CERTIFICATE

It is certified that the work contained in this thesis entitled **"Brain Segmentation of MRI Image Using Hybrid Neural Fuzzy Network",** by **Shruti Agarwal** (Roll no 1190449003), for the award of **Master of Technology** from Babu Banarasi Das University has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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ABSTRACT

Over the past 20 years the global research going on in Artificial Intelligence in applications in medication is a venue internationally, for medical trade and creating an energetic research community. The Artificial Intelligence in Medicine magazine has posted in massive amount. This thesis gives an overview over the history of AI applications in brain MRI analysis to research its effect at the wider studies discipline and perceive demanding situations for its destiny. Analysis of numerous articles to create a taxonomy of research subject matters and results was done. Article is classed which might be posted among 2000 and 2018 with this taxonomy. Efforts are useful in figuring out popular studies works in AI primarily based mind MRI analysis throughout specific issues. Biomedical prognosis was ruled by way of knowledge engineering research in its first decade, whilst gadget mastering and records mining prevailed thereafter. Together these two topics have contributed a lot in latest medical domain. Extraction of highlights from the biomedical picture utilizing the surface and shading space-based image preparing examination calculation is created for the brain MRI utilizing DWT, entropy feature and watershed information change is discussed about in this article. To remove the pixels related to unwanted spaces we have utilized entropy highlights by use of the MATLAB tools of image, DSP and artificial intelligence where it relates to the information image parameter with the utilization of spatial based parameters. The surface investigation based on brain MRI data extraction calculation comprises of steps identified with deteriorating the information image into an arrangement of double images from which the shading space measurements of the subsequent region can be figured keeping in mind the end goal to depict an example application for classifying the Alzheimer disease by neural network and fuzzy logic approach.

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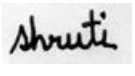

(SHRUTI AGARWAL)

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1. Personal Computer……PC
2. Computerized Tomography……CT
3. Magnetic Resonance Imaging……MRI
4. Positron Emission Tomography……PET
5. Fast Fourier Transform…… FFT
6. Computer Aided Diagnosis……CAD
7. Electro-encephalograms……EEG
8. Functional Magnetic Resonance Imaging……fMRI
9. Single Photon Emission Computed Tomography……SPECT
10. Magneto-Encephalography……MEG
11. Diffusion Weighted Imaging……DWI
12. Perfusion Weighted Imaging……PWI
13. Diffusion Tensor Imaging……DTI
14. Double Inversion Recovery…… DIR
15. Artificial Neural Network ……ANN
16. Forward Propagation-Artificial Neural Network……FP-ANN
17. Support Vector Machine……SVM
18. Back Propagation……BP
19. Stationary Wavelet Transform……SWT
20. Discrete Wavelet Transform……DWT
21. Scaled Conjugate Gradient……SCG
22. White Matter……WM
23. Gray Matter…… GM
24. Cerebrospinal Fluid……CSF
25. State of the Art……SOTA
26. Magnetic Resonance Spectroscopy……MRS
27. Perfusion Imaging……PI
28. Section of Biomedical Image Analysis……SBIA
29. Principal Component Analysis……PCA
30. Alzheimer's Disease……AD
31. Convolutional Neural Network……CNN
32. White Count Number Hypersensitivities……WMH
33. Deep Boltzmann Machine……DBM
34. Random Forest……RF
35. Lesion Segmentation Tool……LST
36. Dice Similarity Coefficient……DSC
37. Metastasis……MS
38. True Positive Rate……TPR
39. Positive Predictive Value……PPV
40. Lesion Wise True Positive Rate……LTPR
41. Lesion Wise False Positive Rate……LFPR

42. Strength Weakness Opportunity Threat……..SWOT
43. Content Based Clinical Photo Retrieval……CBMIR
44. Mutual Information and Tough Set with Particle Swarm Optimization……..MIRSPSO
45. Accuracy……AUC
46. Sequential Functional Choice……..SFS
47. Mutual Statistics with Particle Swarm Optimization……MIPSO
48. Mutual Facts with Sequential Feature Choice……..MISFS
49. Brain Metastasis……BM
50. Gladolinium based contrast retailers……GBCA
51. Deep Learning……..DL
52. Asymmetry, Border, Color, Diameter……ABCD
53. Gaussian Markov Random Fields……GMRF
54. Matrix Laboratory……MATLAB
55. Adaptive Neuro Fuzzy Inference System……ANFIS

Chapter 1

INTRODUCTION

1.1 Introduction:

Image division is a standout amongst the most central and troublesome issues in image investigation. Image division is an imperative part in picture handling. In PC vision, image division is the way toward dividing a image into significant areas or articles. There are different uses of image division like find tumors or different pathologies, measure tissue volume, PC guided medical procedure, treatment arranging, investigation of anatomical structure, find protests in satellite pictures and unique mark acknowledgment and so on. Division subdivides a image into its constituent area or protest. Image division techniques are classified based on two properties intermittence and similitude [1]. In view of this property image division is ordered as Edged based division and area-based division. The division strategies that depend on brokenness property of pixels are considered as limit or edge-based systems. Edge based division strategy endeavors to determine image division by distinguishing the edges or pixels between various districts that have quick progress in force and are separated and connected to frame shut protest limits. The outcome is a twofold picture. In light of hypothesis there are two fundamental edge based division strategies, dark histogram based and angle based technique [2]. Locale based division segments a picture into districts that are comparable as indicated by an arrangement of predefined criteria. The locale-based division is apportioning of a picture into comparative regions of associated pixels. Every one of the pixels in a locale is comparative concerning some trademark or figured property, for example, shading, power and additionally surface. Technique like thresholding, district developing and locale part and blending [2]. Thresholding is an essential system in image division applications. The essential thought of thresholding is to choose an ideal dim level limit an incentive for isolating objects of enthusiasm for a picture from the foundation in light of their dark level dissemination. While people can without much of a stretch differentiable a protest from complex foundation and picture thresholding is a troublesome assignment to isolate them. The dim level histogram of a picture is generally considered as effective instruments for advancement of picture thresholding calculations. Thresholding makes parallel

pictures from dark level ones by turning all pixels underneath some limit to zero and all pixels about that edge to one.

Present day restorative conclusion uses systems of representation of human inside organs (CT, MRI) or of its digestion (PET). Be that as it may, assessment of gained pictures made by human master is normally subjective and subjective as it were. Quantitative investigation of MR information, including tissue arrangement and division, is important to perform e.g. weakening remuneration, movement discovery, and adjustment of halfway volume impact in PET pictures, procured with PET/MR scanners. This present a product, which underpins 2D and 3D medicinal picture examination going for evaluation of picture surface. Actualizes systems for assessment, determination and extraction of profoundly discriminative surface properties joined with different grouping, perception and division. Surface, as saw by people, is a perception of complex examples made out of spatially sorted out, rehashed subpatterns, which have a trademark, some way or another uniform appearance [2]. The nearby subpatterns inside a picture exhibit particular shine, shading size, unpleasantness, directivity, arbitrariness, smoothness, granulation, and so on. A surface may convey generous data about the structure of physical articles – subsequently, textural picture examination is an essential issue in picture handling and comprehension. Particularly, surface assumes a vital part in biomedical pictures, where it portrays inward structure of tissues and organs. Surface is available in lion's share of such pictures gained by various modalities, including PET, MRI, CT, echocardiography, and so forth. People for the most part survey the surface just subjectively, while regularly its quantitative examination is required to get objective and dependable indicative data. It was at that point used in numerous regions including MRI estimation convention streamlining [2] and different medicinal examinations, to say only the most recent [3,4,5,6]. There are very few programming apparatuses for quantitative picture surface accessible.

Solid assessment of surface examination strategies connected for therapeutic pictures speaking to interior organs or tissues is troublesome. Normally these organs are not specifically accessible and can't be estimated to look at got esteems (e.g. of geometrical parameters) to those assessed by a programmed PC examination. One conceivable answer for this issue is use of counterfeit articles (ghosts) with known shape and size. At that point, pictures of these

items are broke down (e.g. divided) and got comes about are contrasted with genuine apparition parameters (e.g. measurements, zone). This approach was utilized to assess picture examination comes about.

1.1.1 Image Features

Exact division of medicinal structures depends on quantitative visual appearance and shape descriptors (picture includes) that assistance to segregate between the structures and their experience on a present picture to be divided, and also on accessible earlier data about the appearance and shape highlights for an arrangement of physically portioned preparing pictures. Essential appearance, shape, and joined shape/appearance highlights to manage the division procedure are outlined underneath.

1.1.2 Appearance Features

Regularly, visual appearances of objective items are related with singular pixel or voxel-wise forces (dim qualities) and spatial connections between the powers as far as combine shrewd or higher-arrange force co-events in a picture.

Power: Individual forces can direct the division if their reaches or, all the more for the most part, likelihood dispersions for a question of-intrigue and its back-ground contrast to a huge degree. At that point the entire protest or if nothing else, the vast majority of its pixels/voxels can be effortlessly isolated from the foundation by contrasting the forces with at least one limits got from the educated reaches or appropriations of the powers. Nonetheless, for the most part, more great discriminative highlights must be utilized.

Spatial connection: The presence of specific surfaces can be related with spatial examples of nearby pixel/voxel force varieties or exact likelihood disseminations of power co-events, called co-event lattices [2] in the pairwise cases. Probabilistic spatial collaboration models consider pictures as tests of a specific arbitrary field of reliant forces determined by their joint likelihood circulation. Spatial area sifting gives the most direct approach to catch nearby spatial collaborations. Early endeavors concentrated on power edges since fine surfaces have a

higher spatial thickness of the edges than the coarser surfaces [10]. Utilization of nonlinear channels figuring contrasts of two counterbalance Gaussians (DOOG) to demonstrate preattentive human visual surface observation. The nonlinearity acquainted with separate between the surfaces with a similar neighborhood first-and second-arrange measurements of powers functioned admirably for both manufactured and characteristic pictures. Comparative work done additionally utilized spatial channels in conjunction with a nonlinear administrator. Other spatial channels abuse morphological (see [13] for more points of interest) and edge administrators that likewise plan to remove picture edges.

Recurrence area sifting originates from the suspicion that human visual framework deteriorates a picture for textural investigation into situated recurrence segments [14]. A multiband sifting approach by utilized an arrangement of recurrence and introduction specific channels to portion and characterize an assortment of normal and engineered surfaces. Smith [16] utilized an arrangement of band-pass channels took after by zero-intersection recognition to encourage a fruitful tree classifier of surfaces. Furthermore, the wavelet recurrence parts deteriorating a picture at various scales and introductions are additionally used to direct the division [17]. These segments can confine spatial frequencies and identify the high recurrence substance of the picture, for example, lines and edges [18]. Fractal models are valuable in displaying measurable unpleasantness and self-likeness at various sizes of numerous common surfaces. Fractal geometry of the nature was first presented in the nineteen seventies and investigated promoted. These models are scale free, show self-similitude, and can demonstrate normal surfaces, for example, mists, leaves, or waterways and in addition some restorative structures (e.g., bosom foundation structures in computerized mammograms [22]). A picture can be sectioned as per at least one fractal parameters related with the objective districts. It was displayed a couple of fractal based surface division methods. Progressed multifractal highlights enhance catching the surface substance to control division (see e.g., [24]). Nonetheless, more adaptable models are expected to show medicinal pictures. Probabilistic Gaussian models accept constant picture motions in an unbounded range (albeit computerized pictures have a limited set Q of forces). The joint circulation p(g) is unimodal and relies upon the two parameters, the mean picture of the size XY or XYZ and the symmetric covariance

lattice of the size (XY)2 or (XYZ)2, separately, to be gained from the preparation pictures. Because of an amazingly huge parameter space, just models with extraordinary straightforward covariance grids, e.g., free Gaussian fields with corner to corner covariance networks, were utilized as a part of training. Tests of a Gaussian model can be gotten sensibly rapidly by means of the quick Fourier change (FFT) [25]. In any case, the model forces critical and for all intents and purposes unjustified limitations on the pictures, for example, just unimodal Gaussian disseminations of powers for any subset of pixels/voxels and in addition just particular unimodal pairwise cooperation between the pixels/voxels regardless of the substantial parameter space included [26]. Practically speaking, observational dispersions of picture powers and matches of forces are generally multimodal and along these lines don't conform to this model.

1.2 Motivation:

The utilization of shading and surface data all in all has solid connections with the human observation and in numerous viable situations the shading alone or surface alone picture data isn't adequately strong to precisely portray the picture content. A case is given by the division of common pictures that display both shading and surface qualities. This instinctive psychophysical perception provoked the PC vision analysts to examine a vast range of scientific models with the point of inspecting the nearby and worldwide properties of these two crucial picture descriptors. Regardless, the powerful reconciliation of shading and surface characteristics is a long way from a unimportant goal and this is propelled, to some extent, by the trouble in separating exact shading and surface models that can locally adjust to the varieties in the picture content. Specifically the division of regular pictures turned out to be a testing errand, since these pictures show huge inhomogeneities in shading and surface and what's more they are frequently portrayed by a high level of many-sided quality, haphazardness and inconsistency. In addition, the quality of surface and shading traits can fluctuate extensively from picture to picture and difficulties included by the uneven brightening, picture commotion, point of view and scale twists make the way toward recognizing the homogenous picture areas to a great degree troublesome. Every one of these

difficulties pulled in generous enthusiasm from the vision analysts, as the hearty joining of the shading and surface descriptors in the division procedure has significant ramifications in the improvement of larger amount picture investigation assignments, for example, protest acknowledgment, scene understanding, picture ordering and recovery, and so forth the principal targets of this work are: (a) to categorise the principle slants in colour– surface incorporation, (b) to test the application setting of the proposed usage (at whatever point such exchange is proper), (c) to talk about the assessment measurements that are presently used to survey the execution of the division strategies, (d) to audit the freely accessible information accumulations (picture databases) and (e) to break down the execution of entrenched best in class usage. It is valuable to take note of that principally worried about the examination of calculations that have been intended for the division of still computerized pictures and we will demonstrate when the assessed approaches have been connected to the division To give a far reaching knowledge into the work in the field of shading surface division, we broke down a generous number of papers distributed in diaries and meeting procedures. we won't confine ourselves just to the specialized appraisal of the researched calculations, however we will likewise attempt to give a plentiful exchange where the thoughts that rose in the field of colour– surface reconciliation over the past are methodicallly sorted and we will inspect the commonsense setting of the explored techniques at whatever point such discourse is conceivable. Additionally, we will put a vital accentuation on the quantitative assessment of the best in class usage in the field of colour– surface examination. In such manner, we will introduce the numerical outcomes accomplished by the investigated cutting edge strategies and we will show the conditions and the sort of information utilized as a part of the assessment procedure.

1.3 Application:

Precise division of 2-D, 3-D, and 4-D medicinal pictures to disengage anatomical objects of enthusiasm for investigation is fundamental in any PC supported determination system or other restorative imaging applications. Different parts of division highlights and calculations have been broadly investigated for a long time in a large group of productions. Be that as it may, the problem remains testing, with no broad and exceptional arrangement, because of a vast and continually developing number of various objects of intrigue, extensive varieties of their properties in pictures, diverse restorative imaging modalities, and related changes of flag homogeneity, inconstancy, and clamor for each protest. Picture division is a standout amongst the most intriguing and testing issues in PC vision for the most part and medicinal imaging applications particularly. Division parcels a picture region or volume into non overlapping, associated districts, being homogeneous as for some flag attributes [1].

Restorative picture division is of significant significance in giving noninvasive data about human body structures that encourages radiologists to envision and concentrate the life systems of the structures [3], reenact organic procedures [4], limit pathologies [5], track the advance of illnesses [6, 7], and assess the requirement for radiotherapy or medical procedures [8, 9]. Hence, division is a fundamental piece of any PC supported finding (CAD) framework, and usefulness of the framework depends intensely on division precision. Be that as it may, precise division of therapeutic pictures addresses with numerous difficulties.

