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# A Review on Automatic Brain Tumor Classification from MRI Imaging

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***Abstract:*** ***Brain tumor is an irrepressible development of cells that may spread in different tissues. It can be recognized through Magnetic Resonance Imaging (MRI) which is a non-surgical investigation of organ for diagnosing any disease related to the symptoms. Tumors may be cancerous or non-cancerous or it can be considered as life threatening or less dangerous. A tumor belongs to two distinct categories such as benign or malignant. Here benign tumor that has been detected is considered as the non-cancerous or less dangerous and it does not spread to the other part of the brain. It has solid boundaries or contouring that indicates the particular shade of the tumor but malignant is the cancerous tumor which is highly dangerous and it can be spread to the other part of the brain by itself. The boundaries of the malignant tumor are not solid in appearance, instead of that it appears as faded in nature. The intension of the paper is to review different approaches regarding brain tumor classification and finding out certain flaws present in the existing systems.***
***Keywords: Support Vector Machine, Brain Tumor, Segmentation, Cell Classification, Malignant, Benign, MRI, Brain Cells.***

## I. INTRODUCTION

Magnetic Resonance Imaging is a standard harmless philosophy utilized in clinical field for the examination, finding and treatment of brain tissues. The early finding of brain tumor helps in saving the patients' life by giving appropriate treatment. The exact identification of tumors in the MRI images turns into a critical errand to perform consequently, by this proposed framework, the classification and division the tumor locale should be possible precisely. Division and 3D reproduction additionally utilizes the recognition of tumor from a MR image. The manual and visual investigation by specialists is limited to keep away from time utilization. The brain tumor recognition permits limiting a mass of unusual cells in a slice of Magnetic Resonance (MR) utilizing SVM Classifier and division of the tumor cells to be familiar with the size of the tumor present in that sectioned region. The separated elements of the sectioned part will be prepared utilizing counterfeit brain organization to show the sort of the tumor. These highlights will likewise be utilized for contrasting the precision of various classifiers in Classification student application [1]. The brain is conceivably the most specific and delicate organs in the human body. The high death rate is due to brain tumors unimaginably fabricate.

As demonstrated by the National Brain Tumor Society, brain tumors are the incredibly disastrous contamination to individuals. It is the grouping or mass of impaired cells in the brain. The cerebral cortex around the brain is very close. Brain tumors can be carcinogenic (compromising) or non-destructive (innocuous). As compromising or perilous tumors foster they increase the squeezing factor inside your brain.

Undermining tumors are disconnected into two sorts; Primary and auxiliary tumors are more risky than innocuous tumors. As the undermining tumor spreads rapidly to various tissues in the brain, the patient's condition declines. An innocuous (sans malignant growth) brain tumor is a mass of steadily creating cells in the brain. It doesn't normally stand and spread. The signs of a brain tumor depend upon how gigantic it is and where it is arranged in the brain. A couple of tumors that grow continuously make no signs every step of the way. Typical secondary effects are not kidding, persevering cerebral agony, seizures (adequate), constant squeamishness, spewing and sluggishness. Earlier condition or fundamental condition, sometimes called likely condition or fundamental condition, is a condition wherein the phones suggested in the peril of disease are surprisingly formed. At the point when left untreated, these circumstances can provoke disease [2].

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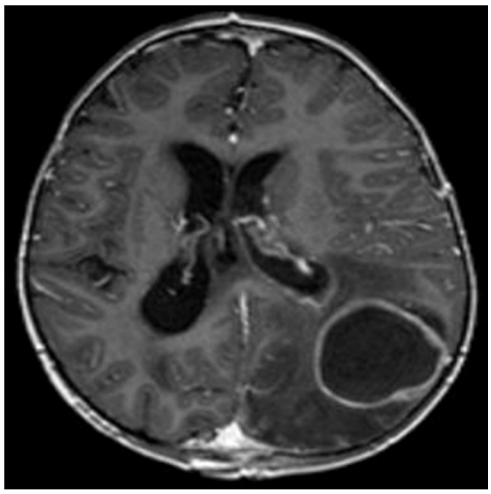


