Journal of Advances in Science and Technology
Vol. 17, Issue No. 1, March-2020, ISSN 2230-9659

A Study the Brain Tumor Detection for MRI Brain Images

Krishna Pratap Singh[1]*, Dr. Kamal Kumar Srivastava[2]

[1] Research Scholar, Shri Krishna University, Chhatarpur M.P.

[2] Associate Professor, Shri Krishna University, Chhatarpur M.P.

Abstract - A brain tumor is an abnormal growth of cells in the brain, and it can spread to neighboring brain cells. One crucial step in avoiding an untimely demise is the diagnosis of brain tumors in an MRI scan of the brain. Tumors will be produced from the tissue of brain itself and it is known as primary brain tumor. There are two types of brain tumors: benign & malignant. A brain tumor can be caused by an uncontrolled growth of abnormal cells in brain tissue. The brain can be considered as the primary support of the human central nervous arrangement which integrated 55-99 billion neurons that figure an enormous area of the nerves. These tumors are entrenching in areas of the brain which affect the sensitive functioning of the human body.

Keywords - Brain, Tumor, Brain Anatomy, MRI image

----------X----------

INTRODUCTION

In general, a brain tumor can be an unusual expansion of cells within the brain, in which a few tumors are in benign stage; some tumors may be in malignant stage. Tumors will be produced from the tissue of brain itself and it is known as primary brain tumor. The cancer tumor from another place in the body will extend to the brain part and it is called as metastasis. The options of treatment can be differed according to the tumor form, range and place. The aims of treatment are therapeutic or focus to lessen the symptoms. The tumor symptoms can be repeated headache and migraines. It can still direct to vision failure. Science currently has limited knowledge of the origins & contributing factors to this atypical tumor growth.

BRAIN ANATOMY

The brain guides the actions which we need to do as our body does not think all alone. The brain controls our power, memory, feelings, and so on. A system of nerves conveys kneads between the brain and different parts of the body. A small amount of nerves directly goes from the brain to the eyes, ears, and different parts of the head. Also, a few nerves go through the spinal rope and interface the brain with different parts of the body. It is an unpredictable nerve cell organization that may be used to convey pieces of information between body and brain. This nervous system may have two fundamental parts: the central nervous system (CNS) is considered as a brain and spinal line comprises; and the secondary nervous system (SNS), these nerves and different sorts of sustaining cells that may associate all through the remainder of the body and convey the info to CNS back.

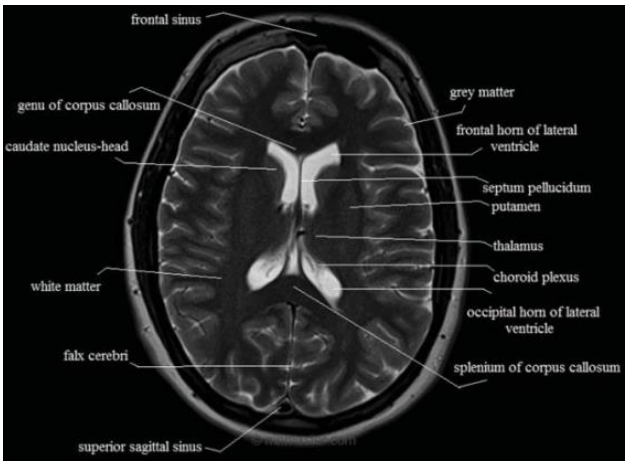


Figure 1 MRI axial brain anatomies

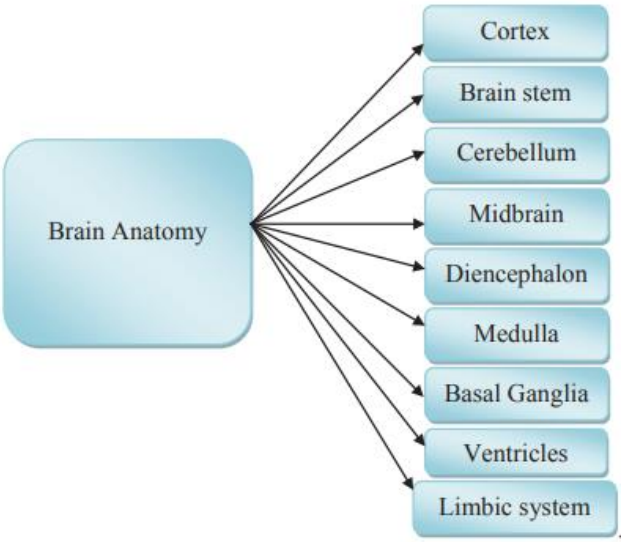


Figure 2 Brain anatomy and its types

Figure 2 shows the different types of brain anatomy methods found and involved. A brain is comprised of millions of nerve system; every last one of this nerve passes on in billions of affiliations that are named as neural associations.

