

**A MODIFIED TECHNIQUE FOR BRAIN MRI CATEGORIZATION
USING 3-DGPR METHOD.**

*Thesis submitted in partial fulfillment of the requirements for the award of degree
of*

**Master of Technology
in
Computer Science & Application**

Submitted By

**Name Ankita Rani
(Roll No. 601634003)**

Under the supervision of:

Ashish Aggarwal
Assistant Professor



THAPAR INSTITUTE
OF ENGINEERING & TECHNOLOGY
(Deemed to be University)

**COMPUTER SCIENCE AND ENGINEERING DEPARTMENT
THAPAR INSTITUTE OF ENGINEERING AND TECHNOLOGY
PATIALA – 147004**

CERTIFICATE

I hereby certify that the work which is being presented in the thesis entitled, "*An modified technique for brain MRI categorization using 3-DPGR Method*" partial fulfillment of the requirements for the award of degree of Master of Technology in *Computer Science & Application* submitted in Computer Science and Engineering Department of Thapar Institute of Engineering and Technology, Patiala, is an authentic record of my own work carried out under the supervision of *Dr. Ashish Aggarwal* and refers other researcher's work which are duly listed in the reference section.

The matter presented in the thesis has not been submitted for the award of any other degree of this or any other University.


Signature:

Ankita Rani

This is to certify that the above statement made by the candidate is correct and true to the best of my knowledge.


M. S.
Dr. Ashish Aggarwal

Assistant Professor,
Computer Science &
Engineering Department

ACKNOWLEDGEMENT

First of all, I would like to express my sincere gratitude towards my supervisor *Mr.Ashish aggarwal* who has supported and guided me throughout my thesis work. He has been helping me from the very starting of my M.E. work in a properly organized manner. The brainstorming sessions in his cabin are among the most worthwhile experiences I have had during my Master's studies.

I appreciate Computer Science and Engineering Department of Thapar Institute of Engineering and Technology for providing the necessary research facilities. I am also thankful to Dr. Maninder Singh (HOD) and Dr. Sanmeet Bhatia (PG Coordinator) and all the respected faculty members of the department for their teaching and guidance. I would also want to extend my obligation towards Nava Nalanda Central Library for providing access to the prominent research journals.

Last but not the least I would like to thank my parents and friends for their support and encouragement. They have been always wanted the best for me and I admire their presence for me.

ABSTRACT

Innovation in medical field and advancements in technology for treating patients towards a healthy living and cure for their ailment is possible through successful researches by the efficient researchers. Invent of every new medicine and treatment involves a great number of people who gather together for a healthy study. In the past, in the absence of advanced technology, treatments were often given to patients based on guesses by the doctors which turned out to be a failure in most of the cases. Good research has removed such guess works from medical field in recent days. Research in medical science evolves many methods of good treatment, care and cure for the patients.

Each year, more than 19,000 people in the United States, 10,000 people in Canada and 9000 people in India are diagnosed with brain tumor. The overall incidence of all brain tumors is 100,000 people per year. Although as many as 70% of children diagnosed with brain tumors survive, but they are often left with long-term side effects. Recently most of the research works are based on early detection of brain tumor and its reliability. This thesis is based on MRI brain tumor detection by segmentation using various soft computing techniques.

TABLE OF CONTENTS

CERTIFICATE	i
ACKNOWLEDGEMENT	ii
ABSTRACT	iii
TABLE OF CONTENTS	iv
LIST OF FIGURES	vi
CHAPTER-1	1-
INTRODUCTION	16
1.1 Introduction	1
1.2 Image processing	1
1.2.1 Types of image processing	2
1.2.2 Applications	2
1.3 Biomedical imaging	3
1.3.1 Applications	4
1.3.2 Technique used in medical imaging	4
1.4 Human brain	5
1.5 Brain tumor	6
1.6 Causes of tumor	7
1.7 Categories of brain tumor	8
1.8 Brain tumor symptoms	9
1.9 Existing techniques to diagnose and treat brain tumor	9
1.9.1 Detection of brain tumor	10
1.9.2 Post biopsy treatment of brain tumor	11
1.10 Image segmentation	12
1.11 Brain tumor segmentation	13
CHAPTER-2	14
LITERATURE SURVEY	17
CHAPTER-3	

PROBLEM FORMULATION	-
3.1 Problem definition	24
3.2 Objectives	17
CHAPTER-4	25
METHODOLOGY	25
CHAPTER-5	25
EXPERIMENTAL RESULTS	25
5.1 MATLAB	
5.2 Experimental Results	26
5.3 Showing Segmented Image using OTSU method	-
5.4 Showing Objects in Cluster	27
5.5 Showing Segmented Tumor	
5.6 Showing Results of Proposed technique	26
5.7 Showing feature set	
5.8 Feature Set Plot	28
5.9 Showing Entropy Comparison	-
5.10 Showing Time Comparison	37
5.11 Showing Accuracy Comparison	
CHAPTER-6	28
CONCLUSION AND FUTURE SCOPE	
REFERENCES	28
	29
	30
	31
	32
	33
	35

35

36

36

37

38

38

39

-

43

LIST OF FIGURES

Fig4.1 Flowchart of Proposed Technique

Fig 5.1 Choosing the image

Fig 5.2 MRI Image of Brain

Fig5.3 Showing Segmented Image Using Otsu Method

Fig 5.4 Showing Objects in Cluster

Fig 5.5 Showing Segmented Tumor

Fig 5.6 Showing results of Proposed Technique

Fig 5.7 Showing Feature Set Plot

Fig 5.8 Feature set plot

Fig 5.9 Showing Entropy Comparison

Fig 5.10 Showing Time Comparison

Fig 5.11 Showing Accuracy Comparison

CHAPTER – 1

INTRODUCTION

1.1 Introduction

Tumor is the premier reason of death in financially created nations and the second most essential reason of death in creating nations. Tumor perceived restoratively as a risky neoplasm, is an expansive social event of a mix of diseases, all concerning unregulated cell improvement. In development, cells partitioned and breed for the most part, confining destructive tumors, and attack nearby parts of the body. The danger may in like manner reach out to additional distant parts of the body through the lymphatic structure or flow framework. Not all tumors are dangerous. Compassionate tumors don't make uncontrollably, don't ambush neighboring tissues, and don't spread all throughout the body.

Tumor can be recognized in different ways, including the closeness of particular signs and reactions, screening tests, or helpful imaging. Once a possible Tumor is recognized, by then it is investigated by tiny examination of a tissue test. Tumor is regularly treated with chemotherapy, radiation treatment and restorative technique. The chances of surviving the ailment change essentially by the sort and zone of the Tumor and the level of disease toward the start of treatment.

While Tumor can impact people everything considered, and a few sorts of Tumor are more commonplace in adolescents, the risk of making Tumor generally augments with age. In 2008, Tumor caused around 13% of each and every human death around the globe (7.9 million). Rates are climbing as more people live to a development and as mass lifestyle changes occur in the making scene [1]. More than 70% of all tumor passings occurred in low-and focus compensation countries. Passings from tumor worldwide are foreseen to continue climbing, with a normal 11.5 million passings in 2030.

Brain tumor is premier explanations behind ascent in mortality between youngsters & grown-ups. A tumor is a mass of tissue that spreads crazy of typical powers that manage

development. Brain tumors happen when one kind of cell changes from its typical attributes and develops and duplicates in an unusual way.

X-ray is utilized to recognize the nearness and nonappearance of tumors. X-ray deliver substantially more prominent variety among various delicate tissues of body than figured tomography (CT) does, making it unconventionally valuable in neurological (brain), oncological, musculoskeletal, cardiovascular and (growth) imaging. Unlike a CT filter. It benefits no ionizing radiation, however utilizes a ground-breaking attractive field to change the atomic polarization of (more often than not) hydrogen particles in water in the body.

1.2 Image Processing

Image processing is a procedure of changing a picture into advanced organization to get an upgraded picture by playing out a few tasks with a specific end goal to see some helpful data. It is the investigation and control of a digitized picture particularly for the change of its quality. The principle motivation behind picture preparing system is to recognize the picture under thought for less demanding representation and for picture honing and reclamation, picture recovery and example estimation. Image Processing shapes the center of the exploration territory inside designing, business and furthermore in software engineering disciplines [2].

It is a sort of banner organization in which input is the photo, like video packaging or photograph and the yield may be picture or some trademark related with that photo. Ordinarily Image Processing structure consolidates seeing pictures as two dimensional signs while applying the formally set banner taking care of procedures to them.

The Three steps of Image processing are as follows,

- i. Importing image with digital photography or optical scanner.
- ii. Manipulating and analyzing image that consists image enhancement & data compression and spotting patterns.

- iii. Output is the last stage in which the result can be an altered image or report that is based on image analysis.

1.2.1 Types of Image Processing

- i. Analog Image Processing
- ii. Digital Image Processing.

Visual strategies for picture planning can be used for the printed forms like printouts and photographs. Picture agents put cash on various nuts and bolts of interpretation while using these visual methods. The photo getting ready isn't just kept to a locale that must be considered anyway on the learning of the specialist. Association is another basic instrument in picture getting ready through visual techniques. So specialists apply a blend of individual data and certification data for picture getting ready [3].

Digital Processing methodology help responsible for the mechanized pictures by using PCs and a rough data of the imaging sensors from satellite stage contains needs. It needs to experience three general stages like pre-preparing, improvement and show, data extraction to acquire creativity of data [4].

1.2.2 Applications

- i. Intelligent Transportation Systems – This system can be utilized in Automatic number plate acknowledgment and Traffic sign acknowledgment.
- ii. Remote Sensing – For this application, sensors catch the photos of the world's surface in remote detecting satellites or multi– otherworldly scanner which is mounted on a flying machine. These photos are prepared by transmission to the Earth station. Systems used to translate the items and areas are utilized in surge control, city arranging, asset preparation, farming generation observing, and so on.
- iii. Moving Object Tracking – This application empowers estimation of movement parameters and obtains a visual record of the moving item.

- iv. Defense surveillance – Aerial surveillance techniques are utilized to ceaselessly watch out for the land and the seas. The critical obligation is to isolate the different items introduced in the water body some portion of the picture. The diverse parameters, for example, length, broadness, zone, border, smallness are set up for arrangement of each partitioned object.
- v. Automatic Visual Inspection System – This improves profitability & quality of item in enterprises (Example - Automatic investigation of glowing light fibers). This includes examination of the knob fabricating process. Because of the nonappearance of consistency in the contribute of the wiring the light, the fiber of the knob gets combined inside a brief length. In this application, a double picture cut of the fiber is made from which the outline of the fiber is created. Outlines are broke down for acknowledgment of the non-consistency in the contribute of the wiring the light. This framework is being utilized by General Electric Corporation.
- vi. Biomedical Imaging methods – For restorative finding, distinctive kinds of imaging devices, for example, X-beam, Ultrasound, Computer Aided Tomography (CT), Magnetic Resonance Imaging (MRI) are used.

1.3 Biomedical Imaging

Therapeutic imaging is the procedure of making visual depictions of within bit of a body for clinical examination and remedial intervention to reveal internal structures concealed by the skin and bones, and notwithstanding investigate and treat the sickness.

