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TUMOR DETECTION AND CLASSIFICATION OF MRI BRAIN IMAGE USING MACHINE LEARNING TECHNIQUE

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Abstract: -
Digital image processing begins with one image and brings on a modified variation of that picture. The stakes in digital image processing stem from the evolution of pictorial information for human understanding and the meting out of scan data for autonomous machine perception. Magnetic Resonance Imaging (MRI) is generally applied to the assessment and assistant analysis of brain tumors due to its compensation of high resolution to soft tissues and nonradioactive damages to human organs. Incorporated with medical information and clinical practice of themselves, the knowledgeable physician can attain the features and other pathological character of head tumors, according to the information in MRI images to create a systematic and realistic therapeutic treatment. In this paper, tumor detection using support vector machine (SVM), decision tree (DT) and gradient boosting (GB) machine learning (ML) technique are presented. The GB ML technique is providing good accuracy compared to other DT and SVM technique. In this model is simulated python language and calculated simulation parameter i.e. precision, recall, accuracy and F1-score.

Keywords:-
MRI Brain Image, Machine Learning, Accuracy, Precision, Recall

I. INTRODUCTION

Image processing is a method that deals with the conversion of an image into digital form and also throws light on some operations performed on the image so as to get an enhanced image or to extract some useful information from the image. Image processing is an indispensable field that provides room for human interpretation, processing, storage of data and transmission of refined pictorial view of images. Image processing modifies pictures to bring in improvement, extraction of information, and also structural change in their pictures. Image processing is a method that facilitates the performance of the necessary operations on images mostly captured by cameras, with an objective to get a better quality of images or for extracting certain attribute information from them. Image processing is administered using the following steps:

- To import the image employing image acquisition tools.
- To carry out analysis and manipulation of the image.
- To get a better image as output or a report that reflects the image analysis results.

An image is defined as a two-dimensional function, f (x, y), where x and y refer to spatial coordinates, and the amplitude of f at any pair of coordinates (x, y) is called the intensity of the gray level of f of the image at that point.

Medical image processing encompasses an interdisciplinary field that includes medicine, computer science, electrical engineering, physics and mathematics. The objective of Medical Image processing is to develop systems that can solve the problems pertaining to medical diagnosis using computerized systems that make use of above mentioned fields of sciences. The computer application programs used in image processing extract clinically useful data from medical images.

II. PROPOSED METHODOLOGY

The distribution in machine learning builds the module based on the training dataset with a classification algorithm. This learning can be categorized into all three possible classification algorithms. In a supervised learning class, labeled data is present at the beginning.

In semi-supervised learning, some of the class labels are known. Whereas in unsupervised learning no class label for the entire dataset.

Once the training phase is finished, features are extracted from the data based on term frequency, and then the classification technique is applied.

The classifiers that we have utilized are SVM, DT, and GB.

Algorithm steps:

Input: D= $\{(\boldsymbol{x1},), (\boldsymbol{x2},), \ldots, (\boldsymbol{xN},\boldsymbol{yN})\}$, $\boldsymbol{L}(\boldsymbol{y},\boldsymbol{O}(\boldsymbol{x}))$

Where: $(\boldsymbol{y},(\boldsymbol{x})$) is the approximate loss function.

Begin

Initialize: $(\boldsymbol{x}) = \frac{\boldsymbol{argmin}}{\boldsymbol{w}} \sum_{i=1}^{n} \boldsymbol{L}(\boldsymbol{yi},\boldsymbol{w})$

$\boldsymbol{for\ m}=\boldsymbol{1}:\boldsymbol{M}$

$$r_{im} = -\frac{\partial L(yi, O(xi))}{\partial O(xi)}$$

Train weak learner $\boldsymbol{C_m}(\boldsymbol{x})$ on training data

Calculate $\boldsymbol{w}$: $\boldsymbol{w_m} = \arg\min \sum_{i=1}^{N} \boldsymbol{L}(\boldsymbol{yi}, \boldsymbol{O_{m-1}}(\boldsymbol{xi}) + \boldsymbol{wC_m}(\boldsymbol{xi}))$

