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Brain Tumor Detection Using Machine Learning Algorithm

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Abstract: *Brain is the regulatory unit in human body. It controls the functions such as memory, vision, hearing, knowledge, personality, problem solving, etc. The main reason for brain tumor is the abandoned progress of brain cells. Many health organizations have recognized brain tumor as the second foremost dispute that causes a large number of human deaths all around the world. Identification of brain tumor at a premature stage offers opportunity of effective medical treatment. Use of Magnetic Resonance Imaging images have been recognized as more detailed and more consistent images when compared to Computed Tomography images. There are various techniques to detect brain tumor or neoplasms. The most competent and effective algorithms are discussed in this paper after studying a number of appropriate research papers. Pre-processing brain images, segmenting them, feature extraction, clustering and detection of the tumor are the methodologies in most researches.*

Keywords: Magnetic Resonance Imaging (MRI), Convolutional Neural Network (CNN), Brain Tumor Classification (BTC), Deep Learning (DL), Machine Learning (ML), Gray-Level Co-occurrence Matrix (GCM)

I. INTRODUCTION

The brain tumor is a clump of irregular cells in the brain that forms a mass. The human brain is enclosed by a rigid skull. Any expansion in such a small area will trigger severe issues. Brain tumors can be cancerous and non-cancerous. The pressure within the skull will rise as benign or malignant tumors develop. This will result in permanent brain injury and even death. Approximately 700,000 people worldwide have a brain tumor, with approximately 86,000 new cases diagnosed in 2019. Since 2019, 16,830 people have died from brain tumors, with a 35 percent life expectancy. As such, scientists and researchers have been working towards developing sophisticated techniques and methods for identifying brain tumors.

Although MRI and Computer Tomography (CT) are the two modalities widely used for marking the abnormalities in terms of shape, size, or location of brain tissues which in turn help in detecting the tumors, MRI is preferred more by the doctors. As a consequence, scientists and researchers have more focused on MRI. While identifying brain tumors from MRI images, conventional inspection by physicians is mostly used. However, automated approaches mainly implemented by computer-aided medical image processing techniques are increasingly aiding physicians in detecting brain tumor.

Machine Learning (ML) algorithms gain insight from training data samples and can predict the class label of the unknown data objects. ML algorithms are popularly being used in the field of health informatics, forecasting pandemic, evaluating user experience in playing games, predicting shear strength. Similarly, many ML based studies are conducted on medical images to classify brain tumors. Medical image processing involves pre-processing, segmentation, feature selection and post-processing classification. These steps can be implemented by the conventional machine learning approach as well as the deep learning approach.

In the conventional machine learning approach, hand-crafted features are used to obtain results from test images and the process is fast.

II. LITERATURE REVIEW

A brain tumor is a clump of irregular cells in the brain that forms a mass [1]. The human brain is enclosed by a rigid skull. Any expansion in such a small area will trigger severe issues. Brain tumors can be cancerous and non-cancerous.

The pressure within the skull will rise as benign or malignant tumors develop. This will result in permanent brain injury and even death. The Magnetic Resonance Imaging (MRI) picture of a healthy brain is shown in Figure 1 (A), while the picture of a brain containing a tumor is shown in Figure 1 (B). Approximately 700,000 people worldwide have a brain tumor, with approximately 86,000 new cases diagnosed in 2019. Since 2019, 16,830 people have died from brain tumors, with a 35 percent life expectancy [2].

As such, scientists and researchers have been working towards developing sophisticated techniques and methods for identifying brain tumors. Although MRI and Computer Tomography (CT) are the two modalities widely used for marking the abnormalities in terms of shape, size, or location of brain tissues which in turn help in detecting the tumors, MRI is preferred more by the doctors. As a consequence, scientists and researchers have more focused on MRI. While identifying brain tumors from MRI images, conventional inspection by physicians is mostly used. However, automated approaches mainly implemented by computer-aided medical image processing techniques are increasingly aiding physicians in detecting brain tumors.

Machine Learning (ML) algorithms gain insight from training data samples and can predict the class label of the unknown data objects. ML algorithms are popularly being used in the field of health-informatics [3]-[5], forecasting pandemic [6], evaluating user experience in playing games [7], predicting shear strength [8]. Similarly, many ML based studies are conducted on medical images to classify brain tumors [9]-[11]. Medical image processing involves pre-processing, segmentation, feature selection and post-processing classification [12]. These steps can be implemented by the conventional machine learning approach as well as the deep learning approach. In the conventional machine learning approach, hand-crafted features are used to obtain results from test images and the process is fast.

III. METHODOLOGY

There are four methodologies Namely they are Preprocessing, Segmentation, Feature Extraction, Classification.