The expression "Biomedical Image Processing" implies the conveyance of computerized picture handling for biomedical sciences. Advanced picture handling turns out to be more essential in social insurance by expanding the utilization of direct computerized imaging frameworks for restorative diagnostics.

Therapeutic Imaging appeared in 1895 when W. K. Roentgen found X-beams. This development was an incredible advance forward for non-intrusive diagnostics. With time, different revelations in the field of restorative imaging were presented, similar to X-beams, bolster drug and attempted to accomplish more precise and compelling finding.

1.3.1 Applications

Biomedical imaging applications include the following:

- i. Heart disease identification– To categorize heart diseases, analytic highlights, for example, size of the heart and its shape are required. Picture examination strategies are utilized to radiographic pictures for improvement in the diagnosis of heart related treatments.
- ii. Lung disease identification – In X-rays, the locales that seem dim contain air, while the area that seems lighter are strong tissues.
- iii. Digital mammograms – This is utilized to distinguish the bosom tumor. Mammograms can be investigated utilizing Image preparing methods, for example, division, shape examination, differentiate upgrade, highlight extraction, and so forth.

1.3.2 Techniques Used in Medical Imaging

- i. X-Ray (radiograph) is a non-intrusive restorative imaging that includes introduction of a piece of the body to a little dosage of ionizing radiation to create photos of within the body.
- ii. CT has turned into an imperative device in medicinal imaging for supplementing X-beams and restorative ultrasonography. CT gadgets utilize numerous X-beams to make a cut by cut picture of the body.
- iii. Optical imaging includes age of pictures utilizing estimations of noticeable or close infrared light scattered crosswise over expansive thicknesses of tissue.
- iv. This sort of imaging is likewise called as Infrared. Thermography/warm imaging/warm video. Thermographic cameras distinguish radiation in the infrared scope of the electromagnetic range and deliver pictures of that radiation.
- v. Ultrasound has been utilized by sonographers to picture the human body for no less than 50 years and has turned out to be a standout amongst the most generally utilized demonstrative devices in present day prescription. This technique is utilized to envision embryos amid routine and crisis pre-birth mind. Such demonstrative applications utilized amid pregnancy are alluded to as obstetric

sonography.

- vi. MRI is a restorative imaging procedure utilized in radiology to envision definite inside structures of the Human body.

1.4 Human Brain

The brain is a perpetual place for examples to enter and keep up among each other. It is the source of all human conduct, contemplations, sentiments and comprehension. It additionally incorporates and controls identifying with adjust and autonomic capacities in the body. The mind produces numerous hormones and controls its preparing, mindfulness, consideration and joining identified with feeling. It is bolstered and ensured by the encompassing skin, bones of the skull & implications. It likewise holds watery liquid called cerebrospinal liquid. This liquid courses through spaces among implications & inside mind spaces known as ventricles. The skull is another unique defender of cerebrum. It is a profoundly confused structure and has conservative & versatile sorts of bones. It gives the structure of face & ensures the cerebrum. The cerebrum is formed of three noteworthy parts: the forebrain, midbrain and Hindbrain. The forebrain is take care of business of cerebrum, thalamus and hypothalamus. The greatest piece of the mind is the cerebrum. The cerebrum makes up 85% of the mind's weight. The cerebrum is the reasoning piece of the mind and it controls and keep up human willful muscles. The midbrain has tectum and tegmentum.

The hindbrain is shaping of cerebellum, pons and medulla. Mind is the boss for the dislodging, dream, appetite, thirst and basically every other fundamental movement important to survive. It controls primary five capacities are getting or taking the data by the faculties, putting away and reviewing the data, Analyzing and contemplating the data, Force the Controlling, Process the capacities at the same time or one by one and appointing all inner and outer elements of the body. This cerebrum encases astonishing number of neurons for computational process specifically unit. These neurons are joined inside the mind and those makes guide associations with different neurons.

The brain is a delicate, sensitive, non-replaceable and elastic mass of tissue. It is a steady place for examples to enter & settle between each other. It is the wellspring of all human

conduct, musings, sentiments and experience. The mind produces numerous hormones and manages its handling, acknowledgment, comprehension and coordination identified with feeling. It is reinforced and anchored by the enveloping skin, bones of the skull and the meninges. It similarly contains watery fluid called cerebro-spinal fluid. This fluid travels through spaces between the meninges & inside mind.

1.5 Brain Tumor

Innovation in medical field and advancements in technology for treating patients towards a healthy living and cure for their ailment is possible through successful researches by the efficient researchers. Invent of every new medicine and treatment involves a great number of people who gather together for a healthy study. In the past, in the absence of advanced technology, treatments were often given to patients based on guesses by the doctors which turned out to be a failure in most of the cases. Good research has removed such guess works from medical field in recent days. Research in medical science evolves many methods of good treatment, care and cure for the patients.

Each year, more than 19,000 people in the United States, 10,000 people in Canada and 9000 people in India are diagnosed with brain tumor. The overall incidence of all brain tumors is 100,000 people per year. Although as many as 70% of children diagnosed with brain tumors survive, but they are often left with long-term side effects. Recently most of the research works are based on early detection of brain tumor and its reliability. This thesis is based on MRI brain tumor detection by segmentation using various soft computing techniques.

The brain is a delicate springy mass of tissue. It is ensured by the bones of the skull and three thin layers called meninges. Watery liquid called cerebro spinal liquid pads the mind. This liquid courses through spaces between the meninges and through spaces inside the cerebrum called ventricles. The mass of cells that outcomes from this uncontrolled development is known as a tumor. While a portion of these tumors don't spread past their purpose of beginning, others are equipped for spreading vast separations, regularly to different organs and tissues. This procedure is called metastasis, and tumors that metastasize are called diseases. Brain tumors can either start from inside

the cerebrum (essential cerebrum tumors) or from disease cells that have metastasized from different organs or tissues (auxiliary cerebrum tumors). Essential mind tumors can be gotten from more than twenty distinctive cell composes that make up the cerebrum. They are named and ordered by the sort of cells that deliver them. The most widely recognized types of growth that deliver optional cerebrum tumors incorporate lung, bosom, kidney, and skin (melanoma) malignancy. While essential cerebrum tumors infrequently metastasize outside of the focal sensory system (CNS), they all have the penchant to spread inside the typical mind, and are all, hence, dangerous. Be that as it may, essential mind tumors do shift fundamentally as far as how quickly they develop and spread. Therefore, most essential cerebrum tumors are depicted as far as review. Poor quality tumors have a tendency to develop gradually and as often as possible stay torpid for extensive stretches of time, while high-review tumors develop and spread quickly.

If a person has symptoms such as headaches, seizures, vision or hearing issues, issues with shortcoming of the arms, legs or face muscles, and interesting sensations in your mind or hands that propose a cerebrum tumor, the specialist may perform at least one of the accompanying strategies: Physical exam, Neurological exam, CT output, and MRI filter. X-ray gives data that varies from other imaging modalities. Its major mechanical preferred standpoint is that it can describe and segregate among tissues utilizing their physical and biochemical properties (water, iron, fat, and additional vascular blood and its breakdown items). Blood stream, cerebrospinal liquid stream, and compression and unwinding of organs, both physiologic and pathologic, can be assessed. The capacity to acquire pictures in different planes adds to its flexibility and symptomatic utility and offers extraordinary focal points for radiation and additionally careful treatment arranging. Incredible outline of anatomic structures results from intrinsic large amounts of differentiation determination. In this thesis MRI brain tumor is detected from unsupervised segmentation technique and various soft computing methods.

Brain tumor plays main role in medical imaging. Tumor is a rapid differentiation growth of abnormal cells in human brain. Brain tumors are often challenging for doctors to diagnose and then give treatment. Diagnosing a cerebrum tumor more often than not includes a few stages. To start with, Doctor will play out a neurological examination,

which in addition to other things incorporates checking human vision, hearing, adjust, coordination and reflexes. Contingent upon the aftereffects of the examination, specialist may propose one of the accompanying tests: Computerized tomography (CT) filter, Magnetic reverberation imaging (MRI) check, Angiogram, X-beams, and single-photon outflow automated tomography (SPECT). X-ray gives substantially more noteworthy differentiation between the distinctive delicate tissues of the body than registered tomography (CT) does making it particularly helpful in neurological, musculoskeletal, cardiovascular, and oncological imaging.

The malignant brain tumors are further classified as Primary & Secondary Brain Tumors.

- i. Primary brain tumors start from cerebrum cells and can be gotten from the more than twenty diverse cell composes that make up the mind. They are named and classified by the sort of cells that create them.
- ii. Secondary brain tumor cells metastasize from other organs or tissues. The most widely recognized types of malignancy that create auxiliary cerebrum tumors incorporate lung, bosom, kidney, and skin (melanoma) growth.

1.6 Causes of Tumor

The causes for tumor are not known but rather certain elements have been recognized as hazard factors which can be reason for worry for the development of tumor. A portion of the hazard factors are portrayed underneath.

A tumor or neoplasm can be caused by an anomalous multiplication of tissues, which might be because of hereditary changes. Not a wide range of neoplasms cause tumorous abundance of tissue. Malignancy foundational microorganisms may assume a noteworthy part in tumor development. Researchers trust disease may have its own particular undifferentiated organisms that effect on the regrowth of tumors.

The development and division of cells in a sound individual are entirely controlled. New cells are made to supplant more established ones and cells that are harmed or never again, amazing as recently developed cells assume responsibility. In this way there is a harmony

amongst development and passing of cells. At the point when this adjust is exasperates a tumor might be framed.

Another explanation behind the reason for tumor might be diminished resistance of the body. The utilization of tobacco is another critical explanation behind reason for growth. Different causes included are benzene and different synthetic compounds and poisons, drinking excessively liquor, natural poisons, for example, certain noxious mushrooms, over the top presentation to daylight, hereditary issues, corpulence, radiation and infections [5, 6].

1.7 Categories of Brain Tumor

- i. **Primary brain tumor:** A Primary malignant brain tumor is one that starts in the mind itself. Albeit essential cerebrum tumors regularly shed dangerous cells to different locales in the focal sensory system (the mind or spine), they once in a while spread to different parts of the body. Essential cerebrum tumors are named because of the cell composes, from which they are begun.
- ii. **Secondary brain tumor:** A secondary (metastatic) brain tumor happens when disease cells spread to the cerebrum from an essential tumor in another piece of the body. Auxiliary tumors are around three times more typical than essential tumors of the mind. Auxiliary or metastatic cerebrum tumors take their beginning from tumor cells which spread to the mind from another area in the body.
- iii. **Benign tumor:** A tumor (solid neoplasm) that makes them constrain development does not overcome different tissues or metastasis. An amiable tumor does not contain malignancy cells and ordinarily, once expelled, does not repeat. Most favorable cerebrum tumors have clear outskirts, which means they don't attack encompassing tissues. These tumors can, be that as it may, cause side effects like destructive tumors due to their size and area in the mind.
- iv. **Malignant tumor:** Malignant brain tumors contain cancer cells. Malignant brain tumors are typically quickly developing and vanquish encompassing tissues. It

scarcely spread to different zones of the body, however may repeat after treatment.

