is less
03	"Structural connectivity centrality changes mark the path toward Alzheimer's disease" (2019)	Advantage: Can be used to detect Alzheimer's in early stage. Disadvantage: System is very complex and more computation is required.
04	"Early Prediction of Alzheimer's Disease Using OCT Imaging Technique "(2019)	Advantage: Charges of OCT is exceptionally fractional to some different methods and is a solid strategy for detection of disease. Disadvantage: Analysis may be in accurate because brain Images is not used.

4. EXISTING SYSTEM

Present strategy for Alzheimer's Disease detection is based on cognitive impedance testing which tragically does not appear precise analyze until the understanding has advanced past a direct AD stage. AD is considered to be one of the foremost common diseases that cause the human passing particularly in individuals over 60 years old. Numerous computer-aided determination strategies are presently broadly spread to help in Alzheimer's diagnosis.

Fig -1: Existing System
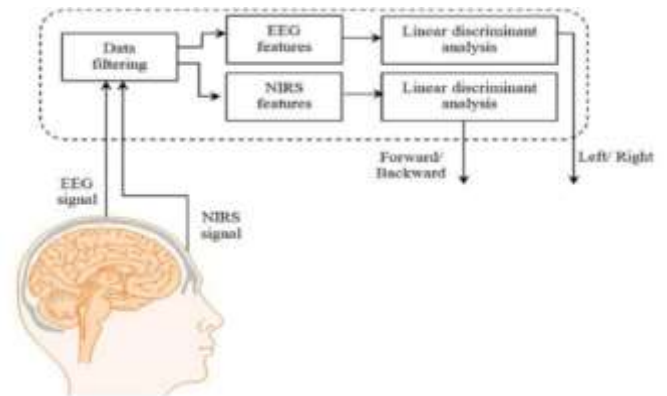
5. PROPOSED SYSTEM

5.1 Input MRI Image

The Radiological imaging strategy, MRI all these strategies where created amid deserting of ultrasonic sound. It is broadly utilized for detection of tumor. Point by point picture of the human body organ can be made utilizing MRI Scanning. It is scientifically termed as magnetic resonance imaging in medical field. Strong magnetic field and radio waves are utilized to watch the portion of the human body that were prior not conceivable by X-rays, Ultra sound or CT scan. Specialist can presently watch interior ligaments, tendon, muscles, joints and cartilage.

5.2 Preprocessing of MRI Image

In this Stage the MRI is prepared by utilizing vital picture division strategy or segmentation technique. This strategy is utilized to create the feature of the picture way better and visual at most reduced level. This does not include any additional feature but particularly it evacuates undesirable feature from picture. Picture resizing, Picture Transformation, and intensity alteration of pictures are done.
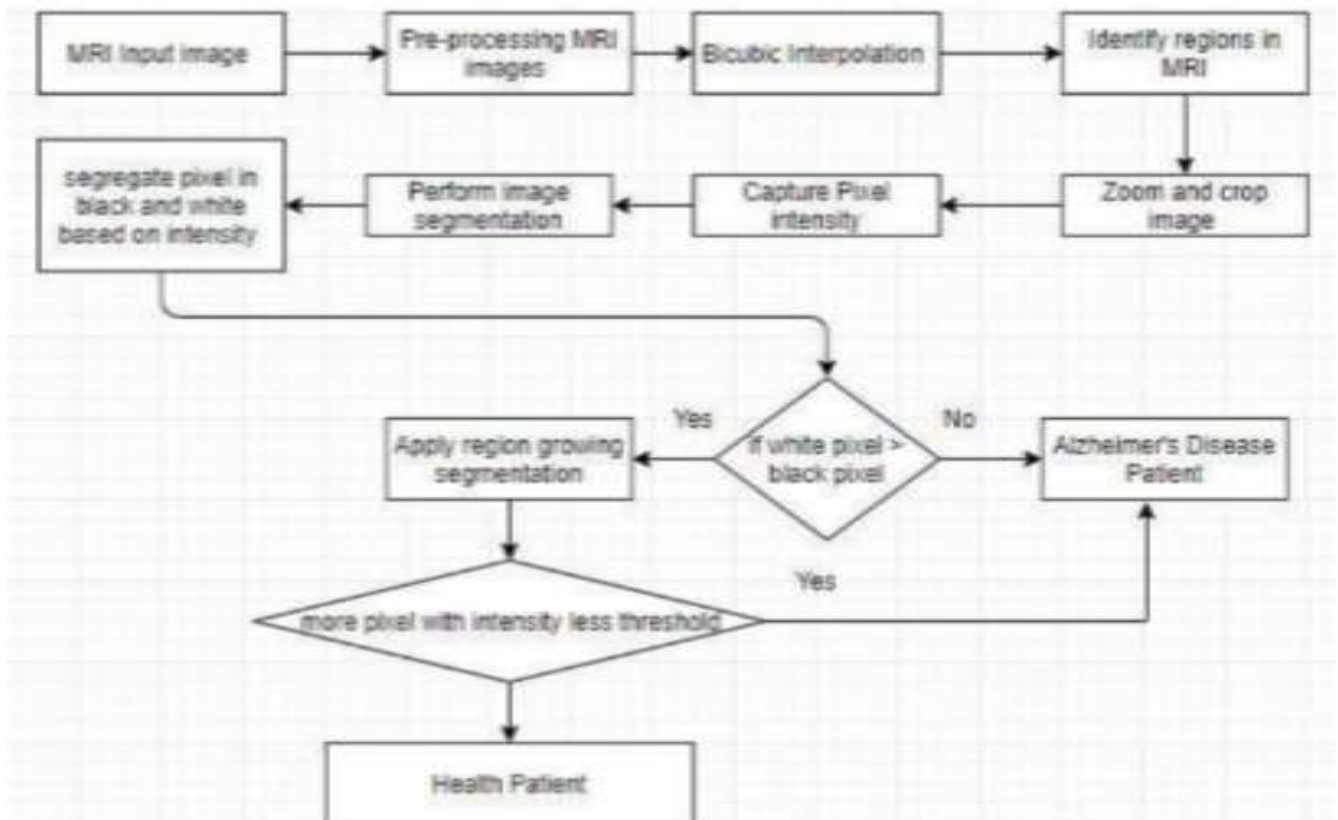
Fig -2: Flowchart of Proposed System