Data Preprocessing

Pre-processing is required as it improvises the image data which enhances some of the image features that are important for the further processing. The RGB MRI image is converted to grey scale image and the median filter is applied to brain MR images for noise removal. The noise has to be removed for further processing as high accuracy is required. The edges are detected from filtered image using canny edge detection. The detected image of the edges is required for segmentation of the image.

Segmentation

Segmentation is the process of dividing an image into multiple segments. The aim of segmentation is to change the representation of an image into something which is easier to analyze. Segmentation is the process of separating the tumor from normal brain tissues. Watershed segmentation is performed for finding the location of the tumor in the MRI images. The result of watershed segmentation is label image. In label image, the different objects that are identified will have different pixel values When an input to an algorithm is very large and redundant to be processed, it is transformed into reduced representative set of features called feature vector. Transformation of this input data into a set of features is called feature extraction.

In this step, the important features required for image classification are extracted. The segmented brain MRI image is used and texture features are extracted from the segmented image which shows the texture property of the image. When a input to an algorithm is very large and redundant to be processed, it is transformed into reduced representative set of features called feature vector. Transformation of this input data into a set of features is called feature extraction.

In this step, the important features required for image classification are extracted. The segmented brain MRI image is used and texture features are extracted from the segmented image which shows the texture property of the image. These features are extracted using Grey Level Co-occurrence Matrix (GLCM) as it is robust method with high performance. This texture feature extraction method is very competitive as using smaller number of grey levels shrinks the size of GLCM which reduces the computational cost of the algorithm and also maintains the high classification rates. These features are used to differentiate between normal and abnormal brain.

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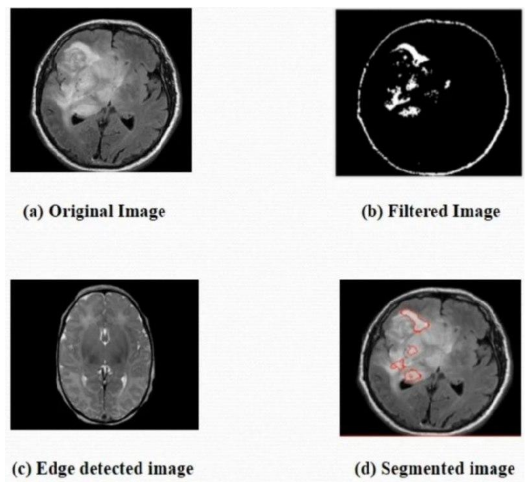
Classification

Classification of MR brain image either as normal or abnormal. With the help of above modules, we can detect weather the Tumor is present or not.

GREY SCLAED IMAGE



(a) Original Image (b) Filtered Image

(c) Edge detected image (d) Segmented image

IV. ALGORITHM

Logistic regression is one of the most popular Machine Learning algorithms, which comes under the Supervised Learning technique. It is used for predicting the categorical dependent variable using a given set of independent variables. Logistic regression predicts the output of a categorical dependent variable. Therefore, the outcome must be a categorical or discrete value. It can be either Yes or No, 0 or 1, true or False, etc. but instead of giving the exact value as 0 and 1, it gives the probabilistic values which lie between 0 and 1. Logistic Regression is much similar to the Linear Regression except that how they are used.

Linear Regression is used for solving Regression problems, whereas Logistic regression is used for solving the classification problems. Logistic Function (Sigmoid Function): The sigmoid function is a mathematical function used to map the predicted values to probabilities. It maps any real value into another value within a range of 0 and 1. The value of the logistic regression must be between 0 and 1, which cannot go beyond this limit, so it forms a curve like the "S" form.

The S-form curve is called the Sigmoid function or the logistic function. In logistic regression, we use the concept of the threshold value, which defines the probability of either 0 or 1. Such as values above the threshold value tends to 1, and a value below the threshold values tends to 0. By using this logistics regression algorithm that we classified or separate the MRI scan with positive and negative separately. Predicting the probability of the person having the brain tumor or not classified the MRI scan. Predicting the mortality in injured person. Predicting the probability of failure in the given process.