Sometimes, mind tumors that are not growth are called threatening as a result of their size and area, and the harm they can do with the indispensable elements of the cerebrum.

1.8 Brain Tumor Symptoms

As indicated by the exploration led by the Musella establishment for cerebrum tumor research and data on different patients and distinguished the accompanying real side effects of mind tumor. Mind tumor patients detailed social and intellectual changes, for example, issues with ongoing memory, failure to focus or searching correct words, carrying on - no persistence or resistance, & loss of restraints - saying or doing things that are not suitable for circumstance. Mind tumor side effects differ from patient to patient, & greater part of these manifestations can likewise be found in individuals who don't have cerebrum tumors.

1.9 Existing Techniques to Diagnose and Treat Brain Tumor

The current technological development in Digital image processing and analysis has found many applications in various fields like satellite image analysis, medical image analysis and other industrial applications related to process automation. Recently, researchers have developed automated computer based analysis systems for tissue classification and analysis, but none of them provide precise morphological information for the cancerous tumors.

1.9.1 Detection of Brain Tumor

Till today, there are no blood tests or other screening tests recommended by the medical experts for detection of brain tumors .Therefore, the early detection and immediate treatment can definitely improve the survival rate of the patient.

After reviewing the physical symptoms of the suspected patient of brain tumor, a diagnosis of brain tumor consists following steps:

a. Neurological examination

b. Brain scan

c. Biopsy.

Neurological Examination: A neurological examination is a progression of tests to quantify the capacity of the patient's sensory system and physical and mental readiness. A common test includes testing of reflexes, sensation, muscle quality, eye and mouth development, coordination, and readiness [7, 8]. In the event that reactions to these tests are not typical, the doctor may suggest examining of cerebrum and after that alludes the patient to a neurologist or neurosurgeon.

Brain Scan Techniques: A scan is an image of the inner structures in the cerebrum. Utilizing PC innovation, an output orders a picture of the cerebrum by shooting it from different points. Nowadays, with advancement of computer technology, all the images are readily available in digital form [9, 10]. The various scanning or imaging techniques are available as listed below:

(i) Magnetic resonance imaging (MRI)

(ii) Computed tomography (CT)

(iii) Positron emission tomography (PET)

(iv) X-Ray

(v) Angiogram

Biopsy: Biopsy is a surgery in which an example of tissue is taken from the tumor site and inspected under a magnifying instrument. The biopsy will give data about the kinds of anomalous cells display in the tumor. The reason for a biopsy is to find the sort and grade of a tumor. A biopsy is the most precise strategy for acquiring a determination [8, 9, 11]. Once an example is gotten, a pathologist analyzes the tissue under a magnifying lens and investigations the mind tissue. Some of the time the pathologist will be unable to

make a correct determination. This might be on the grounds that in excess of one review of tumor cells exists inside a similar tumor.

1.9.2 Post-Biopsy Treatment of Brain Tumor

After analyzing the sample brain tissue by Biopsy and confirming the presence of cancer, the following post Biopsy treatment of Brain tumor are recommended by the Neurologists depending on the diagnosis:

i) Surgery

ii) Radiation Therapy

iii) Chemotherapy.

A brief review of post biopsy treatments is presented below.

Surgery: Surgery is the first line of treatment for patients with essential mind tumors. For a few tumors, finish careful expulsion is regularly conceivable. Grade I Tumors like astrocytomas and ependymomas can be removed entirely [8, 12]. However, if the tumors cannot be completely removed safely without affecting adjacent normal brain tissue, partial removal of tumor can have a noteworthy advantageous impact on the viability of other supporting medications, for example, radiation treatment and chemotherapy.

Radiation Therapy: The term 'radiation therapy' as a matter of fact signifies an assortment of medications that use subatomic particles or the radiation that these particles discharge to treat tumor. Radiation treatment (otherwise called 'radiotherapy') arrives in an assortment of structures and it can slaughter disease cells by an assortment of instruments. External beam, fractionated radiotherapy is one of the important types of radiation therapy. This type of treatment utilizes high-vitality radiation, which is created from a source that is situated outside of the body to harm the DNA of tumor cells. Tumor cells are not as productive as would be expected cells in repairing the harm caused by radiation [8, 11]. In this way, giving this type of radiation in little measurements at standard interims, enables the typical cells to recoup from harm while tumor cells can't recuperate.

Chemotherapy: Chemotherapy may be defined as any pharmaceutical, managed by mouth, intravenously, or specifically into the cerebrum, which forestalls encourage tumor development. There has been a veritable blast of new medications and new strategies for regulating these medications that were not accessible ten years back. Classical chemotherapy is the most commonly performed chemotherapy for treatment of tumor [13]. Most of the drugs, used for chemotherapy, harm essential cell apparatus and accordingly incite the phones to experience a procedure called 'apoptosis'. Apoptosis happens in ordinary cells when their DNA is seriously harmed or transformed. Under these conditions, cells initiate a progression of procedures and don't pass on their harmed DNA to their offspring cells and don't meddle with ordinary real capacity. At the end of the day, apoptosis is a type of 'cell suicide' intended to shield our bodies from the risky impacts of malignancy influenced DNA. By harming DNA or meddling with the duplication of DNA that happens when cells increase, these chemotherapeutic medications instigate the tumor cells to experience apoptosis—driving eventually to the demise of the tumor [10]. Thus, depending on type or grade of the tumor and its intrusion in the neighboring normal brain tissue, the physician recommends one of the treatments to the patient.

1.10 Image Segmentation

Image segmentation includes apportioning a picture into an arrangement of homogeneous and important locales, with the end goal that the pixels in each divided district have an indistinguishable arrangement of properties or traits [14]. These arrangement of properties of the picture may incorporate dim levels, differentiate, ghastly qualities or textural properties. Such division, brings about various homogeneous locales, each having remarkable name. A picture is along these lines characterized by an arrangement of locales that are associated and covering, with the goal that every pixel in the picture secures a one of a kind area. The sectioned arrangement of picture objects experiences ensuing preparing of question characterization and scene depiction, with a specific end goal to perceive the district in the scene.

The primary target of example acknowledgment is to perceive questions in the scene

from an arrangement of estimations of the items. Each protest is an example and the deliberate qualities are the highlights of the example. In this manner, these deliberate highlights of the protest may constitute crude pixels of information or the limit of the district, or gathering of pixels isolating distinctive areas or every one of the focuses in the locale that can be made as a contribution to the portrayal and question depiction phase of the DIP for recognizing and marking the protest. The portrayal is likewise called highlight determination which manages removing properties that outcome in some quantitative data of enthusiasm for separating one class of articles from another. Picture division is a fundamental picture preparing system and it is utilized wherever the picture examination is required.

1.11 Brain Tumor Segmentation

The critical objective of cerebrum tumor imaging investigation is to separate the patient-particular huge clinical data, and the demonstrative highlights. This data implanted inside the multidimensional picture information, can prompt and oversee intercessions after the infection has been detected and limited, in the long run prompting learning for clinical determination, organizing, and treatment of malady. These procedures can be spoken to diagrammatically as a pyramid [15]. At each level of the pyramid, exact methods are fundamental to process the information, concentrate, mark, and speak to the data.

The primary goal of picture division is to segment a picture into fundamentally unrelated areas to such an extent that every locale is spatially bordering and the pixels inside the district are homogeneous as for a predefined rule [16]. This characterizes the significant constraint of the greater part of the division techniques, particularly when characterizing and depicting "unusual tissue writes", on the grounds that the tumors to be sectioned are anatomical structures which are regularly non-unbending and complex fit as a fiddle, differ incredibly in size and position, and show extensive inconstancy from patient to tolerant.

Brain tumor division strategies can be characterized into three classifications as per the level of the required human communications in particular manual division, self-loader division, and completely programmed division.

- i. **Manual Segmentation:** Manual segmentation of brain tumors includes manual illustration of the limits of the tumor and structures of intrigue, or painting the district of anatomic structures with various marks. Here, human specialists (radiologists/anatomists/prepared technologists) not just make utilization of the data exhibited in the picture yet additionally make utilization of extra information, for example, life systems. Manual depiction requires programming devices with refined graphical UIs to encourage drawing locales of intrigue and picture show. Practically speaking, the choice of the tumor area, which is the Region of Interest (ROI), is a monotonous and tedious undertaking. X-ray scanners create different two-dimensional cross-areas (cuts), and the human master needs to experience the dataset cut by cut for picking the most illustrative ones from which the applicable districts are deliberately depicted. Manual division of cerebrum tumors is likewise ordinarily done based on a solitary picture with power upgrade gave by an infused differentiate operator.
- ii. **Semiautomatic Segmentation:** The mediation of a human administrator is regularly required in self-loader cerebrum tumor division to introduce the strategy, to check the exactness of the outcome, or even to physically rectify the division result. The vast majority of the ebb and flow inquire about is focused at self-loader division of cerebrum tumors with the expectation of having the slightest human cooperation conceivable. The principle segments of an intelligent cerebrum tumor division technique are the computational part, the intuitive part, and the UI. The computational part compares to at least one bits of projects equipped for producing a depiction of the tumor which gives a few parameters. The intelligent part is in charge of interceding data between the client and the computational part. It deciphers the result created by the computational part into visual criticism to the client and the information contribution by the client into parameters for the program. The genuine correspondence between the PC and the client is done by means of the yield and information gadgets controlled by the UI. The client breaks down the visual data showed on the screen and responds appropriately, giving criticism to the calculation.

- iii. **Fully automatic Segmentation:** In fully automatic methods, the computer decides the division of tumor with no human collaboration. Completely programmed strategies by and large fuse human insight and earlier learning in the calculations, and are normally created making utilization of delicate registering and model-based methods, for example, deformable models.

Be that as it may, growing exceptionally exact programmed strategies remains a testing issue. This is effortlessly clarified by the way that people must utilize abnormal state visual handling, and should join particular space information to play out this assignment, which makes growing completely programmed strategies to a great degree troublesome. Despite the fact that this is valid for some example acknowledgment and vision issues, mind tumor division has a few properties that diminish the preferred standpoint that people have over machines. For instance, the cerebrum anatomical properties can help the accentuation of the head's appearance in MR pictures as generally unsurprising, the mind is very much evaluated basically, and the conduct of various tissue composes in various MR modalities is all around portrayed.

Moreover, there is no fleeting part and the mind stays stationary. Henceforth the capacity to outwardly track protests after some time has no preferred standpoint. Another property which diminishes the upside of people over machines is that the perspective is known and that people see the information as a progression of two-dimensional cuts. Along these lines the capacity of people to utilize three dimensional data in division is likewise decreased in this errand since there is no three-dimensional demonstrating of structures in light of a huge scope of perspectives of the protest. Concerning the light, albeit neighborhood attractive in homogeneities of the curls framework and powerlessness impacts caused serious issues for post-preparing of the informational indexes and medicinal diagnostics, in the most recent decade a few hearty calculations for redressing force in homogeneities in MRI pictures have been proposed, making the capacity to adjust for contrasts in brightening less of preference.

