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A Comparative Study of Various Machine Learning Techniques for Brain Tumor Detection

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Abstract - *Brain tumors are produced by abnormal brain cell growth and can be fatal. Early tumor discovery can lower the mortality rate. In recent years, machine learning algorithms have replaced human doctors' proneness to error in diagnosing tumors when it comes to medical imagery and data. Early disease prediction can be done efficiently by using the right data mining categorization technique. Data mining and machine learning techniques have a large place in the medical industry. The accuracy of the system strongly depends on a variety of computations employed in medical processing and imaging. The main objective is to study various Machine Learning techniques for brain tumor detection.*

Key Words: Data Mining, Brain tumor Detection, Machine Learning, Classification, Clustering.

1. INTRODUCTION

Essentially, a tumor represents the aberrant and unregulated cell development within the body. A brain tumor is a distorted mass of tissue in which the brain tissues experience sudden, uncontrollable cell multiplication. The detection of brain tumors is one of the most difficult jobs involved in the processing of medical pictures. A brain tumor is characterized by an abnormal or unusual growth of brain cells. Grading anomalies, evaluating the tumor, and treating it are all made easier with regular tumor tissue monitoring. For this procedure, the doctors need imaging technology. Images produced by medical resonance imaging (MRI) are clearer and more accurate due to their better spatial resolution. It is essential for figuring out the pathology and size of the tumor.

The processes in traditional machine learning classification approaches are often limited to pre-processing, feature extraction, feature selection, dimension reduction, and classification. Despite the astoundingly low number of methods that have been used due to the multiple inherent difficulties, deep learning algorithms, and in particular CNN, have demonstrated extraordinary effectiveness in bioinformatics.

2. LITERATURE SURVEY

Khairandish et. al. [1] provided an explanation of how brain tumors actually behave, and with the aid of many methodologies and the analysis of research studies using a variety of criteria, it offers a clear image of this stage. The examination is conducted in relation to the dataset, proposed model, proposed model performance, and type of method used in each paper. Between 79 and 97.7% of the publications under study had accurate results. They employed Convolutional Neural Network, K-Nearest Neighbour, K-Means, and Random Forest algorithms, in that sequence (highest frequency of use to lowest). Here Convolutional Neural Network gave the highest accuracy of around 79-97.7%

Someswararao et. al. [2] developed a new novel method for detecting tumors in MR images By using machine learning techniques, particularly the CNN model, in this study. This study combined a CNN model classification challenge for determining whether or not a subject has a brain tumor with a computer vision problem to automatically crop the brain from MRI scans. Other techniques used were Convolutional Neural Network, K-Means Clustering and the highest Accuracy is given by Convolutional Neural Network which is around 90%.

Choudhury et. al. [3] proposed a new CNN-based system that can distinguish between different brain MRI images and label them as tumorous or not. The model's accuracy was 96.08%, and its f-score was 97.3. The model uses a CNN with three layers and only a few pre-processing steps to yield results in 35 epochs. The goal of this study is to emphasize the significance of predictive therapy and diagnostic machine learning applications. Other techniques used were Support Vector Machine, Convolutional Neural Network, k-Nearest Neighbour, Boosted trees, Random forest and Decision trees.

Hemanth et. Al [4] concluded that Data mining and Machine learning techniques have a large place in the medical industry, majority of which is effectively adopted. A list of risk factors that are being tracked down by brain tumor monitoring systems is examined in this study. Additionally, the technique used in brain tumor surveillance systems. For

the identification, classification, and segmentation of brain tumors, the proposed methods guarantee to be extremely effective and exact. Precise automatic or semi-automatic methods are required to accomplish this. The study relies on CNN to determine and classify data using an automatic segmentation method that is suggested. Other techniques used are Convolutional Neural Network, Conditional random fields, Support Vector Machine, Genetic algorithm. The highest accuracy and efficiency is achieved using CNN which is around 91%,and 92.7% respectively.