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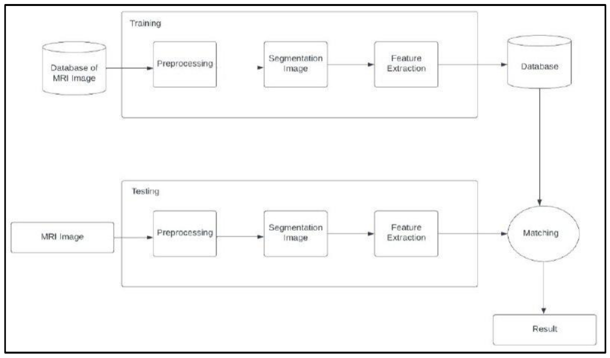
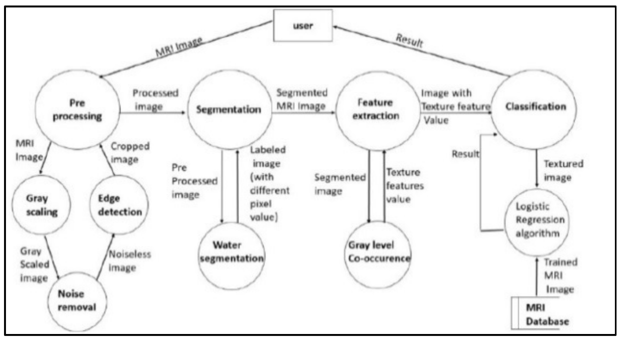
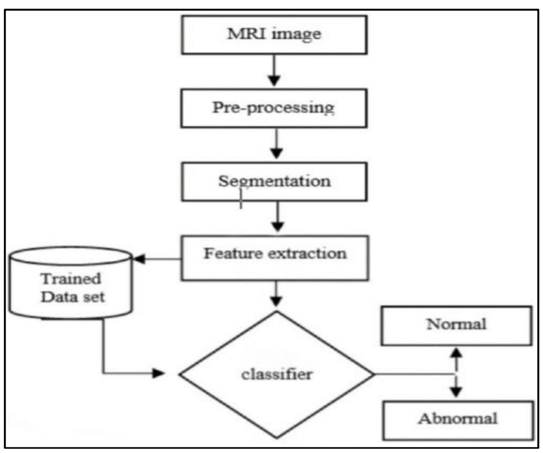
V. SYSTEM ARCHIETECTURE



VI. DATAFLOW DIAGRAM



VII. FLOWCHART



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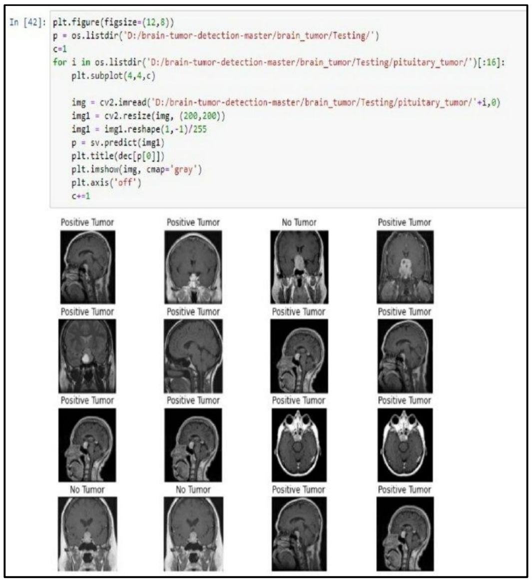
VIII. FINAL PROTOTYPE



IX. RESULT

Our Dataset contains tumor and non-tumor MRI images and collected from different online resources. Kaggel contains real cases of patients, tumor images were obtained from Kaggel and Brain Tumor Image Segmentation. 22 In this work, efficient automatic brain tumor detection is performed by using convolution neural network. Simulation is performed by using python language. The accuracy is calculated and compared with the all-other state of arts methods. The training accuracy, validation accuracy and validation loss are calculated to find the efficiency of proposed brain tumor classification scheme. with some images.

```
In [28]:
sv = SVC()
sv.fit(pca_train, ytrain)

Out[28]: SVC()

In [29]: ##### Evaluation
print("Training Score:", lg.score(pca_train, ytrain))
print("Testing Score:", lg.score(pca_test, ytest))

Training Score: 1.0
Testing Score: 0.9591836734693877

In [30]: print("Training Score:", sv.score(pca_train, ytrain))
print("Testing Score:", sv.score(pca_test, ytest))

Training Score: 0.9938587512794268
Testing Score: 0.963265306122449

In [31]: #### Prediction
pred = sv.predict(pca_test)
np.where(ytest!=pred)

Out[31]: (array([ 36,  51,  68, 120, 212, 214, 220, 227, 239], dtype=int64),)

In [32]: pred[36]
Out[32]: 0

In [33]:
ytest[36]
Out[33]: 1
```

X. CONCLUSION

MRI-based medical image analysis for brain tumor studies has been gaining attention in recent times due to an increased need for efficient and objective evaluation of large amounts of medical data. Because of the high death rate linked with brain tumors, it is critical to diagnose them early to treat them and reduce mortality. Manual diagnosis of the brain and tumor tissues is time-consuming and operator-dependent due to the intricacy of brain tissue. Therefore, in this research, an effective transfer learning-based SC model, which was named VGG-SCNet, was proposed to classify brain tumors from MRI Images. The F1 score obtained by the proposed classifier shows the efficacy of the approach followed by this study.

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