BRAIN TUMOUR DETECTION USING IMAGE PROCESSING

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Abstract:

Brain tumors are a serious threat to human life, and early detection is essential for successful treatment and better patient outcomes. This project introduces an automated brain tumor detection system based on Python, using image processing and machine learning methods. The system uses MRI (Magnetic Resonance Imaging) scans to detect and classify brain tumors with high accuracy.

The process includes pre-processing of MRI images to boost quality and then using various segmentation techniques to delineate areas of interest. The features are extracted from the data using processes like histogram analysis, edge detection, and texture features. A labeled dataset is then used to train a Convolutional Neural Network (CNN) so that the images can be accurately classified as tumor or non-tumor. The application of deep learning highly enhances the ability of the model to identify complex patterns in the brain scans.

I.Introduction

Abnormal growth of cells in the brain causes brain tumor. Early detection is important, as it significantly contribute to the condition and treatment.Braintumors can be detected by using MRI scans. Previously,medical expertise uses MRI scans to detect tumors manually, which can be time consuming,which also has disadvantages of human error.In recent years, computer-aided diagnosis (CAD) systems have been developed to assist medical professionals in detecting abnormalities more efficiently. By using Python's built-in libraries, such as matplotlib,NumPy, we can detect brain tumor using processed MRI images. Automatic brain tumor detection provide faster and efficient way to identify tumors.

II. Related Work

Related Work Many studies have looked into using machine learning and deep learning for tumor detection. Meanwhile, early image processing techniques still have their own advantages, especially for quick sample. Thresholding , morphological filtering and edge pattern are used todetectthe issues without theuse of complex resources.

Dataset Description

For this study, we used the Brain Tumor MRI dataset, which you can find on Kaggle. The dataset contains MRI scans shows as "yes" if the is tumor present or "no" if there is no tumor. We focused only on the scans to find our tumor detection process. We store the dataset on Google Drive and accessed it through Google Colab.

III. Methodology

Our approach includes several steps, each aimed at honing in on tumor detection.

3.1 Image Acquisition and Preprocessing

We loaded images from the dataset and resized them all to a standard resolution of 240x240 pixels for consistency. For more detailed work, one specific image (Y104.jpg) was resized to 500x590.

3.2 Grayscale Conversion

We converted the color image to grayscale. This makes it easier for the processing of the MRI images and helps to focus more on the detailed part.

3.3 Thresholding

We applied two types of binary thresholding:

- Regular Binary Threshold: Mainly works on the brighterarea.
- Inverted Binary Threshold: Mainly works on the darkerarea.

These methods helps in differentiating between the tumor and normal brain cells.

3.4 .Processes

Detection : Small holes in the tumor are identified by a rectangular box.

Erosion and Dilation: These steps remove small artifacts and enhance the shape of the detected regions.

3.5 Masking and Region Isolation

An operation and processed binary mask is used to identify the tumor region.

3.6 Edge Detection with Automatic Canny

An version of the Canny edge detection algorithm was applied. It calculates the image's median intensity by using optimal lower level and upper level.

3.7 Contour Detection and Visualization

Contours were extracted from the edge-detected image. These contours compares the original image with the processed one by overlaying and use red boundaries to identify tumor's location and shape.

IV. Methodology

4.1. Mount Google Drive and Import Libraries:

```
from google.colab import drive
import os, cv2, glob
import numpy as np
from google.colab.patches import cv2_imshow
import matplotlib.pyplot as plt
from mpl_toolkits.axes_grid1 import ImageGrid
drive.mount('/content/drive')
```

4.2. Load and Display Tumor Images:

```
tumour_images = []
for name in glob.glob('/content/drive/MyDrive/brain_tumor_dataset/yes/*.jpg'):
    image = cv2.imread(name)
    image = cv2.resize(image, (240, 240))
tumour_images.append(image)
fig = plt.figure(figsize=(10., 10.))
grid = ImageGrid(fig, 111, nrows_ncols=(4, 4), axes_pad=0.1)
for ax, im in zip(grid, tumour_images[0:16]):
ax.imshow(im)
plt.show()
```

4.3. Image Preprocessing and Thresholding:

```
img_path = '/content/drive/MyDrive/brain_tumor_dataset/yes/Y104.jpg'
image = cv2.imread(img_path)
image = cv2.resize(image, (500, 590))
cv2_imshow(image)

# Convert to grayscale
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
cv2_imshow(gray)

# Binary thresholding
(T, thresh) = cv2.threshold(gray, 155, 255, cv2.THRESH_BINARY)
cv2_imshow(thresh)

# Inverse binary thresholding
(T, threshInv) = cv2.threshold(gray, 155, 255, cv2.THRESH_BINARY_INV)
cv2_imshow(threshInv)
```