Cortex

It is an external layer of synapses. The gray tissue of the brain consists of the cerebral cortex, which is the brain's outermost layer. This is where all of our cognition & doing takes place. Numerous indicators that cause our brain to sign up for service in the cerebral cortex. We store visual information in a region of the brain called the visual cortex, which is located in the brain's posterior. Touch on any area of the body is registered in the somatosensory cortex, a band that runs across the top of the brain. It offers guidelines to our bodies based on different reactions. It may configure and administrate the body actions such as examining, thoughts, knowledge and emotions.

Brain Stem

The brain is the control center of the body and is home to many nerve cells. The brainstem is situated directly beneath the brain & front of the cerebellum. It originates in the cerebral cortex & communicates with the spinal cord. The medulla oblongata, pons, & midbrain make up the brain stem. Breathing, heart rate, and pulse are just a few of the many vital body functions that it complements. The brain is often called the body's "autopilot" because it directs information between the brain's upper & lower regions. In addition, ten of the twelve cranial nerves have their origins here. There is no connection between the spinal cord & cranial nerves, which means that the 12 cranial nerves access the brain in a completely legal fashion. The brain stem acts as a connection point for the spinal cord & rest of the brain. It controls essential body capacity, for example, breathing movement, internal heat level, and circulatory strain.

Cerebellum

The cerebellum is the second largest part of the brain & often referred to as the "small brain." The cerebellum is an organ that is connected to the midbrain and lies beneath and behind the brain. There is black tissue on the outer cortex of the equator and white tissue in the innermost center. The cerebellum plays a role in a variety of processes, including those involved with walking, posture, reflexes, eye & head growth, and general development. It is an arrangement of subliminal developments, for instance, balance and facilitated development. The cerebellum is continually getting refreshes about the considerable body's position and its development accordingly. Likewise, it is used to send the directions to our muscles directly which alter our stance and keeps our body moving easily. The cerebellum would take care of the exercises of the human body and furthermore it controls the balance while strolling and standing positions.

Midbrain

It is the midbrain that is involved in eye reflexes & development, as it is the reflex location for cranial nerves III & IV. The pons connects the midbrain to the medulla oblongata, and it has the potential to aid in simple relaxation. Reflexes for cranial nerves 5–8 are located in the pons. Biting, tasting, drooling, hearing, & musical harmony are all functions of the pons. Foramen magnum is where the medulla oblongata connects to the spinal cord, and this has direct effects on the heart, the respiratory system, and blood circulation. It's in exchange for some coughing & hiccupping.

Diencephalon

The diencephalon is a primal area where it is situated between the brain and midbrain. It comprises the thalamus and nerve center which lie somewhere down in the cerebral halves of the globe. Focusing on the nerve center directs our internal heat level, glucose, craving, and hormones. The thalamus is engaged with tactile where signs are directly sent to the higher forebrain, specifically the cerebral cortex area. Likewise, the thalamus takes part in terms of brain control and managing cortex energy. The brainstem is connected to both spinal cord & forebrain regions via a number of different pathways.

Medulla

The structures in this area of the brain are responsible for the regulation of our digestive, respiratory, and cardiovascular systems, and are thus regarded to be part of the higher brain. The pons has connections to the cerebellum, respiratory system, and motor control. Various parts of the pons are responsible for regulating sleep & excitement. Information is also transmitted from the brain to the spinal cord via the pons. An aggregate of neurons is

responsible for the instigation of these symptoms of nausea, vomiting, & sneezing.

Ventricles

These four hollows in the brain contain liquid. The ventricles collaborate to secrete cerebrospinal fluid, which is a rational, stunned-retaining fluid with constant motion. Figure 1.4 shows the internal portion or structure of the human brain. The cerebrospinal fluid pads the brain disperses supplements and gathers squanders.