As a matter of first importance, numerous anatomical structures are inhomogeneous as for spatial dreariness of individual pixel/voxel powers or their assembled co-events. Two ordinary illustrations (lung tissues on a CT picture and kidney on a MRI) are appeared in Fig. 1.1: both the lungs and kidneys are hard to isolate on account of comparable lung vessels and chest tissues visual appearances and additionally covering kidney and foundation appearances, separately. impediments or flag deviations and clamor caused by various imaging modalities and picture catching procedures. A few cases of prostate and corpus callosum MRI and advanced photographs of normal articles are given in Fig. 1.1. 3-D and 4-D (spatio-worldly) pictures exhibit additionally challenges, for example, e.g., bury and intrasubject fluctuation of shapes and surfaces of a protest of-enthusiasm for pictures gathered over some undefined time

frame for a similar subject or a gathering of various subjects. Subsequently, a specific division strategy may function admirably for one, however not for another subject, or just on specific pictures of one subject. Figure 1.2 represents the shape fluctuation over a 3-D cardiovascular MRI informational index for a solitary subject.

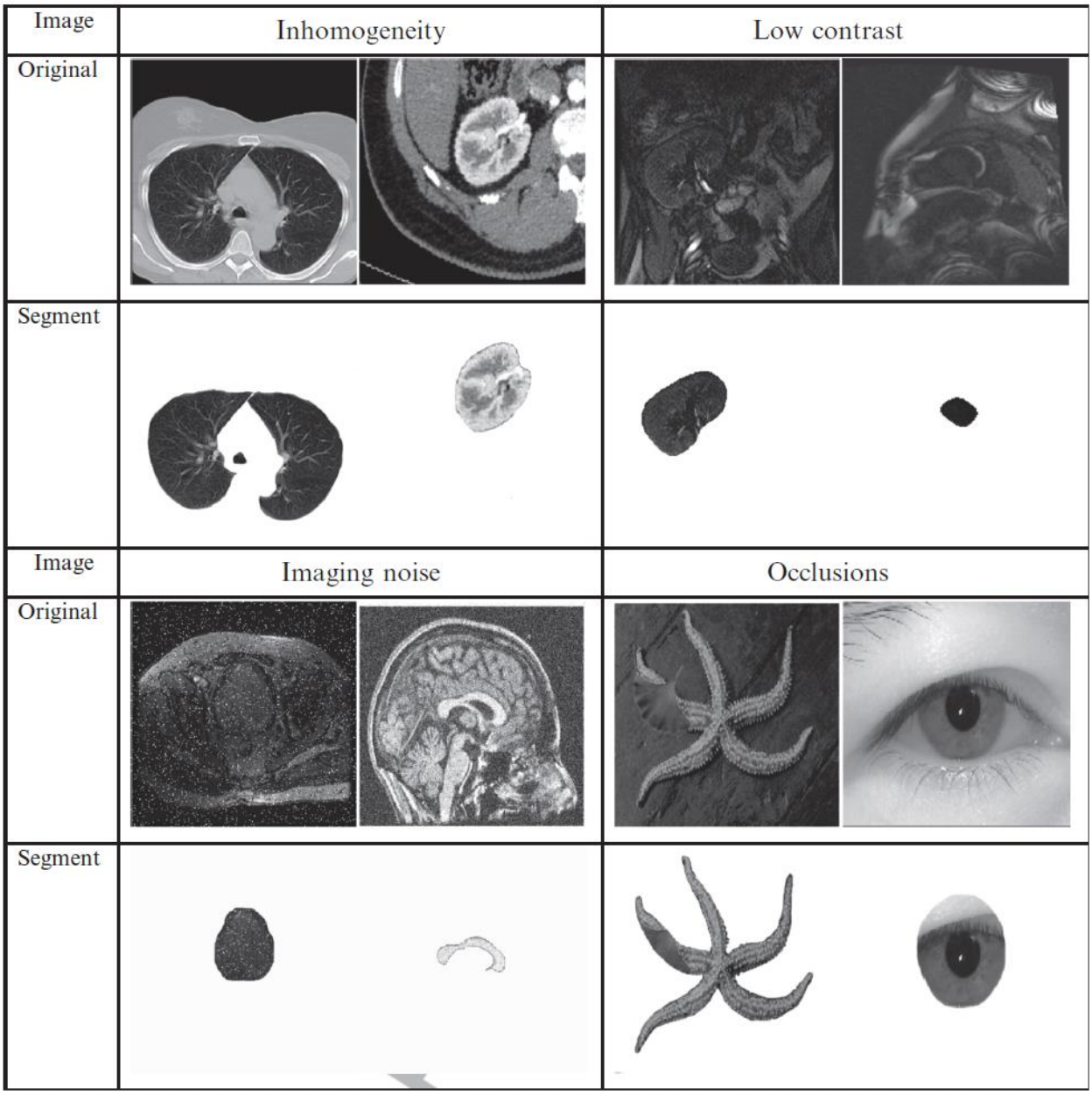

Fig. 1.2: Segmentation challenges: picture inhomogeneity, low complexity, commotion, and impediments

Their arrangement depends on objectives and particular parts of information preparing included. Specifically, shape , locale , and pixel/voxel-based strategies go for getting limits of objective articles, framing associated districts involved by these items, or performing just pixel-/voxel-wise order, individually. The greater part of the known district or pixel-based methods habitually include a couple of form based advances utilizing e.g., deformable models (limits), i.e., shut 2-D bends or 3-D surfaces developing to the objective question shape or surface under inward powers mirroring the present model shape or potentially outer powers relying upon the flag homogeneity inside and outside the model. As for the client's mediation, the division can be client intuitive, client instated, or completely robotized. Numerous division issues are expressed as far as particular cost or vitality capacities relying upon the homogeneity of objective districts, and their answers are found by limiting the cost or vitality over the entire arrangement of all the conceivable area maps or its possible subset. Commonly, these capacities are multimodal in the hunt space, and correct or estimated worldwide improvement strategies, for example, iterative diagram cut, loopy conviction engendering, dynamic programming, or hereditary calculations are utilized to play out the best division. Rather than unsupervised division, the managed methods summon extra preparing information (pictures with physically got locale maps) for adjusting to specific kinds of items and pictures. Chart book based division improves the adjustment because of the utilization of at least one accessible standard medicinal anatomical maps, or map books of segments over the human body, where each guide point is named with the relating object class. The least complex chart book based method adjusts a picture to an applicable anatomical guide to relate the protest names with the picture.

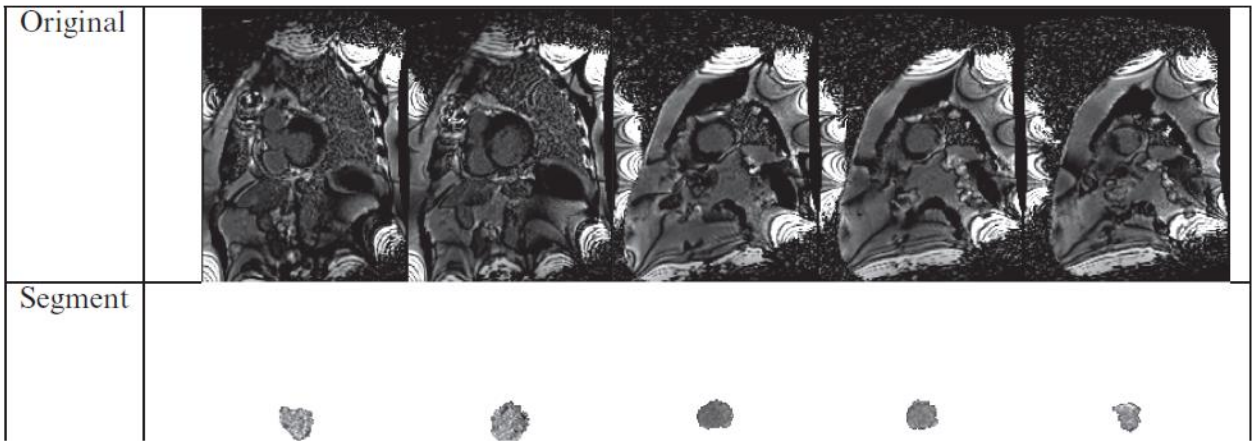

Fig. 1.3 Large intrasubject shape changes: Inner depressions in a 3-D heart MRI of a similar subject.

1.4 Problem Statement:

In the course of recent decades, the field of picture division in light of the reconciliation of shading and surface descriptors has grown widely, topping with a plenitude of calculations distributed between the years 2007 and 2009. It is helpful to take note of that in the period secured in the vicinity of 1984 and 2009 in excess of 1000 papers have been distributed in the writing and this figure recognizes the way that colour– surface investigation has situated itself as a standout amongst the most looked into territories in the field of picture handling and PC vision. The insights that assess the quantity of calculations distributed on the point of colour–surface investigation over the most recent three years (2007– 2009) unmistakably show that this field of research has achieved development and, thus, particular examples or classes of methodologies that example either the idea of the component extraction process or the approaches utilized for include combination can be recognized. The point is to dissect from a hypothetical viewpoint the fundamental headings of research in the field of colour– surface examination and to survey the ideas and procedures that have been explored during the time spent colour– surface joining with a perspective of achieving strong picture division. we don't know about any work in the writing that was worried about the efficient investigation of the ideas and systems that were utilized in the improvement of colour– surface picture division calculations. we are especially worried about the investigation and categorisation of the

distributed works as for the joining of shading and surface data in the division procedure, which, as we would like to think, is the main sensible approach that can prompt a significant understanding into this vital field of research. There are for the most part two reasons that legitimize the received approach. Right off the bat, such examination encourages an exact categorization of the distributed calculation in light of the standards behind information combination (highlight joining) process, which is the focal issue.

1.5 Theory About Brain Disease:

Doctors may use brain scans to identify strokes, tumors, or other problems that can cause dementia. Also, cortical atrophy—degeneration of the brain's cortex (outer layer)—is common in many forms of dementia and may be visible on a brain scan. The brain's cortex normally appears very wrinkled, with ridges of tissue (called gyri) separated by "valleys" called sulci. In individuals with cortical atrophy, the progressive loss of neurons causes the ridges to become thinner and the sulci to grow wider. As brain cells die, the ventricles (or fluid-filled cavities in the middle of the brain) expand to fill the available space, becoming much larger than normal. Brain scans also can identify changes in the brain's structure and function that suggest Alzheimer's disease.

The most common types of brain scans are computed tomographic (CT) scans and magnetic resonance imaging (MRI). Doctors frequently request a CT or MRI scan of the brain when they are examining a patient with suspected dementia. CT scans, which use X-rays to detect brain structures, can show evidence of brain atrophy, strokes and ischemia, changes to the blood vessels, and other problems such as hydrocephalus and subdural hematomas. MRI scans use magnetic fields and focused radio waves to detect hydrogen atoms in tissues within the body. They can detect the same problems as CT scans but they are better for identifying certain conditions, such as brain atrophy and damage from small strokes or subtle ischemia.

Doctors also may use electroencephalograms (EEGs) in people with suspected seizures, which may occur in some forms of dementia. In an EEG, electrodes are placed on the scalp over several parts of the brain in order to detect and record patterns of electrical activity and check

for abnormalities. This electrical activity can indicate cognitive dysfunction in part or all of the brain. Many patients with moderately severe to severe dementia of any sort have abnormal EEGs. An EEG may also be used to detect seizures, which occur in about 10 percent of Alzheimer's disease patients as well as in many other disorders. EEGs also can help diagnose CJD.

Several other types of brain scans allow researchers to watch the brain as it functions. These scans, called functional brain imaging, are not often used as diagnostic tools, but they are important in research and they may ultimately help identify people with dementia earlier than is currently possible. Functional brain scans include functional MRI (fMRI), single photon-emission computed tomography (SPECT), positron emission tomography (PET), and magnetoencephalography (MEG). fMRI uses radio waves and a strong magnetic field to measure the metabolic changes that take place in active parts of the brain. SPECT shows the distribution of blood in the brain, which generally increases with brain activity.

PET scans can detect changes in glucose metabolism, presence of amyloid proteins, oxygen metabolism, and blood flow, all of which can reveal abnormalities of brain function. MEG shows the electromagnetic fields produced by the brain's neuronal activity. Currently, the use of PET to detect the tau protein is only available through research.

Brain issue fluctuate extraordinarily in side effects and seriousness. They can be brief or permanent, and might be easy or difficult. Some have situational causes, while others might be hereditary. Some Brain conditions are minor, and others can be perilous.

While most Brain issue are minor, others can demonstrate a more difficult issue. Contact to the specialist helps to figure outone of these basic Brain issues.

Not all Brain issue react to treatment. A few conditions leave without treatment. Individuals with lasting Brain conditions regularly experience times of extreme indications. Now and again, individuals can drive serious conditions into reduction. Be that as it may, most Brain conditions return because of specific triggers, for example, stress or ailment.

You can frequently treat Brain issue that are transitory and restorative with:

- medicated advice
- consumption of healthy items
- good cleanliness
- small way of life alterations, for example, rolling out certain dietary improvements

Counteracting Brain issue

Certain Brain issue are not preventable, including hereditary conditions and some Brain issues because of different ailments. Be that as it may, it's conceivable to keep some Brain issue.

Take after these tips to avoid irresistible Brain issue:

- Sleep for no less than seven hours every night.
- Drink a lot of water.
- Avoid over the top physical or enthusiastic pressure.
- Eat a nutritious eating routine.
- Get inoculated for irresistible Brain conditions,

Finding out about appropriate healthy Brain and treatment for Brain issue can be vital for Brain wellbeing. A few conditions require the consideration of a specialist, while you can address others securely at home. You ought to find out about your side effects or condition and chat with your specialist to decide the best treatment strategies.

Brain MRI:

MRI provides better resolution of neural structures than CT. This difference is most significant clinically for visualizing the following:

- Cranial nerves
- Brain stem lesions
- Abnormalities of the posterior fossa
- Spinal cord

CT images of these regions are often marred by bony streak artifacts. MRI is especially valuable for identifying spinal abnormalities (eg, tumor, abscess) compressing the spinal cord and requiring emergency intervention. Also, MRI is better for detecting demyelinating

plaques, early infarction, subclinical brain edema, cerebral contusions, incipient trans tentorial herniation, abnormalities of the cranio-cervical junction, and syringomyelia. MRI is **contraindicated** if patients

- Have had a pacemaker or cardiac or carotid stents for < 6 wk
- Have ferromagnetic aneurysm clips or other metallic objects that may overheat or be displaced within the body by the intense magnetic field

Visualization of inflammatory, demyelinated, and neoplastic lesions may require enhancement with IV paramagnetic contrast agents (eg, gadolinium). Although gadolinium is thought to be much safer than contrast agents used with CT, nephrogenic systemic fibrosis (nephrogenic fibrosing dermopathy) has been reported in patients with impaired renal function and acidosis. Before using gadolinium in patients with renal disease, clinicians should consult with a radiologist and a nephrologist.

There are several MRI techniques; choice of technique depends on the specific tissue, location, and suspected disorder:

- Diffusion-weighted imaging (DWI) allows rapid, early detection of ischemic stroke and helps distinguish cerebral abscess from tumor. It can also help diagnose Creutzfeld-Jacob disease.
- Perfusion-weighted imaging (PWI) can detect areas of hypoperfusion in early ischemic stroke but cannot yet reliably distinguish areas with benign oligemia from those with injurious hypoperfusion due to infarction.
- Diffusion tensor imaging (DTI) is an extension of DWI that can show white matter tracts in 3 dimensions (tractography) and can be used to monitor the integrity of CNS tracts affected by aging and disease.

- Double inversion recovery (DIR), used in research centers, can detect demyelination of gray matter better than other MRI techniques; gray matter demyelination is now considered common in multiple sclerosis.
- Functional MRI (fMRI) shows which brain regions are activated (shown by increased flow of oxygenated blood) by a specific cognitive or motor task, but its clinical use is still being defined.