Fig. 1.Benign Tumor MRI Image

Risky tumors are destructive tumors that continuously decline and lead to death. As opposed to cleanse tumors, destructive ones grow rapidly, they are covetous, they search for another area and they spread (metastasize). Impaired cells that structures a perilous tumor grows rapidly. The magnetic field fragment used to conclude radio recurrence to make unequivocal pictures of organs, sensitive tissues, bone and other internal developments in the human body. The MRI-strategy is particularly reasonable in recognizing brain tumors. Brain tumor acknowledgment ought to be conceivable with MRI pictures. In image processing, image updates clusters that are used for clinical image diagnosis to additionally foster picture quality. EDGE detection, histogram and division limits expect a critical part in recognizing and gathering brain tumors. The objective of this work is to find different channels, detachment methods and estimations to perceive brain tumors [2].



Fig. 2.Malignant Tumor MRI Image

Fig. 3.

## II. RELATED WORKS

### *A. Related Works*

Mircea Gurbin et al. [3] proposed the brain tumor recognition and classification framework is carried out utilizing CWT, DWT and SVMs. The proposed strategy involves various levels for wavelets, the high precision part is gotten utilizing CWT. The CWT forestalls the deficiency of edges in division. The outcome shows that SVMs having the legitimate arrangements of preparing information can recognize unusual and typical tumor locales and characterize them accurately as a harmless tumor, malignant tumor or normal brain. SVMs have critical computational benefits. This classification is vital for the doctor in laying out an exact symptomatic and suggesting a right further treatment. The acquired outcomes show that CWT gives higher calculation contrasting DWT. Regardless of whether the calculation time is longer, on the off chance that we are principally keen on perception, coordinating and include recognition, utilizing CWT is better. In the event that we are keen on de-noising, pressure, rebuilding, DWT is much of the time more fitting.

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A half and half methodology is suggested in settling appropriately the location and classification issues in brain tumors. T. A. Jemimma et al. [4] proposed brain tumor division and classification is executed through the Water Shed Algorithm (WSA), Dynamic Angle Projection Pattern highlights and these elements are ordered by utilizing CNN. The significance of the watershed division calculation removes the tumor areas in a powerful way for capable DAPP highlight extraction. The DAPP removes the surface elements from the fragmented tumor districts and histogram highlights are acquired. These component vectors are elevated to the contribution for CNN classifier which plays out the classification. The division and classification of MRI brain image are vital for the capable conclusion of brain tumor. The trial results are executed through the BRATS data set which accomplishes better dice score proficiency 93.5% and awareness 94.2%. Later on work, for classification and division of brain tumor, a few other various elements can measure up to get more exactness. It can likewise be stretched out to distinguish different kinds of tumors like a pancreatic tumor, adenomas, fibromas.

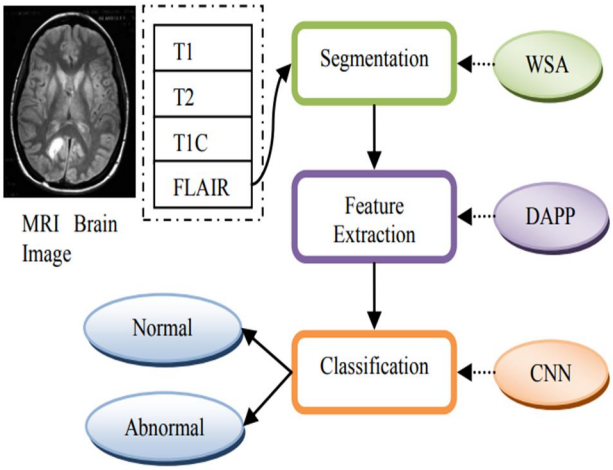



Fig. 4.Overview of the System [3]