4.4. Morphological Operations:

```
kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (10, 5))
closed = cv2.morphologyEx(thresh, cv2.MORPH_CLOSE, kernel)
cv2_imshow(closed)

closed = cv2.erode(closed, None, iterations=14)
closed = cv2.dilate(closed, None, iterations=13)
cv2_imshow(closed)
```

4.5. Apply Mask to Highlight Tumor Region

```
ret, mask = cv2.threshold(closed, 155, 255, cv2.THRESH_BINARY)

final = cv2.bitwise_and(image, image, mask=mask)

cv2_imshow(final)
```

4.6. Edge Detection using Auto-Canny

```
def auto_canny(image, sigma=0.33):
    v = np.median(image)
    lower = int(max(0, (1.0 - sigma) * v))
    upper = int(min(255, (1.0 + sigma) * v))
    edged = cv2.Canny(image, lower, upper)
    return edged
canny = auto_canny(closed)
cv2_imshow(canny)
```

4.7. Contour Detection:

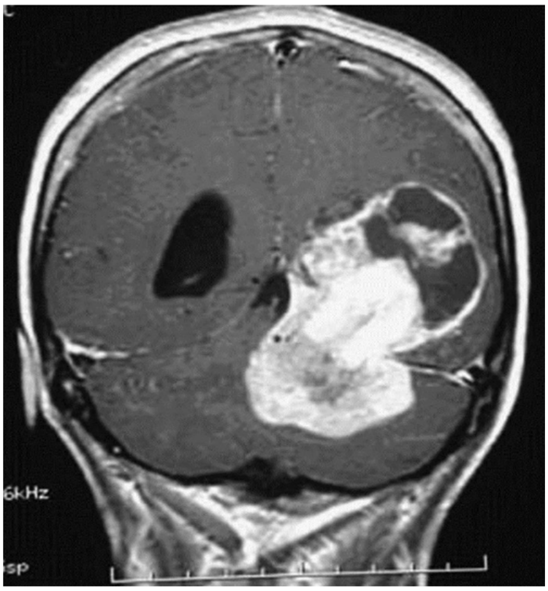
```
(cnts, _) = cv2.findContours(canny.copy(), cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)

cv2.drawContours(image, cnts, -1, (0, 0, 255), 2)

cv2_imshow(image)
```

5.0 Result and conclusion

Our main goal is to detect brain tumors using simple image processing methods. As shown in the abovefigure(), the tumors have been successfully detected and marked using red boundary. The techniques, such as grayscale conversion, thresholding, edge detection and outline drawing helped us to detect the exact place of the tumor in the MRI image.

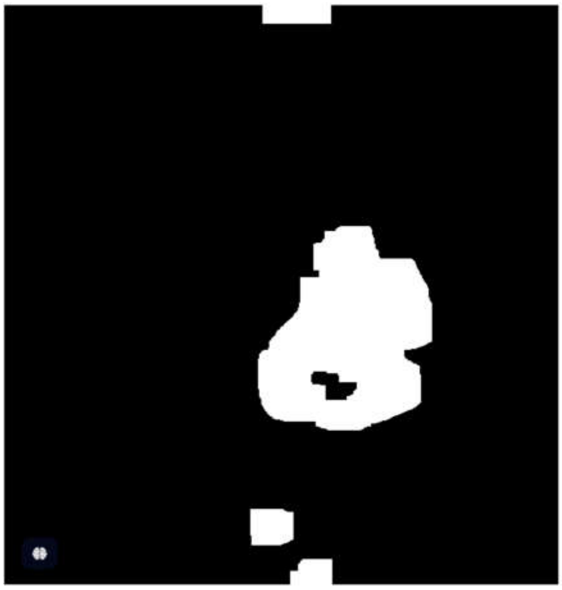
The results show that even without using machine learning or deep learning modelslike resnet50, VGG19 traditional methods like openCV can still give good results. The tumor is clearly visible and separated from the normal brain parts. We can also see that small unwanted regions are also detected at bottom of the image, but they are not affecting the main tumor detection.

