Brain Tumor MRI Image Processing and Classification by Edge Detection using ML Algorithms

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ABSTRACT
A tumor on a brain is an abnormal growth of cells in the brain, which may turn into a malignant tumor and can become fatal as per the studies suggested by various institutes such as Brain Tumor Epidemiology: Consensus from the Brain Tumor Epidemiology Consortium (The University of Texas), etc. The major problem with a brain tumor is specifying its location, shape, and size. Despite many efforts and promising results in this field of tumor detection, accurate classification from type benign to type malignant is still challenging. One of the most common methods of diagnosing brain tumors is Magnetic Resonance Imaging (MRI) but its accuracy is not very high. The proposed system suggests a novel method for Brain Tumor Detection and Classification by using some of the prominent Machine Learning (ML) based algorithms such as Convolutional Neural Network (CNN), Support Vector Machine (SVM), and K-Nearest Neighbor (KNN). This approach is to separate images from an MRI that can be classified as type benign or type malignant. In this experimentation, K-NN has shown promising classification accuracy of 89%.

Keywords
Image processing, Support Vector Machine (SVM), MRI images, Convolutional Neural Network (CNN), K-Nearest Neighbor (KNN).

1. INTRODUCTION
Image processing is a course of separation, controlling the Image to play a specific task to extract data from it. Clinical imaging attempts to reveal internal development hidden by the body unnecessarily and without tearing down and treating disease. And in addition, it sets out a collection of structured human life information and physiology to make it possible to identify species at a higher level. Nowadays, one specific predictor of mortality is the growth of the frontal cortex. Abnormal or uncontrolled cell development within the human body is called frontal cortex cancer. This combination of growths acts within the skull, considering what normal brain activity is disturbing. The growth of the frontal cortex is a terrible infection in real life. So what is not seen before the stage, can ruin the life of each individual. The growth of the frontal cortex can be in three major groups called liberal, risk, premenstrual syndrome. Harmful growth causes traumatic turn of events. Treatment for frontal cortex growth depends on a variety of factors, for example, authenticity and specific variations such as cancer type, region, size, and progression status. Already the growth period is used to really be seen with the help of image emergence by experienced authorities and often requires a few theories and the results may be incorrect. There are different types of cerebrum cancer and basically a pro master can be ready to give a specific result. Today a variety of contraption PCs are used in the medical field. These gadgets have the property of a quick and unique effect. The X-shaft is the most commonly used imaging module to assess the internal development of the human body. The ideal place to grow is a real therapeutic response. In the same way they need an accurate diagnostic gadget for effective treatment. Verification involves detecting the presence of growth. Detecting the growth of the frontal cortex using imaging techniques involves four stages. Front image handling, splitting, fuse removal, and image. An important task of forecasting is to work on the possibility of the existence of Magnetic Resonance (MR) Imaging, eliminating unnecessary chaos and unwanted parts in the distance and maintaining their edges. Separate the previously integrated cortex of MR Images is converted into identical Images. Include extraction is a method aimed at combining basic level image data, for example, camouflage, position, location and titles. Also, in a combined demonstration effort, the separator is used to organize standardized visual tests and informal image tests.

With total expansion, the risk is an old disease. According to the diagram, honestly, the number of employers in corrupt people is estimated at 12.7 million of whom 7.6 million social groups explode hopelessly due to illness. Brain growth is the uncontrolled development of the muscles of the frontal cortex, causing factors in the functioning of the frontal cortex. Brain development is of two types early in the first stage of cancer starting in the frontal cortex tissue itself and the other starting with one piece of the body and moving to the frontal cortex.

Graphic Design plays an important role in a variety of treatment programs. Appealing Resonance Imaging is an undeniable way of clinical thinking that provides valuable information about the life structures of a person's fragile tissues. It has fewer advantages than other imaging processes as it coats three-layer data with high separation between sensitive tissue. The growth of the frontal cortex is a fact, which is the driving force behind the illness-related death in young people and active adults. According to the Central Brain Tumor Registry of the United States, 64,530 new examples of the basic frontal cortex and the growth of the central tactile structure are investigated annually.

For the most part speaking, more than 6 00,000 people experience the side effects of the disease. Shocking

achievements have been made with regard to the growth of the frontal cortex when the nuclear imaging system evolved into an important logical component. X-beam is often used to detect various dangerous developments. The threat indicates disease that is associated with uncontrolled cell development. In disease, cells divide and grow hard, producing cancerous growths and invading nearby body parts. In this we will address two issues that exist in our previous cortex. Distinguish the progressive development into its sub-status.

2. LITERATURE SURVEY

D. Suresha and N. Jagadisha [1] Proposed a system for selecting whether the brain has grown or whether the disease has been released in the MR image using the K-Means combination method and vector support mechanism. In phase the image data is adjusted to reduce the scale using a double threshold and the spots are visible. Open spaces are viewed in the same way as their ability to see common sense and development. The game plan for the extracted part in this way is shown using a K-Means test, at which point the confirmation of the disease is completed using a backup machine.