5.3 Bi-cubic Interpolation

This area cannot easily be used to detect a feature near the pixel on the original brain MRI. Therefore, interpolation is a technique used to improve the image, which is quite flexible and can be utilized in some image processing applications. In this setting, it is for the discovery of therapeutic magnetic resonance images. The result obtained from bilinear interpolation and nearest neighbor interpolation is not that smooth that is the reason why bi cubic interpolation is used.
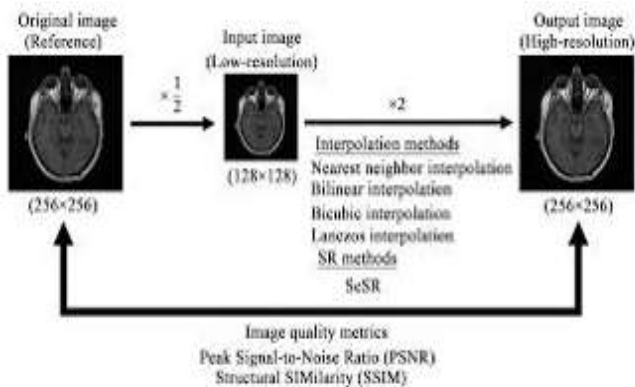

Fig -3: Demonstration of bi cubic interpolation

5.4 Region of Interest

Identifying the region of interest on an MRI. To detect Alzheimer's disease, the hippocampal atrophy area, brain atrophy, and parietal lobe are region of interest
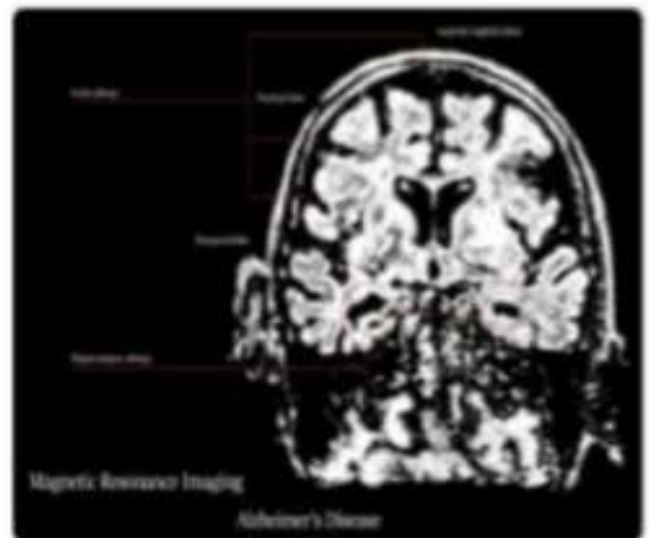

Fig -4: Region of Interest

5.5 Watershed Algorithm

Watershed transform is a type of segmentation technique in mathematics morphology. In geography, a watershed

means the ridges that divides areas drained by different river system in topology. The watershed transform is a morphological segmentation technique based on gradient differences. The gradient map of the image is considered as a relief map in which different heights corresponds to different gradient value.
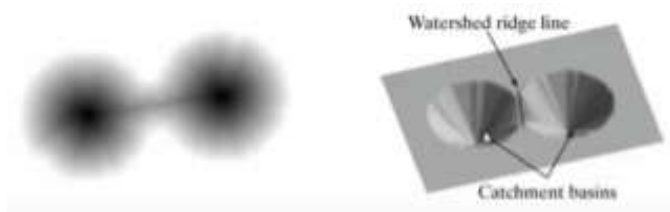

Fig -4: Result of watershed algorithm

5.6 Image Segmentation

The pixel dimensions of the area of interest are identified and plotted by the size and zoom of the selected region. Various algorithms use this selected image to adjust the intensity of the pixels. The pixel intensity for the cropped image is classified in black and white. The white area here represents living tissue and the black area represents dead tissue. The number of black and white pixels is measured, and if the black pixel is a much smaller fraction than the white pixel, the patient is healthy. Depending on the proportion of presence of black pixels, the patient is classified as with mild cognitive impairment, Alzheimer's disease or a healthy patient.

