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An Implementation Convolutional Neural Network for Detection of Brain Tumor

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Abstract: *Image processing is the one of the most demanding and promising field nowadays. Tumor is a abnormal growth of cell in human brain. The tumor can be categorized as benign(non-cancerous) and malignant(cancerous). Earlier stage of tumor is used to be detected manually through observation of image by doctors and it takes more time and sometimes gets inaccurate results. Today different automated tools are used in medical field. These tools provide a quick and precise result. Magnetic Resonance Images (MRI) is the most widely used imaging technique for analyzing internal structure of human body. The MRI is used even in diagnosis of most severe disease of medical science like brain tumors. The brain tumor detection process consist of image processing techniques involves four stages. Image pre-processing, image segmentation, feature extraction, and finally classification. There are several existing of techniques are available for brain tumor segmentation and classification to detect the brain tumor. There are many techniques available presents a study of existing techniques for brain tumor detection and their advantages and limitations. To overcome these drawbacks, propose a Convolution Neural Network (CNN) based classifier. CNN based classifier used to compare the trained and test data, from this get the best result.*

Keywords: CNN (Convolutional Neural Network).

I. INTRODUCTION

Medical imaging refers to a number of techniques that can be used as non-invasive methods of looking inside the body [1]. Medical image encompasses different image modalities and processes toimage the human body for treatment and diagnostic purposes and hence plays a paramount and decisive role in taking actions for the betterment of the health of the people.

Image segmentation is a crucial and essential step in image processing which determines the success of a higher level of image processing [2]. The primary goal of image segmentation in medical image processing is mainly tumor or lesion detection, efficient machine vision and attaining satisfactory result for further diagnosis. Improving the sensitivity and specificity of tumor or lesion has become a core problem in medical images with the help of Computer Aided Diagnostic (CAD) systems. According to [3], Brain and other nervous system cancer is the 10th leading cause of death, and the five-year survival rate for people with a cancerous brain is 34% for men and 36% for women. Moreover, the World Health Organization (WHO) states that around 400,000 people in the world are affected by the brain tumor and 120,000 people have died in the previous years [4]. Moreover, An estimated 86,970 new cases of primary malignant and nonmalignant brain and other Central Nervous System (CNS) tumors are expected to be diagnosed in the United States in 2019 [5].

A brain tumor occurs when abnormal cells form within the brain [6]. There are two main types of tumors- Malignant and Benign. Malignant brain tumors originate in the brain, grows faster and aggressively invades the surrounding tissues. It can spread to other parts of the brain and affect the central nervous system. Cancerous tumors can be divided into primary tumors, which start within the brain, and secondary tumors, which have spread from elsewhere, are known as brain metastasis tumors.

On the other hand, a benign brain tumor is a mass of cells that grow relatively slowly in the brain. Hence, early detection of brain tumors can play an indispensable role in improving the treatment possibilities, and a higher gain of survival possibility can be accomplished. But manual segmentation of tumors or lesions is a time consuming,

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challenging and burdensome task as a large number of MRI images are generated in medical routine. MRI, also known as Magnetic Resonance Imaging is mostly used for a braintumor or lesion detection.

Brain tumor segmentation from MRI is one of the most crucial tasks in medical image processing as it generally involves a considerable amount of data. Moreover, the tumors can be ill-defined with soft tissue boundaries. So it is a very extensive task to obtain the accurate segmentation of tumors from the human brain.

II. LITERATURE REVIEW

[1] Capsule Networks for Brain Tumor Classification Based On MRI Images And Coarse Tumor Boundaries. As stated by the WHO, cancer is deemed to be second leading cause of human casualties. Out of different types of cancer, brain tumor is perceived as one of the fatal due to its vigorous nature, diverse characteristics and relatively low survival rate. Discovering the type of brain tumor has remarkable impact on the choice of therapy and patient's survival. Human based identification is usually inaccurate and unreliable leading in a recent sweep of interest to automize this process using convolutional neural network (CNN). As CNN fails to completely utilize spatial relations, which may lead to incorrect tumor classification. In our technique, we have included newly evolved CapsNet to prevail this shortcoming. The main offering is to provide CapsNet with access to tissues neighbouring the tumor, without diverting it from the principal target. An improved CapsNet architecture is consequently proposed for the classification of brain tumor, that takes the coarse boundaries of tumor as additional input within its pipeline for surging the focus of the CapsNet.