CHAPTER 2

LITERATURE REVIEW

In 2000 Laurence Germond et. al., worked on automatic segmentation of MRI brain scans was a complex task for two main reasons: First, because of the large difference in the brain structure, which allows limited use of general knowledge and, essentially to obtaining MRI, the details present in images that are difficult to process. To overcome such challenges, the authors have proposed in [1], co-operative framework which uses knowledge and information in individual systems, at the present time with multi-agent system, deformable model and an edge detector. The authors in [1] have used co-operative framework which is an adaptation of segmentation process of MRI brain scans. Realistic brain phantoms is reported for its evaluation. The result is that the constrained automatic and dynamic set of regions and edge agents perform co-operative segmentation including the specific gray levels in the image under consideration, brain structure's statistical model and general knowledge about MRI brain scans. Basically, there are three stages of segmentation process. First is seeded region's specialization. Second is heterogeneous information fusion and third is action-reaction over slices. The individual systems interact having three modes of cooperation, namely, integrative, augmentative and confrontational which are used during three stages of segmentation process as discussed earlier. In front of the complexity of MRI brain scans segmentation, several approaches have been proposed [2,3,4] to combine several autonomous modules, each responsible for a part of the task.

In 2004 PJ Drew et. al published an article on artificial intelligence which is a branch of computer science and is capable of analyzing complex medical data. For predicting, treatment and diagnosis, outcome in many clinical scenarios is as a result of use of relationship in datasets. Using terms like 'artificial intelligence' and neural networks, many internet and Medline searches were done. By cross referencing articles, references were procured. Apart from clinical applications, an overview of many artificial intelligence techniques have been discussed by author in [5]. The use of many artificial techniques have been applied in almost every medical domain. The analytical tool most commonly used is ANN while other

techniques included fuzzy expert systems, evolutionary computation and hybrid intelligent systems. Artificial intelligence techniques have the ability to be used in every domain of medicine. Clinical trials are needed before these techniques are used in clinical settings. To solve clinical problems many AI techniques are present. However, AI techniques have not been used proactively in medical domain. The attitude of clinicians is the main reason towards use of AI techniques in decision making process. In a way which seems difficult to understand and impossible with opposite facts, there is no reluctance in accepting the biochemical results generated from an image produced by MRI. However, it is the duty of the researchers working in this field to produce proof that these techniques work on practicality. It is necessary, for confirmation of effectiveness of AI systems in medicine, and there is a necessity to undertake arbitrary controlled studies. Thus, this explains the importance of application of AI techniques in medicine in 21st century. There is no ambiguity that these techniques will improve the medical brain power in future clinicians.

In 2006, the authors in [6] published a paper which presented a general framework that brought together new restrictions in deformable models to establish spatial relations. In [6], the authors have depicted spatial relations as fuzzy subsets of the image space and implemented in the deformable model, which is used as new external force. In [3], the authors have considered three methods that are used to deduce external force from a fuzzy set which depicts spatial relations. The proposed method in [6] are utilized for segmenting subcortical brain structures from magnetic resonance images. The main variable constants are predicted to define relations using a training step. To improve the segments of structure having little contrast and poorly-defined boundaries, the spatial relations in deformable model has been brought in.

In the paper, the authors in [6] brought together new types of limitations based on spatial relations, in deformable models. Fuzzy subsets of the 3D space describe spatial relations. Deriving from Fuzzy set, the external forces are brought in for construction. Proposal of three different methods has been done. The relations must be satisfied where the forces have the property for the deformable model where it meets. In [6], the authors have general framework

in which they have taken distance and directional relations and can hold relations which are depicted by spatial fuzzy set. The use is not limited to basic relations, but complex relationships like “between” can be used for which spatial fuzzy relationships were depicted. The framework does not depend upon options chosen relating to design of the deformable model and is available for two or three dimensions. To make the procedure sturdy, with the option of trade-off between the external force, the initiation of training step was done in order to evaluate the parameters involved in spatial relations. However, it should be kept in mind that the spatial relations are not directly extracted from training set, rather done in advance from anatomical knowledge. Thus, there is no obligation towards performing on training set and the parameters can be adjusted manually as discussed for thalamus in [6]. This framework has been used for segmenting the brain subcortical structures in MRI which includes the ventricles, the caudate nuclei and the thalami. To obtain high degree of accuracy, the quantitative validation was carried out. The paper showed that when spatial relations were used, the segmentation of brain was better with poorly-defined boundaries. The objective of the authors in [6] was to propose methodology that would demonstrate the validity and utility of spatial relations in deformable model via segmentation of brain. In a main view point, the shape constraints applied to deformable model and different objects segmentation is performed. Finally, the applied framework can be used in other areas. Potential applications include medical imaging such as application in thoracic or abdominal structures in which some principles have been applied and facial features.

The research paper published in 2007 by H. Selvaraj et. al,[7] proposes an intelligent classification technique to identify normal and abnormal slices of brain MRI data. When a large amount of MRI data has to be studied, it may lead to wrong diagnosis by radiologists and physicians when physical understanding of tumor slices has to be done. For tumor detection, and to get rid of human error, an automated intelligent classification system has been considered which takes into account the importance of classification of image slices when abnormal MRI volume has been detected. In [7], the authors have proposed a classification system based on Least Square Support Vector Machine has been presented when tried for MRI

image slices. The classifier in [7] uses linear as well as non-linear radial basis function kernels. On comparing it with other classifiers like Support Vector Machines having linear and non-linear Radial Basis Function kernels, Multi-Layer Perceptron and K-nearest neighbor classifiers, it was deduced that Least Square Support Vector Machines performed better than all the other classifiers. Accuracy, specificity and sensitivity are the parameters on which performance has been tested. The results suggested that Least-Square Vector Machine gave better performance. This technique can be used in computer-aided healthcare systems and even in different pathological conditions.

In 2010 Ahmad El Dahsan et. al presented a paper in which a hybrid technique for the classification of the magnetic resonance images (MRI) has been discussed. There are three stages in hybrid technique which includes feature extraction, dimensionality reduction and classification. Using discrete wavelet transform, features have been extracted related to first stage of MRI image. Principal Component analysis has been used to reduce features in second stage. Two classifiers have been used in classification stage. The authors in [8] have developed first classifier which is based on feed forward artificial neural network and second classifier based on k-nearest neighbour. These classifiers are used to classify image as normal image or abnormal image. A feed forward back propagation artificial neural network and K-nearest neighbour has success rate of 97% and 98% respectively. The proposed technique shows results which are effective and better than other works. The authors in [8] have developed a medical decision system that classifies image as normal image or abnormal image. The main benefit of medical decision support system is to aid the physicians in making a diagnosis without any hesitation. For k-nearest neighbour the sensitivity rate is 100% and specificity rate is 90%. Whereas for FP-ANN the sensitivity rate is 98.3% and specificity rate is 90%. The authors in [8] have discussed that SOM and SVM have produced almost similar results. Artificial neural networks have produced worst sensitivity and specificity rates. The authors in [8] have stated that their results have been compared to other results based on T2-weighted MRI database. The method discussed in [8] is applicable for all types of MRI images, whether its T1-weighted, T2 weighted or Proton Density images. The method

proposed in [8] was developed for discrete wavelet transform, principal component analysis and feed forward back propagation artificial neural network and for method was discrete wavelet transform, principal component analysis and k-nearest neighbour. Accurate and Robust classifier can be made out of the results. The classification [8] performances of this study show the advantages of this technique: it is rapid, easy to operate, non-invasive and inexpensive. The limitation [8] of this work is that it requires fresh training each time whenever there is an increase in image database. The future work involves study of pathological brain tissues including tumours and lesions.

In 2010 Yudong Zhang et. al[9] a wavelet transform method was used in extracting features of an MRI. However, translational variant property in present in discrete wavelet transform which will obtain features with two images on the same topic and with small movement. In order to solve the problem, the paper extracts feature which uses SWT instead of DWT. The wavelet coefficients obtained via SWT are far more superior as compared to DWT In addition, we applied SWT to normal and abnormal brain classification. The results demonstrate that SWT-based classifier is more accurate than that of DWT. In this paper the superiority of SWT is discussed which is used to obtain features. SWT is better when compared to discrete wavelet transform when we take into account its translational invariant property. SWT was applied to obtain normal and abnormal brain image classification. The results as obtained in [9] show that classification of brain image is efficient and accurate in normal and abnormal brain images. It is expected that SWT based features will be researched on denoising, fusion and compression.

In 2011 a paper by Yudong Zhang et. al stated that the automated and accurate classification of MR brain images work shows importance for the analysis and interpretation of the images and many methods have been proposed regarding it. In this paper, they have presented a neural network (NN) based method to classify an MR brain image as normal or abnormal. PCA or principal component analysis is used to reduce features of prior extracted features done by wavelet transform. The reduced features are then sent to a back propagation (BP)

neural network which uses scaled conjugate gradient (SCG) to find the optimal weights of the neural network. In this paper authors have applied this method on 66 images (18 normal, 48 abnormal). The calculated computation time for an image is 0.0451s and the classification accuracy achieved is 100% for both training set and test set. In [10] the authors have used a hybrid classifier which classifies both normal and abnormal images. The authors in [10] have proposed future work with underlying points as follows: First it is applied for MRI images having mechanisms such as T1 weighted, diffusion weighted and proton-density weighted. Second, the lift-up wavelet, which is an advanced wavelet transform, can be used to accelerate computation points. Third, study of multiple-class classification of Brain MRI can be done.

In 2014, the authors in [11] have shown that normal brain tissues which include White matter (WM), Gray matter (GM) and Cerebrospinal fluid (CSF) have been divided from different tumor tissues such as active cells, necrotic core and edema. Due to non-invasive imaging and soft tissue contrast of MRI, the brain tumor segmentation techniques are attracting attention. The author in [11] states that in the span of two decades, the computer aided techniques are becoming more and more upgraded for segmentation of brain tumor which come approaching the routine applications. The motive of the authors is to provide overview of brain tumor segmentation. Firstly, a crisp introduction to brain tumor segmentation using image modalities is given. The prior processing of working and SOTA (state of the art) methods of MRI based segmentation is brought in. The results of MRI based brain tumor segmentation is assessed and validated. Finally, trends are directed for brain MRI segmentation methods and future developments are made. The authors in [11], have provided a complete outline SOTA (state of the art) of MRI based brain tumor segmentation. The taking different characteristic features and taking spatial information in a local neighborhood into account, many of the brain tumor segmentation methods operate MRI images due to the non-invasive and good soft tissue contrast of MRI and employ classification and clustering methods. The purpose of the methods is to provide an exploratory judgement in advance on diagnosis, tumor monitoring and therapy for clinical research. The results are good in medical image analysis for algorithms. However, there is distance in clinical applications. In most of the cases under

research, the clinicians depend on manual segmentation of brain tumor, and there is deficit of interaction between clinicians and researchers. The availability of tools focuses on authentic research and is scarcely useful for clinicians. Therefore, using the tools in simple to use environments is unavoidable in the future. To enhance the clinical applications more quickly, some standard clinical protocols are being formulated. Computation time is also valid criterion, apart from accuracy and validity. The computation time lasts for few minutes. This computation time is hard to be accepted in clinical routines, over few minutes and real time segmentation is toilsome. Another important aspect for brain tumor segmentation methods is robustness. If in any case the automatic brain image segmentation fails, then clinicians will lose trust and will not use this method. As a result, robustness emerges as an important criterion for new results obtained. The main focus of researchers is brain tumor segmentation and not feature obtainability. However, the latter seems to be important when considering variation or difference in viewing the different brain tumor grades and its types in actual applications. It would be interesting to explore how new features are used to obtain enhanced results. This can improve the accuracy, validity, and robustness of MRI-based brain tumor segmentation. The brain image segmentation will undoubtedly improve in near future and will continue to enhance itself. MRI techniques like Magnetic Resonance Spectroscopy known as MRS and other techniques like Perfusion Imaging (PI) and Diffusion Tensor Imaging are used. For example, a group called Section of Biomedical Image Analysis (SBIA) has worked on these modalities for over 15 years. For localization of areas brain tumor, these modalities can be used. To segment brain tumor from normal tissues, PI data, MRS data and DTI data can be used. Brain tumor segmentation provides better anticipated data and helps making full use of treatment options.

In the same year, the authors in [12] have proposed in an article that computer-aided detection/diagnosis (CAD) systems can enhance the diagnostic capabilities of physicians and reduce the time required for accurate diagnosis. The main purpose of the paper is to review segmentation and classification techniques and SOTA for the brain MRI. The authors in [12] have stated why CAD systems of human brain can still pose a problem. The paper proposes a

hybrid intelligent machine learning technique using CAD through which segmentation of brain tumor can be done using MRI. The authors in [12] have used feedback-pulse coupled neural-network for segmentation, DWT is used for feature extraction, PCA for dimensionality reduction of wavelet coefficients feed forward back propagation neural network for classifying normal image and abnormal image. The proposed method in [12] uses 14 normal and 87 abnormal brain MRI dataset. The classification accuracy achieved is 99%. When compared to other techniques, it is much more effective. The results show that it is more robust, accurate and fast. As computational intelligence and machine learning techniques have progressed, CAD is a better technique used. It has become one major technique used in radiology and research. In [12], the papers used in this study ranges in between 2006 to 2012.For detecting the region of interest and image segmentation, the proposed network uses feedback pulse coupled network, and then applies DWT for extraction of features. Third, PCA is applied to reduce dimensionality and find out more accurate classifier. Lastly, the reduced features are then sent to back propagation feed forward network to classify image as normal or abnormal. Robustness of the technique used is primary parameter for assessment. The authors in [12] have realized a large number of algorithms and compared it with the proposed method. According to the results, this methodology is more efficient. The authors in [12] have taken out accuracy of 99%, specificity as 92% and sensitivity as 100%. The proposed method in [12] shows that the methodology used improves the diagnosis and differentiates between normal and abnormal images using a classifier. On comparing with other methods, the used method in [12] is efficient and robust. The motive is to obtain generalized CAD systems, without taking into account database size and quality. Therefore, CAD system poses a problem. There are several directions which will enhance CAD systems:1) Getting images from different institutions 2) Enhancing classification accuracy, and extracting features 3) There is scope for other researchers to utilize machine learning and use it in hybrid structure 4) Further studies are required to prove that it can be used for non-specific applications.

In 2015 year, a publication by Andrez Larozza et. al [13] shows that to develop a classification model using texture features and SVM (support vector machine) in contrast-enhanced T1-

weighted images to differentiate between brain metastasis and radiation necrosis. 115 lesions were used to obtain texture features. 32 radiation necrosis were diagnosed. A total of 179 features were extracted six texture analysis method, 60 untreated metastases, and 23 as radiation treated metastasis. To obtain a subset of features that provided optimum performance which was a feature selection technique based on SVM (support vector machine). With a subset of seven features, when the classifier was trained with untreated metastasis and tested on treated ones, the highest classification accuracy which was evaluated over test sets was achieved with a subset of ten features when the untreated metastasis was considered. Receiver operating characteristics was obtained by considering area under the curve having mean of 0.94 and S.D of 0.07 and 0.93 mean and S.D of 0.02. It was concluded that to differentiate between radiation necrosis and brain metastasis, a high classification accuracy (AUC > 0.9) was achieved using texture features and SVM classifier in a method based on conventional MRI.

In 2015, the authors in [14] have stated in an article that there are many approaches for accurate and automatic classification of brain MRI. In [14], a proposed method for detection and classification is done. Malignant and benign brain MRI classification has been used by ANN (artificial neural network). The three stages in brain segmentation are 1) Pre-processing 2) Feature Extraction 3) Classification. In removing noise, filters are used in pre-processing stage. When dealing with feature extraction, colour moments are extracted from MRI and colour moments obtained and given to feed forward ANN in order to classify the image. The method applied in [14] utilized 70 images in totality. Out of which 25 were normal images and 45 abnormal images. In [14] the authors have achieved accuracy of 88.9% for training data with overall accuracy of 91.8% was achieved. The accuracy achieved for validation data was 94.9% and 94.2 % for testing data. Digital Image Processing is used for classification of image into normal and abnormal. Considering the literature, it was inferred that different authors have used different techniques in different problems. To remove the noise in MRI, median filter has been used. For considering main features for classification colour moments are

considered for feature extraction. ANN has been used for classifying image into normal or abnormal image. To classify the image into normal and abnormal image a binary classifier has been used. For future scope, multi-class classification is required to identify different diseases present in human brain.