And also this method is successfulbecause the image used was clear and had good clarity. Overall,, the result of this method is more accurate and it shows that brain tumor detection is possible even without using complex AI models. It saves time and can be used in basic medical analysis



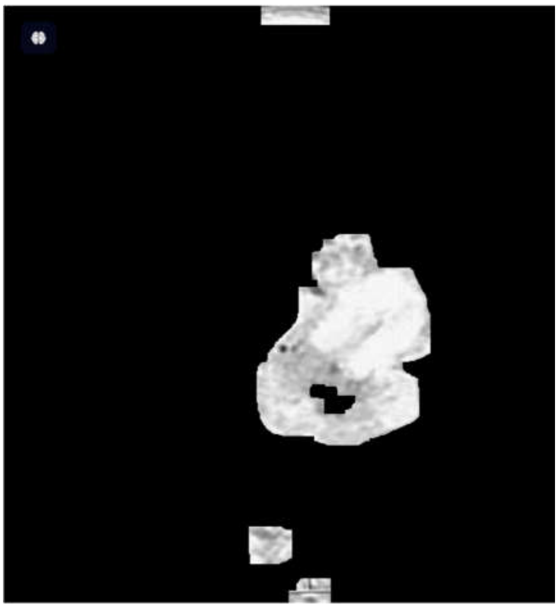
MRI scan of brain

Figure 1



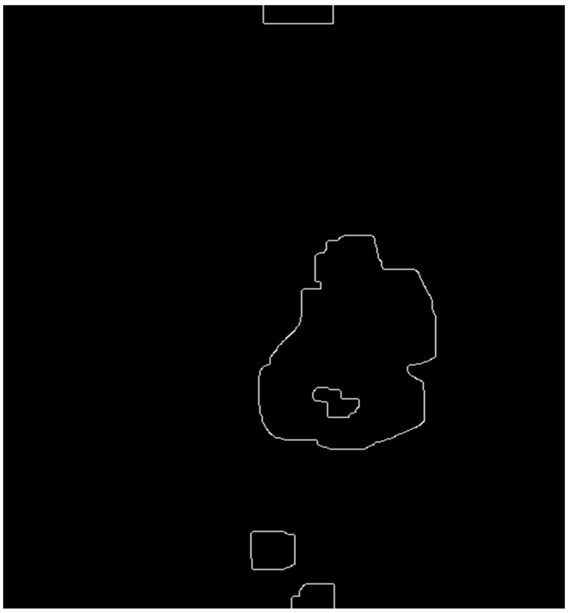
Threshold of brain tumor

Figure 2



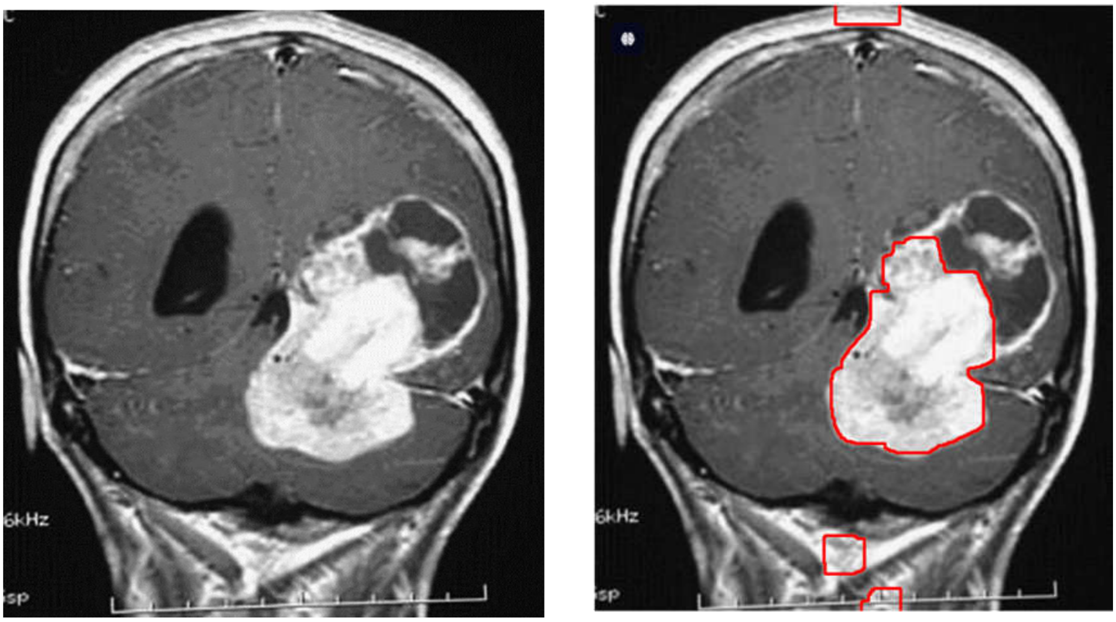
Mask generated by threshold

Figure 3



Edge detection using computed median

Figure 4



We can clearly identify the brain tumour by comparing above images

6.0 FUTURE WORK

In future, we have decide to create an application to detect brain tumour. This application will be used by medical experts to detect brain tumour from MRI scan. The purpose of creating this application is to enable users without medical knowledge to utilize it. In future, we have decide to create an app to detect brain tumour. This app will be used by medical experts to detect brain tumour from MRI scan. The purpose of creating this application is to enable users without medical knowledge to utilize it.

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