[2] A Hybrid Feature Extraction Method with Regularized Extreme Learning Machine for Brain Tumor Classification of the brain tumor is the crucial step that depends upon understanding and expertise of the physician. The automated classification system of the brain tumor is vital to assist radiologists and physicians to identify the tumor. Nonetheless, the precision of the current systems needs to be improved for the successful treatment. In this paper the proposed approach consists of, (1) brain image pre-processing, (2) feature extraction of the image & (3) brain tumor classification. Initially the input images of the brain are transformed into intensity brain images using minmax normalization rule resulting into enhanced and improved contrast of the edges and regions of the brain. Then by applying feature extraction to the brain images using hybrid feature extraction and then computing the covariance matrix of the features extracted to project them into a notable set of features using principle component analysis (PCA). Ultimately, the type of brain tumor is classified using regularized extreme learning machine (RELM). As per the results the suggested approach proved to be more effectual compared to the current approaches. Also the performance in terms of accuracy of the classification improved from 91.51% to 94.233% for the experiment.

[3] Tumor Detection and Classification of MRI Brain Image using Different Wavelet Transforms and Support Vector Machines The brain is the principal organ of human body. An abnormal growth of cells leads to the brain tumor. This abnormal growth of cells results in unusual functioning of brain and eradication of healthy cells. The brain tumors can be classified as malignant(cancerous) and benign(noncancerous) tumors. In this paper the proposed approach includes (1) Pre-processing, (2) Training the SVM & (3) Submit training set to SVM and output the obtained predictions. At first stage denoising the medical images using different kind of wavelets while maintaining the important features. In segmentation for the extraction of the features, Otsu method is used for converting grey-level image to binary image. Finally, the data has two classes and we can apply SVM for classification. The outcome shows that SVM with proper training dataset is able to differentiate between normal and abnormal tumor regions and categories as malignant tumor, benign tumor or a healthy brain.

[4] Segmentation and Recovery of Pathological Mr Brain Images Using Transformed Low-Rank and Structured Sparse Decomposition A general framework is proposed for the concurrent segmentation and recovery of pathological magnetic resonance images (MRI), where low rank and sparse decomposition (LSD) schemes have been used extensively. Due to the lack of constraint between low-rank and sparse components, conventional LSD techniques often construct recovered images with distorted pathological areas. For resolving this issue, a transformed low rank and structured sparse decomposition (TLS2D) method is proposed, that is vigorous for taking out pathological regions. By using structured sparse and computed image saliency as adaptive sparsity constraint the well recovered images can be acquired. The exploratory results on the MRI images of brain tumor shows that the TLS2D can successfully provide adequate performance on image recovery as well as tumor segmentation.

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[5] Brain Tumor Segmentation Using Convolutional Neural Networks in MRI Images Out of different types of brain tumors, malignant tumors are assertive and commonly occurring, decreasing the life expectancy. MRI is extensively used imaging method for assessing the tumors. Due to the huge amount of data produced by MRI stops the manual segmentation in a fair time, restricting the use of accurate quantitative measurements in clinical practices. For resolving this, an automatic segmentation technique based on CNN is proposed, exploring small kernels. Employing small kernels allows designing a deeper architecture, alongside having an advantage against overfitting, given the small number of weights in the network. Use of intensity normalization in pre-processing with data augmentation has proven to be effectual for brain tumor segmentation in MRI images.

[6] Development of Automated Brain Tumor Identification Using MRI Images Brain tumor is a prime reason for human casualties every year. Magnetic resonance imaging (MRI) is a commonly used technique for brain tumor diagnosis. An automated approach which incorporates enhancement at an early stage to reduce gray scale colour variations. For better segmentation the unnecessary noises were decreased as much as possible using filter operation. The proposed approach uses threshold-based Otsu segmentation rather than colour segmentation. Ultimately, the feature information provided by the pathology experts was used to identify region of interests. The exploratory results demonstrate that the proposed approach was able to provide adequate results as compared to present available approaches in terms of accuracy.

[7] Brain Tumor Segmentation to Calculate Percentage Tumor Using MRI Brain tumor is a type of disease that damages the brain through an uncontrolled growth of cells. The details of the brain tumor is obtained through MRI. For giving right treatment the analysis of the tumor must be performed accurately. Segmentation method is used for the purpose of analysis, and is done to distinguish the brain tumor tissue from other tissues such as fat, edema and normal tissue. The MRI image must be maintained at the edge of the first image with median filtering, followed by segmentation process that requires thresholding. Segmentation process is performed by giving a mark on the area of the brain and area outside the brain using watershed method then clearing the skull with cropping. 14 brain tumor images are used as an input in this study. The segmentation result compares brain tumor area with brain tissue area. The tumor was determined with average error rate of 10 percent.