In the year 2017, the authors in [15] have stated that the automatic segmentation [15] of brain tumor is the process of separating abnormal tissues from normal tissues, such as white matter (WM), gray matter (GM), and cerebrospinal fluid (CSF). Due to the variability in shape, size and location, the process of segmentation needs a lot of effort. Magnetic Resonance Images, Positron Emission Tomography and Computer Tomography images are used to get elaborated information, psychological process and metabolic process information. For accurate brain tumor segmentation, the required information is combined using multimodal imaging techniques. Using imaging techniques like Positron Emission Technique, Magnetic Resonance Imaging, multimodal imaging and Computer Tomography, an overview of brain tumor segmentation techniques is given in [15]. The authors in [15] have discussed methods, techniques, working principle, advantages, limitations and future challenges. The methods, advantages, their limitations, and future challenges are discussed to provide insight into various techniques. Due to the good soft tissue contrast and non-invasiveness of MRI, MRI based tumor segmentation methods have been applied more to segment brain tumor image. However, due to lack of communication and co-ordination between developers and physicians, the application of brain tumor image segmentation techniques is very low. In real time applications, technically sound algorithms are difficult to be used. Although there are many techniques for brain tumor image segmentation, manual segmentation is used for routine life. The authors in [15] have stated that due to lack of definability and easiness of tool handling, clinicians do not prefer automatic brain segmentation techniques. Therefore, easier to use tools should be referred by clinicians. The authors in [15] have stated that clinical applicability is affected due to failing systems even for lesser number of times. As, a result robustness and accuracy should be considered while using automated system. In tumor

assessment, tumor volume estimation, tumor progression estimation and classification will help in achieving the goal. The brain tumor segmentation have a wider scope of research.

In 2018, in an article published by Yanqing Zhang and Jyoti Islam, it was stated that Alzheimer's disease is a non-curable, progressive neurological brain disorder. Earliest detection of Alzheimer's disease, can be used to properly treat and prevent brain tissue damage. For the diagnosis of AD(Alzheimer's disease),many statistical and machine learning models have been used by researchers. For detection of AD, analysis of brain MRIs have been done in clinical study. Due to the alikeness in the AD MRI data and aged people's standard MRI, Alzheimer's disease detection is difficult. In recent times, advanced deep learning techniques have been used successfully to show human-level performance in varied fields which includes medical image analysis. The authors have proposed in [16], a deep convolutional neural network (CNN) for Alzheimer's disease diagnosis using analysis of MRI data. However, most of the existing methods are using binary-classification, the model discussed in [16] is used to recognize AD at different levels and has better performance for detecting AD at early stages. The authors conducted experiments which showed better results on comparison to other methods. The authors in [16] have demonstrated a competent approach for AD diagnosis using brain MRI dataset obtained from OASIS. While, most of the work focuses on binary classification, authors in [16] have shown considerable improvement in multi-class classification. The proposed method in [16] can be very useful for diagnosis of AD at early stage. The method proposed in [16] has been focused on AD, and can be used in other domains and the proposed approach can be used in applying CNN into other areas with a limited dataset. The authors plan to use the proposed model for different AD datasets and other diagnosis of diseases.

Muhammad Febrian Rachmadi et. Al., (2018) [17], proposed an version of a convolutional neural community (CNN) scheme proposed for segmenting brain lesions with significant mass-effect, to section white count number hyperintensities (WMH) characteristic of brains without any or moderate vascular pathology in recurring medical mind magnetic resonance

photos (MRI). This is a as an alternative difficult segmentation trouble due to the small area (i.e, volume) of the WMH and their similarity to non-pathological mind tissue. The authors in [17] check out the effectiveness of the 2D CNN scheme by way of evaluating its performance in opposition to the ones received from some other deep studying technique: Deep Boltzmann Machine (DBM), two conventional devices getting to know strategies: Support Vector Machine (SVM) and Random Forest (RF), and a public toolbox: Lesion Segmentation Tool (LST), all said to be beneficial for segmenting WMH in MRI. The authors in [17] additionally introduce a manner to include spatial statistics in convolution degree of CNN for WMH segmentation named worldwide spatial statistics (GSI). Analysis of covariance corroborated recognized associations between WMH progression, as assessed by using all methods evaluated, and demographic and medical facts. Deep gaining knowledge of algorithms outperform conventional gadget mastering algorithms by means of apart from MRI artefacts and pathologies that seem much like WMH. The proposed approach of incorporating GSI additionally correctly helped CNN to gain higher computerized WMH segmentation no matter community's settings examined. This imply Dice Similarity Coefficient (DSC) values for LST-LGA, SVM, RF, DBM, CNN and CNN-GSI were 0.2963, 0.1194, 0.1633, 0.3264, 0.5359 and 5389 respectively.

The published paper [18] by author Joe Bernal et. al, mentions that the best performance in a myriad of computer vision problems such as visual object recognition, detection and segmentation is done by deep convolution neural networks or CNNs. The authors in [18] have stated that deep convolutional neural networks are also used for analyzing medical image which includes lesion segmentation, anatomical segmentation and classification. The paper mentioned in [18] focuses on architectures, preprocessing, data-preparation and post-processing strategies. There are three facets of the study. First facet is that how architecture has been developed or evolved itself considering State Of Art(SOTA), examining the advantages and disadvantages and convert the results into datasets. Secondly, this paper gives research carried out in deep convolutional neural networks. Finally, it gives future scope of deep convolutional neural network. The proposed method was applied to MS lesion

segmentation, brain tumor segmentation and structural segmentation. Although,[18] there are public datasets available for these applications, researchers still prefer to work on their databases. The limitation of public dataset is the number of training samples. Small dataset will affect the performance of deep convolutional neural networks and will restrict the capacity of algorithms. The measurements on which evaluation is done is by pixel-wise or volume-wise basis. For a better evaluation, more than one observer may be involved. In the literature reviewed, there are many parameters on which evaluation is done. Concerning the brain tumor segmentation and MS lesion, different parameters are there on which evaluation is made, such as DSC, precision, recall, true positive rate (TPR) and positive predictive value (PPV), absolute volume difference, lesion-wise true positive rate (LTPR) and the lesion-wise false positive rate (LFPR) are also used. Similarly, for brain tumor [18] and structure segmentation applications, the DSC score, precision, and recall are among the widely used measurements. The reason behind these parameters is the challenge it poses to organizers.
Convolutional neural networks (CNNs), an outstanding branch of deep learning applications to visual purposes, have earned major attention in the last years due to its breakthrough performances in varied computer vision applications, such as in object recognition, detection and segmentation challenges [19,20,21], in which they have achieved astonishing performances [22,23,24,25,26].

In the year 2019, Anjali Wadhwa et. al, stated in the paper that the process [27] of segmenting tumor from MRI image of a brain is one of the highly focused areas in the community of medical science as MRI is noninvasive imaging. The paper highlights the literature review which discusses the methods involved in brain tumor segmentation and brain imaging. The paper discusses the state-of-Art methods and quantitative end performance of state-of art methods. Contribution of various authors and different methods of image segmentation has been discussed. In the paper, it is stated that an effort has been made for researchers to explore new areas of research and it has been observed that there are other effective methods to segment brain tumor, which includes conditional random fields (CRF) with convolutional neural network (CNN) or CRF with Deep Medic ensemble. The paper discusses exhaustive

methods for image segmentation. For accurate diagnosis of tumor, the clinicians not only set new directions of research but also quantitative analysis having different parameters help readers among different state of art methods. It has widespread applications in medical science, for example, tissue classification, localization of tumors, tumor volume estimation, delineation of blood cells, surgical planning, atlas matching, and image registration [28]. Mathematical algorithms of feature extraction, modeling and measurement can be exploited in the images to detect pathology, an evolution of the disease, or to compare a normal subject to an abnormal one [29]. The accurate and reproducible quantification and morphology of tumors are of crucial importance for diagnosis, treatment planning as well as monitoring of response to oncologic therapy for brain tumors [30]. . Brain tumor segmentation consists of separating the different tumor tissues (active tumor, edema and necrosis) from normal brain tissues: GM, WM, and CSF [31].

The authors in [32] have stated that artificial intelligence and machine learning has become an actuality in medical practice. In the last century many artificial intelligence techniques have been used which includes algorithms used for diagnosis and mage processing and image postprocessing. The authors in [32] have stated that artificial intelligence has taken place of radiologists and have created imaging workflows. The artificial intelligence techniques has its own pros and cons which creates an obstacle in clinical domain. The paper discussed in [32] has reviewed artificial intelligence methods and a SWOT analysis (Strength Weakness Opportunities Threats) has been done in the paper.

Siyuan Lu et. al. (2019) [33] studied to automatically detect pathological brain in magnetic resonance images (MRI) based on deep learning structure and transfer learning. Deep learning is now the trending topic in both, academics and industry. To train the entire deep learning structure, usually, the volume of Brain MRI datasets are small. Overfitting, is a problem which is faced in training. Therefore, transfer learning was introduced to train the deep neural network. First, AlexNet structure was obtained. Then, the last three-layer parameters were replaced with weights and rest of the parameters were treated as initial values. Finally, MRI

dataset was used to train the model.100% accuracy was achieved. The authors have proposed a method for pathological brain detection using AlexNet and transfer learning. Out-performing five SOTA(state of the art) , 100% accuracy was achieved. AlexNet was retrained by transfer learning which reduced time to retrain it. The proposed method in [33] was used by doctors in clinical diagnosis. The authors in [33], have proposed a novel method which classifies a sample as normal or pathological, moreover, multi-class classification is to be developed to detect some specific-brain diseases. The use of pathological brains plays an important role for medical treatment, which remains unknown with the author's method. The future scope discussed in this paper is that the authors intend to use more MRI dataset for their proposed method and use other advanced deep learning structures for pathological brain detection.

Muhammad Owais et. al, (2019) [34], Medical-picture-primarily based prognosis is a tedious task, and small lesions in numerous medical snap shots may be disregarded with the aid of medical examiners due to the restricted attention span of the human visible device, which could adversely affect clinical treatment. However, this problem can be resolved by using exploring comparable cases inside the preceding medical database via an efficient content-based clinical photo retrieval (CBMIR) gadget. The authors in [34] have stated that in the past few years, heterogeneous scientific imaging databases have been developing hastily with the advent of various forms of medical imaging modalities. Recently, a scientific medical doctor normally refers to diverse styles of imaging modalities all collectively along with computed tomography (CT), magnetic resonance imaging (MRI), X-ray, and ultrasound, and so on of diverse organs so as for the diagnosis and treatment of precise sickness. Accurate category and retrieval of multimodal medical imaging facts is the important thing assignment for the CBMIR machine. Most preceding attempts use handmade features for scientific photo class and retrieval, which show low overall performance for a huge collection of multimodal databases. Although there are a few previous studies on the usage of deep features for classification, the wide variety of training is very small. To clear up this hassle, we advocate the classification-primarily based retrieval device of the multimodal clinical images from numerous styles of imaging modalities by the use of the method of synthetic intelligence,

named as a more suitable residual network (ResNet). Experimental results with 12 databases such as 50 lessons display that the accuracy and F1. Rating by our method is respectively 81.51 % and 82.52% which are higher than the ones by the previous method of CBMIR (the accuracy of 69.71% and F1. Rating of 69.63%).

Shigao Huang et. al, (2019) [35], This research work is done to pick out the highest quality diagnosis index for brain metastases by using system getting to know 700 cancer patients with brain metastases have been enrolled and divided into 446 schooling and 254 checking out cohorts. Seven functions and seven prediction techniques had been decided on to evaluate the performance of most cancers' diagnosis for every patient. The authors in [35] have used mutual information and tough set with particle swarm optimization (MIRSPSO) techniques to are expecting affected person's analysis with the best accuracy at vicinity under the curve (AUC) = 0.978 with deviation of 0.06. The development by means of MIRSPSO in terms of AUC became at 1.72%, 1.29%, and 1.83% higher than that of the conventional statistical technique, sequential function choice (SFS), mutual statistics with particle swarm optimization (MIPSO), and mutual facts with sequential feature choice (MISFS), respectively. Furthermore, the medical performance of the great diagnosis became superior to standard statistic method in accuracy, sensitivity, and specificity. In end, identifying gold standard machine-learning techniques for the prediction of normal survival in brain metastases is critical for scientific programs. The accuracy rate by gadget-getting to know is some distance higher than that of conventional statistic methods. . The prognosis for patients with brain metastases (BM) is known to be poor, as BM is one of the deadliest among various types of cancers [36,37,38,39].

Jens Kleesiek et. al, (2019) [40], Gadolinium-primarily based contrast retailers (GBCAs) have turn out to be an essential component in each day clinical choice making in the final 3 many years. However, there is a extensive consensus that GBCAs need to be exclusively used if no assessment-unfastened magnetic resonance imaging (MRI) technique is available to lessen the amount of implemented GBCAs in sufferers. In the current take a look at, we inspect the

opportunity of predicting evaluation enhancement from non-contrast multiparametric mind MRI scans the use of a deep-mastering (DL) structure.

Mahmoud Mostapha et. al, (2019) [41], Deep gaining knowledge of algorithms and in particular convolutional networks have shown first-rate fulfilment in medical picture evaluation packages, although highly few techniques have been implemented to toddler MRI statistics due several inherent demanding situations such as in-homogenous tissue appearance throughout the photograph, big photo intensity variability throughout the first year of existence, and a low signal to noise placing. The paper gives strategies addressing those demanding situations in two selected applications, mainly little one brain tissue segmentation at the isointense degree and pre-symptomatic disorder prediction in neurodevelopmental disorders. Corresponding techniques are reviewed and as compared, and open troubles are recognized, particularly low information length restrictions, elegance imbalance issues, and shortage of interpretation of the resulting deep mastering answers. The authors in [41] talk how present solutions can be adapted to approach those issues in addition to how generative models appear to be a in particular robust contender to address them.

Andreas M. Rauschecker et. al, (2020) [42] worked on artificial intelligence (AI) shows promise across many aspects of radiology, the use of AI to create differential diagnoses for rare and common diseases at brain MRI has not been demonstrated. To evaluate an AI system for generation of differential diagnoses at brain MRI compared with radiologists as stated in [42]. As published in this paper, between January 2008 and January 2018, for probabilistic diagnosis, this study tested performance of 19 common and rare diagnosis. The AI system uses methodologies, which includes deep learning and Bayesian networks. Deep learning was detected in first lesion. Atlas based co-registration and segmentation was used to extract 18 quantitative imaging features. Using Bayesian inference which is used to develop differential diagnosis, the image features were combined with five clinical features. Tuning on a training set of 86 patients whose mean age 49 with 16 S.D and 53 women were done by quantitative feature extraction algorithms and conditional probabilities. Accuracy was compared with

radiology residents, general radiologists, neuroradiology fellows, and academic neuroradiologists by using accuracy of top one, top two, and top three differential diagnoses in 92 independent test set patients as demonstrated in [42]. It was concluded that the AI system in [42] approached overall top one, top two, top three differential diagnosis accuracy of neuroradiologists and exceeded that of less-specialized radiologists. Artificial intelligence (AI) shows great potential for transforming health care and medical imaging, with deep learning being the AI tool with the most impact [43,44]

Muhammad Waqas Nadeem et. al, (2020), [45], worked on Deep Learning (DL) algorithms enabled computational models encompass a couple of processing layers that constitute information with more than one tiers of abstraction. In latest years, utilization of deep learning is unexpectedly proliferating in nearly every area, especially in medical photograph processing, medical photograph evaluation, and bioinformatics. Consequently, deep getting to know has dramatically changed and stepped forward the way of reputation, prediction, and diagnosis selectively in several areas of healthcare consisting of pathology, brain tumour, lung most cancers, stomach, cardiac, and retina. Considering the extensive range of programs of deep studying, the goal of this newsletter is to check primary deep studying standards pertaining to mind tumour evaluation (e.g., segmentation, type, prediction, assessment.). An assessment carried out by means of summarizing a massive range of medical contributions to the sphere (i.e., deep getting to know in brain tumour evaluation) is offered in this examine. In [45], a coherent taxonomy of research panorama from the literature has also been mapped, and the essential components of this rising field had been discussed and analysed. A crucial dialogue phase to reveal the constraints of deep mastering techniques has been covered on the quit to elaborate open studies demanding situations and guidelines for destiny paintings in this emergent place. There is a number of medical domains where e-health care systems are beneficial [46]. Different medical imaging techniques and methods that include X-ray, Magnetic Resonance Imaging (MRIs), Ultrasound, and Computed Tomography (CT), have a great influence on the diagnosis and treatment process of patients [47,48]

Lilia Lazli et. al. (2020) [49], Computer-aided diagnostic (CAD) structures use gadget learning strategies that offer a synergistic impact among the neuroradiologist and the computer, permitting an efficient and rapid analysis of the patient's situation. As a part of the early analysis of Alzheimer's ailment (AD), that is a prime public fitness hassle, the CAD gadget affords a neuropsychological evaluation that helps mitigate its results. The use of records fusion strategies by way of CAD structures has validated to be beneficial, they allow for the merging of data regarding the mind and its tissues from MRI, with that of different varieties of modalities. This multimodal fusion refines the great of brain photographs by way of decreasing redundancy and randomness, which contributes to enhancing the scientific reliability of the prognosis as compared to the use of a single modality. The purpose of this text is first to determine the main steps of the CAD gadget for brain magnetic resonance imaging (MRI). Then to bring collectively some studies paintings related to the diagnosis of brain disorders, emphasizing AD. Thus, the maximum used strategies inside the tiers of class and brain regions segmentation are defined, highlighting their blessings and disadvantages. Secondly, on the basis of the raised problem, we advise an answer inside the framework of multimodal fusion. In this context, primarily based on quantitative size parameters, a performance takes a look at of multimodal CAD systems is proposed by using evaluating their effectiveness with the ones exploiting a single MRI modality. In this situation, advances in information fusion techniques in scientific imagery are accentuated, highlighting their benefits and downsides. The contribution of multimodal fusion and the interest of hybrid fashions are sooner or later addressed, as well as the primary clinical assertions made, inside the subject of mind disease diagnosis. The paper discusses about Alzheimer's disease which is a form of dementia. It gradually deteriorates cognitive and behavioral capacities and the causes of this disease remain unknown [50].