Update : $\boldsymbol{O_m}(\boldsymbol{x}) = \boldsymbol{O_{m-1}}(\boldsymbol{x}) + \boldsymbol{wC_m}(\boldsymbol{x})$

End for

End

Output: $\boldsymbol{O_m}(\boldsymbol{x})$

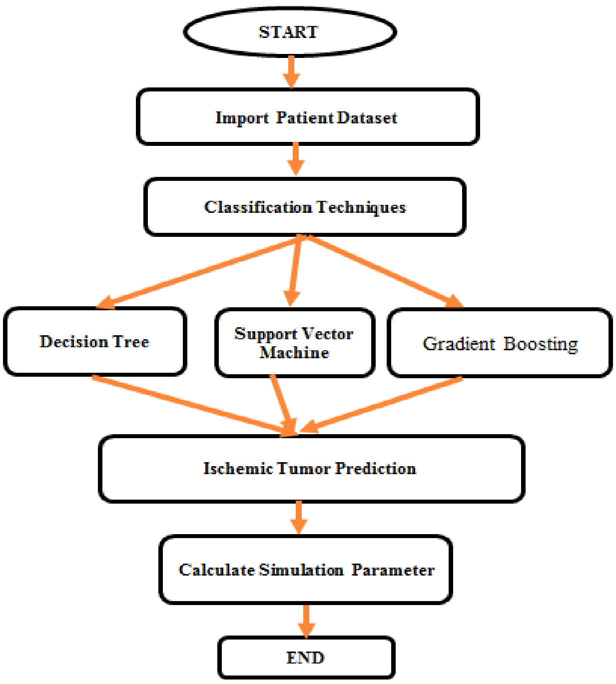

Fig. 1: Flow chart of Proposed Methodology

DT:-

A DT is a choice help instrument that utilizes a tree-like model of choices and their potential results, including chance occasion results, asset expenses, and utility. It is one method for showing a calculation that just holds back restrictive control explanations. DT are ordinarily utilized in tasks

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research, explicitly in choice examination, to assist with recognizing a technique probably going to arrive at an objective, but at the same time are a well known device in ML.

GB:-

GB calculation is one of the most remarkable calculations in the field of AI. As we realize that the blunders in AI calculations are extensively characterized into two classifications for example Inclination Error and Variance Error. As inclination supporting is one of the helping calculations limiting predisposition mistake of the model is utilized.

SVM:-

In ML, SVM are directed learning models with related learning calculations that examine information for grouping and relapse examination.

To isolate the two classes of data of interest, there are numerous conceivable hyperplanes that could be picked. Our goal is to find a plane that has the greatest edge, for example the greatest distance between data of interest of the two classes. Boosting the edge distance gives some support so future information focuses can be grouped with more certainty.

Step for DT, GB and SVM

Step 1	Importing the libraries and packages
Step 2	Initializing the parameters:
Step 3	Reading the path of input files and initialize the output data
Step 4	Pre-processing the heart disease data for giving them as the input to the model
Step 5	Converting the heart and diabetic disease data to matrix form; flattening each heart disease data into an array vector
Step 6	Assigning the labels to the heart and diabetic disease data classes
Step 7	Rearranging the information to forestall overfitting and speculation of preparing
Step 8	Isolating the train information and test information
Step 9	Normalizing the heart and diabetic illness information
Step 10	Characterizing a model and its individual layers
Step 11	Ordering the model
Step 12	Squeezing the information into the ordered model, i.e., preparing the model utilizing the at first characterized boundaries
Step 13	Plotting the Accuracy bends of the preparation interaction
Step 14	Print the Classification Report and Confusion Matrix of the preparation interaction

III. SIMULATION RESULTS

Data collection

Collect data from fig share website containing four classes like no tumor, pituitary_tumor, meningioma_tumor, glioma_tumor, 2870 images with 512*512 height and width.