Limbic System

It is engaged with the declaration of personal practices and feelings, hunger, animosity, etc. This framework comprises of various configuration, containing the fornix, cingulate gyrus, amygdala, hippocampus, and different thalamus parts. The limbic framework additionally screens every single tactile message to the cerebral cortex. It can be found somewhere down in the transient projection. The cingulate gyrus, corpus callosum, mammillary body, olfactory tract, amygdala, & hippocampus are all parts of the limbic system. The brain controls body temperature, appetite, hydration, pituitary hormone production, emotions, and other autonomic functions like sleep and wake cycles.

Basal Ganglia

It is found in the forebrain and comprises structures associated with brain forms. The basal ganglia work alongside the brain territories of the cortex and cerebellum for arranging and planning certain deliberate developments and the basal ganglia are made of gray tissue. These disorders are treated as high priority disorders in basal ganglia because it leads to an obsessive-compulsive disorder which is in the part of risky disorders list. The basal ganglia are a collection of structures in the center of the brain that coordinate communications or activities between different parts of the brain. The frontal, parietal, temporal, & occipital lobes of the brain are divided into four distinct types of projections.

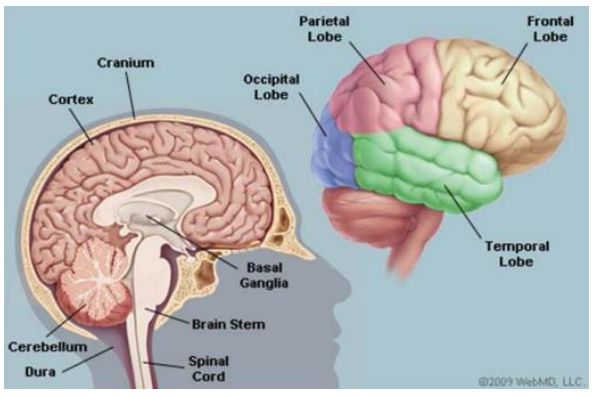


Figure 3 Internal structure of brain

1. The frontal lobes

These are answerable for taking care of issues and judgment. The frontal lobe is the part of the brain that controls significant psychological aptitudes in people, for example, passionate articulation, critical thinking, memory, language, judgment, and sexual practices. It is, basically, the "control panel" of our character and our capacity to impart.

2. The parietal lobes

These lobes are answerable for penmanship and oversee sensation. It is additionally answerable for body position. The parietal lobe forms sensory data for intellectual purposes and helps facilitate spatial relations. It lives in the center area of the brain behind the focal sulcus, over the occipital lobe.

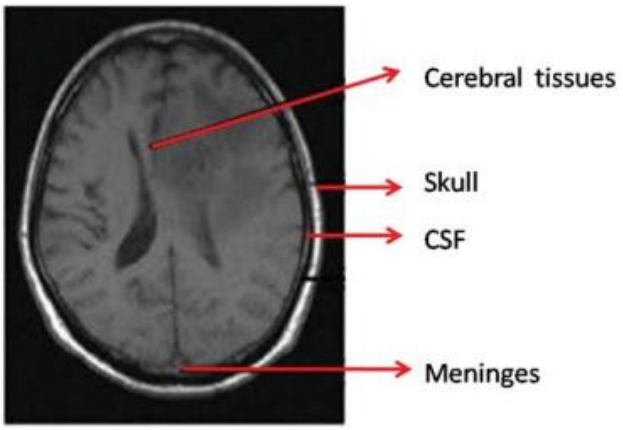
3. The temporal lobes

Memory and hearing capacity responsibilities are taken care of by temporal lobes. On both cerebral hemispheres of the mammalian brain, it lies beneath the lateral fissure.