R.Lavanyadevi et al. [5] proposed strategy includes precisely perceiving the semantically significance full regions in an image. As result, by connection of each and every pixel in the image alongside which signify a semantically importance and the doctor or radiologist can identify threat and conclude it. The elements of adjoining twofold models and dark level co-events are eliminated from brain images with harmless or dangerous or typical images. In preparing mode the eliminated highlights alongside semantic elements are prepared utilizing PNN classifier. In classification mode similar highlights are removed from test brain image and mystery with prepared models utilizing PNN classifier. At the point when the test image isn't like any preparation image then the image can be remembered for preparing set information. On correlation among PNN and CNN, PNN is considered to enjoy significant benefits. It is because of reality that PNN gains from preparing information momentarily. As PNN has speed of learning capacity, it can adjust its learning progressively. Hein Tun Zaw et al. [6] proposed technique can help the clinical staffs, for example, specialists and radiologists to analyze the brain malignant growth from MRI images particularly for GBM which requires the discovery of all conceivable spreading destructive regions. In this strategy, brain tumors have been identified utilizing Naïve Bayes classification with the assistance of most extreme entropy edge. The REMBRANDT data set is utilized in this review. The created calculation can precisely distinguish the tumor in all potential areas of the brain that the tumor can exist, including the worldly projection. The calculation yields 81.25% recognition rate on tumor images and 100 percent discovery rate on non-tumor images with the general precision 94%. Ragib Shahariar Ayon et al. [7] proposed a procedure for simple division of the brain tumor and ID of the tumor type. Brain tumor discovery is finished by preprocessing the image with denoising and inclination remedy which was then taken care of to the handling stage as information image. We applied the spatial FCM for sectioning the brain MR image and took the likely tumor cut. After that the tumor cut was taken care of to the post-handling stage where it goes through an area channel. The result image is a separated image of anticipated tumor area. We utilized similar highlights to prepare various kinds of classifiers and pick the one with most precision which predicts the tumor type. Subsequent to contrasting and various kinds of bunching and classification calculations we can express that the proposed strategy is better for tumor division and classification than ordinary techniques.

Table No. I Related Works

| Paper | Author | Publication | Brief |
|---|---|---|---|
| Development of Automated Brain Tumor Identification Using MRI Images [15] | T. M. Shahriar Sazzad, K. M. Tanzibul Ahmmed, M. U. Hoque and M. Rahman | International Conference on Electrical, Computer and Communication Engineering (ECCE), Cox'sBazar, Bangladesh, 2019, pp. 1-4. | Based on OTSU's thresholding by segmentation. It is based on color separation. But luminance may degrade the precision and false alarm rate may get increases. |
| Tumor Detection & Classification for MRI Brain images [16] | M. G., M. L. and D. Lascu | International Conference on Telecommunications and Signal Pro., Budapest, 2019. | System is based on conventional image processing and classification technique to extract the abnormal cells from brain MRI image and obtain the result accordingly. Conventional approach is bit poor as compare to the deep model. |
| Watershed Algorithm based DAPP features for Brain Tumor Segmentation and Classification [17] | Jemimma, T. A.; Vetharaj, Y. Jacob | IEEE 2018 International Conference on Smart Systems and Inventive Technology (ICSSIT) - Tirunelveli, India | Based on watershed algorithm which is a weaker feature extraction method because there is deep learning involved in it and traditional classification has been done in this research. Weaker model pertain less accuracy or precision rate with lots of error or false alarm rate that should not be entertained in medical science. |
| Brain tumor classification and segmentation in MRI images using PNN [18] | Lavanyadevi, R.; Machakowsalya, M.; Nivethitha, J.; Kumar, A. Niranjil | 2017 IEEE International Conference on Electrical, Instrumentation and Communication Engineering (ICEICE) - Karur, Tamilnadu, India | Based on PNN (Probabilistic Neural Network) for performing the training module. But PNN is bit slower than multilayer perception that directly degraded the precision of the system. |
| Tumor Detection in the Brain using Faster R-CNN [19] | R. Ezhilarasi and P. Varalakshmi | 2018 International Conference on IoT in Social, Analytics | System is based on R-CNN model. R-CNN requires more memory as compare to the conventional CNN and due to that system computational time increases and perform slower operation. |
| Detection of Brain Tumor in MRI Images by Applying Segmentation and Area Calculation Method Using SCILAB [20] | M. Kurnar, A. Sinha and N. V. Bansode | 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), Pune, India | Based on SCILAB which is indirectly based on KNN classifier which is not an intellectual classifier that does not deal with non-linear data and accuracy may degraded due to that. It also does not work with large dataset. It is also not able to deal with high dimensional data and it also lose the sensitive information related to the MRI image. |