CHAPTER – 2

LITERATURE SURVEY

El-Dahshan et al. [17] suggested a hybrid technique, in which feed forward pulse-coupled neural network is applied for the segmentation of the brain images. For feature extraction they consider approximation component of DWT. For feature reduction they used PCA and for the classification they used back propagation neural network and achieved 99% accuracy.

Chaplot et al. [18] have introduced a scheme for feature extraction and classification. To validate the introduced system they are taken a standard dataset of 52 brain MRI images. For feature extraction, they consider coefficient of level-2 approximation subband of 2D DWT. Daubechies-4 (DAUB4) filter is used as decomposition filter. After getting the features they employed SOM & SVM as classifier & they achieved higher classification rate for SVM with radial basis function (RBF) classifier i.e. 98% compared to the self-organizing map i.e. 94%.

Chatterjee et al. [19] have planned a scheme for feature extraction and classification. For the feature extraction they have used slantlet transform (ST) and for the classification they used BPNN and archived ideal result. In [5] they introduced a scheme, they used ST for feature extraction and fuzzy c-means for classification and from the experimental result they observed that the proposed scheme outperformed.

Selvaraj et al. [20] suggested a system for brain MR image classification. For classification they have used many classifier i.e. SVM classifier, Neural classifier, statistical classifier. Among all these classifier LS-SVM outperformed with 98% of success rate.

El-Dahshan et al. [21] suggested a technique. The suggested technique comprises three stages i.e. feature extraction, feature reduction and classification. For feature extraction

the approximation subband of DWT is considered. PCA is used for feature reduction and for the classification FP-ANN & k-NN used as classifier & they attained 97% & 98% accuracy, respectively.

Zhang et al. [22] have proposed a scheme for classification. They have taken 160 images (20 normal, 140 abnormal) to validate the scheme. For feature extraction level-3 approximation component using Haar wavelet is used. After feature extraction, PCA is used for feature reduction and for the classification forward neural network is used and they achieved 98.75% classification accuracy.

Saritha et al. [23] suggested a scheme, in which they have used entropy of wavelet approximation component at level-8 computed along with SWP for feature extraction. For the classification they used Probabilistic neural network (PNN) and their results indicate that they achieve high success rate.

Yang et al. [24] suggested a wavelet-energy based approach for brain MR image classification. For feature extraction they have used 2D DWT. For brain image classification SVM classifier was employed and BBO method was utilized to optimize the weights of the SVM. They noticed that their scheme was superior than KSVM, PSO-KSVM and BPNN.

Nayak et al. [25] have proposed hybrid technique for brain MR image classification. For feature extraction through brain MR images they utilize the approximation coefficient of level-3 of discrete wavelet transform (DWT). To reduce the large set of extracted features from brain MR images they have employed kernel principal component analysis (KPCA). After getting the reduced set of features they have employed least square support vector machine (LS-SVM) as a classifier with different kernel function and they have reported that proposed scheme outperforms with high accuracy.

Rao et al. [26] introduce a mechanized technique to distinguish and portion the cerebrum tumor districts. Therapeutic picture planning is an exceedingly troublesome field. Therapeutic imaging procedures are used to picture the inside bits of the human body for helpful conclusion. MR pictures are broadly utilized as a part of the analysis of mind

tumor. The proposed strategy comprises of three principle steps: introductory division, demonstrating of vitality work and advance the vitality work. To influence our division more solid we to utilize the data exhibit in the T1 and FLAIR MRI pictures. We utilize Conditional arbitrary field(CRF) based structure to consolidated the data introduce in T1 and FLAIR in probabilistic area. Fundamental favorable circumstances of CRF based system is we can demonstrate complex shapes effectively and we fuse the perceptions in vitality work.

Purnima et al. [27] proposed another approach towards this field i.e. Wise Water Droplets calculation. Mind tumor limit discovery is of most extreme significance these days in medicinal line as a great many cases are being enrolled day by day of this deadly tumor. For this reason various division systems are additionally being utilized, for example, Multifractal Texture Estimation, Artificial Bee Colony calculation, Integrated Bayesian Model and so on. Be that as it may, aftereffects of these calculations are very little effective. IWD is a swarm based approach that has been utilized as various critical thinking strategies and because of its inclination to deliver much ideal and effective outcomes, I have instilled it in recognizing the limit of mind tumor in MRI pictures.

Zhang et al. [28] proposed a novel self-loader division calculation to section mind tumors from attractive reverberation imaging (MRI) pictures. Initial, an edge mindful channel is utilized to get the smoothed variant of the first picture. Also, Otsu construct multilevel thresholding is performed in light of the smoothed picture and the first picture, individually. At that point the two division maps are combined by the administer of K Nearest Neighbors (KNN) to acquire the refined division result. The blend of the three stages can be signified as multi-scale Otsu based division. At last, a bi-directional district developing strategy is utilized to portion the mind tumor area around seeds which are embedded by the client. The proposed calculation is tried on MRI-T2 pictures and it produces promising outcome: the fragmented tumor areas are more precise contrasted with those acquired by other cutting edge strategies.

Sehgal et al. [29] acquainted a completely programmed technique with recognize cerebrum tumors. A cerebrum tumor or intracranial neoplasm is shaped when irregular

cells get amassed inside the mind. These cells duplicate in an uncontrolled way and harm the mind tissues. Attractive Resonance Imaging (MRI) filters are generally used to analyze cerebrum tumors. Notwithstanding, dividing and identifying the mind tumor physically is a monotonous assignment for the radiologists. Henceforth, there is a requirement for programmed frameworks which yield precise outcomes. The proposed strategy comprises of five phases, viz., Image Acquisition, Preprocessing, Segmentation utilizing Fuzzy C Means procedure, Tumor Extraction and Evaluation. Tumor extraction is completed by utilizing Area and Circularity as a criteria. The outcomes are at long last checked by contrasting them and the physically sectioned Ground Truth. Dice coefficient is likewise figured and the normal dice coefficient esteem got was 0.729.

Pereira et al. [30] propose a programmed division strategy in view of Convolutional Neural Networks (CNN), investigating little 3 portions. Among cerebrum tumors, gliomas are the most well-known and forceful, prompting a short future in their most elevated review. In this manner, treatment arranging is a key stage to enhance the personal satisfaction of oncological patients. Attractive reverberation imaging (MRI) is a generally utilized imaging procedure to evaluate these tumors, yet the substantial measure of information delivered by MRI counteracts manual division in a sensible time, constraining the utilization of exact quantitative estimations in the clinical practice. Thus, programmed and dependable division techniques are required; be that as it may, the extensive spatial and basic fluctuation among cerebrum tumors make programmed division a testing issue. The utilization of little pieces permits outlining a more profound design, other than having a constructive outcome against overfitting, given the less number of weights in the system. This paper additionally examined the utilization of force standardization as a pre-handling step, which however not regular in CNN-based division strategies, turned out to be extremely successful for cerebrum tumor division in MRI pictures.

Lu et al. [31] proposed anisotropic dispersion and Markov irregular field (MRF) smooth limitation. Mind tumor division strategy is a critical clinical prerequisite for the cerebrum tumor finding and the radiotherapy arranging. Be that as it may, the quantity of bunches is exceptionally hard to characterize for high decent variety in the presence of tumor

tissue among the diverse patients and the vague limits about the sores. In our investigation, the nonparametric blend of Dirichlet process (MDP) show is utilized to section the tumor pictures consequently, which can be performed without introduction of the bunching number. Division comes about for the multimodal MR glioma picture groupings demonstrated the properties, for example, precision and processing speed about our calculation exhibits extremely great.

Goel et al. [32] presents a Multispectral approach for division of tumor center utilizing three MRI symbolism viz. T1-differentiate, T2 and Flair. In all nations the quantity of individuals determined to have mind tumor is expanding quickly. This puts individuals' life in genuine peril. A lot of MRI filters demonstrating cerebrum tumor are as of now being created in centers. The manual procedure for tumor division by Radiologists is very tedious and inclined to human mistakes and inclinations. Subsequently programmed and dependable frameworks to do the errand are required. The proposed calculation for division of cerebrum tumor is free of info parameters and appraisals. So it is totally self-ruling. The calculation works in five stages: Image Acquisition, Image Enhancement took after by Segmentation (Fuzzy C Means calculation) at that point Extraction of tumor center utilizing Area and Circularity as criteria lastly assessing the outcome with Ground Truth. The mean estimation of dice coefficient for portioning tumor center is 0.88. Subsequently division of tumor center utilizing proposed strategy yields proficient outcomes.

Dawngliana et al. [33] proposed hybridized multilevel thresholding and level set technique for programmed division of mind tumor. Division of tumor from attractive reverberation picture (MRI) mind pictures is a developing examination region in the field of therapeutic picture division. As division of mind tumor assumes a vital part for fundamental treatment and arranging of tumor medical procedure. Notwithstanding, division of the cerebrum tumor is as yet an extraordinary test in centers, exceptionally programmed division. The advancement for this paper is to interface the underlying division from multilevel thresholding and concentrate a fine representation utilizing level set technique with morphological activities. The outcomes are contrasted and the current strategy and furthermore with radiologist manual division which affirm the adequacy of

this hybridized worldview for mind tumor division.

Akram et al. [34] propose a strategy for programmed mind tumor demonstrative framework from MR pictures. Theoretical - Magnetic reverberation (MR) pictures are an exceptionally helpful instrument to recognize the tumor development in cerebrum yet exact mind picture division is a troublesome and tedious process. The framework comprises of three phases to recognize and fragment a mind tumor. In the primary stage, MR picture of cerebrum is obtained and preprocessing is done to expel the commotion and to hone the picture. In the second stage, worldwide limit division is done on the honed picture to portion the mind tumor. In the third stage, the divided picture is post handled by morphological tasks and tumor veiling so as to evacuate the false portioned pixels. Results and analyses demonstrate that our propose procedure precisely recognizes and sections the mind tumor in MR pictures.

Edgar et al. [35] introduce a methodical way to deal with describe inconstancy in tumor limits that uses comparability tests as a way to decide if a tumor volume has fundamentally changed after some time. Mind tumor investigation is moving towards volumetric evaluation of attractive reverberation imaging (MRI), giving a more exact portrayal of malady movement to better educate clinical basic leadership and treatment arranging. While a large number of division approaches exist, innate inconstancy in the aftereffects of these calculations may mistakenly show changes in tumor volume. To show these ideas, 32 MRI thinks about from 8 patients were divided utilizing four unique methodologies (factual classifier, locale based, edge-based, information based) to create distinctive areas of enthusiasm speaking to tumor degree. We demonstrated that over all examinations, the normal Dice coefficient for the superset of the diverse strategies was 0.754 (95% certainty interim 0.701-0.808) when contrasted with a reference standard. We show how inconstancy got by various divisions can be utilized to distinguish critical changes in tumor volume between consecutive time focuses. Our examination shows that inconstancy is an intrinsic piece of deciphering tumor division comes about and ought to be considered as a component of the understanding procedure.