	File	DiseaseID	Disease Type
0	pituitary_tumor/p (27).jpg	0	pituitary_tumor
1	pituitary_tumor/p (175).jpg	0	pituitary_tumor
2	pituitary_tumor/p (260).jpg	0	pituitary_tumor
3	pituitary_tumor/p (125).jpg	0	pituitary_tumor
4	pituitary_tumor/p (384).jpg	0	pituitary_tumor

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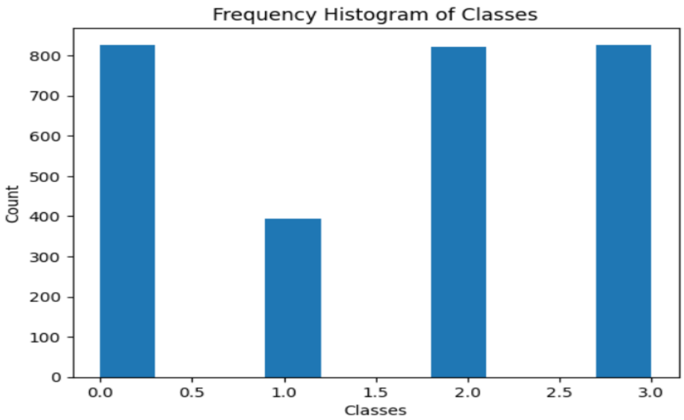

Fig. 2: Expletory Data Analysis

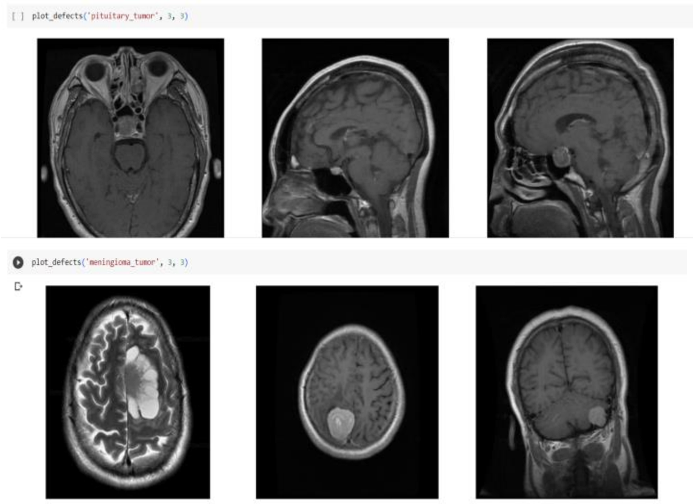

Fig. 3: Input Image

Preprocessing
Resize and rescale images into 200*200 and convert into a numpy array