5.7 Algorithm

1. Accept the brain magnetic resonance imaging as input image.

2. Perform bi-cubic interpolation technique to accepted MRI Image.

3. Region of Interest like hippocampus and enlarged ventricles are extracted.

4. Red, green, and blue pixel values for the highlighted hippocampus and enlarged ventricular region are summed.

5. If the sum of the red, green and blue matrix values is zero, consider them a black pixel. Or else, take into account the given pixel as a white pixel.

6. A number of black pixels are added to the cavity and a number of white pixels are added to the cavity.

7. The length of cortex and cavity region is checked and compared.

7.1 Suppose cavity region has over 50% of region than cortex region then person with Alzheimer's is in stage 2.

7.2 Suppose cavity region is between 30% to 50% pixel then the person with Alzheimer's is in stage 1.   7.3 Suppose cavity region is more than 10% but less than 30% then Patient can have mild cognitive impairment.

7.4 Suppose cavity region is a smaller than 10% with respect to cortex region then move to step 8.

8. A cerebral magnetic resonance gradient image was obtained using the watershed algorithm. Whole brain magnetic resonance image is examined.

9. Each and every pixel is counted whose intensity is 0.

9.1 If the limit or threshold is exceeded by pixel intensity, then consider the patient as Alzheimer's.

9.2 Else the person belongs to healthy group.

6. HARDWARE AND SOFTWARE REQ.

Software Requirements

Frontend: MATLAGUI

Backend: MATLAB, MATLAB IP Toolbox

Operating system: WINDOWS-7and above   Hardware Requirements

Main processor: Pentium IV processor1.13GHz and above

Internal memory capacity:4GB

Hard disk capacity: 250GB

7. CONCLUSION

The goal of early detection of Alzheimer's has been achieved and this information can be used to diagnose Alzheimer's. The result is increased vascular and cerebral atrophy. Implementation is executed using technique called image segmentation to spot any vascular enlargement. The amount and proportion of the increase classifies the patient as a healthy patient, first stage AD, second stage AD, cases of mild cognitive impairment based on black and white pixels. Another necessary consideration for the detection of Alzheimer's disease is cerebral atrophy. A watershed algorithm for image segmentation is employed to spot brain atrophy. Image gradient is used to examine atrophy of the brain cavity. This machine-driven technique incorporates a straightforward methodology and lower temporal complexness of the image. This solves the problem of early detection without brain damage. This will encourage research in the field of image processing and medical imaging.

8. REFERENCES

[1] https://www.nia.nih.gov/health/alzheimers-disease-fact-sheet.

[2] Asmiya Naikodi ,Nida Fatima, Shamili.P,Neha Gopal.N"Early detection of Alzheimer's Disease using image processing using MRI Scan ".International Journal for Technological Research in Engineering, Volume 3, Issue 9, May2016.ISSN:2347-4718

[3] B .Karthikeyan, V.Vithiyanathan,B. Venkataraman, M .Menaka "Analysis of image segmentation radio graphic images". Indian Journal of Science and Technology "volume 5, Issue 11, November 2012.ISSN-0974-6846.

[4] Nemirakpam Dhanchandra,Khumanthem Manglem ,Yembem Jina Chanu "Image segmentation using the k-means clustering algorithm and Subtractive clustering algorithm". Eleventh International multi conference on Information processing -2015764-771 (IMCIP-2015). ELSEVIER

[5] SiqiLiu,SidongLiu,Studen tMember,IEEE,Wein dong Cai,Member IEEE,Sonia Pujol,Ron Kikinis, Dagan Feng,Fellow IEEE "Early Diagnosis of Alzheimer's disease with Deep Learning" 2014IEEE11 the international Symposium on Biomedical Imaging (ISBI).31stJuly2014.ISSN-1945-8457.

[6] Rohini Paul Joseph, C.SenthilSingh, M.Manikandan, "Brain Tumor MR IImage Segmentation and Detection in ImageProcessing".International Journal of Research in Engineering and Techonology. eISSN:2319-1163| PISSN:2321-7308.

[7] Raju Anitha,S.Jyothi,P.Ramesh Babu."Detection of brain abnormality for Alzheimer's Disease using Image Processing Techniques".

[8] John Martin,Alex Pentland,Member IEEE Computer Society, Stan Scholar off Member IEEE Computer Society and Ron Kikinis."Characterization of Neuropathology Shape Deformations".