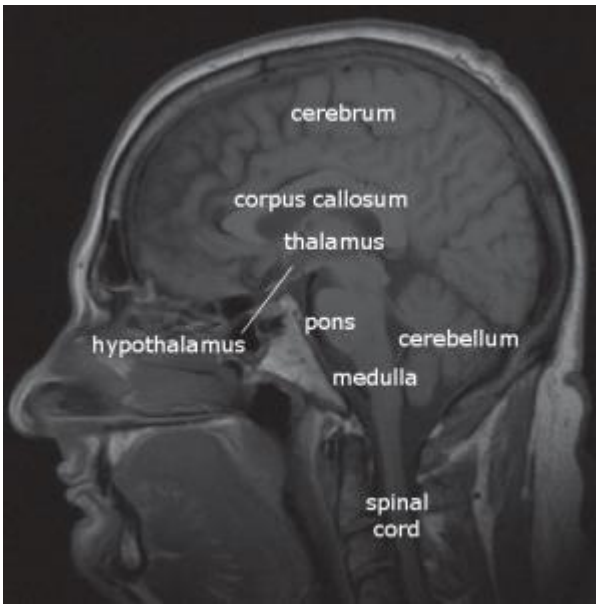
4. The occipital lobes

The visual processing system of the brain is located in these lobes. The majority of the anatomical area of the visual cortex is located in the occipital lobe, which is the mammalian brain's visual processing center. The meninges are a collection of delicate tissues that surround the brain & spinal cord and control cognitive thought. There are four main types of meninges, and they are composed of various sensations & quick growth. The liquid form of the brain, or cerebrospinal fluid, contains salts, different types of platelets, glucose levels, and common catalysts. The referred CSF preserves the place of spinal rope and isolating the brain from irregular or disturbed absorbance

CSF prefers besides with the ventricles showing up at spinal rope incorporating the brain. These four functions of CSF are, it protects the brain & spinal cord from trauma, it provides nutrients to nervous system tissue, it detached waste products from cerebral metabolism and it provides optimism and moisture to the brain & spinal rope. The brain area involves sensitive tissues that are sheltered into different matters such as, Gray and White and they are guaranteed by the structure of the brain like an outer skull. This gray matter in any case known as neuroglia where is made out of neurons and it may administrate brain activity. White matters comprised of abstained from axons. The connections are made between the cerebral cortex alongside various brain regions (Mallikarjuna 2015). It ensures brain protection against any type of injury. Skull stripping is a cycle that unfilled irregular tissue regions such as cranium, meninges, and fleece.



(a)



(b)

Figure 4 (a) & (b) Different portion of the human brain

Christian R. Linder (2000) skull stripping measure impacts the productivity if there should be an occurrence of tumor discovery. This stripping procedure faces numerous difficulties because of the changeability in parameters of MRI scanner and brain multifaceted nature. Figure 4 (a) & (b) shows the different portions of the subtleties of brain image and human brain. Figure 5 represents the MRI image of the brain tumor. Here, the upper portion of the left half of the MRI demonstrates a tumor, base bolt shows the white tissue also on the right half of MRI top bolt demonstrates skull and base bolt demonstrates the dim tissue.

Cerebrospinal Fluid (CSF) is a suitable, monotonic bodily liquid found in the brain & spinal cord. It is produced by certain ependymal cells in the ventricles of the brain's choroid plexuses and is kept in the arachnoid granulations. About 125 ml of CSF are present at any given time, and 500 ml are produced daily. CSF goes about as a pad or support, giving essential mechanical and immunological assurance to the brain inside the skull. CSF likewise serves an essential capacity in the cerebral auto-regulation of cerebral bloodstream.

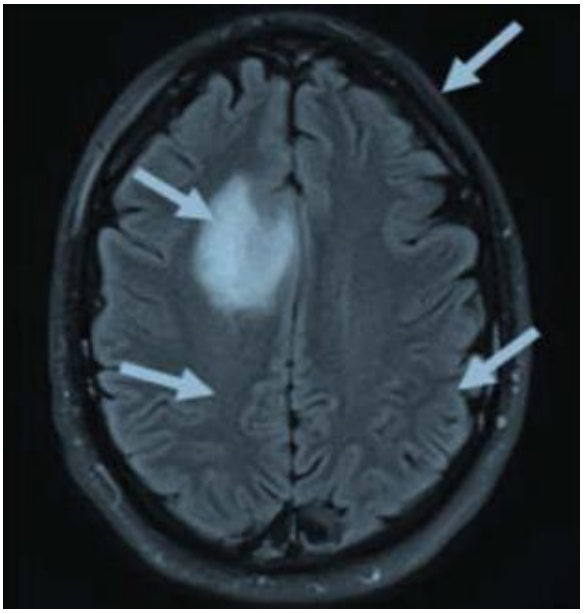
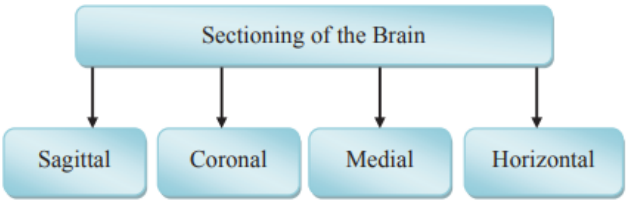