CHAPTER 3
METHODOLOGY

Brain MRI is a standout amongst the most expanding malignancies on the planet. For example, it was accounted for in [1] that one out of six Americans creates Brain MRI malignancy sooner or later. Brain MRI represents 33% of all diseases in the United States, and specifically dangerous melanoma represents 75% of all passings related with Brain MRI growth [1]. Early identification enormously enhances the forecast of patients with threatening melanoma, since it can be relieved with a straightforward extraction. With a specific end goal to analyze Brain MRI injuries, doctors survey the injury in view of various guidelines. For melanocytic sores, a standout amongst the most well known is the ABCD manage (Asymmetry, Border, Color, Diameter) [2]. A specialist dermatologist, be that as it may, in the wake of gaining from colossal measure of sores, appears to build up the capacity to analyze Brain MRI injuries utilizing design investigation. Example examination of Brain MRI sores is accepting consideration in writing. For example, Serrano and Acha [27] as of late proposed a strategy in view of Markov irregular fields for identification of examples in dermoscopic pictures. The best grouping rate in the assignment of segregating between reticular, globular, cobblestone, homogeneous, and parallel example was 86%. For every particular example considered, 40_40 picture tests were utilized to prepare the classifier. In spite of the fact that these examples are relied upon to be analytically valuable, the execution regarding last conclusion stays to be examined. As opposed to conventional calculations intended to copy rules like the ABCD, we propose a strategy that consequently separates pertinent highlights characteristic of danger or benignancy in melanocytic Brain MRIsores, gave that a decent database of the sort of injuries of premium is accessible for learning.

In 1992, Stoecker and Moss condensed in their article the potential advantages of applying advanced imaging to dermatology. These advantages were seen by the innovation accessible at the time, including obviously the capacities of PC vision strategies, and the consequences of the prior research in the zone (e.g. [6]). Among others, these included target non-obtrusive documentation of Brain MRI, frameworks for their indicative help by danger scoring,

distinguishing changes, and telediagnosis. This was the first run through a diary had devoted a whole extraordinary issue to strategies for electronic examination of pictures in dermatology particularly connected to Brain MRI. Presently, right around two decades later, the 2011 distribution of the second unique issue—Advances in Brain MRI picture investigation [4]—enables us to plainly observe the progressions that have occurred in this field. All the more imperatively, we can perceive that we are so near making certain advantages genuine as opposed to potential, and which ones have ended up being significantly more advantageous than at first anticipated.

As now and then occurs with disciplines identified with two basically unique fields of concentrate like dermatology and PC vision, there can be sure ambiguities in covering phrasing. These ambiguities may effectively misdirect perusers not acquainted with one of the fields, in this manner driving them to reach false determinations about the subject. Along these lines, keeping in mind the end goal to encourage the presentation of PC vision specialists into the field of dermatological picture examination, this paper gives definite direction in the significant medicinal material.

Brain MRIis the biggest organ in the human body and comprises of two primary layers2: the epidermis and the dermis (see Fig. 1). The epidermis is a stratified squamous epithelium, a layered scalelike tissue, which fills in as assurance against outer animosities (wounds, contaminations, bright radiation and water misfortune).

3.1 Image Segmentation:

The utilization of shading and surface data all things considered has solid connections with the human observation and in numerous pragmatic situations the shading alone or surface alone image data isn't adequately strong to precisely portray the image content. An illustration is given by the division of regular images that show both shading and surface qualities. This instinctive psychophysical perception incited the PC vision specialists to examine an extensive range of scientific models with the point of inspecting the nearby and worldwide properties of these two major picture descriptors. In any case, the vigorous reconciliation of shading and surface properties is a long way from a minor target and this is inspired, to some extent, by the

trouble in separating exact shading and surface models that can locally adjust to the varieties in the picture content. Specifically the division of normal pictures ended up being a testing undertaking, since these pictures show critical inhomogeneities in shading and surface and what's more they are frequently described by a high level of unpredictability, arbitrariness and inconsistency. In addition, the quality of surface and shading traits can differ extensively from picture to picture and intricacies included by the uneven brightening, picture commotion, point of view and scale contortions make the way toward distinguishing the homogenous picture locales amazingly troublesome. Every one of these difficulties pulled in considerable enthusiasm from the vision analysts, as the hearty reconciliation of the shading and surface descriptors in the division procedure has significant ramifications in the advancement of larger amount picture examination undertakings, for example, question acknowledgment, scene understanding, picture ordering and recovery, and so forth.

In the course of recent decades, the field of image division in view of the joining of shading and surface descriptors has grown widely, cresting with a plenitude of calculations distributed between the years 2007 and 2009. It is valuable to take note of that in the period secured in the vicinity of 1984 and 2009 in excess of 1000 papers have been distributed in the writing and this figure recognizes the way that colour– surface investigation has situated itself as a standout amongst the most explored regions in the field of picture preparing and PC vision. The measurements that assess the quantity of calculations distributed on the subject of colour– surface examination over the most recent three years (2007– 2009) obviously show that this field of research has achieved development and, accordingly, unmistakable examples or classes of methodologies that example either the idea of the component extraction process or the strategies utilized for include coordination can be recognized. The point of this paper is to dissect from a hypothetical viewpoint the principle headings of research in the field of colour– surface examination and to audit the ideas and techniques that have been explored during the time spent colour– surface incorporation with a perspective of accomplishing powerful picture division. Albeit a few overviews have tended to the assessment of shading alone [1– 3] or surface alone [4– 9] division calculations, we don't know about any work in the writing that was worried about the efficient investigation of the ideas and strategies that were utilized in

the improvement of colour– surface picture division calculations. We might want to accentuate that in this audit we are especially worried about the examination and categorisation of the distributed works regarding the coordination of shading and surface data in the division procedure, which, as we would see it, is the main intelligent approach that can prompt a significant knowledge into this essential field of research. There are chiefly two reasons that legitimize the received approach. Right off the bat, such examination encourages an exact categorisation of the distributed calculation in view of the standards behind information combination (highlight reconciliation) process, which is the focal issue in the advancement of colour– surface division plans, and furthermore such line of examination will additionally permit the distinguishing proof of non specific colour– surface mix designs that are decoupled from the application setting that is the predominant normal for the shading and surface element extraction procedures. Along these lines, the chief targets of this paper are: (a) to arrange the principle slants in colour– surface incorporation, (b) to test the application setting of the proposed executions (at whatever point such exchange is suitable), (c) to talk about the assessment measurements that are at present used to evaluate the execution of the division procedures, (d) to audit the freely accessible information accumulations (picture databases) and (e) to break down the execution of entrenched best in class usage. It is helpful to take note of that this audit is essentially worried about the investigation of calculations that have been intended for the division of still computerized pictures and we will demonstrate when the assessed approaches have been connected to the division of video information. To give an exhaustive understanding into the work in the field of colour– surface division, we broke down a generous number of papers distributed in diaries and gathering procedures. To widen the extent of this paper, we won't limit ourselves just to the specialized appraisal of the researched calculations, yet we will likewise endeavor to give an abundant dialog where the thoughts that developed in the field of colour– surface mix in the course of recent decades are deliberately sorted and we will look at the viable setting of the explored techniques at whatever point such exchange is conceivable.

Likewise, we will put an essential accentuation on the quantitative assessment of the cutting edge usage in the field of colour– surface examination. In such manner, we will exhibit the

numerical outcomes accomplished by the broke down best in class techniques and we will show the conditions and the sort of information utilized as a part of the assessment procedure.

Medicinal pictures assume imperative part in helping social insurance suppliers to get to patients for analysis and treatment. Concentrate medicinal pictures depends predominantly on the visual understanding of the radiologists. Be that as it may, this devours time and generally subjective, contingent upon the experience of the radiologist. Subsequently the utilization of PC supported frameworks turns out to be exceptionally important to defeat these constraints. Man-made consciousness strategies, for example, computerized picture handling when joined with others like machine learning, fluffy rationale and example acknowledgment are so profitable in Image methods can be gathered under a general structure; Image Engineering (IE). This is contained three layers: picture handling (bring down layer), picture examination (center layer), and picture seeing (high layer), as appeared in Fig 3.1. Picture division is appeared to be the initial step and furthermore a standout amongst the most basic undertakings of picture investigation. Its goal is that of separating data (spoke to by information) from a picture through picture division, protest portrayal, and highlight estimation, as appeared in Fig 1. Aftereffect of division; clearly have impressive impact over the exactness of highlight estimation [2]. The computerization of medicinal picture division assumes an imperative part in restorative imaging applications. It has discovered wide application in various regions, for example, determination, restriction of pathology, investigation of anatomical structure, treatment arranging, and PC coordinated medical procedure. Be that as it may, the inconstancy and the many-sided quality of the anatomical structures in the human body have brought about medicinal picture division remaining a difficult issue [3].

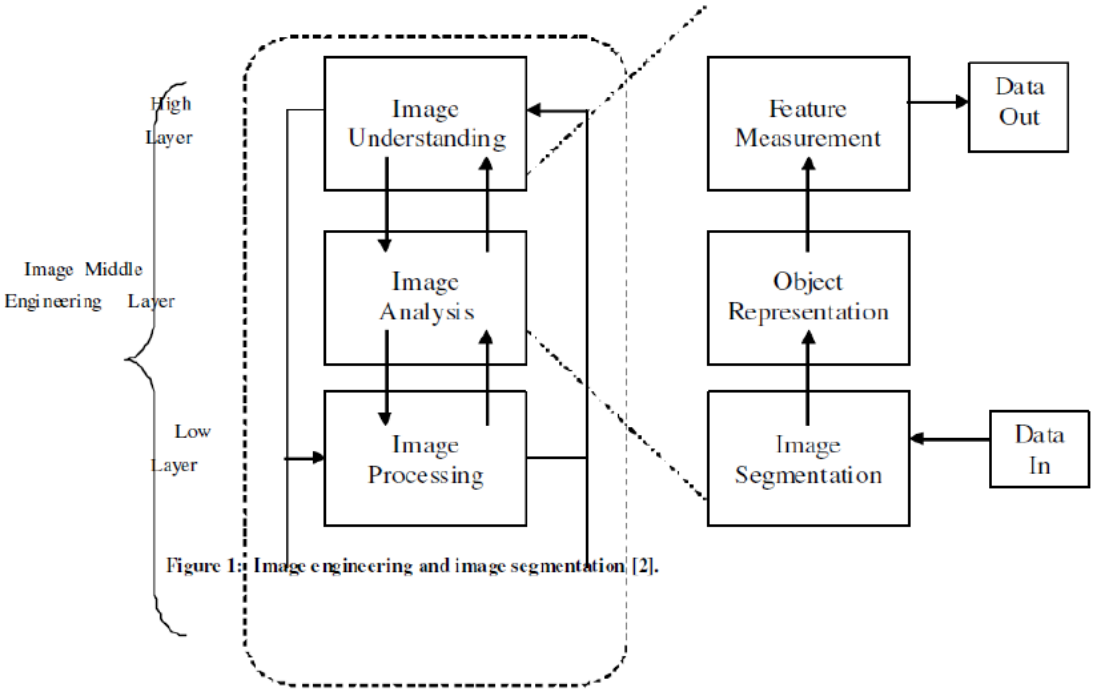

Fig 3.1: Image designing and image division [2].

In light of various innovations, picture division approaches are as of now separated into following classifications, in view of two properties of image.

3.2 Image Texture Analysis:

Surface is the term used to describe the surface of a given protest or marvel and it is without a doubt one of the primary highlights utilized as a part of picture handling and example acknowledgment. It is normally concurred that surface investigation assumes a major part in grouping objects and sketching out the noteworthy areas of a given dark level image. Surface can be found in pictures running from multispectral remote detected information to minute images. An answer for the surface investigation issue will extraordinarily propel the picture preparing and design acknowledgment fields and it will likewise bring much advantage to numerous conceivable mechanical applications.

Surface examination is an essential issue in picture preparing and PC vision. It is a key issue in numerous application zones, for example, question acknowledgment, remote detecting, and substance based picture recovery. Despite the fact that there is no correct definition for the

term surface, this is a characteristic effortlessly understood by people, and it is an affluent wellspring of visual data (while considering the tri-dimensional nature of physical articles). The significance of surface discernment in human vision is one of the early strides towards recognizing items and understanding a scene. Numerous endeavors have been made to comprehend these systems consistently. Some ongoing outcomes. Truth be told, the visual instrument has enlivened numerous models of question acknowledgment utilized today in PC vision. Ongoing reports from both neuroscience and PC vision have shown that organically conceivable highlights [27] are appealing in visual acknowledgment. Organic propelled techniques in PC vision began ending up surely understood toward the start of the 1980s. David Marr's book assumed a critical part in its promotion. From that point forward, neurological primate mind models have prompt the advancement of numerous PC vision strategies. Then again, organic models have made it less demanding to comprehend Mathematics in view of visual qualities. Considering, numerous numerical techniques without organic motivation have additionally been proposed, which is the situation of the strategy proposed here. It isn't specifically required with natural roused techniques, however makes utilization of Pattern Recognition and Computer Vision ideas that were improved by neuroscience propels. As indicated by, a picture surface is characterized as a component of spatial variety in pixel forces (dim qualities). This definition is valuable in an assortment of utilizations and is the subject of this examination. Fundamentally, a surface example can have numerous or few surface natives (miniaturized scale surfaces) as well as hierarchic spatial courses of action of these natives (full scale surface). The textural view of a picture relies upon the spatial size of these natives. Huge natives offer ascent to full scale surface (i.e. coarse surface) and little crude to small scale surface (i.e. fine surface). Because of this trademark, the meaning of a surface class must consider the detached natives, as well as the connection among them and their neighbors. Considering, Julesz demonstrates that two surfaces are not discriminative by human vision if their second request insights are indistinguishable. Subsequently, surface portrayal and distinguishing proof require a technique which can express the setting encompassing every pixel, hence joining nearby and worldwide surface qualities. It ought to be said that there is a developing group of writing on surface portrayal. It

can be separated into four noteworthy classifications: measurable, geometrical, show based and flag preparing techniques. Great surveys of conventional strategies can be found.