Ashfaq Hussain and Ajay Khunteta [2] proposed structure some MRI images were taken as sources. A brain scan was performed to remove malignant tumors of the cerebrum tissue from MRI images of the cortex, MRI images should be screened, for example, with a medial closed frame and skull removal should be performed in front of the face, a cycle performed on MRI images provided using water separation strategy. By then the location of the isolated disease had finally been identified. What's more from that point in some of the outstanding sections divided by GLCM strategies using the MATLAB system. At that time, at the time, a few images were shown using a vector support device (SVM), and this framework achieved an average accuracy of 93.05%. Surprisingly good is different from other standard models.

S. Suhas and C. R. Venugopal [3] proposed an evaluation of the performance of MRI image imaging techniques is provided. The methods used are the central Gaussian channel obviously, the Max channel, the Min channel, and the Arithmetic Mean channel. All of the above channels are used in MRI brain and spinal cord imaging and the results are noted. Another strategy is proposed that changes the current local channel by adding highlights. The test result of the proposed system is then dispersed with three other image separation statistics. The size of the crop image is carefully evaluated to select root mean square misunderstanding (RMSE), signal-to-ruckus degree (SNR), top sign to complain degree (PSNR).

N. Varuna Shree and T. N. R Kumar [4] proposed X-bar method contains many imaginative ways of compassing and holding within the head of the human frontal cortex. In this experiment, we have embarked on a system of upheaval ejection release, removal of weak features at the level of co-event association (GLCM), a DWT-based frontal cortex that creates a dent in order to reduce the various system and function in the show. This was followed by a morphological discontinuation that eliminated the disorder that could be manifested after separation. The probabilistic neural affiliation classifier has been used to prepare and evaluate the accuracy of the exhibition in the undisputed confirmation of the developmental area in cerebrum MRI images. The experimental results achieved in all objectives and objectives are 100 percent accuracy in detecting normal and stunted tissue from the frontal cortex MR images.

N. B. Bahadure, A. K. Ray and H. P. Thethi [5] proposed electronic design uses k-recommend as a dividing element of a social media event while Discrete Wavelet Transform (DWT) and Key Component Analysis (PCA) are embedded fragments of the extraction component and elements for reducing elements, only. The vector support mechanism (SVM) is a major piece of our proposed framework as it incorporates the development of the weird brain in LGG and HGG after the extraction and reduction of excellent materials.

3. OBJECTIVES OF SYSTEM

Various objectives of proposed system are as follows:

- To classify the brain tumor as type Benign or type Malignant
- To use CNN techniques to train a dataset of roughly 500 photos
- To minimize error by improving the current values of the weight associated with each edge
- To improve the brain tumor detection performance by proposing a CNN-based brain tumor detection technique to highlight the edge around the detected tumor

4. IMPLEMENTATION DETAILS OF MODULE

Using the filter and detecting edge, the proposed work analyzes MRI brain images to identify and classify tumor and non-tumor images. To detect a tumor, image processing methods such as isolation and subtraction are used. Released features saved to file. The appropriate category is created to detect brain cancer by selecting a few factors. The system is described as easy to use.

Step 1: Obtain a scan of the patient and a proper medical diagnosis.

Step 2: Preview the data and extract the features. Features are stored on file. Divide the site into two sections: training and testing. Convolutional Neural Network Techniques were used to train the website.

Step 3: Checks the KNN and SVM separator data. When a tumor is detected, point to the result and arrange the edge