Ruiz et. al. [5] suggests a categorization scheme for in vivo hyperspectral brain data. Four hyperspectral images from four different individuals with globlastoma grade brain tumors were selected in order to train and then identify the models. The findings demonstrated that SVM often beats RF, achieving up to 97% of mean accuracy (ACC). RF outperformed SVM in categorizing the pictures used for training, attaining around 100% of the mean ACC for each of the five aforementioned classes. This work demonstrates the effectiveness of SVM and the potential of RF for real-time brain cancer detection.

Suresha et. al. [6] suggested an approach in this study analyses brain MR images to assess whether or not a tumor is present using a combination of K-Means and support vector machine technology. This article recommends using image processing to find brain tumors. Brain malignancies can be automatically detected with the use of the provided method. In this case, K-means, a clustering technique, and Support Vector Machine (SVM) were successfully coupled. The irregularities in the brain that the MR image exposes are recognised by this system. With a smaller training set, the technology provides accurate results and speeds up tumor diagnosis. The system that is being proposed was developed using Python programming. The Accuracy achieved in this model is 96%.

Sr. No.	Paper	Best Technique	Other Techniques Tested	Dataset	Performance Parameter
1	The Performance of BrainTumor diagnosis based on Machine Learning Techniques Evaluation – A Systematic Review. [1]	Convolutional Neural Network (CNN)	Decision Tree, C-Means, K- Means, Genetic Algorithms (GA),Decision Trees, Artificial Neural Networks (ANN), Local Binary Pattern (LBP), Random Forest (RF), Support Vector Machines (SVM), K-Nearest Neighbour (KNN), Convolutional Neural Network (CNN)	57,100 patients diagnosed in Europe in 2012, along with this record shows 45,000 deathsof brain tumors	Accuracy (79-97.7%)
2	Brain Tumor detection model from MR Imagesusing convolutional Neural Network. [2]	Convolutional Neural Network (CNN)	Convolutional Neural Network(CNN), K-Means Clustering.	UCI data repository. The Image data that wasused for this problem is Brain MRI Images for Brain Tumor Detection, data collectedfrom Nishtar Hospital, Pakistan	Accuracy (90%)
3	Brain Tumor detection and Classification using convolutional Neural Network and Deep Neural Network. [3]	Convolutional Neural Network (CNN)	Support Vector Machine (SVM), Convolutional Neural Network (CNN), K-Nearest Neighbour (k-NN), Boosted trees, Random Forestand Decision Trees	Kaggle	Accuracy(score-96.08%), F-Score(97.3)
4	Design and implementingbrain tumor detection using Machine Learning Approach. [4]	Convolutional Neural Network (CNN)	Convolutional Neural Network (CNN), Conditional Random Field(CRF), Support Vector Machine (SVM), Genetic Algorithm (GA)	UCI Datasets.	Accuracy (91%), Efficiency (92.7%)
5	Multiclass Brain Tumor classification using Hyperspectral imaging and Supervised Machine Learning. [5]	Random Forest (RF)	Support Vector Machine (SVM),and Random Forest (RF)	Dataset from University Hospital 12 de Octubre ofMadrid (Spain)	Accuracy (99% avg.)
6	Detection of Brain Tumor using Image Processing.[6]	Hybrid K- Means and SVM	Hybrid K-Means and SupportVector Machine (SVM)	MRI imagesof Brain.	Accuracy (96%)

3. CONCLUSIONS

From this survey, it is observed that the problem of Brain Tumor Detection can be solved using various Machine Learning Algorithms such as Decision Tree, C-Means, K-Means, Genetic Algorithms (GA), Decision Trees, Artificial Neural Networks (ANN), Local Binary Pattern (LBP), Random Forest (RF), Support Vector Machines (SVM), K-Nearest Neighbour, Convolutional Neural Network. Also, it is found that the Convolutional Neural Network CNN, have demonstrated extraordinary effectiveness in bioinformatics and Brain Tumor Detection.

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BIOGRAPHIES

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