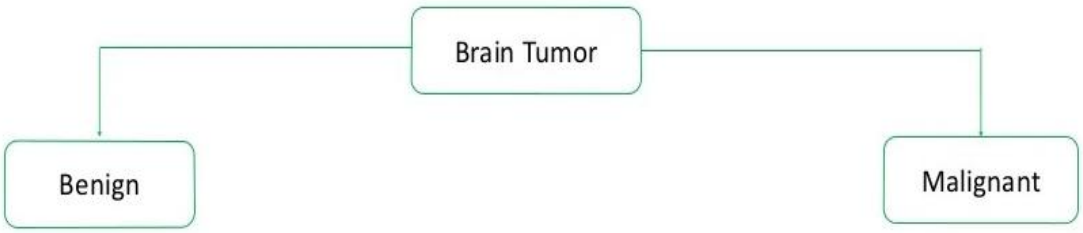
III. PROPOSED SYSTEM

In our proposed methodology, there are two distinct model for segmentation and detection of Brain tumor. First model segmented the tumor by FCM and classified by traditional machine learning algorithms and the second model focused on deep learning for tumor detection. Segmentation by FCMgives better result for noisy clustered data set [15]. Though it takes more execution time, it retains more information.

Proposed Methodology of Tumor Segmentation and Classification Using Traditional Classifiers

In our first prospective model, brain tumor segmentation and detection using machine learning algorithm had been done, and a comparison of the classifiers for our model is delineated. Our proposed Brain image segmentation system consists of seven stages: skull stripping, filtering and enhancement, segmentation by Fuzzy C Means algorithm, morphological operations, tumor contouring, feature extraction and classification by traditional classifiers. The results of our work accomplished satisfactory results. The main stages of our proposed model (Fig. 1) will be illustratedin the following fig.

Types of Tumors



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- Non cancerous
- Brain cancers
- Grows rapidly and invades healthy brain tissues
- Distorted borders
- Grows slowly: do not spread into other tissues
- Have clear borders

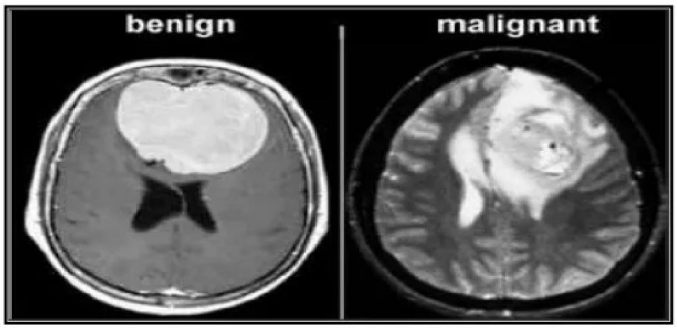

Fig 2: Benign and Malignant Tumor [2]

The brain images are obtained using Magnetic Resonance Imaging (MRI), which are prone to noise and artfactssuch as labels and intensity variations during acquisition [2]. In addition, there are many structures in the brainimage such as cerebrospinal fluid, grey matter, and white matter and skull tissues apart from the tumor.