| | | | |
|---|---|---|---|
| Tumor region extraction using edge detection method in brain MRI images [21] | Manisha, B. Radhakrishnan and L. P. Suresh | 2017 International Conference on Circuit ,Power and Computing Technologies (ICCPCT), Kollam | Based on edge detection method. Edge detection method is not able to deal with complex structure and brain MRI image is bit complex in nature. Edge detection method may erode the sensitive information and due to that false alarm rate may increases. |
| Effective Algorithm For Benign Brain Tumor Detection Using Fractional Calculus [22] | S. K. Chandra and M. Kumar Bajpai | TENCON 2018 - 2018 IEEE Region 10 Conference, Jeju, Korea (South), 2018, pp. 2408-2413 | System is based on Fractional Calculus which is not suitable for disease diagnosis because it has limited feature mapping approach and it has also has vanishing gradient problem where system started calculating false result. |
| Enhanced Automatic Classification of Brain Tumours with FCM and Convolution Neural Network [23] | L. J. Rao, R. Challa, D. Sudarsa, C. Naresh and C. Z. Basha | 2020 Third International Conference on Smart Systems and Inventive Technology (ICSSIT) | Based on C-means clustering and CNN model. But C-means clustering is generally used for classification and CNN is used for feature extraction. CNN has not been designed for classification process, CNN has the potential to obtain the input features and enhances the features by using distinct filter and train the layers accordingly and generate a model that can able to diagnose or recognize the target object. |

## III. PROBLEM IDENTIFICATION

L.Jagjeevan Rao et al. [8] proposed an implementation model which is based on FCM (Fuzzy C-Means Clustering) and CNN (Convolutional Neural Network) approaches. Here system uses FCM for extracting the features of the brain as well as impairments and CNN is used as classifier. But C-means clustering is generally used for classification and CNN is used for feature extraction. CNN has not been designed for classification process, CNN is a convolutional neural network that has the potential to obtain the input features and enhances the features by using distinct filter and train the layers accordingly and generate a model that can able to diagnose or recognize the target object. SVM is considered as the best classifier in the field of disease diagnosing. The disadvantage of the FCM is that; it requires large amount of time to converge the data and it is more sensitive to the noise and hard to handle the non-linear data. Conventional CNN model is poor in training and building heavy network that directly affects the execution time. System pertained 91% of accuracy which is bit lesser that can be enhanced by using distinct methods.

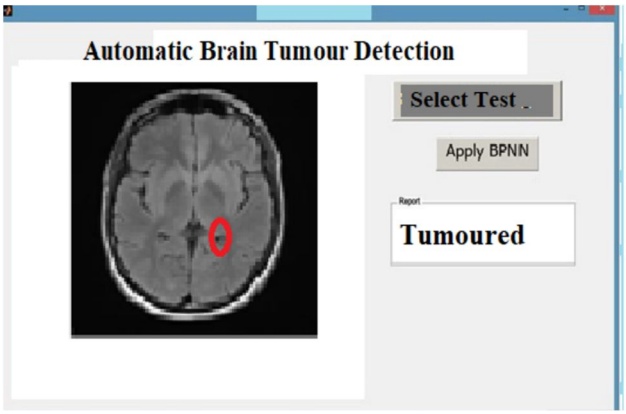



Fig. 5.Graphical Representation of Previous Result [8]