Aslam et al. [36] introduced an Improved Edge Detection calculation for mind tumor

division. Picture division is utilized to isolate objects from the foundation, and hence it has ended up being an intense apparatus in bio-therapeutic imaging. It relies upon Sobel edge distinguishing proof. It combines the Sobel system with picture subordinate thresholding methodology, and finds unmistakable areas using close shape computation. Finally tumors are removed from the photo using power information inside the close shapes. The count is completed in C and its execution is evaluated evenhandedly and what's more emotionally. Reenactment occurs show that the proposed count gives better execution over conventional division procedures. For relative examination, diverse parameters are used to display the power of proposed methodology over the customary ones.

Samriti et al. [37] defer utilizing watershed and differentiation strategy. In therapeutic picture handling mind tumor location is a testing errand. Picture of cerebrum is hard to get it. Commotion and postpone influences the picture precision. In this technique MRI (attractive reverberation imaging) has turned into a valuable therapeutic indicative device for conclusion of cerebrum and other restorative pictures. Picture division is a noteworthy region of medicinal picture handling.

Dubey et al. [38] surveys a few existing mind tumor division and location strategy for MRI of cerebrum picture. Division of hierarchical fragments of the cerebrum is the fundamental issue in restorative picture examination. Out and out the stages for recognizing mind tumor have been talked about containing pre-preparing steps. Pre-handling includes a few tasks like non nearby, analytic amendment techniques; Markov arbitrary field strategies and wavelet based techniques have been talked about.

Kothari et al. [39] talked about different division systems. Division of cerebrum tumor is a vital and urgent advance in the underlying location of tumor in the Medical Image Analysis. In spite of the fact that different strategies are available for cerebrum tumor division, yet discovery of tumor still is a testing undertaking since for specialists as tumor has complex qualities in appearance and limits. Cerebrum tumor division must be finished with accuracy in the clinical practices. The target of this audit paper is to presents a complete outline for MRI cerebrum tumor division techniques. Relative

examination among these different division traditions has been talked about in a word.

Bahadure et al. [40] division, identification, and extraction of tainted tumor zone from attractive reverberation (MR) pictures are an essential concern however a dull and time taking undertaking performed by radiologists or clinical specialists, and their exactness relies upon their experience as it were. In this way, the utilization of PC helped innovation turns out to be extremely important to defeat these confinements. In this examination, to improve the execution and diminish the multifaceted nature incorporates into the therapeutic picture division process, we have investigated Berkeley wavelet change (BWT) based cerebrum tumor division. In addition, to improve the accuracy and quality rate of the assistance vector machine (SVM) based classifier, apropos features are expelled from each distributed tissue. The exploratory outcomes of proposed strategy have been evaluated and affirmed for execution and quality examination on alluring resonation mind pictures, in perspective of precision, affectability, specificity, and dice comparability list coefficient. The exploratory results achieved 96.51% exactness, 94.2% specificity, and 97.72% affectability, demonstrating the feasibility of the proposed procedure for perceiving ordinary and irregular tissues from mind MR pictures. The preliminary happens in like manner gained a typical of 0.82 dice comparability document coefficient, which indicates better cover between the modernized (machines) evacuated tumor zone with physically removed tumor region by radiologists. The propagation comes to fruition show the importance to the extent quality parameters and precision interestingly with front line frameworks.

Jasmine et al. [41] reason for this investigation is to investigate the MR pictures of the cerebrum tumor division strategies and imaging modalities. In human body the imperative part is mind. Thus, cerebrum picture division is to be done precisely and superbly. Cerebrum tumor division is to separate the accessible tumor tissues like dynamic cells, neroticcore, and edema from ordinary mind tissues of WM, GM & CSF. From the review of the tumor division every one of these years it is discovered that cerebrum tumors can be effectively identified through MR pictures. The conclusion and investigation will be reliant on the level of division exactness. The tasks to be handled before division is broke down with the examination of various mind pictures and the

characteristics of various methodologies are considered and looked into altogether.

CHAPTER – 3

PROBLEM FORMULATION

3.1 Problem Definition

An abnormal growth of cells in the brain is called a brain tumor. A brain tumor consists of a collection of abnormally functioning brain cells that have begun to grow and reproduce inappropriately. The uncontrolled growth of group of cells compresses and damages normal brain structures, which causes a variety of neurological symptoms. According to the reports of National Cancer Institute, Primary brain tumors are the leading cause of tumor cancer deaths in children, now surpassing acute lymphoblast leukemia and are the third leading cause of cancer death in young adults ages 20 to 39. There are more than 120 different types of brain tumors, making effective treatment very complicated. As per classification system defined by World Health Organization (WHO), brain tumor is named for the cell type of origin. Brain tumors can either originate from within the brain or from cancer cells that have metastasized from other organs or tissues. Various techniques are developed in the past to detect brain tumor. This research work proposed a Modified Technique for Brain MRI Categorization using 3-DPGR (3-Level Daubechies wavelet , PCA,GLCM and RBF Kernal) Method.

3.2 Objectives

1. Study different Brain MRI techniques and Tumor types.
2. Load the MRI Image and Perform Segmentation to extract list of features like - Variance, Kurtosis, Skewness, Contrast, Correlation and Entropy.
3. Based upon features Train RBF Kernel using Support vector machine to show the type of Tumor and system Accuracy.

CHAPTER – 4

METHODOLOGY

1. Input the Brain MRI Image. The magnetic resonance image of brain is taken as input image for further processing.
2. Resize Image into 200x200 Size
3. Apply Otsu Method for binary Segmentation. Otsu method is used to automatically perform clustering-based image [thresholding](#) or the reduction of a graylevel image to a binary image.
4. Apply 3-Level Daubechies wavelet transform. The Daubechies wavelet transforms are stated in similar manner as Haar wavelet transform by calculating running averages and differences via scalar products with scaling signals and wavelets the only difference among them comprises in how these scaling signals and wavelets are stated.
5. Pass 3-Level Daubechies wavelet transform feature by Principal Component Analysis to generate best feature Matrix. *Principal component analysis (PCA)* is a statistical procedure which utilizes an orthogonal transformation to convert a

set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables known as principal components.

6. Optimized Features Matrix using GLCM (Gray-Level Co-Occurrence Matrix). A factual strategy for looking at surface that considers the spatial relationship of pixels is the gray-level co-occurrence network (GLCM), otherwise known as dim level spatial reliance grid. The GLCM capacities portray the surface of a picture by ascertaining how frequently combines of pixel with particular esteems and in a predetermined spatial relationship happen in a picture, making a GLCM, and after that separating factual measures from this lattice.
7. Extract list of features like - Variance, Kurtosis, Skewness, Contract, Correlation and Entropy.
8. Create a Feature Matrix by combining all above features values.
9. Pass combined feature Matrix through Support Vector Training using Radial Basis Function (RBF)
10. Perform training using Support Vector Machine (SVM) and Classify Tumor type with accuracy percentage.

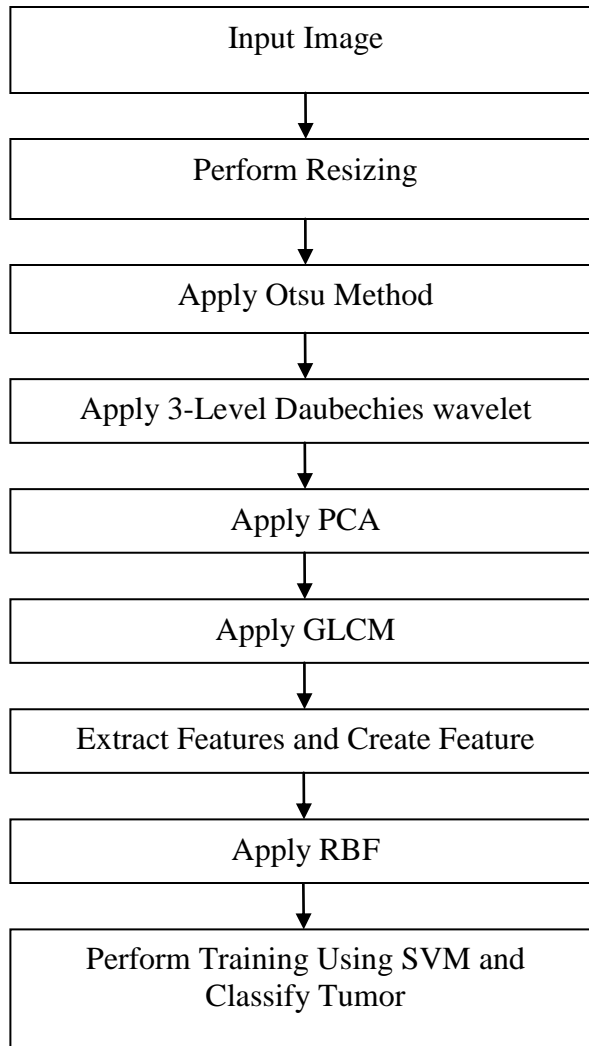


Figure 4.1: Flowchart of Proposed Technique

CHAPTER – 5

EXPERIMENTAL RESULTS

5.1 MATLAB

For implementation of the proposed system, MATLAB apparatus is utilized. MATLAB

remains for 'Grid Laboratory'. MATLAB is a shrewd structure whose fundamental information factor is a bunch that doesn't require dimensioning. This permits tending to many committed handling inconveniences, particularly those with system and vector itemizing, in a brief period it'd take to make programming in a scalar non astute vernacular, for example, "C" and 'FORTRAN'.

MATLAB is a predominant tongue for particular enlisting. MATLAB is an instinctive structure whose basic data segment is a show that does not require dimensioning. It joins computation, portrayal, and programming in an easy to-use condition where issues and courses of action are imparted in ordinary numerical documentation. Typical utilizations consolidate Math and estimation Algorithm change Data getting Modeling, reenactment, and prototyping Data examination, examination, and observation Scientific and outlining delineations Application headway, including graphical UI building. Tool compartments are far reaching accumulations of MATLAB capacities (M-documents) that stretch out the MATLAB condition to tackle specific classes of issues. There is also an image processing toolbox in MATLAB.

5.2 Experimental Results

This section presents experimental results of the proposed technique.