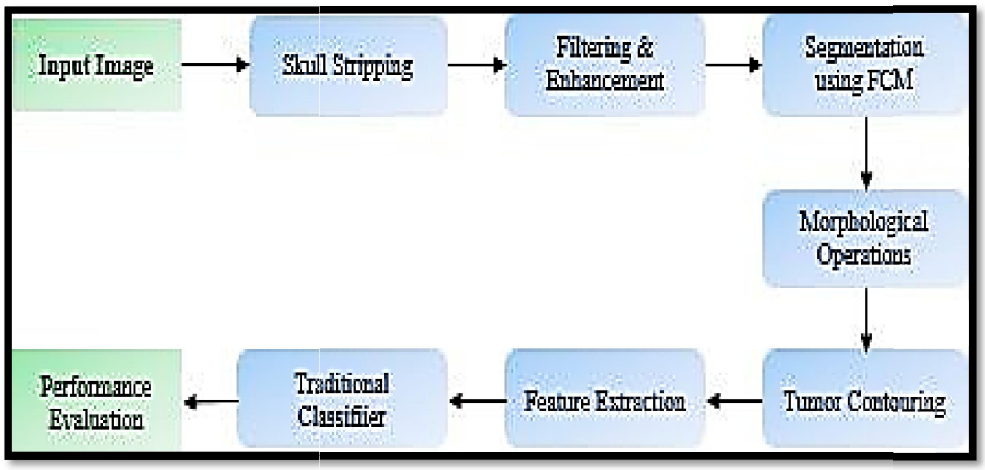

Fig. 3.1 Methodology for classification using Traditional Classifiers

Convolutional Neural Network is broadly used in the fieldof Medical image processing. Over the years lots ofresearchers tried to build a model which can detect the tumormore efficiently. We tried to come up with an exemplarywhich can accurately classify the tumor from 2D Brain MRIimages. A fully-connected neural network can detect thetumor, but because of parameter sharing and sparsity ofconnection, we adopted CNN for our model.A Five-Layer Convolutional Neural Network isintroduced and implemented for tumor detection. Theaggregated model consisting of seven stages including thehidden layers provides us with the most prominent result forthe apprehension of the tumor. Following is the proposedmethodology with a brief narration-

Convolutional Neural NetworkUsing convolutional layer as the beginner layer, an inputshape of the MRI images is generated which is 64*64*3converting all the images into a homogeneous dimension.After accumulating all the images in the same aspect, wecreated a convolutional kernel that is convoluted with theinput layer — administering with 32 convolutional filters ofsize 3*3 each with the support of 3 channels tensors.

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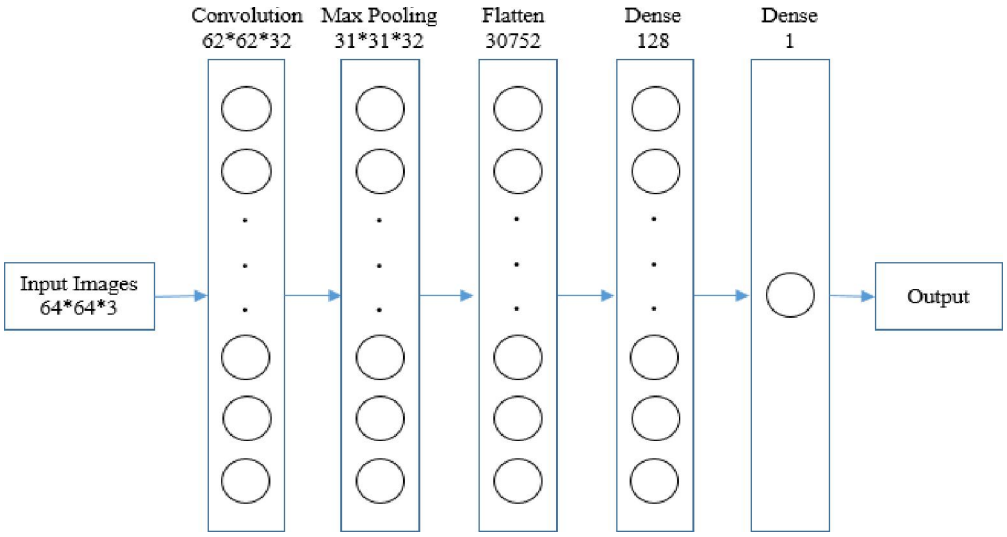

Fig. 3.2 Methodology for tumor detection using 5-Layer Convolutional Neural Network

The dense function isapplied in Keras for the processing of the Neural Network,and the obtained vector is work as an input for this layer.There are 128 nodes in the hidden layer. Because the number of dimension or nodes proportional with the computing resources we need to fit our model we kept it as moderate aspossible and for this perspective 128 nodes gives the mostsubstantial result. ReLU is used as the activation function because of showing better convergence performance. After the first dense layer, the second fully connected layer was used as the final layer of the model. In this layer, we used sigmoid function as activation function where the total number of the node is one because we need to lower the uses of computing resources so that a more significant amountass uages the execution time.