$$\text{Sensitivity} = \frac{TP}{TP + FN} * 100\,\%$$

$$\text{Specificity} = \frac{TN}{FP + TN} * 100\,\%$$

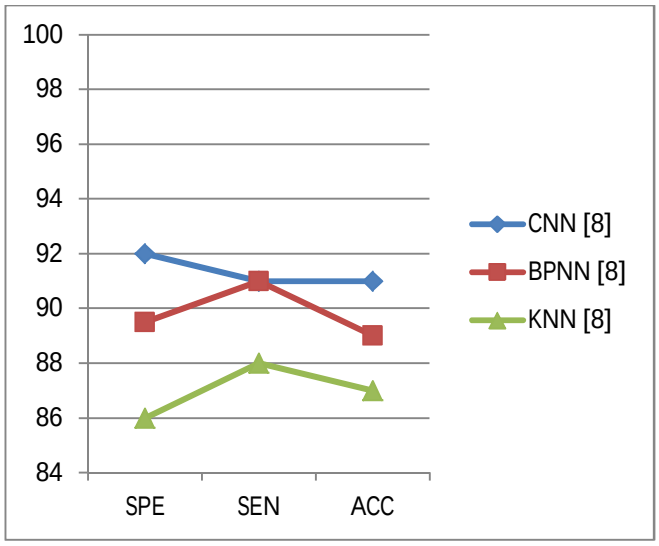
$$\text{Accuracy} = \frac{TP + TN}{TP + FP + TN + FN} * 100\,\%$$

SEN: Sensitivity, SPE: Specificity, ACC: Accuracy.

Table No. II Result Comparison

| Methods | Specificity in % | Sensitivity in % | Accuracy in % |
|---|---|---|---|
| CNN [8] | 92.00 | 91.00 | 91.00 |
| BPNN [8] | 89.50 | 91.00 | 89.00 |
| KNN [8] | 86.00 | 88.00 | 87.00 |

Graph I Result Comparison




## IV. CONCLUSION & FUTURE SCOPE

Magnetic Resonance Imaging is a standard harmless philosophy utilized in clinical field for the examination, finding and treatment of brain tissues. The early finding of brain tumor helps in saving the patients' life by giving appropriate treatment. The exact identification of tumors in the MRI images turns into a critical errand to perform consequently, by this proposed framework, the classification and division the tumor locale should be possible precisely. Division and 3D reproduction additionally utilizes the recognition of tumor from a MR image. The manual and visual investigation by specialists is limited to keep away from time utilization. The brain tumor recognition permits limiting a mass of unusual cells in a slice of Magnetic Resonance (MR) utilizing SVM Classifier and division of the tumor cells to be familiar with the size of the tumor present in that sectioned region. The separated elements of the sectioned part will be prepared utilizing counterfeit brain organization to show the sort of the tumor. These highlights will likewise be utilized for contrasting the precision of various classifiers in Classification student application. The brain is conceivably the most specific and delicate organs in the human body. The high death rate is due to brain tumors unimaginably fabricate. As per the survey of national brain society the brain tumor has been raised day by day rapidly. It can be more dangerous if treatment has not been initiated. The impaired cells grow inside the brain and it may spread to the other part of the brain or organ and it can be more worsen if it covers large density of the brain. It is required to stop immediately otherwise it may take humans lives. As per the quantitative data analysis there are equal chances of brain tumor in both the genders i.e. male or female, boys or girls. There is no restriction or it has not been restricted as per the gender wise.