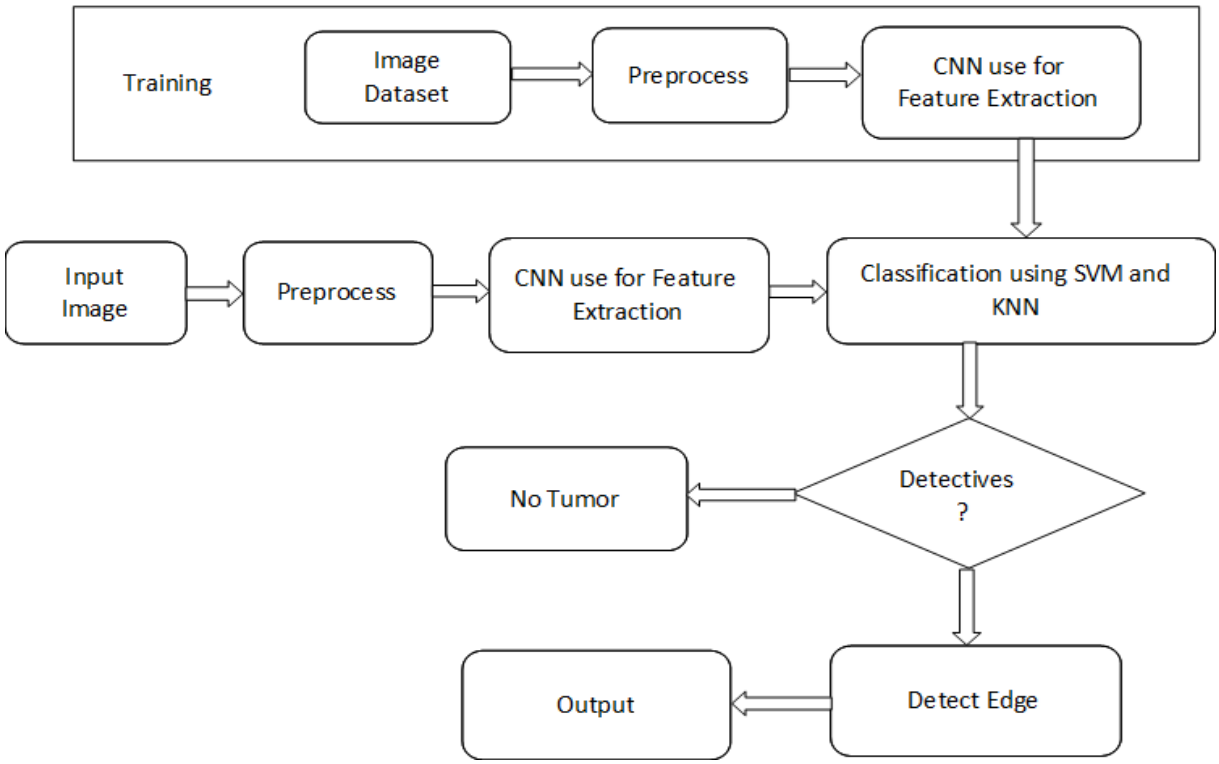

Figure 1: System Architecture

5. RESULT & DISCUSSION

To validate the performance of the algorithm, two datasets (Testing, Training) are used and both datasets are collected from Kaggle, which includes 253 MRI sample images. In this dataset, 98 of 155 images included are tumor-infected brain tissues. The proposed algorithm was carried out using Python, TensorFlow, etc. which runs on the Windows 10 operating system and has an Intel core i5 8th gen processor and 8GB RAM. CNN Algorithm has been used for feature extraction part and K-NN, SVM has been used for training the model. In preprocessing part edge detection of the brain tumor has been done as shown in figure 2 and figure 3.

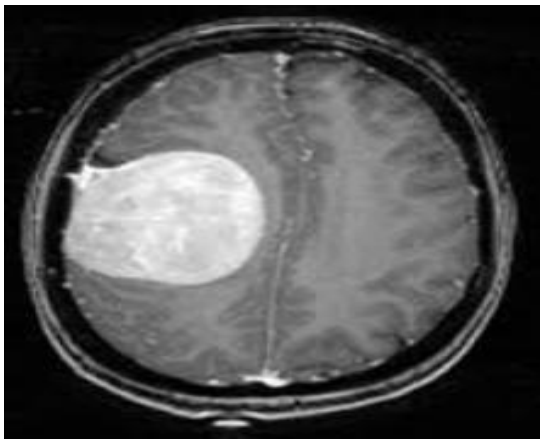

Figure 2: Original Brain MRI Image

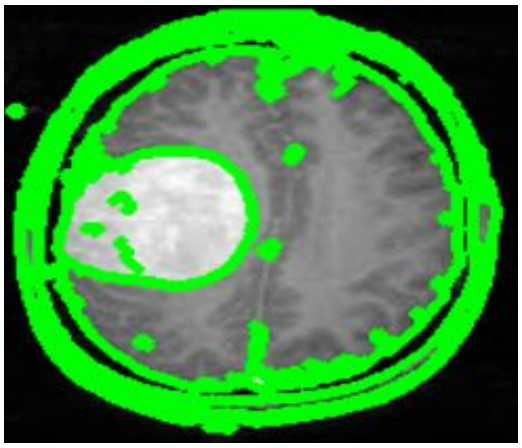

Figure 3: Edge Detected Brain MRI Image

```
[STATUS] start time - 2022-03-15 20:53
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_10 (Conv2D)           (None, 630, 630, 32)      896
_________________________________________________________________
activation_10 (Activation)   (None, 630, 630, 32)      0
_________________________________________________________________
max_pooling2d_10 (MaxPooling (None, 315, 315, 32)      0
_________________________________________________________________
conv2d_11 (Conv2D)           (None, 315, 315, 64)      8256
_________________________________________________________________
activation_11 (Activation)   (None, 315, 315, 64)      0
_________________________________________________________________
max_pooling2d_11 (MaxPooling (None, 315, 157, 32)      0
_________________________________________________________________
conv2d_12 (Conv2D)           (None, 315, 157, 128)     16512
_________________________________________________________________
activation_12 (Activation)   (None, 315, 157, 128)     0
_________________________________________________________________
max_pooling2d_12 (MaxPooling (None, 315, 78, 64)       0
=================================================================
Total params: 25,664
Trainable params: 25,664
Non-trainable params: 0
_________________________________________________________________
[INFO] successfully loaded base model and model...
[INFO] encoding labels...
[INFO] completed label - no
[INFO] completed label - yes
```