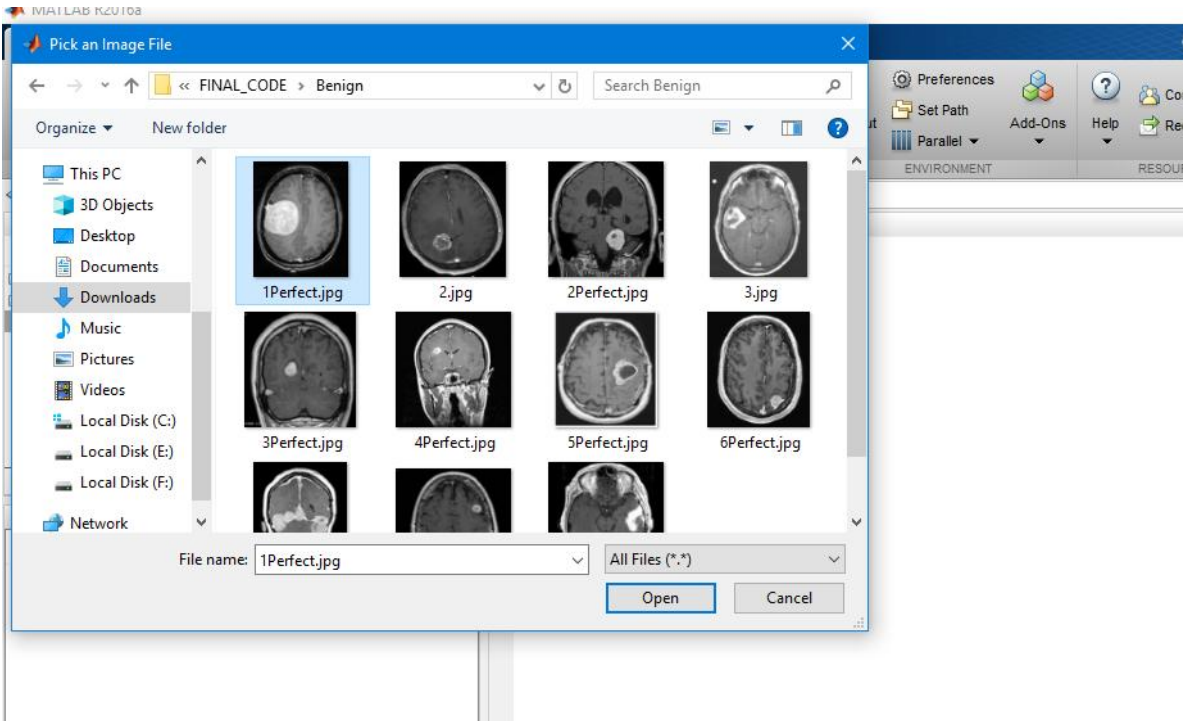


Figure 5.1: Choosing the image

This is the first window, Here we select an image of brain to segment brain tumor.

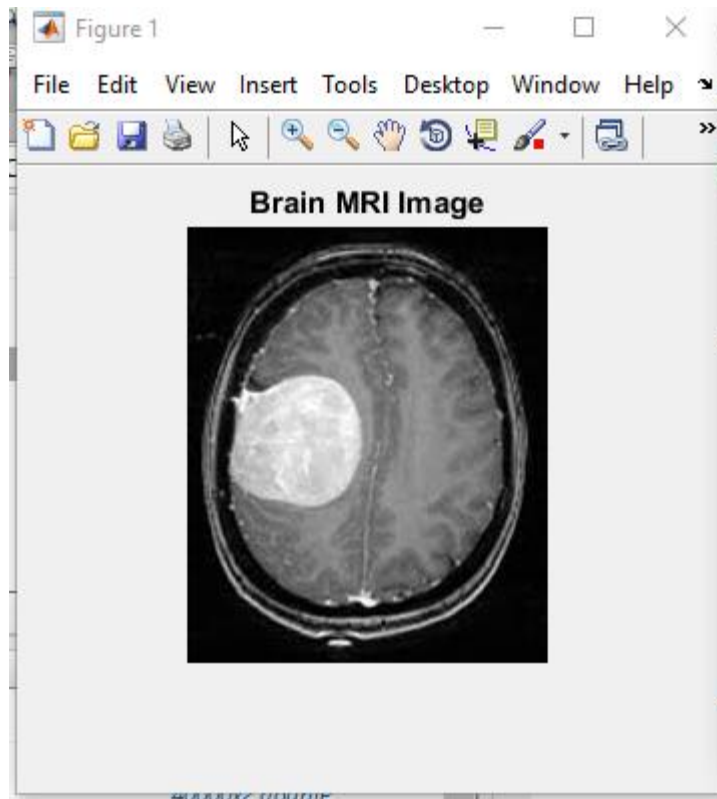


Figure 5.2: MRI Image of Brain

Above figure shows magnetic resonance image (MRI) of brain. MRI is a noninvasive method for imaging internal tissues and organs.

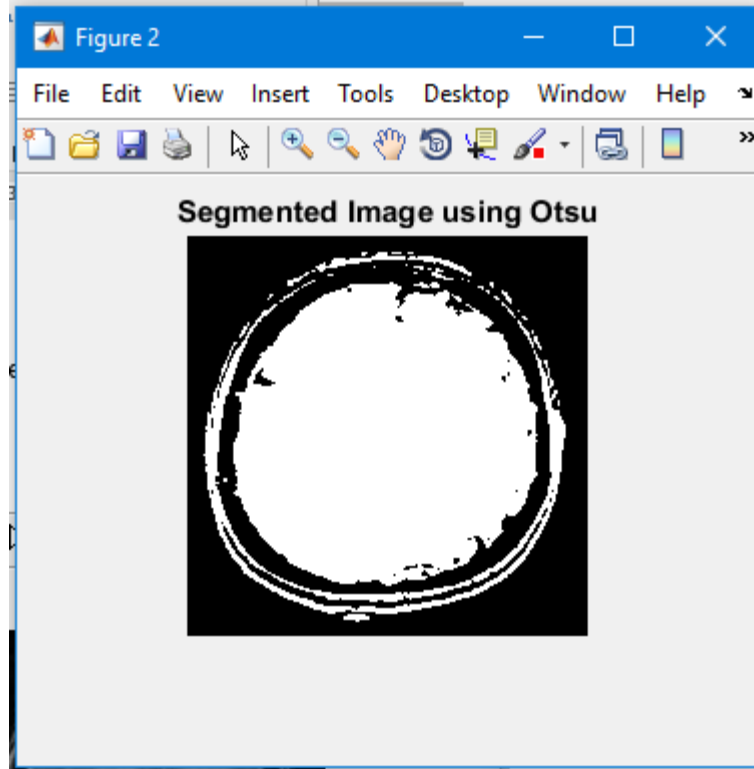


Figure 5.3: Showing Segmented Image Using Otsu Method

Above figure shows segmentation of brain MRI (magnetic resonance image) of the brain image using Otsu method. [Otsu's method](#) is a means of automatically finding an optimal threshold based on the observed distribution of pixel values

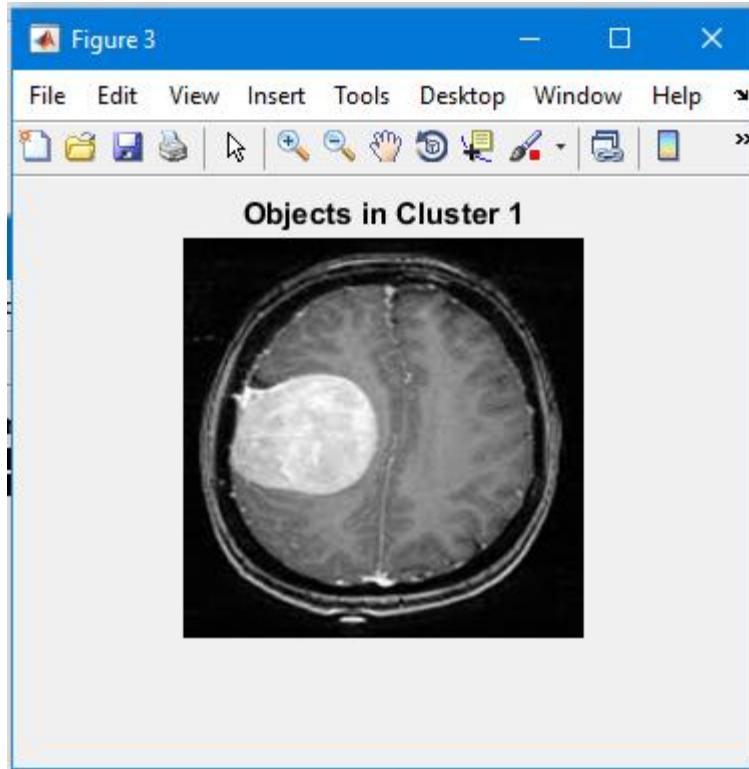


Figure 5.4: Showing Objects in Cluster

Above figure shows objects in the form of cluster. Cluster is used to show similar type of objects together. A *cluster* is therefore a collection of objects which are “similar” between them and are “dissimilar” to the objects belonging to other clusters.

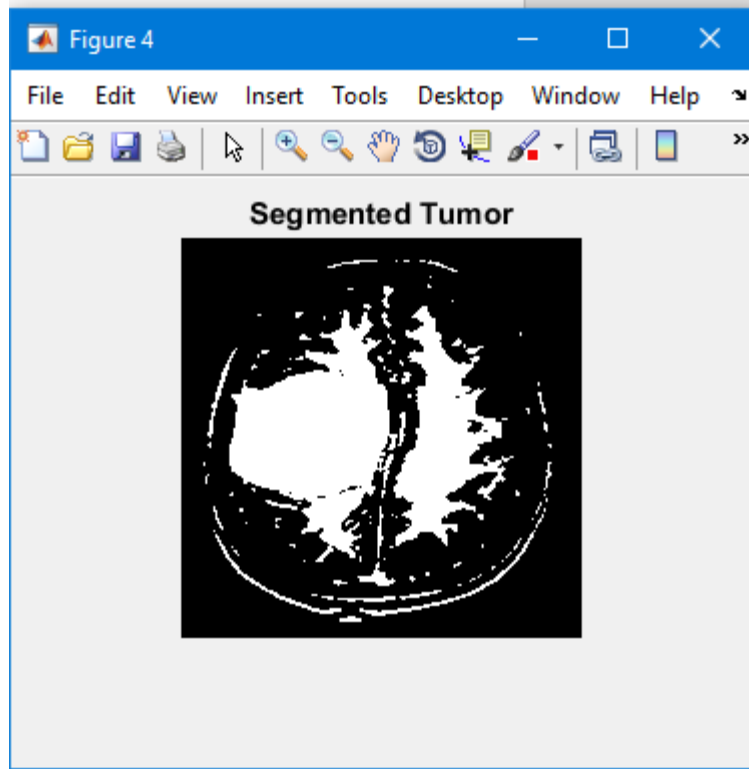


Figure 5.5: Showing Segmented Tumor

Above figure shows segmented image of brain tumor.

```
Accuracy of Proposed Technique is: 91.0197%

Proposed_Technq_time =

    1.2699

ans =

Accuracy of Linear kernel is: 65%

Result_parameters =

           Mean: 0.0031
          Variance: 0.0080
Standard_Deviation: 0.0898
          Correlation: 0.1990
          Smoothness: 0.9205
           Contrast: 0.2088
           Energy: 0.7621
Homogeneity: 0.9352
           Entropy: 3.1735
           Kurtosis: 7.3282
           Skewness: 0.4690
```

Figure 5.6: Showing results of Proposed Technique

Above figure shows the results of proposed technique. Accuracy of proposed technique is 91.0197%, time for proposed technique is 1.2699. Mean is 0.0031, variance is 0.0080, standard deviation is 0.0898, correlation is 0.1990, smoothness is 0.9205, contrast is 0.2088, energy is 0.7621, entropy is 3.1735.