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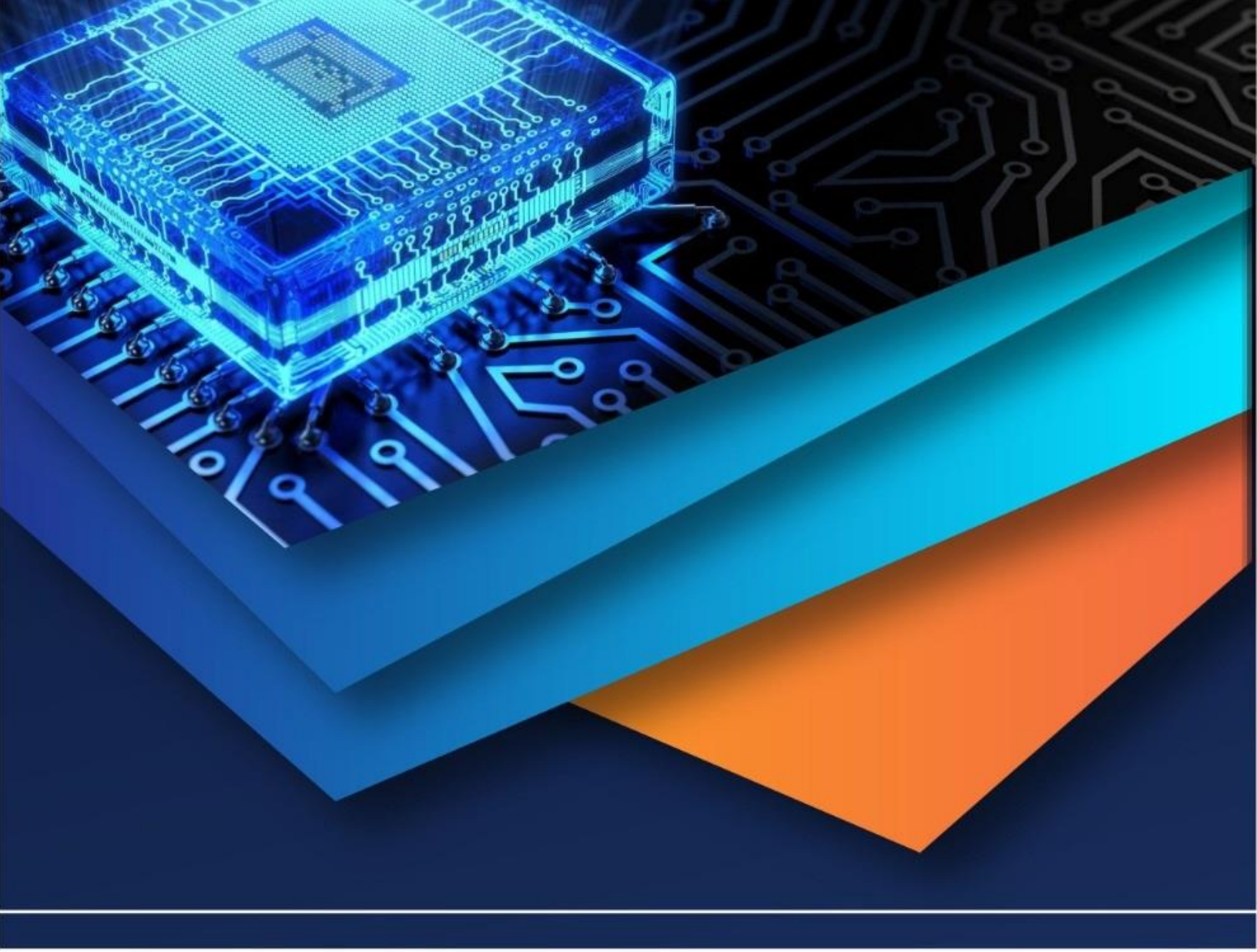
Age matters but not a lot, so it is required to obtain the disease or diagnose the disease at early stage of the cancer. A couple of tumors that grow continuously make no signs every step of the way. In future, the accuracy, precision, specificity and sensitivity can be enhanced by using hybrid classifiers or models because accuracy plays a very important role in the field of medical science. Brain tumor is a life threatening disease, so that is why it is required to obtain the better level of accuracy with very fewer false error rates.

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