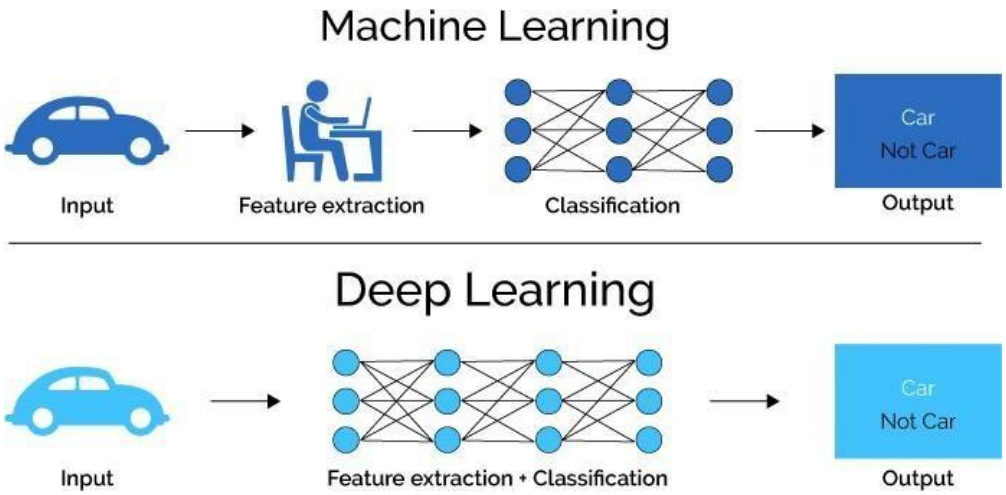

Fig. 3.3 Machine Learning and Deep Learning

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IV. RESULT ANALYSIS

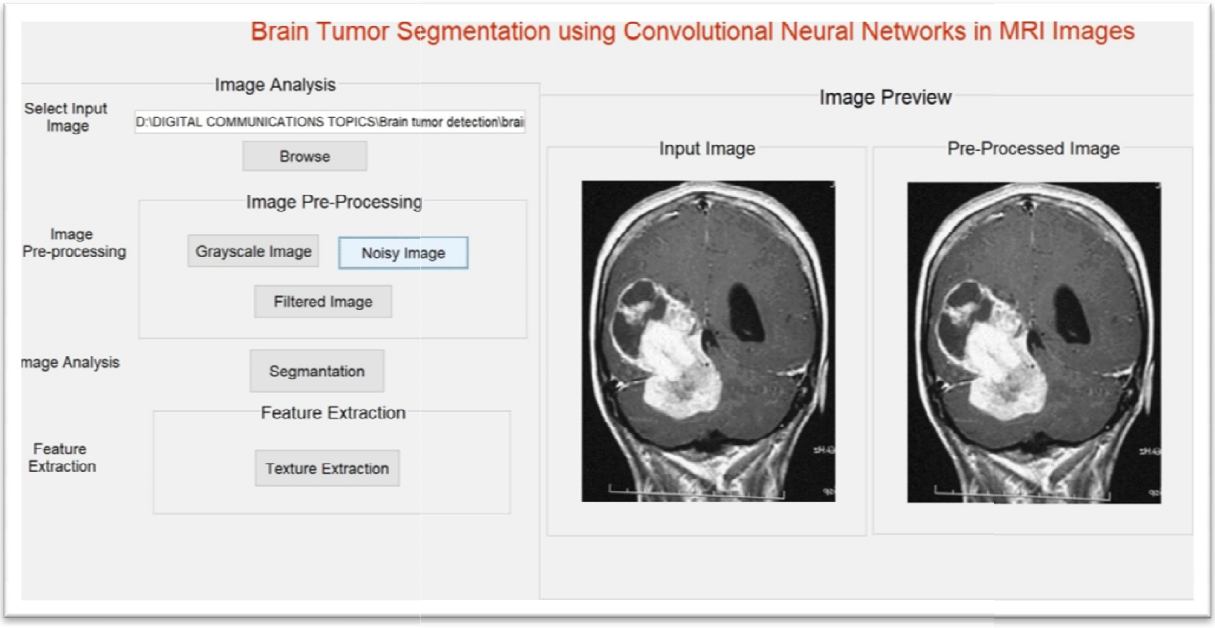

Figure 4.1 Noisy Image in Brain Tumor Detection Using CNN

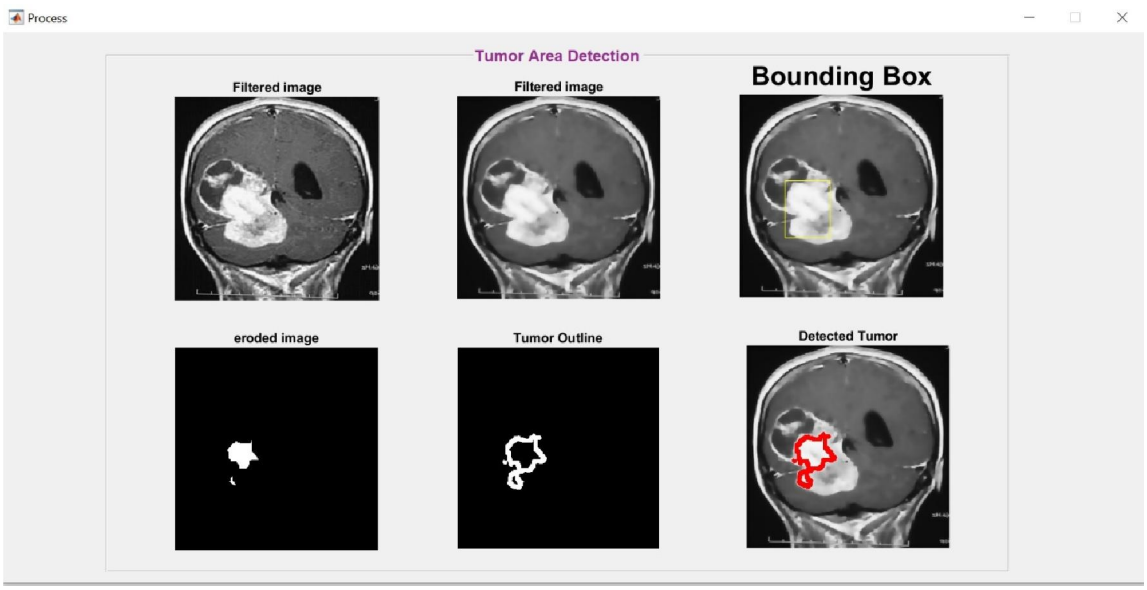

Figure 4.2 Brain Tumor Detection Using CNN

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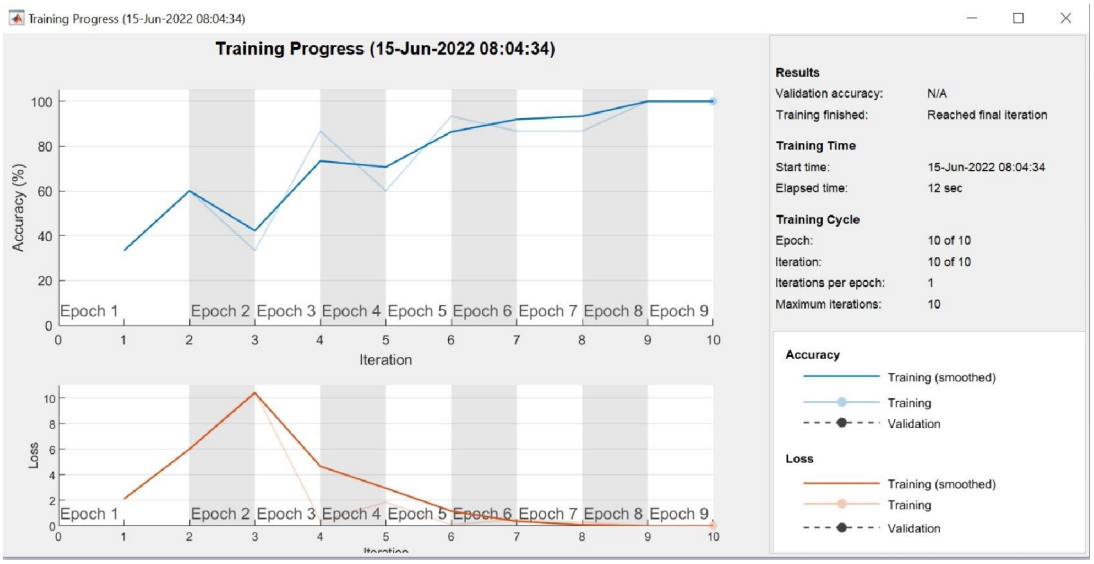

Figure 4.3 Accuracy VS Loss Brain Tumor Detection Using CNN

V. CONCLUSION

We propose a CNN-based method for segmentation of brain tumors in MRI images. There are several existing of techniques are available for brain tumor segmentation and classification to detect the brain tumor. There are many techniques available presents a study of existing techniques for brain tumor detection and their advantages and limitations. To overcome these limitations, propose a Convolution Neural Network (CNN) based classifier. CNN based classifier used to compare the trained and test data, from this get the best result.

VI. FUTURE SCOPE AND EXTENSION OF THE RESEARCHWORK

Some of the future scope of this research are as follows.

- The dataset can be increased by adding more types of abnormalities.
- The proposed model can be developed with more generalization capabilities.
- An automated web-based system can be developed that can assist in real-time diagnosis to medical professionals.

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