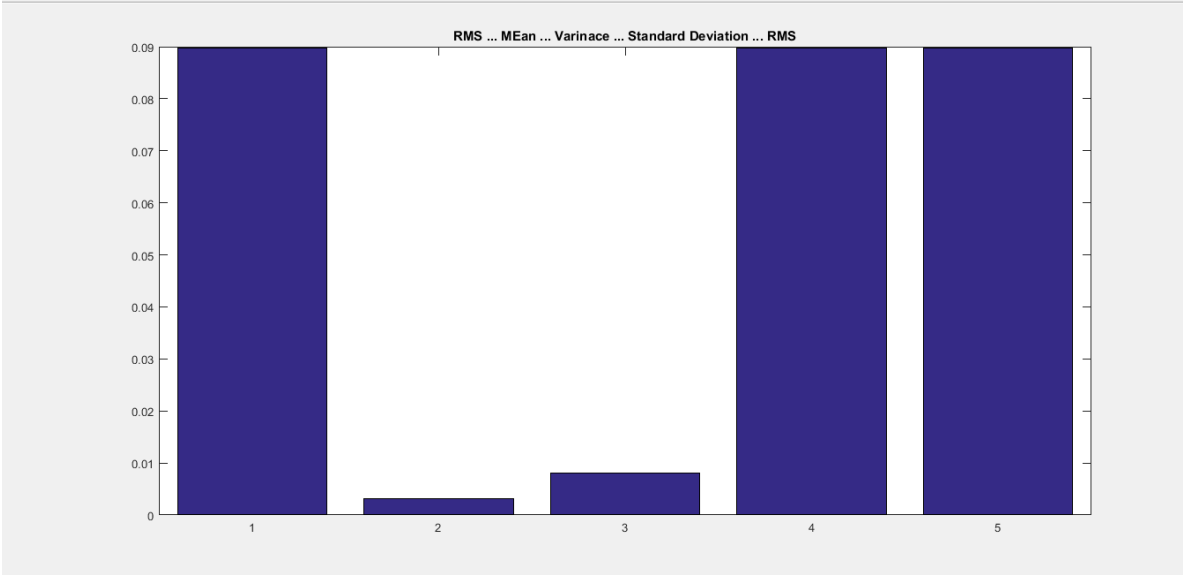


Figure 5.7: Showing Feature set plot

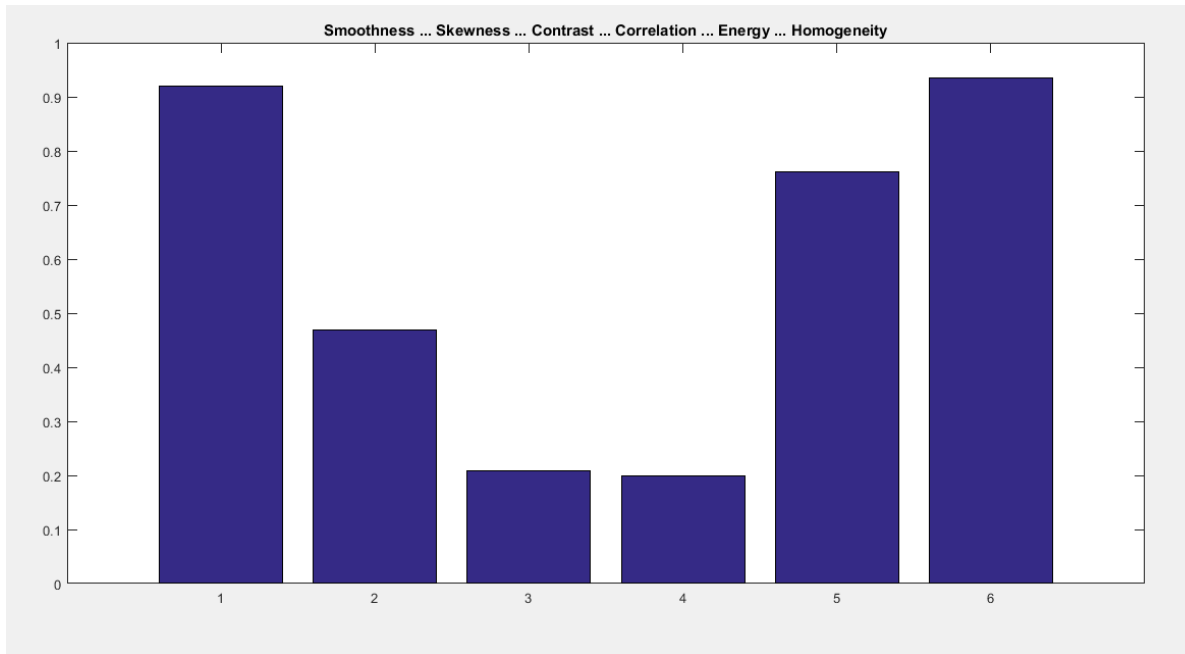


Figure 5.8: Feature set plot

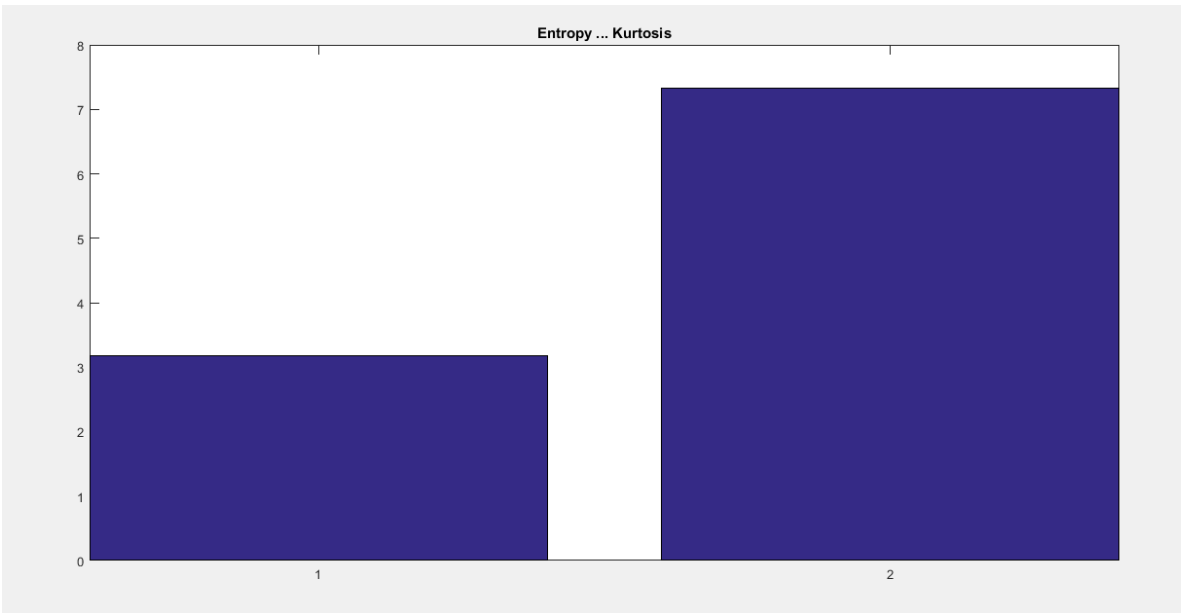


Figure 5.9: Showing Entropy Comparison

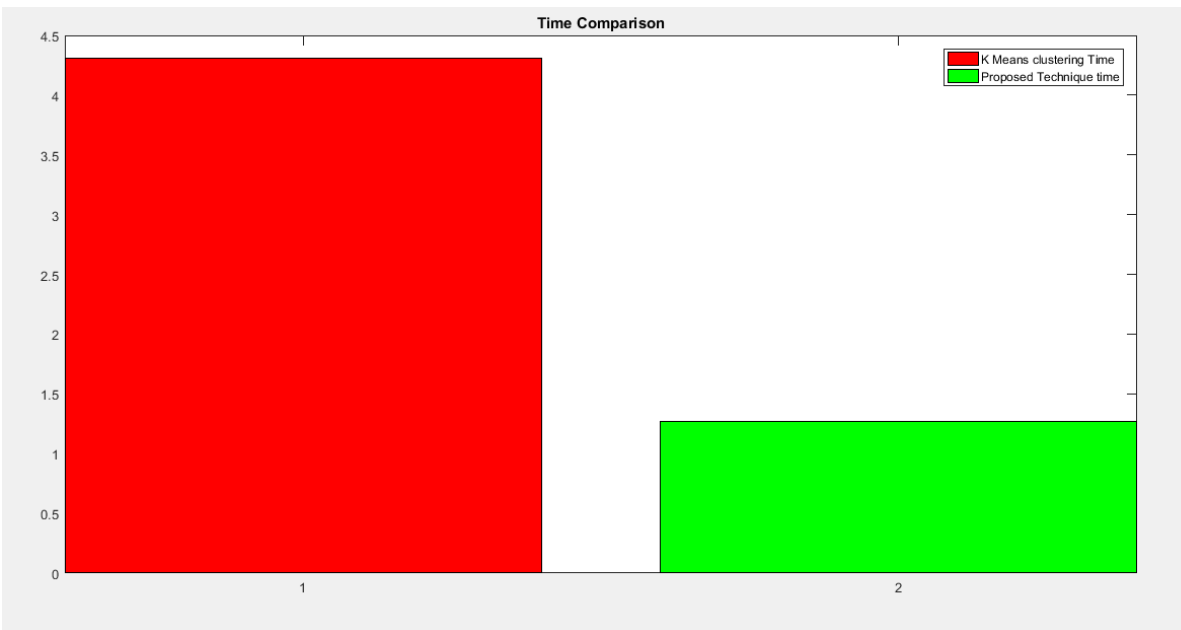


Figure 5.10: Showing Time Comparison

Above figure shows comparison of time among proposed technique and K-means clustering technique. It is clear from the graph that time taken by proposed technique is less as compared to existing technique.