Figure 5 MRI image of brain tumor

Sectioning of the Brain

This section consists of four different types of brain sectioning. The brain can be isolated into three essential units: the forebrain, the midbrain, & rear brain. These areas are Occipital projection, Temporal lobe, Parietal projection, Frontal projection, Cerebral cortex, Cerebellum, Hypothalamus, Thalamus, Pituitary organ, Pineal organ, Amygdala, Hippocampus, and Midbrain. This brain sectioning part can be classified into four types like sagittal, coronal, medial, and horizontal sections of the brain image. Figure 1.6 shows the different sectioning of the brain (Matthew E. Bain, 2019).



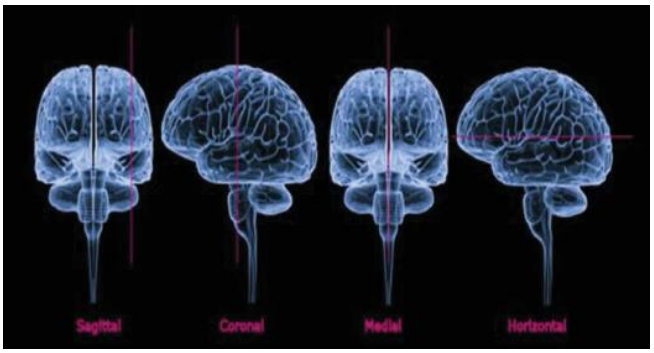


Figure 6 Different sectioning of brain

Sagittal

Partitioning of the left & right halves of the brain occurs on the sagittal plane. The midsagittal plane would divide the privilege & left sides of the brain into halves, including chopping down the center of a heated potato before you put on the toppings. When we move along this plane, we use the strength of our muscles to propel certain body parts forward or backward. Here, the two functions of expansion & flexion may occur along the sagittal plane.

Coronal

The frontal plane is another name for the coronal plane. The distinct parts of the brain in the coronal plane are anterior & posterior. Cuts made in the coronal plane of the brain are comparable to slices of bread. Make level cuts as though you were slicing a bagel or hamburger bun. The left and right halves of the brain are divided by the sagittal plane. The coronal plane runs along with the longitudinal hub, or from the mouth to the rear-end. The term proximal portrays the course toward the coronal plane, while distal depicts the direction away from the coronal plane.

Medial

The medial directional terms that attention to zones of the sensory system that are nearer to the midline of the brain or spinal cord. The medial surfaces of the cerebral sides of the equator are level and isolated for the vast majority of their degree by the longitudinal gap and falx cerebri. They are associated in parts by the cerebral commissures and by the structures hop in the third ventricle.

Horizontal

The brain is considered to be a three-dimensional structure where the brain areas can be limited. Although this limitation is localized on three planes are namely called x, y, and z planes respectively. At any cost, the brain can be separated on any of these planes and which are namely called the coronal plane, flat plane, or sagittal plane. Figure 7 (a), (b) & (c) shows the human brain consists of three planes of a section on given "synthetic MR" images produced by BrainWeb. Also, Figure 8 shows the two different sections of the MRI image and namely called sagittal and horizontal sections from a Real MRI image. Figure 9 shows the vertical portions of the coronal, horizontal, and sagittal planes for a better understanding (Jin Seo Park et al. (2010)).