Figure 4: CNN

As shown in figure 4, the CNN Model consists of three filters of size 32, 64, 128 respectively and three convolutional layers and pooling with the batch size of 32. The output images are labeled as 1 i.e., Tumor detected or 0 i.e., Tumor not detected.

```
[STATUS] start time - 2022-04-12 19:43
              precision    recall  f1-score   support

           0       0.85      0.89      0.87        99
           1       0.93      0.90      0.91       156

    accuracy                           0.89       255
   macro avg       0.89      0.89      0.89       255
weighted avg       0.90      0.89      0.89       255

train complete
[STATUS] End Time - 2022-04-12 19:44
```

Figure 5: KNN Accuracy

```
[STATUS] start time - 2022-04-12 19:27
              precision    recall  f1-score   support

           0       0.87      0.78      0.82        98
           1       0.87      0.93      0.90       155

    accuracy                           0.87       253
   macro avg       0.87      0.85      0.86       253
weighted avg       0.87      0.87      0.87       253

train complete
[STATUS] End time - 2022-04-12 19:40
```

Figure 6: SVM Accuracy

As shown in figure 5 and figure 6, the ML model achieved accuracy of 89% for KNN and 87% for SVM. The training time for KNN is 120 seconds and SVM is 840 seconds approximately. To perform predictions faster and with high accuracy KNN is used for classification.

Table 1: - Accuracy Comparison

Sr.no	Result	Accuracy
1	KNN	89 %
2	SVM	87%

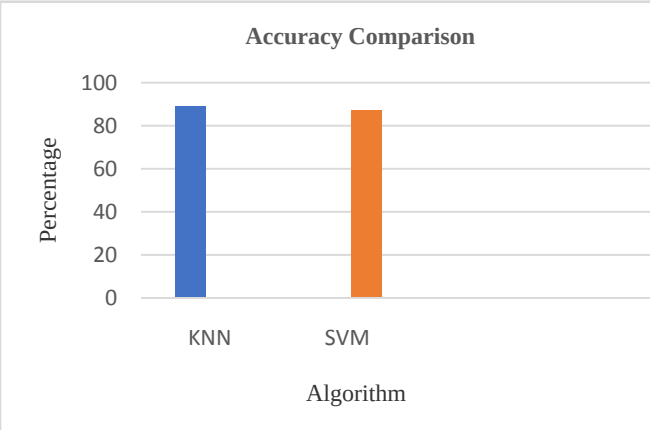

Figure 7: Accuracy comparison

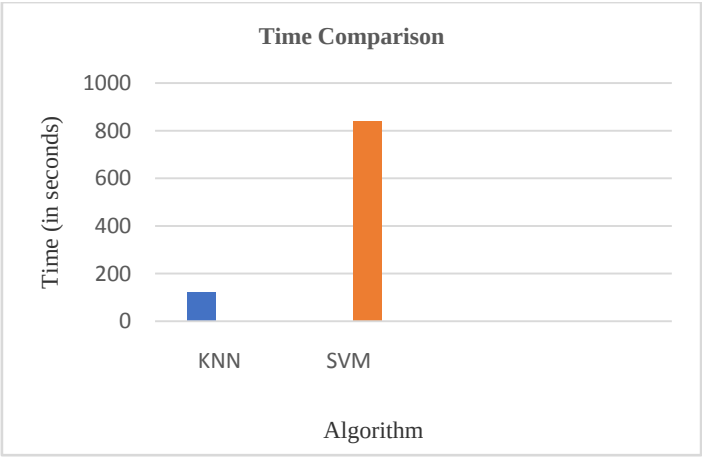

Figure 8: Time comparison (in seconds)

6. CONCLUSION

The ML-based proposed system is used for detection and classification approach that had integrated clinical decision-making systems for primary diagnostics and diagnostic radiologists or clinical specialists for diagnosing Brain Tumors so that early treatment can prevent death. The accuracy achieved is 89% for the experiment, indicating the proposed strategy's effectiveness in identifying normal and abnormal tissue growth in MRI images. This method leads to more accurate and faster detection of the tumor in the brain and the identification of the tumor's exact location. More work is needed in this area to investigate high-resolution machine learning models of survival, and this can be achieved by translating the separating and modeling features into radiomics.

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