Surface is a standout amongst the most imperative attributes in recognizing imperfections or defects. It gives imperative data to acknowledgment and addition. Truth be told, the undertaking of recognizing deserts has been to a great extent saw as a surface examination issue. Highlights with substantial between class varieties and little intra-class varieties are looked to better separate contrasting surfaces. Much exertion has been put into removing helpful surface highlights. As it isn't commonsense to give a thorough overview of all surface highlights, this area focuses on those methods that have been generally utilized as a part of surface examination or show great potential for application to programmed investigation.

3.2.1 Statistical Approaches:

Factual surface investigation strategies measure the spatial conveyance of pixel esteems. They are all around established in the PC vision world and have been widely connected to different errands. Countless surface highlights have been proposed, running from first request measurements to higher request insights. Among many, histogram insights, co-event networks, autocorrelation, and neighborhood paired examples have been connected to visual investigation.

3.2.2 Structural Approaches:

In auxiliary methodologies, surface is described by surface natives or surface components, and the spatial game plan of these natives. Subsequently, the essential objectives of auxiliary methodologies are right off the bat to remove surface natives, and also to display or sum up the spatial position rules. The surface crude can be as basic as individual pixels, an area with uniform gray levels, or line portions. The situation tenets can be acquired through demonstrating geometric connections between natives or taking in measurable properties from surface natives. In [19], Chen proposed a basic way to deal with recognize abandons in material pictures. The image was first threshold utilizing histogram investigation and afterward was mapped into an information structure which speaks to the skeleton structure of

the surface. Factual estimations were taken from both area and length histograms of the skeleton. These estimations were contrasted and a pre-characterized acknowledgement run which was learnt from deformity free examples to identify deserts. Kittler et al. utilized K-implies bunching to part arbitrarily finished tile pictures into parallel stacks, in which blob examination was performed to quantify the natives. The estimations included size, edge fractality, elongatedness, and spatial conveyance. The creators connected morphological tasks to feature deserts in textures. Wen and Xia performed calfBrain MRIsurface deformity identification by extricating edge sections and measurably assessing those edges, for instance, in light of their length and quality.

3.2.3 Filter based Approaches:

The methods inspected in this segment to a great extent share a typical trademark, which is applying channel depends on the picture and process the vitality of the channel reactions. The strategies can be isolated into spatial space, recurrence area, and joint spatial/spatial-recurrence area methods.

3.2.4 Model based Approaches:

Show based techniques incorporate, among numerous others, fractal models, autoregressive models [27], arbitrary field models, the encapsulation demonstrate, and the texem display. Fractals, at first proposed by Mandelbrot, are geometric natives that are self-comparable and unpredictable in nature. Pieces of a fractal protest are correct or measurable duplicates of the entire question and they can coordinate the entire by extending and moving. Fractal measurement and lacunarity are the most vital estimations in fractal models. The previous servs as a measure of many-sided quality and inconsistency; and the last measures the auxiliary variety or inhomogeneity. Conci and Proenca utilized box checking to extricate fractal highlights for recognizing surrenders in texture pictures. In a similar report by Ohanian and Dubes, the fractal technique performed sensibly well against co-event networks, Gabor channels, and Markov arbitrary fields in surface order. Be that as it may, it has made restricted progress in genuine applications. Fractals can have a similar fractal measurement yet look

totally changed. Fractal models are for the most part reasonable for common surfaces where self-closeness may hold.

MRF hypothesis gives a helpful and steady path for demonstrating setting subordinate substances, for example, pixels, through portraying shared impacts among such elements utilizing contingent MRF circulations. The foundation of the identicalness amongst MRFs and Gibbs dissemination [8] gave tractable intends to factual examination as Gibbs conveyance takes a substantially less complex shape. In [26], Cohen et al. utilized Gaussian Markov Random Fields (GMRF) to show surrender free material web. The examination procedure was dealt with as a speculation testing issue on the measurements got from the GMRF show. The testing picture was parceled into non-covering sub-squares, where every window was then delegated deficient or non-faulty. This strategy was actualized in a continuous application with a committed DSP framework. The creators demonstrated that MRF based techniques were focused in a near report against other factual and unearthly based strategies in deformity identification. Recently, Xie and Mirmehdi proposed a novel measurable model, called surface models or texems, to speak to and examine irregular surfaces. In a two-layer structure, a surface picture, as the principal layer, is thought to be a superposition of various surface models, potentially covered, from the second layer. Every surface model, or essentially texem, is portrayed by mean qualities and comparing covariances. Each arrangement of these texems may include different sizes from various picture scales. Diverse Gaussian blend models were investigated to take in these texem portrayals. Like the embodiment display, just crude pixel esteems are utilized as opposed to separating reactions. Be that as it may, dissimilar to the embodiment the texem display does not implement the surface natives consolidating to a solitary picture fix. The model was connected to limit absconds on irregular finished artistic tile surfaces and demonstrated critical upgrades thought about against Gabor separating based strategies in a curiosity location structure.

3.2.5 Comparative Studies:

A characterization of the surface investigation systems utilized for imperfection identification. As said before, the measurable and channel based techniques have been in support as far as the

measure of research revealed. It is likewise important that the categorization of the surface investigation procedures utilized for deformity location as depicted previously. There are strategies that join techniques from various classes for surface investigation, applies co-event estimation on wavelet changed detail pictures. There are a few similar examinations in the writing that assess surface investigation techniques in application to desert identification. It must be noticed that distinctive investigations utilize diverse datasets and conceivably extraordinary parameter settings. ¨Ozdemir et al. analyzed six surface highlights, comprising of MRF, KL change, 2D Lattice channels, Laws channels, co-event grids, and a FFT-based technique, for identifying material deformities. Surface displaying utilizing a high (ninth) arrange MRF demonstrate gave the best location result. Iivarinen showed LBP and co-event grids highlights had comparable execution in investigating finished surfaces. As of late, Monadjemi actualized three measurable (histogram-based, LBP, and co-event lattices) and five flag preparing plans (Gabor channels, directional Walsh-Hadamard change, discrete cosine change, eigenfilters, and sythesis of Gabor channels) for haphazardly finished artistic tile variation from the norm recognition. The Gabor channel based arrangement plot was observed to be the most precise strategy with great reliable execution crosswise over different tile composes. In spite of the fact that a strong conclusion can not be attracted to decide the best strategy for imperfection recognition, it is plainly obvious that sifting approaches, specifically Gabor separating, have been all the more prevalently connected in these zone. Be that as it may, an appealing thought is to utilize nearby neighborhood pixel connections to demonstrate the surface, e.g. utilizing techniques in view of the LBP, MRF, or the embodiment and texem models. Indeed, multi-channel separating underpins the claim that the joint conveyance of neighboring pixels decides surface appearance, as the joint appropriation of pixel esteems in the channel bolster window decides the circulation of the channel reaction. Quite, Varma and Zisserman exhibited better execution in surface grouping utilizing little neighborhoods than utilizing channel bank-based methodologies. Speaking to surface utilizing natives is additionally powerful, for instance the texton portrayal. Be that as it may, because of the troubles in unequivocally determining crude portrayal and related removal rules, there are moderately constrained works utilizing auxiliary methodologies.

3.3 Image Watershed Transform:

Watershed change is the strategy which is normally utilized as a part of image division. It is presently being perceived as an intense technique utilized as a part of image division because of its numerous favorable circumstances, for example, effortlessness, speed and finish division of the image. Watershed change or Watershed Algorithm depends on gray scale morphology. It is named a locale based division approach. Notwithstanding when the objective areas having low differentiation and week limits, watershed change can give shut shapes. At the point when a scene or topographic alleviation is overflowed with water, the gap lines of the spaces of rain falling over the districts shapes the watersheds. Instinctively, a drop of water falling on a topographic alleviation streams towards the "closest" least. The "closest" least is that base which lies toward the finish of the way of steepest plummet. As far as geology, this happens if the point lies in the catchment bowl of that base. An elective approach is to envision the scene being inundated in a lake in which gaps are punctured in the nearby minima is known as the catchment bowl. Water will be topped off at these beginning neighborhood minima and at focuses where water originating from various bowls would meet and dams will be assembled. At the point when the water level achieves the most noteworthy top in the scene the procedure is halted. Subsequently, the scene is parceled into districts or bowls isolated by dams, called watershed lines or basically watersheds.

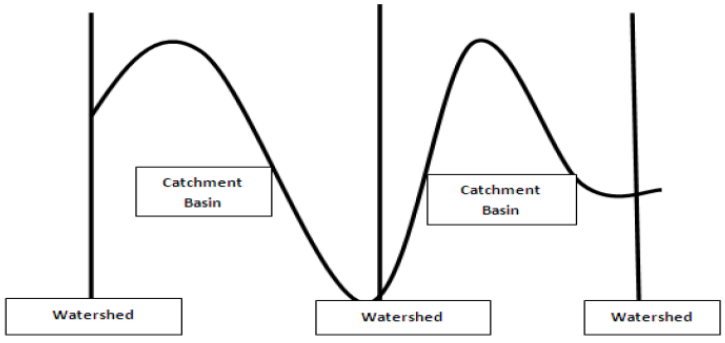

Fig. 3.2: Watershed division nearby minima yield catchment bowls; neighborhood maxima characterize the watershed lines.

Let $f \in (D)$ have minima $\{mk\}_{\in}$, for some index set I. The catchment basin (mi) of a minimum m_i is defined as the set of points $x \in D$ which are topographically closer to *mj* than to any other regional minimum :

$$CB(m_i) = \{x \in D\} | \forall jl\{i\}: f(m_i) + T_f(x, m_i) < f(m_j) + T_f(x, m_i) \quad \text{(i)}$$

The watershed of f is the set of points which do not belong to any catchment basin:

$$Watershed = (f) = D \cap \left(\bigcup_{i \in l} CB(m_i) \right)^C \quad \text{(ii)}$$

Let W be some label W . The watershed transform of f is a mapping λ: $D \rightarrow I \cup \{W\}$, such that $\lambda\ p = i\ if\ p \in (mi)$, and $\lambda\ p = W\ if\ p \in Watershed$.

So, the watershed transform of f assigns labels to the points of D, such that (i) different catchment basins are uniquely labeled, and (ii) a special label W is assigned to all points of the watershed of *f*.

3.4 Image DWT2:

Single-level discrete 2-D wavelet transform

Syntax-

[cA,cH,cV,cD] = dwt2(X,*'wname'*)

[cA,cH,cV,cD] = dwt2(X,Lo_D,Hi_D)

[cA,cH,cV,cD] = dwt2(...,'mode',MODE)

Description-

The dwt2 command performs a single-level two-dimensional wavelet decomposition. Compare this function to wavedec2, which may be more useful for your application. The decomposition is done with respect to either a particular wavelet (*'wname'*, see wfilters for more information) or particular wavelet decomposition filters (Lo_D and Hi_D) you specify.

[cA,cH,cV,cD] = dwt2(X,*'wname'*) computes the approximation coefficients matrix cA and details coefficients matrices cH, cV, and cD (horizontal, vertical, and diagonal, respectively),

obtained by wavelet decomposition of the input matrix X. The *'wname'* character vector contains the wavelet name.

[cA,cH,cV,cD] = dwt2(X,Lo_D,Hi_D) computes the two-dimensional wavelet decomposition as above, based on wavelet decomposition filters that you specify.

- Lo_D is the decomposition low-pass filter.
- Hi_D is the decomposition high-pass filter.

Lo_D and Hi_D must be the same length.

Let sx = size(X) and lf = the length of filters;

then size(cA) = size(cH) = size(cV) = size(cD) = sa where sa = ceil(sx/2),

if the DWT extension mode is set to periodization. For the other extension modes,

sa = floor((sx+lf-1)/2).

[cA,cH,cV,cD] = dwt2(...,'mode',MODE) computes the wavelet decomposition with the extension mode MODE that you specify.

MODE is a character vector containing the desired extension mode.

An example of valid use is

```
[cA,cH,cV,cD] = dwt2(x,'db1','mode','sym');
```

3.5 Proposed Work:

The target of work is to perform image division by apportioning them into disjoint groups with proportional execution of human impression of the district of intrigue. It will be an unsupervised division of organs filtered pictures which achieve the prerequisite of making earlier presumptions about the ROI. We will apply a two-arrange strategy for such images division will be played out that can procedure both textured and non-textured. In the first place arrange ascertains textured highlights from the groups coefficients of the double tree wavelet change of image. From there on middle sifting will be connected to limit the ambiguities of surface districts at the limits of the image objects.

The computed surface component will be utilized to discover the space based slope capacity and afterward watershed change will be connected to acquire the underlying division.

The second stage the sectioned areas acquired by watershed change are assembled to important locale of comparable highlights by utilizing otherworldly bunching method by utilizing the weighted mean based cost work for district parceling.

3.6 ALGORITHM:

1. Image obtaining: Read the biomedical image (I) and perform image resizing and select locale of intrigue that will be edited.

2. 1 level Image DWT: Perform the principal level 2d DWT on the image and acquire the estimation segment (An) of the changed information.

[A DH DV DD]= DWT (I)

3. 2 level Image DWT: Perform the second level 2d DWT on the image and acquire the following estimation segment (A1) of the changed information.

[A1 DH1 DV1 DD1]= DWT(A)

4. Approximated Image Reconstruction by 2level IDWT: Perform converse DWT and reproduce the image by considering just approx segment and stifling the DH, DV and DD point by point segment.

5. Entropy separating: Apply entropy sifting to remake approximated image.

6. Remove little protests: Remove the undesirable openings having size under 100 pixels.

7. Morphological Processing: Apply image shutting and filling tasks to wipe out clamor in the separated picture.

8. Texture Masking: Mask the texture 1 and texture 2 to create texture based divided image.

9. Edge Detection: Apply sobel filtering for highlighting the edge boundaries and then determine the gradient magnitude to get image having one at boundaries otherwise zero for inner regions.

10. Edge Erosion: Apply erosion of object less than disk size 4 pixel and perform reconstruction.

11. Edge widening: Apply dilation of object less than disk size 4 pixel and perform reconstruction.

12.Thresholding: Apply the threshold on edge objects to selects the segmented boundaries to high intensity.

13. Watershed Transform: Apply watershed change on the picture got after division.

14. Superimposing of portioned image: Superimpose surface based fragments image over the watershed change connected divided image by alpha mixing.

15. Extract the image features using entropy,wavelet coefficient and textures data for all the images.

16.Develop the training and testing data.

17.Apply clustering to generate fuzzy inference system.

18.Apply ANN to reform the developes fuzzy system.

CHAPTER 4

RESULTS AND DISCUSSIONS

Figure 4.1 shows the BRAIN MRI image of a patient suffering from Alzheimer disease (AD). This image is read in the MatLab and cropped with maximum coverage of image data .After reading the image its entropy value is found to discriminate the pixels as per the value of amount of information in the image.

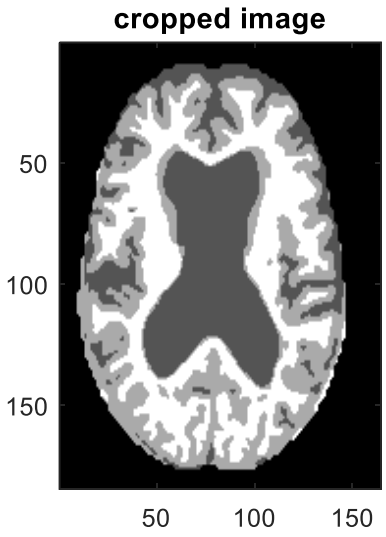

Figure 4.1 (a): Brain MRI image for the patient suffering from Alzheimer disease

Figure 4.1 (b): Image after apply entropy filtering

Figure 4.1 (b) is obtained on applying the entropy filter along with the opening and closing operations. The white parts indicates the area of image where the information content is high.

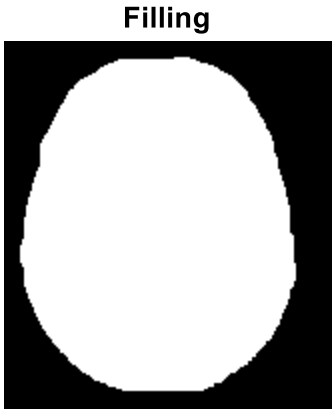

Figure 4.1 (c): Image obtained after applying the filling operation.