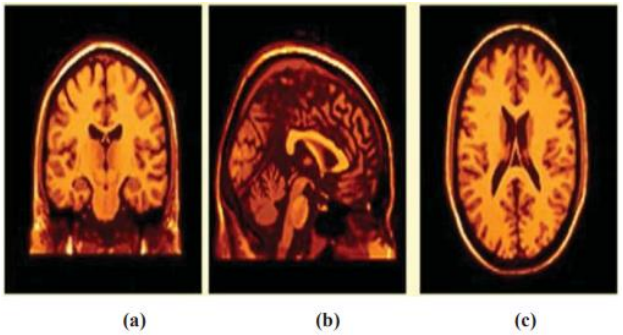


Figure 7 (a) Coronal section, (b) Sagittal section and (c) Horizontal section

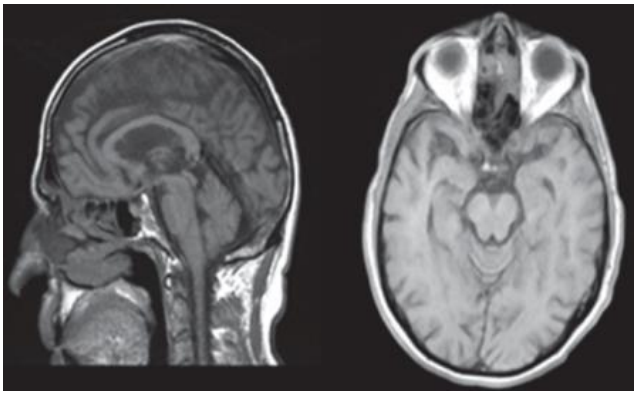


Figure 8 Sagittal and horizontal sections from a real MRI

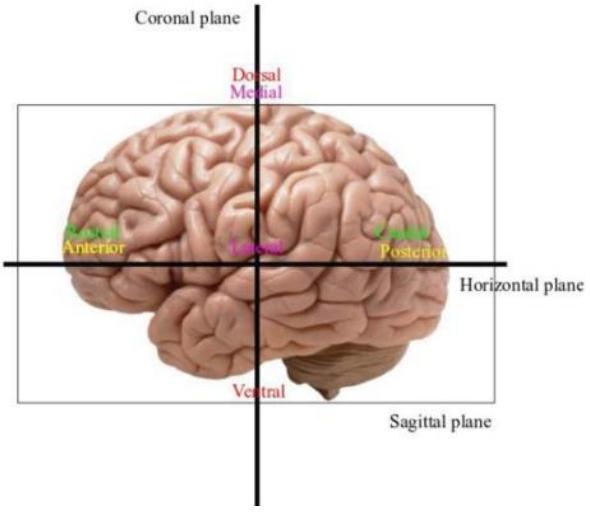


Figure 9 Vertical portions of the coronal, horizontal and sagittal planes

MAGNETIC RESONANCE IMAGE (MRI)

MRI is the newest, most and perhaps the most versatile, medical imaging technology. Detection of brain tumor requires high resolution brain MRI. It

uses a strong magnetic field and radio waves to create pictures on a computer of tissues, organs and structures inside our body. Any region of the body can be captured in crystal-clear images. Thus, it is helpful in many situations where more thorough examinations are not necessary. A PET scan & computed tomography (CT) scan are analogous to an MRI. MRI, PET, & CT scans are used for the majority of medical imaging research & detection. The main aspects to bear in Mind with MRI are stated below:

- MRI scanning creates images of the internal organs using radio waves, magnets, & computer.
- MRI scans are painless and do not expose patients to radiation from x-rays.
- Due to the magnet's effect, patients with heart pacemakers, metal implants, metal chips, or clips in or around the eyes cannot be scanned with an MRI machine.
- Claustrophobic sensation can arise with MRI scanning

IDENTIFICATION OF BRAIN TUMOR

An MRI testing technique is currently being utilized to catch high-quality images with better proficiency. However, images may consist of some helpful data on the segments of the human body. MR imaging is habitually used to get pictures of the tumors, organs, joints, and delicate tissues. MR picture gives such high goals where we can acquire the itemized anatomical information to inspect the brain tumor, and to recognize the turn of events and variations from the norm inside the cerebrum, assuming any. These procedures for the grouping of MR pictures are incorporate fuzzy strategies, neural organizations, atlas strategies, information-based strategies, shape techniques, and a variety of division.