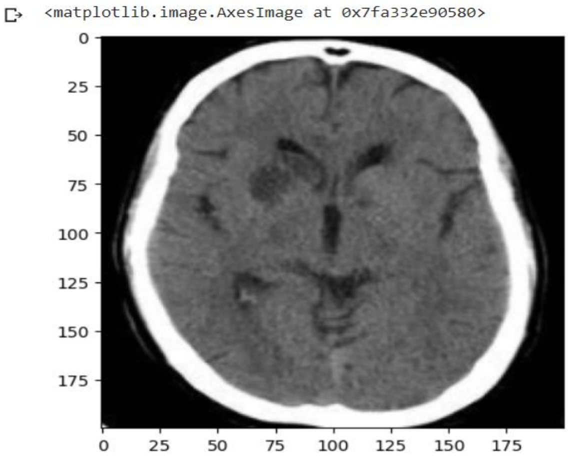

Fig. 4: Final processed image

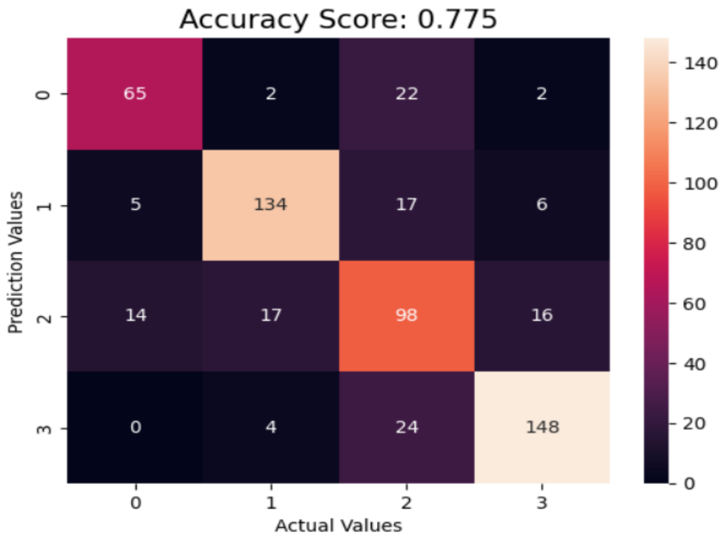

Fig. 5: Confusion Matrix of DT

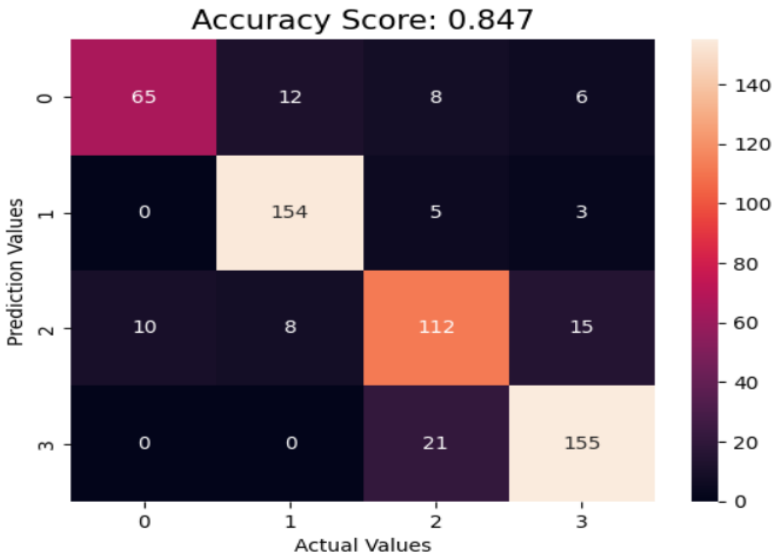

Fig. 6: Confusion Matrix of SVM

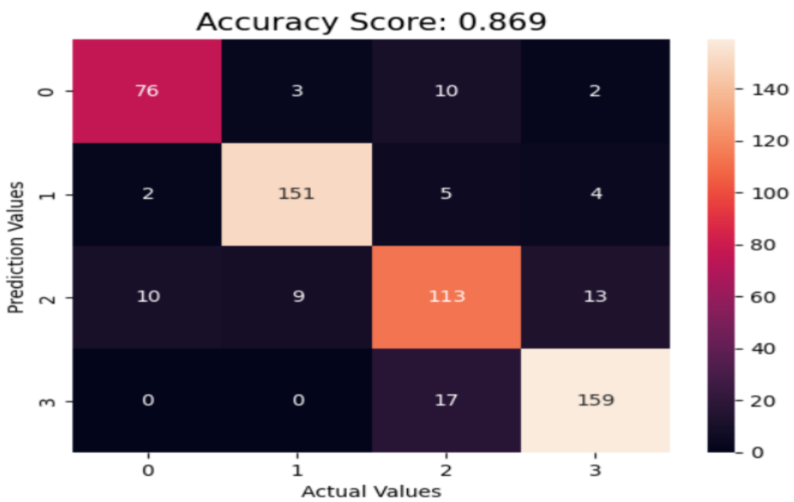

Fig. 7: Confusion Matrix of GB

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Table 1: Comparison Result

Technique	Precision	Recall	Accuracy	F1-Score
DT	97.01%	96.40%	77.5%	77.52%
SVM	84.41%	100%	84.7%	84.66%
GB	86.93%	98.69%	86.9%	86.93%