After applying the entropy filter the significant data part of image are retrieved from Brain MRI then the filling operation applied that gives the image that covers the actual brain segments as white and the background as black.

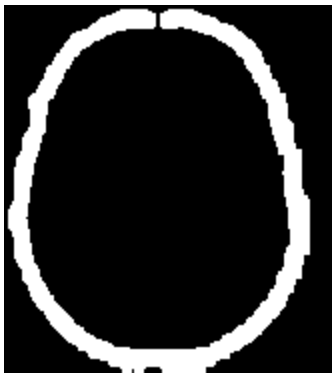

Figure 4.1 (d): The image boundary obtained by applying the edge detection method.

The figure 4.1 (d) shows the black white image after applying the edge detection method it discriminated the boundary (perimeter) of brain this part is obtained by applying the entropy filter on second time.

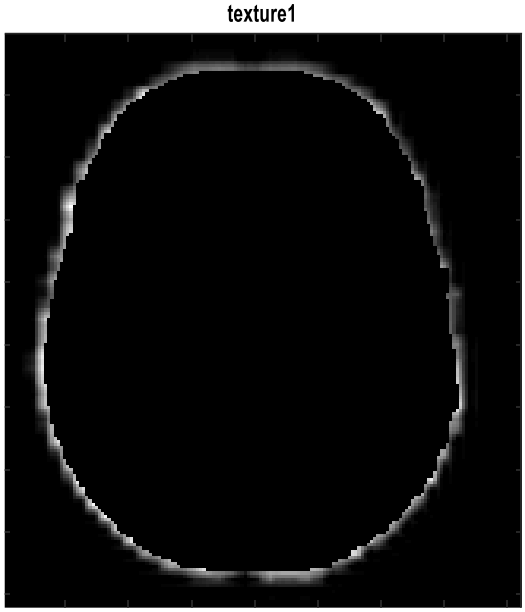

Figure 4.1 (e): Image segment describing the texture 1 of the Brain MRI.

The boundary image when superimposed on original Brain MRI the perimeter og brain are clearly visible hence after this stage it gave the perimeter of original brain MRI taken as texture 1.

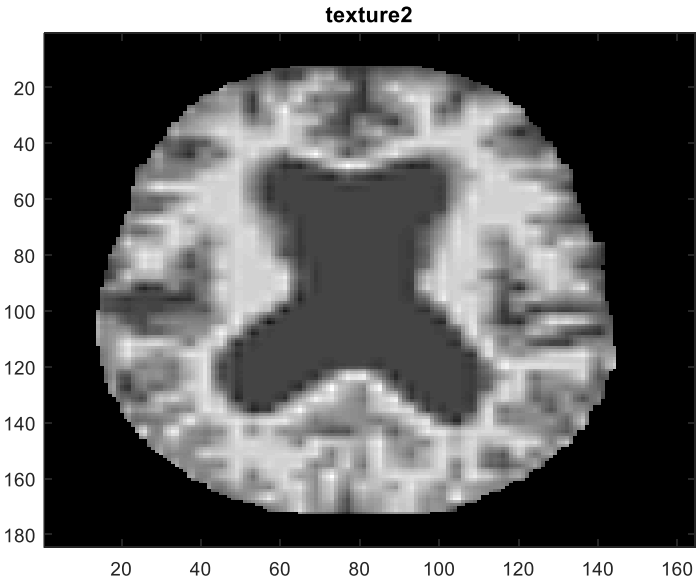

Figure 4.1 (f): Image segment describing the texture 2 of the Brain MRI.

The information other than the texture 1 is separated by reversed masking of texture 1 and in this way original Brain MRI is observed as texture2.

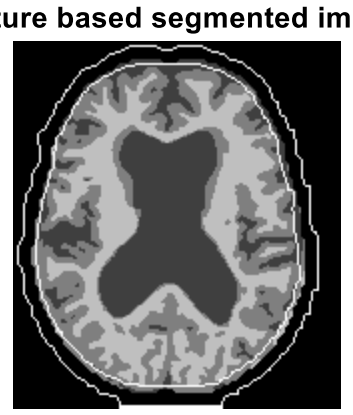

Figure 4.1 (g): Image obtained with edges representing the segmented portion of different textures.

In figure 4.1 (g) both the textures are covered by white edge to demonstrate the accuracy of segmentation of two different textures.

Figure 4.1 (h): Image showing the gradient magnitude

Figure 4.1 (h) is obtaining on calculating the gradient of brain MRI it gives the white lines where the rate of change of pixel intensity is high. In this way the internal boundaries are captured as information feature data.

Figure 4.1 (i): Modified regional maxima superimposed on original image.

Figure 4.1 (i) is showing the internal segment of image obtained on calculating the maxima of the pixel intensity value and complement operation with opening and closing based morphological operations.

Figure 4.1 (j): Image after thresholded opening-closing by reconstruction

Figure 4.1(j) shows the image after applying the thresholding and opening closing to get the detail of brain MRI.

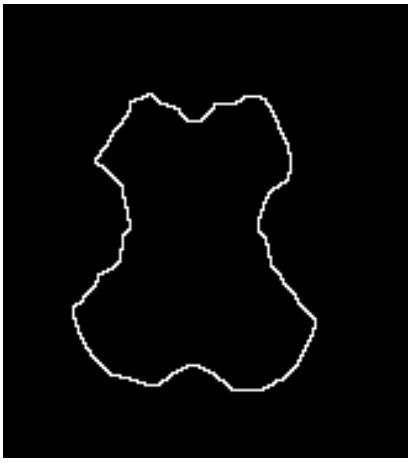

Figure 4.1 (k) : Image showing watershed lines.

Watershed transform is applied to get the boundary of inner segment of the Brain MRI as shown in figure 4.1 (k).

Figure 4.1 (l): Object boundaries superimposed on original image

All the objects that are segmented under different operation are finally superimposed on original image object boundaries superimposed on original image as the white lines.

In this chapter results are shown for demonstrating the segmentation process on the different images of MRI for diagnosis of Alzheimer disease. The proposed algorithm is applied on each image and the results are displayed and image features are extracted.

Table 4.1 Segmentation Results

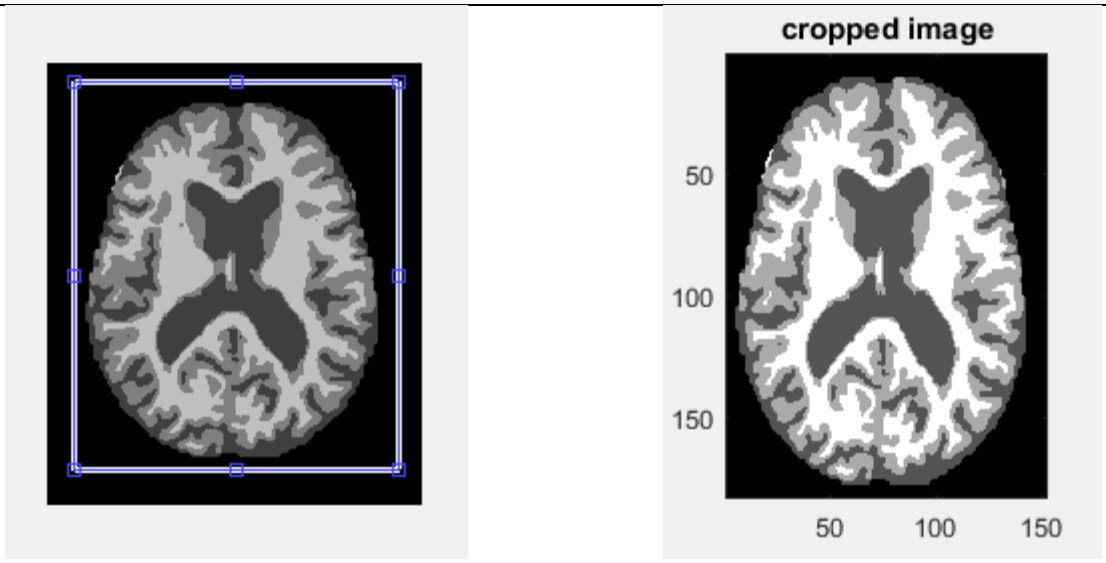

Fig 4.1 a: Original (left) and Cropped Image(Right) with normal subjects

Similar operation is applied for all the images under the data group of normal persons Ans the patients suffering from the Alzheimer disease. The information is saved as the entropy level, gradient, texture area, wavelet coefficient value. These features are giving the info of the number of pixels under different segments of image and taken as the input. For developing the image classifier using ANFIS.

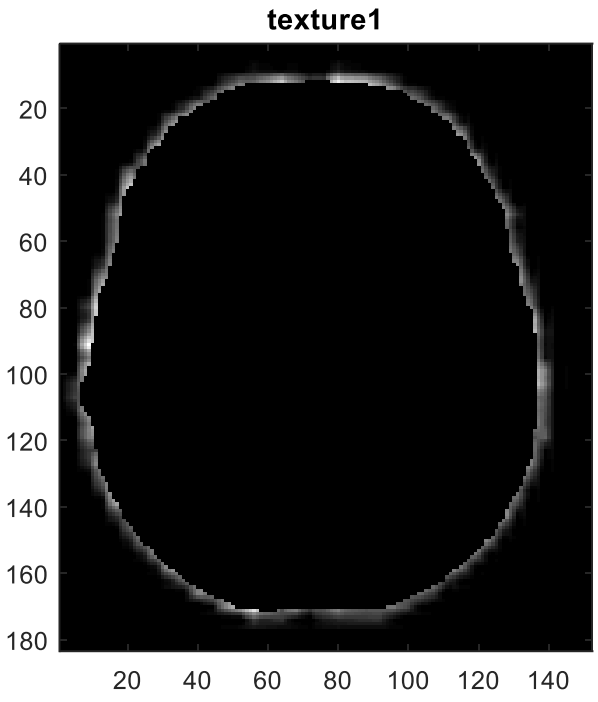

Fig 4.1 b: Texture 1

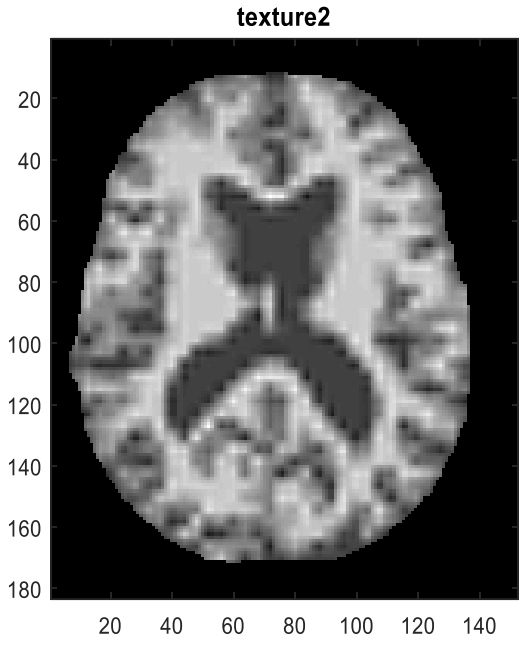

Fig 4.1 c: Texture 2

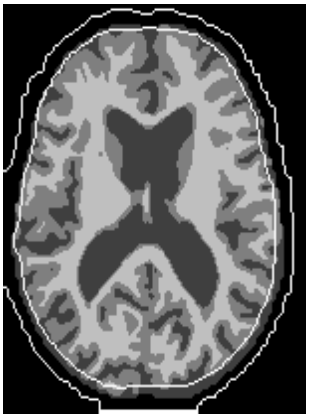

Fig 4.1d: Texture based Segment Image

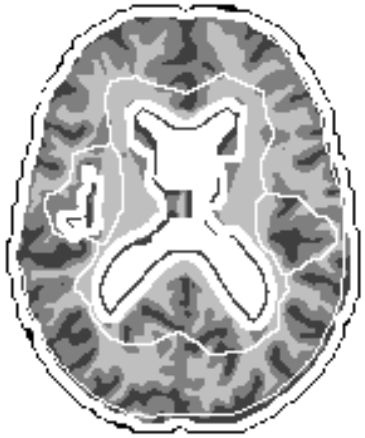

Fig 4.1e Marked and Object Boundaries Superimposed on Original Image

The figure 4.1 demonstrates the picture of brain MRI without any disease see. This picture (figure 4.1.a) is utilized for envisioning WATDWT division of these organs pictures division for the point of location and separation of textures and contamination from different tissues and picture foundation. The removed locale is deciphered by doctors to assess conclusion. The

WATDWT division display was connected to assess surface highlights (figures 4.1.b and 4.1.c) where both show diverse districts in light of the surface. Figure 4.1.d demonstrates the surface based fragmented picture, while Figure 4.1.e demonstrates the markers and protest limits superimposed on unique picture. Division aftereffects of the picture in figure 4.1.b are gone through watershed changes to get fragmented hues for various locales 4.1.f. At last the shaded portions of water shed change (Fig 4.1.f) are superimposed with surface based sectioned picture (figure 4.1.d) to get Fig 4.1.g. The images are taken from interface. The connection comprise of 101 brain MRI images of interest having both kind of subjects with and without Alzheimer disease. We have considered these pictures. From OASIS database website. The figure 1 is for AS1_0001_MR1_mpr_n4_anon_111_t88_masked_gfc_fseg_tra_90.gif. Brain MRI without in disease. For applying the image classification the ANFIS model is developed by taking the features data of 101 images taken from OASIS database. The data is separated into training and testing data by randomly shuffling the images and dividing into two containing both king of images with and without Alzheimer disease. If the AD is absent the output is marked as zero ,for mild level of AD output is 0.5 and high level of AD output is 1.The inputs are entropy value under texture 1 and 2,wavelet coefficient value in both textures and number of pixels under inner segment of watershed line and outer part of watershed line, The ANFIS model is developed using the training data and finally the developed is tested on remaining data to find the accuracy. For this purpose first of all a fuzzy inference system is developed for the input data by clustering technique then ANN is used to further improve the fuzzy inference system by learning algorithm.

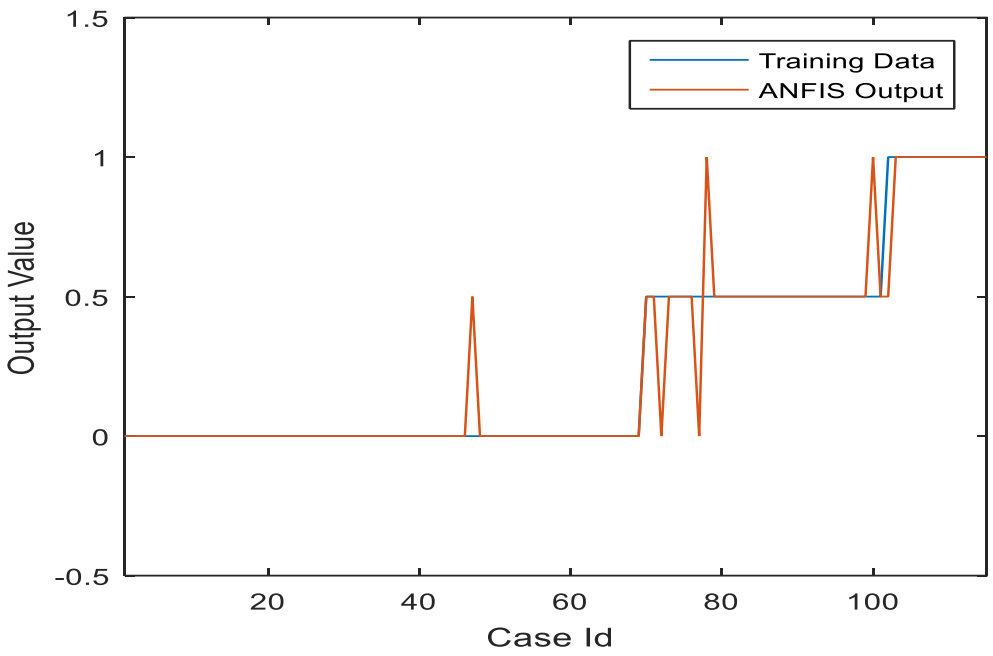

Figure 4.3 : ANFIS based predicted output and actual output

Figure 4.3 shows the plot for representing the mathing of the predicted results of ANFIS with the actual results these values are used to finaly calculate the accuracy. It is observed that the developed model has accuracy of 94.78%.