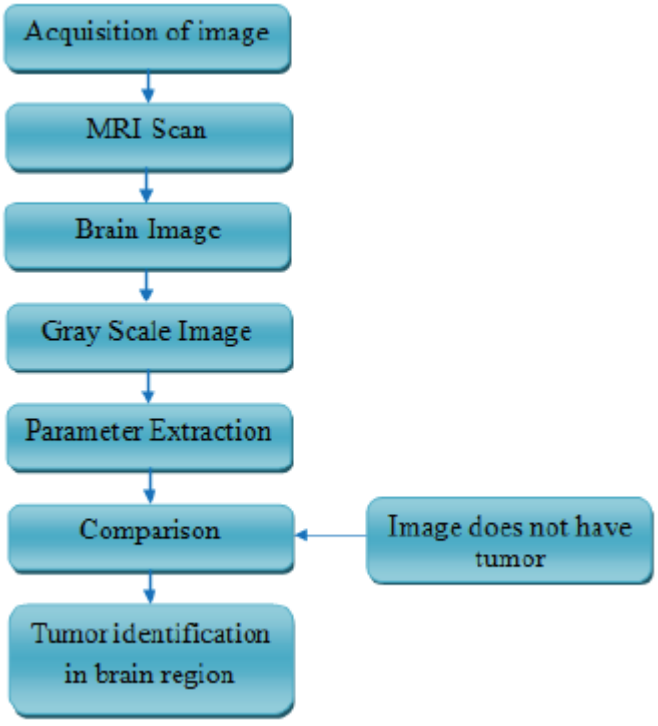


Figure 10 Basic structure identification of brain tumor

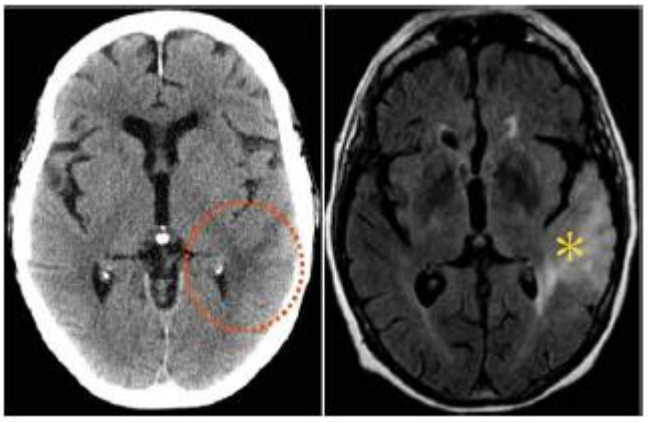


Figure 11 Malignant tumor detection in brain by MRI

It comprises T1, T2 and PD weighted pictures and is handled by a framework that incorporates fuzzy-based strategy with the multispectral investigation. Pre-handling of MR pictures is the essential advance in picture examination. Pre-preparing steps incorporate the picture resize, picture upgrade, and evacuation of commotion just as decrease procedure. There are a few techniques that are utilized to improve the picture quality, after which morphological tasks are applied to identifying the tumor inside the brain which has been now caught through MR pictures. The morphological activities are fundamentally applied to certain suspicions about the size & state of the tumor. In the end, we planned the tumor as per the first grayscale picture along with 255 power esteems. These qualities make it noticeable the tumor in the picture. Cutting-edge, in the clinical field, to analyze the interior structure of the body, MRI is one of the ordinarily utilized strategies, which is in effect often utilized for the discovery and perception of the structure of the body. X-ray inspects the contrasts between the tissues and how the influenced tissues are not quite the same as one another.

The X-ray method is vastly improved when contrasted with the processed tomography (CT). It is broadly utilized for brain tumor identification and malignancy imaging. It is named as recommended; it utilizes a solid field of magnetic to the magnetization of the nuclear by its arrangement changes and some RF which may be recognized by the scanner, while the CT utilizes ionizing based radiation. The sign created, can additionally be prepared to get more data of the particular aspect of the body, particularly the influenced tissues. Because brain tumors various shapes, sizes, and appearances may provide the exact estimation of cerebrum tumors is very efficient. 3D division of pictures is assuming an essential function in clinical imaging before executing object acknowledgment. 3D picture division helps in the autonomous determination of cerebrum tumors in the subjective

and quantitative investigation of pictures, for example, estimating the precise size and volume of distinguished segments. Figure 10, represents the basic structure of brain tumor detection methods. It clearly shows the hierarchical way of identifying the tumor along with different extractions can be done. Malignant tumor detection in the brain region by using an MRI scanning system is shown in Figure 11.

CONCLUSION

In medical image analysis, MRI was most commonly used for brain image scanning. The brain MRI is mainly used to identify the tumor tissues in the brain region and to find the spatial location of the tumor. CT images provide clear information about the bone region compared to a tissue region. But MRI provides both structural and anatomical information about the brain. MRI is a non-invasive technique. So MRI is highly recommended for brain imaging compared to CT. Due to its multi-plane imaging capability, MRI provides clear anatomic data and high sensitive characteristics of the brain. In MRI imaging different modalities of images are available.