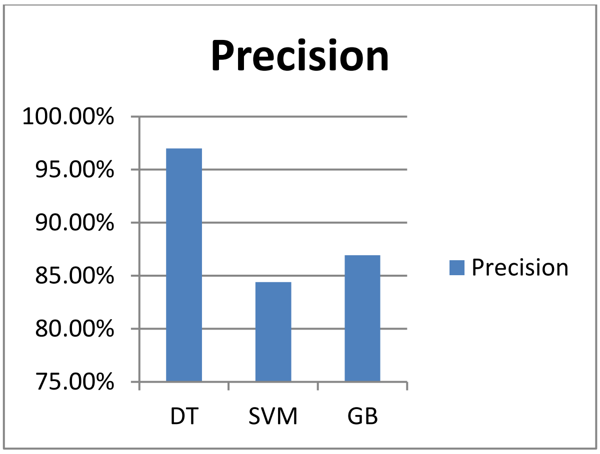

Fig. 8: Graphical Represent of Precision

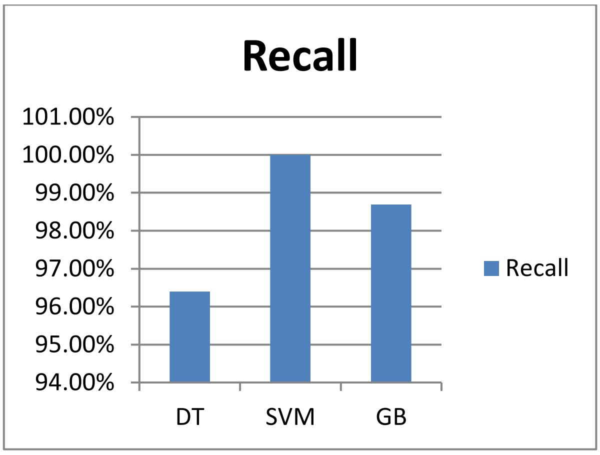

Fig. 9: Graphical Represent of Recall

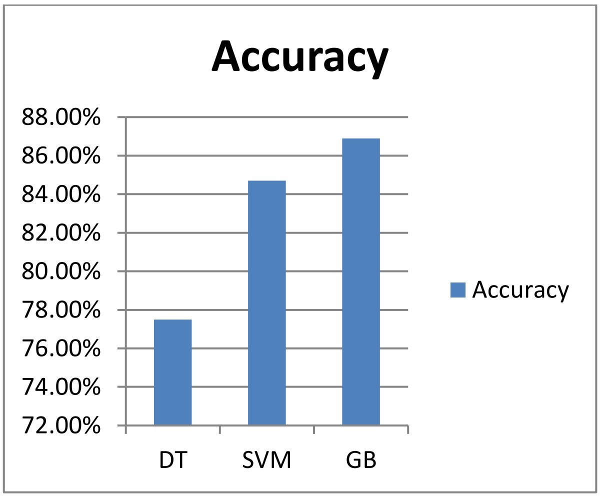

Fig. 10: Graphical Represent of Accuracy

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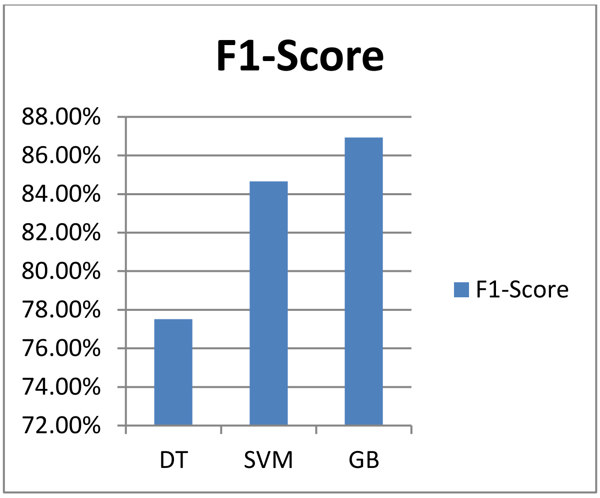

Fig. 11: Graphical Represent of F1-Score

IV. CONCLUSION

Medical image processing gains popularity due to various types of disease detection, prediction and classification. The processing and evaluation of normal as well as abnormal images is the major objective of medical image processing which helps in diagnosing the tumor affected regions from brain image dataset. It enables the automated processing to challenging scenarios without human intervention. But how accurately and effectively it is diagnosing the tumor images, it depends on the techniques we are using in various phases of cancer recognition. Then brain diagnosis automatically replaces cumbersome traditional methods that sometimes lead to errors, and a system is implemented using DT, SVM and GB ML technique. The DT achieves 77.52% accuracy, SVM achieves 84.7% accuracy and GB achieves 86.9% accuracy. It is clearly that the GB ML technique is provides good accuracy compared to SVM and GB ML technique.

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