Table 4.2 : The actual output value and predicted output value by ANFIS.

S.No.	Actual	Predicted	S.No.	Actual	Predicted	S.No	Actual	Predicted	S.No.	Actual	Predicted
1.	0	0	26.	0	0	51.	0	0	76.	0.5	0.5
2.	0	0	27.	0	0	52.	0	0	77.	0.5	0.5
3.	0	0	28.	0	0	53.	0	0	78.	0.5	0.5
4.	0	0	29.	0	0	54.	0	0	79.	0.5	0.5
5.	0	0	30.	0	0	55.	0	0	80.	0.5	0.5
6.	0	0	31.	0	0	56.	0	0	81.	0.5	0.5
7.	0	0	32.	0	0	57.	0	0	82.	0.5	0.5
8.	0	0	33.	0	0	58.	0	0	83.	0.5	0.5
9.	0	0	34.	0	0	59.	0	0	84.	0.5	0.5
10	0	0	35.	0	0	60.	0	0	85.	0.5	0.5
11	0	0	36.	0	0	61.	0	0	86.	0.5	0.5
12	0	0	37.	0	0	62.	0	0	87.	0.5	0.5

13	0	0	38.	0	0	63.	0	0	88.	0.5	0.5
14	0	0	39.	0	0	64.	0	0	89.	0.5	0.5
15	0	0	40.	0	0	65.	0	0	90.	0.5	0.5
16	0	0	41.	0	0	66.	0	0	91.	0.5	0.5
17	0	0	42.	0	0	67.	0	0	92.	0.5	0.5
18	0	0	43.	0	0	68.	0	0	93.	0.5	0.5
19	0	0	44.	0	0	69.	0	0	94.	0.5	0.5
20	0	0	45.	0	0	70.	0.5	0.5	95.	0.5	0.5
21	0	0	46.	0	0	71.	0.5	0.5	96.	0.5	0.5
22	0	0	47.	0	0.5	72.	0.5	0	97.	0.5	0.5
23	0	0	48.	0	0	73.	0.5	0.5	98.	0.5	0.5
24	0	0	49.	0	0	74.	0.5	0.5	99.	0.5	0.5
25	0	0	50.	0	0	75.	0.5	0.5	100.	0.5	0.5

CHAPTER 5
CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

Surface and coarseness of organs are outwardly extraordinary. On applying image handling in the division examination it is discovered useful to quantitatively assess contrasts surface highlights when connected on wavelet approximated segment.

We have checked on a few diary articles to consider different image division systems. The greater part of the procedures confront comparable issues like inadaptability to various modalities, tremendous measure of information to portion and clamor included. The surface is the presence of the smooth surface. To the highlights of this surface, numerous elements are happening, for example eating routine and hydration, measure of collagen and hormones, and, obviously barin MRI. A steady decrease in division quality also happens because of superimposing of abnormal state subtle elements. As subtle elements builds more slender picture designs are created and all the more effectively harm the division quality with the presence of lines and unpredictable thin questions. The crumbling is likewise joined by an obscuring of the foundation or limit shading for an over ingestion of the regular shading color, melanin, by the best most cell layer of body organs. The surface additionally relies upon its body area. On account of picture handling, we have considered the way that surface appearance is changing with picture recording parameters, i.e. camera, light and heading of view, an issue basic to any genuine surface.

In this work, we have utilized a surface examination and estimations in view of division based approach of the surface acknowledgment. Image is first caught and Level 1 and Level 2 DWT are connected, after which image is reproduced utilizing Level 2 IAWT. After entropy sifting little protests are expelled and morphological preparing and surface concealing are completed. Edge is then identified, dissolved and widened. Utilizing thresholding watershed change is connected. The two images are then superimposed utilizing alpha mixing. Finally the Fuzzy and ANN is used to develop classifier model for discriminating the normal and Alzheimer disease MRI.The results shows high accuracy of classification.

5.2 Future Scope

In future the methodology created can be adjusted for use in 3D alongside time measurement, rather than simply still 3D. This will empower constant utilization of Segmentation system amid live tasks.

For instance if combined with I-cut which is misleadingly insightful, the technique can guarantee exact and finish evacuation of tumors. Along these lines guaranteeing that nor is there a probability of contaminated tissue remaining, nor is exorbitant sound tissue expelled.

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CAREER OBJECTIVE

To work with a world class organization where I can hone my skills and contribute towards development

QUALIFICATIONS

Degree	College/ University	Year	%
POST-GRADUATION			
M.Tech(CSE)	BBD University	2021	77.43
GRADUATION			
B.Tech(EC)	Shri Ramswaroop Memorial College of Engineering and Management, Lucknow (UPTU)	2011	71.20
ACADEMIC	**School/College**		
XII	City Montessori School, Lucknow (ISC)	2007	83.25
X	City Montessori School, Lucknow (ICSE)	2005	88.40

EXPERIENCE AT HCL TECHNOLIGIES LTD LUCKNOW

- Worked from July 2016 (3 months training+3 months OJT) having experience of 3.1 years in totality.
- Last Project UNUM.
- Worked in the capacity of IT Analyst, Critical Incident Manager and Offshore Associate
- Worked across clients of different GEOs namely US, Europe, and China.
- Also involved in handling client calls.
- Worked on **SNOW.**
- Worked on **Moogsoft**
- Worked on **BMC Remedy OnDemand**
- Worked on **BMC TrueSight Operations Management.**
- Worked on **BMC Remedy with Smart IT.**
- Worked in different projects.
- Incident Management and performing Root Cause Analysis.
- Monitoring and Analysis of alerts and alarms.
- Escalation of alerts and alarms to appropriate teams
- Currently working at DR Site.
- Key team player and reporting at the end of day.

EXPERIENCE AT CMC LTD

- Worked on Double Entry Accounting System (DEAS) in U P. Development of uniform financial accounting system for the Urban Local Bodies of Uttar Pradesh.
- Making of Jasper Reports on JasperSoft iReports for different masters
- Reporting at the end of day activity
- Troubleshooting
- Manual Testing of software(JAVA).
- Making Test cases
- Updating of tasks in WEB PROMPT
- Matching every entry in database with that of entered by Nagar Nigam in software
- Updating the Requirements Traceability Matrix(RTM)
- Making JSP on Eclipse2
- Worked on struts.xml file, tiles.xml file
- CMMI Level 5 Quality Assurance Testing

OTHER PROFESSIONAL QUALIFICATIONS/TRAININGS

- Doing a course in Graphic Designing (Print and Publishing) from MAAC.
- One-month certificate course in AutoCAD (Electronics) from PTC University in 2015.
- Pursued CJET from CMC Ltd. (A TATA Enterprise) (DOJ 1st Aug,2013-Nov,2013).
- On Job Training in System Integration (Jan 31st 2013-June 2013) from CMC Ltd. (A TATA Enterprise)
- Certificate course in Developing Applications using Core Java at NIIT Lucknow in 2008.
- Diploma in Computer Applications from Escol Informations Pvt. Ltd, Dehradun in 2001.
- **Summer Internship**:

Company-BRICS in Collaboration with Simplifix Automation & Solutions Pvt. Ltd., IIT Kanpur	**Training in Embedded Systems JUNE-JULY 2010**	• Developed Line following Robot using Atmega16. • Software Used: Eclipse

Company – Hewlett Packard	**Training in J2EE JUNE-JULY 2009**	• Project on Share Trading designed on **J2EE technology** using **Struts Framework** to know the latest updates of the stock market in an easy way

ACHIEVEMENTS & AWARDS

- **Was placed in Concentrix Daksh India Pvt. Ltd(BPO Services).**
- **Was placed in Tata consultancy services through campus selection in the capacity of Assistant System Engineer, discontinued due to illness in 2011.**
- **Best Comparer** in Tech-fest of SRMCEM-"**GANTAVYA-2K9**".
- **First Prize** in Picture Perception/ 'matka' decoration in "Abhivyakti" SRMCEM, Lucknow.

- Passed Yogasana course of Prathmik level with **'A+' grade** organized by Ramamani Iyengar Memorial Yoga Institute, Pune.

EXTRA CURRICULAR ACTIVITIES AND SOCIAL INITIATIVES

- Participated in IOT Online Quiz Competition in association with The Institution of Engineers, India held in 2020.
- Participated in CSR activity of HCL Foundation i.e., Community Service, painting a school held at Noida.
- Participated in CSR activity of HCL Foundation i.e., Drawing Competition & General Awareness Program" at CHETNA Lucknow.
- Participated in a 5-month long Awareness and Life-skill-based Student Development Program conducted by Advait-Life –Education during January-May 2008 and 2009.
- Member of Technical club – "Technotatva" in SRMCEM in the capacity of Co-ordinator (EC)

PERSONAL DETAILS

D.O.B: 15th November 1988,

Mother's Name: Mrs. Seema Agarwal, (**Shruti Agarwal**)

Father's Name: Mr. P.K Agarwal, Date:

Permanent Address: C1/50 Vikrant Khand, Gomtinagar, Lucknow. Place: Lucknow.

Present Address: Same as above.

APPENDIX 1

PUBLICATION CERTIFICATE

International Journal of Information And Computing Science

An ISO : 7021 - 2008 Certified Journal

ISSN NO: 0972-1347 / web : www.ijics.com / e-mail : submitijics@gmail.com

Address : # B11 - 157, Katraj - Dehu Road, Pune, Maharastra - 412101.

CERTIFICATE OF PUBLICATION

Certificate ID : IJICS/S1623

This is to certify that the paper entitled

"ANFIS Based Detection of Alzheimer Diseases using Brain MRI Segmentation"

Authored by

Shruti Agarwal

From

BBDU, Lucknow, U.P

Has been published in

IJICS JOURNAL, VOLUME 8, ISSUE 5, MAY- 2021.

Dr. K. M. Pandey
Editor-In-Chief
IJICS
www.ijics.com

DOI:16.10089/IJICS

BABU BANARASI DAS UNIVERSITY, LUCKNOW

CERTIFICATE OF THESIS SUBMISSION FOR EVALUATION

(Submit in Duplicate)

1. Name: …Shruti Agarwal……..

2. Enrollment No.:…11904490639……

3. Thesis title: ….Brain Segmentation of MRI Image Using Hybrid Neural Fuzzy …….Network……...
……..……

4. Degree for which the thesis is submitted: …Master of Technology……

5. Faculty of the University to which the thesis is submitted
.……Dr. Gaurav Kumar Srivastava…….

6. Thesis Preparation Guide was referred to for preparing the thesis. ☐ ✓ YES ☐NO

7. Specifications regarding thesis format have been closely followed. ☐ ✓ YES ☐NO

8. The contents of the thesis have been organized based on the guidelines. ☐ ✓ YES ☐NO

9. The thesis has been prepared without resorting to plagiarism. ☐ ✓ YES ☐NO

10. All sources used have been cited appropriately. ☐ ✓ YES ☐NO

11. The thesis has not been submitted elsewhere for a degree. ☐ ✓ YES ☐NO

12. Submitted 2 spiral bound copies plus one CD. ☐ ✓ YES ☐NO

Shruti

(Signature of the Candidate)
Name:Shruti Agarwal…….
Roll No …1190449003……...
Enrollment No.:11904490639…….

BABU BANARASI DAS UNIVERSITY, LUCKNOW
CERTIFICATE OF FINALTHESIS SUBMISSION
(To be submitted in duplicate)

1. Name: ……Shruti Agarwal……

2. Enrollment No.: …11904490639……..

3. Thesis title: Brain Segmentation of MRI Image Using Hybrid Neural Fuzzy Network....
……..……..

4. Degree for which the thesis is submitted: Master Of Technology…….

5. School (of the University to which the thesis is submitted)
…….School of Engineering(Computer Science Engineering)……..

6. Thesis Preparation Guide was referred to for preparing the thesis. ☐ ✓ YES ☐ NO

7. Specifications regarding thesis format have been closely followed. ☐ ✓ YES ☐ NO

8. The contents of the thesis have been organized based on the guidelines. ☐ ✓ YES ☐ NO

9. The thesis has been prepared without resorting to plagiarism. ☐ ✓ YES ☐ NO

10. All sources used have been cited appropriately. ☐ ✓ YES ☐ NO

11. The thesis has not been submitted elsewhere for a degree. ☐ ✓ YES ☐ NO

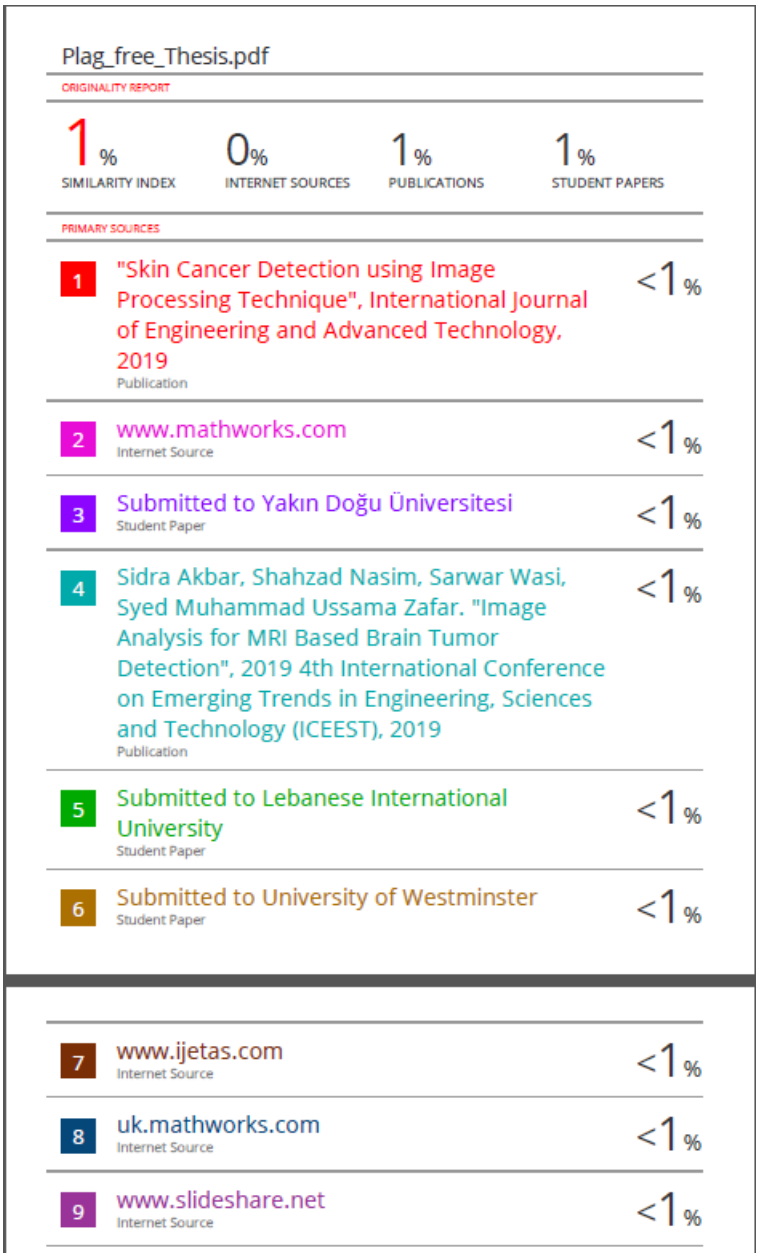
12. All the corrections have been incorporated. ☐ ✓ YES ☐ NO

13. Submitted 4 hard bound copies plus one CD. ☐ ✓ YES ☐ NO

(Signature(s) of the Supervisor(s))
Name(s): Dr Gaurav K Srivastava
Assistant Professor CSE,BBDU

(Signature of the Candidate)
Name:Shruti Agarwal……
Roll No: 1190449003……
Enrollment No.:11904490639……...

PLAGARISM REPORT



Plag_free_Thesis.pdf

ORIGINALITY REPORT

1%	0%	1%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	"Skin Cancer Detection using Image Processing Technique", International Journal of Engineering and Advanced Technology, 2019 Publication	<1%
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