REFERENCES

1. A.Padma, R.Sukanesh, “Automatic Classification and Segmentation of BrainTumor in CT Images using Optimal Dominant Gray level Run length Texture Features”, International Journal of Advanced Computer Science and Applications, Vol. 2, No. 10, 2011
2. Abdelmajid Bousselham, Omar Bouattane, Mohamed Youssfi & Abdelhadi Raihani 2019, 'Towards reinforced brain tumor segmentation on MRI images based on temperature changes on pathologic area', Hindawi International Journal of Biomedical Imaging, vol. 2019, pp. 1-14.
3. Abdullah, Ngah N, Aziz U.K., "Image classification of brain MRI using support vector machine," IEEE International Conference on Imaging Systems and Techniques (IST), pp.242-247, 2011.
4. Abhishek Bal, Minakshi Banerjee, Amlan Chakrabarti & Punit Sharma 2018, „MRI Brain Tumor Segmentation and Analysis using RoughFuzzy C-Means and Shape Based Properties", Journal of King Saud University - Computer and Information Sciences.
5. Ali Isin, Cem Direkoglu, Melike Sah, “Review of MRI-based Brain Tumor Image Segmentation Using Deep Learning Methods Procedia Computer Science, vol.102, pp. 317-324, 2016.
6. Al-Tamimi, Mohammed *et al.*. ‘Tumor brain detection through MR images: A review of literature”, Journal of Theoretical and Applied Information Technology, Vol 2, Issue 2, pp 387-403, 2014
7. Amin Kabir Anaraki, Moosa Ayati & Foad Kazemi 2018, „Magnetic resonance imaging-based brain tumor grades classification and grading via convolutional neural networks and genetic algorithms", Biocybernetics and Biomedical Engineering, vol. 39, no. 1, pp. 63-74.
8. Ansari, MA, Rajat Mehrotra& Rajeev Agrawal 2020, ‘Detection and classification of brain tumor in MRI images using wavelet transform and support vector machine’, Journal of Interdisciplinary Mathematics, vol. 23, no. 5, pp. 955-966.
9. AntoniosDrevelegas and Nickolas Papanikolaou, “Imaging Modalities in Brain Tumors”, Imaging of Brain Tumors with Histological Correlations, Springer Publications 2011.
10. Berger, Abi. “Magnetic Resonance Imaging.” BMJ: British Medical Journal,2002.
11. Deepthi Murthy, T.S, "Brain tumor segmentation using thresholding, morphological operations and extraction of features of tumor", IEEE International Conference on Advances in Electronics, Computers and Communications (ICAECC), 10-11 Oct. 2014, pp 1 -6
12. Dickson, S& Thomas, B 1997, ‘Using neural networks to automatically detect brain tumors in MR images’, In: Int J Neural Syst.,vol. 4, no. 1, p. 91-99.
13. Kumar, D& Halder, A 2012, ‘Automatic brain tumor detection and isolation of tumor cells from MRI images’, In: Int J Comput., Appl., vol. 39, no. 16, pp. 26-30.
14. Law, A, Lam, F& Chan, F 2002, ‘A fast deformable region model for brain tumor boundary extraction’, in: Int Conf EMBS.,vol. 2, pp. 1055-1056.
15. Lee, C, Wang, S, Murtha, A, Brown, M,Greiner, R 2008, ‘Segmenting brain tumors using pseudoconditional random fields’, in: Proc MICCAI,no.11,pp.359-66.
16. Leela GA & Veenakumari HM 2014, ‘Morphological approach for the detection of brain tumour and cancer cells’, Journal of Electronics and Communication Engineering Research, vol. 2, no. 1, pp. 7-12.
17. Li Hong Juang& Ming Ni Wu 2010, ‘MRI brain lesion image detection based on color converted K-means’, Science Direct Measurement, vol. 43, no. 7, pp. 941-949.
18. Luders, Eileen, Helmuth Steinmetz, and Lutz Jancke. "Brain size and gray matter volume in the healthy human brain." Neuro report 13.17, pp. 2371-2374, 2002.

19. Mallikarjuna, E. (2015). Brain Tumor Detection using Segmentation based Object Labeling Algorithm '. *J. Computer. Biosci. Eng*, *3*(2), 0-3.
20. Pereira, S, Pinto, A, Alves, V & Silva, CA 2016, 'Brain tumor segmentation using convolutional neural networks in MRI images', Transactions on Medical Imaging, IEEE ,vol. 35, no. 5, pp. 1240-1251.

Corresponding Author

Krishna Pratap Singh*

Research Scholar, Shri Krishna University, Chhatarpur M.P.