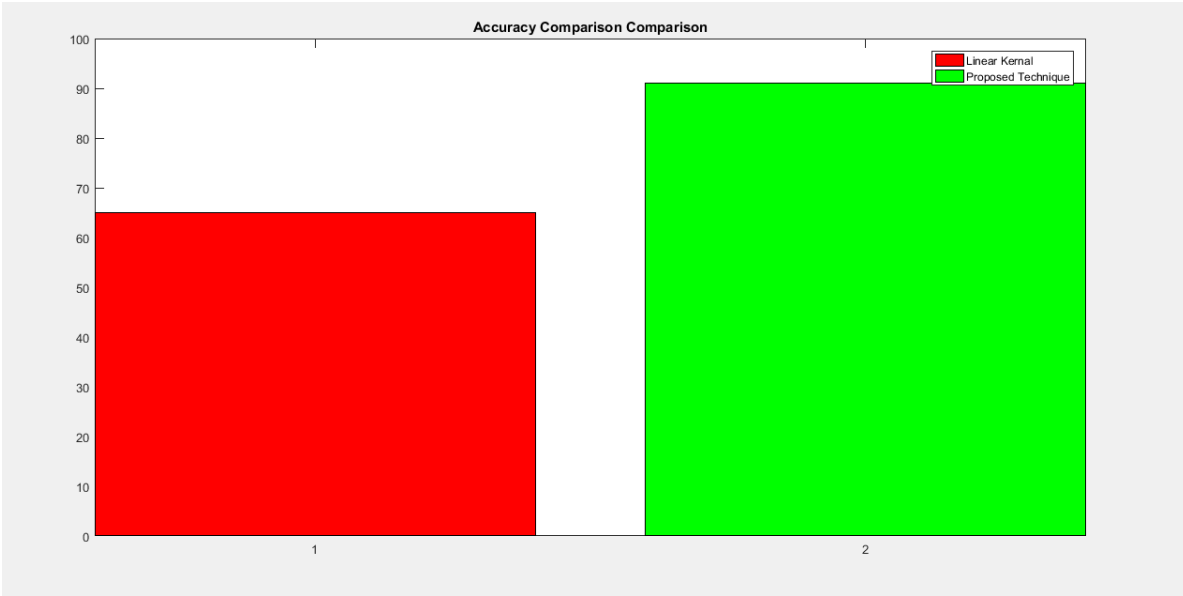


Figure 5.11: Showing Accuracy Comparison

Above figure shows comparison of accuracy among proposed technique and K-means clustering technique. It is clear from the graph that accuracy of proposed technique is more as compared to existing technique.

CHAPTER – 6

CONCLUSION AND FUTURE SCOPE

This research work proposed a Modified Technique for Brain MRI Categorization using 3-DPGR (3-Level Daubechies wavelet , PCA,GLCM and RBF Kernal) Method. In human body the very important part is brain. So, brain image segmentation is to be done accurately and perfectly. Various techniques are developed in the past to detect brain tumor. This work study different Brain MRI techniques and Tumor types. Based upon features this work train RBF Kernal using Support vector machine to show the type of Tumor and system Accuracy Proposed technique is implemented using MATLAB. Performance of the proposed technique is evaluated on various parameters like accuracy and time taken. Results of the proposed technique are compared with the K-means clustering (existing) technique. Experimental results show that proposed technique has more accuracy than the existing technique and takes less time as compared to the existing technique. It is demonstrated that proposed technique outperforms the existing technique.

In this work, k-means and support vector machine are used as a classification algorithm. In future, we may use neural network or any other machine learning application instead of using support vector machine. Also, in future feature set vector are optimized for further optimization so that time of classification will reduce.

REFERENCES

- [1] Jemal, A, Bray, F, Center, MM, Ferlay, J, Ward, E, Forman, D 2011,'Global cancer statistics', CA: a cancer journal for clinicians, vol. 61, no.2,pp. 69–90.
- [2] Cohen, L 1991, 'On active contour models and balloons', Computer Vision, Graphics and Image Processing, vol. 53, pp. 211 - 218.
- [3] Jahne, B 2004, 'Practical handbook on image processing for scientific and technical applications', CRC Press.
- [4] Gonzales, RC & Woods, RE 2002, 'Digital image processing", Second Edition, Prentice Hall.
- [5] Sasco, AJ, Secretan, MB & Straif, K 2004, 'Tobacco smoking and cancer: a brief review of recent epidemiological evidence', Lung Cancer,vol. 45, no. 2, pp. S3-S9.
- [6] Kuper, H, Adami, HO & Boffetta, P 2002, 'Tobacco use, cancer causation and public health impact', Journal of Internal Medicine, vol. 251, no. 6, pp. 455-66.
- [7] Mehta A R, Sampat M B.,The Diagnosis & Management of Cancer.1st Edition, Orient Longman Ltd Hyderabad (India), 1983.
- [8] Schiffer David, Brain Tumor Pathology: Current Diagnostic Hotspots & Pitfalls. Springer, Second edition, 2006.
- [9] Elison D , Love S , Neuropathlogy. London: Mosby, 1998.

- [10] Herbert B. Newton, Handbook of Brain Tumor Chemotherapy. Academic Press, 2006.
- [11] Peter Black, Sharon Cloud Hogan, Dr. Peter Black's Guide to Taking Control of Your Treatment. Macmillan, 2006.
- [12] Linda M. Liau, Donala P. Becker, Timothy F. Choughesy, Brain Tumor Immunotherapy. Humana Press, 1st Edition, 1999.
- [13] Chamberlain M.C., Kormanik P.A., Practical Guidelines for the treatment of malignant gliomas. West J Med 1998;168:120.
- [14] Linda Shapiro, & George Stockman, C 2001, 'Computer vision', new jersey, Prentice-Hall, pp. 279-325.
- [15] Wong, K 2005, 'Medical image segmentation: methods and applications in functional imaging', Handbook of Biomedical Image Analysis, vol.2, pp.111-182.
- [16] Bhandarkar, S, Koh, J & Suk, M 1997, 'Multiscale image segmentation using a hierarchical self-organizing map', Neurocomputing, vol.14, pp.241-272.
- [17] E.-S. A. El-Dahshan, H. M. Mohsen, K. Revett, and A.-B. M. Salem, "Computer-aided diagnosis of human brain tumor through mri: A survey and a new algorithm," Expert systems with Applications, vol. 41, no. 11, pp. 5526–5545, 2014.
- [18] S. Chaptol, L. Patnaik, and N. Jagannathan, "Classification of magnetic resonance brain images using wavelets as input to support vector machine and neural network," Biomedical Signal Processing and Control, vol. 1, no. 1, pp. 86–92, 2006.
- [19] M. Maitra and A. Chatterjee, "A slantlet transform based intelligent system for magnetic resonance brain image classification," Biomedical Signal Processing and Control, vol. 1, no. 4, pp. 299–306, 2006.
- [20] H. Selvaraj, S. T. Selvi, D. Selvathi, and L. Gewali, "Brain mri slices classification using least squares support vector machine," International Journal of Intelligent

Computing in Medical Sciences & Image Processing, vol. 1, no. 1, pp. 21–33, 2007.

- [21] E.-S. A. El-Dahshan, T. Hosny, and A.-B. M. Salem, “Hybrid intelligent techniques for mri brain images classification,” *Digital Signal Processing*, vol. 20, no. 2, pp. 433–441, 2010.
- [22] Y. Zhang, S. Wang, and L. Wu, “A novel method for magnetic resonance brain image classification based on adaptive chaotic pso,” *Progress In Electromagnetics Research*, vol. 109, pp. 325–343, 2010.
- [23] M. Saritha, K. P. Joseph, and A. T. Mathew, “Classification of mri brain images using combined wavelet entropy based spider web plots and probabilistic neural network,” *Pattern Recognition Letters*, vol. 34, no. 16, pp. 2151–2156, 2013.
- [24] G. Yang, Y. Zhang, J. Yang, G. Ji, Z. Dong, S. Wang, C. Feng, and Q. Wang, “Automated classification of brain images using wavelet-energy and biogeography-based optimization,” *Multimedia Tools and Applications*, pp. 1–17, 2015.
- [25] D. R. Nayak, R. Dash, and B. Majhi, “Least squares svm approach for abnormal brain detection in mri using multiresolution analysis,” in *Computing, Communication and Security (ICCCS), 2015 International Conference on*. IEEE, 2015, pp. 1–6.
- [26] C.Hemasundara Rao, P.V. Naganjaneyulu, K.Satya Prasad, “Brain tumor detection and segmentation using conditional random field”, *IEEE, International Advance Computing Conference*, 2017, pp. 807-810.
- [27] Purnima, Vikas Wasson, “BRAIN TUMOR BOUNDARY DETECTION USING IMPROVED OPTIMIZATION TECHNIQUE”, *International Journal of Computer Engineering and Applications*, Volume VI, Issue III, June 14, pp. 69-75.
- [28] Xiaoli Zhang, Xiongfei Li, Hongpeng Li, and Yuncong Feng, “A SEMI-AUTOMATIC BRAIN TUMOR SEGMENTATION ALGORITHM”, *IEEE*.
- [29] Aastha Sehgal, Shashwat Goel, Parthasarathi Mangipudi, Anu Mehra, Devyani Tyagi, “Automatic Brain Tumor Segmentation And Extraction In MR Images”, *IEEE*,

2016, pp. 104-107.

- [30] Sérgio Pereira, Adriano Pinto, Victor Alves, and Carlos A. Silva, “Brain Tumor Segmentation Using Convolutional Neural Networks in MRI Images”, IEEE, TRANSACTIONS ON MEDICAL IMAGING, VOL. 35, NO. 5, MAY 2016, pp. 1240-1251.
- [31] Yisu Lu, Wufan Chen, “Automatic Multimodal Brain-tumor Segmentation”, IEEE, International Conference on Instrumentation and Measurement, Computer, Communication and Control, 2015, pp. 939-942.
- [32] Shashwat Goel, Aastha Sehgal, Parthasarathi Mangipudi, Anu Mehra, “Brain Tumor Segmentation in Multispectral MR Images”, IEEE, International Conference on Signal Processing and Integrated Networks, 2017, pp. 1-4.
- [33] Malsawm Dawngliana, Daizy Deb, Mousum Handique, Sudipta Roy, “Automatic Brain Tumor Segmentation in MRI: Hybridized Multilevel Thresholding and Level Set”, IEEE, International Symposium on Advanced Computing and Communication, 2015.
- [34] M. Usman Akram, Anam Usman, “Computer Aided System for Brain Tumor Detection and Segmentation”, IEEE, 2011.
- [35] Edgar A. Rios Piedra, Ricky K. Taira, Suzie El-Saden, “Assessing Variability in Brain Tumor Segmentation to Improve Volumetric Accuracy and Characterization of Change”, IEEE, 2016, pp. 380-383.
- [36] Asra Aslam, Ekram Khan, M.M. Sufyan Beg, “Improved Edge Detection Algorithm for Brain Tumor Segmentation”, International Symposium on Computer Vision and the Internet, 2015.
- [37] Samriti, Mr. Paramveer Singh, “Brain Tumor Detection Using Image Segmentation”, International Journal of Engineering Development and Research, 2016.

- [38] Swati Dubey, Lakhwinder Kaur, “An Assessment on Automatic Brain Tumor Detection”, International Journal of Computer Science and Mobile Computing, Vol.5 Issue.3, March- 2016, pp. 236-243.
- [39] Arati Kothari, B. Indira, “An Overview on Automated Brain Tumor Segmentation Techniques”, International Journal of Computer Trends and Technology, 2016.
- [40] Nilesh Bhaskarrao Bahadure, Arun Kumar Ray, and Har Pal Thethi, “Image Analysis for MRI Based Brain Tumor Detection and Feature Extraction Using Biologically Inspired BWT and SVM”, International Journal of Biomedical Imaging, 2017.
- [41] M.Jasmine, “A Relative Study of MRI Based Brain Tumor Segmentation Methods”, International Journal of Pure and Applied Mathematics, 2017.

LIST OF PAPERS PUBLISHED

- 1.) Modified technique for brain MRI categorization using 3DGPR method.(research paper)
- 2.) Modified technique for brain MRI categorization using 3DGPR method.(review paper)

