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Brain Tumour Detection and Classification Using SVM

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ABSTRACT

The brain is one of the most complicated organs in the human body, with billions of cells working together. When cells divide uncontrollably, they form an abnormal group of cells around or inside the brain, which is known as a cerebral tumour. This cell group has the ability to disrupt brain activity and kill healthy cells. Brain tumours are graded into benign or low-grade (grades 1 and 2) and malignant or high-grade (grades 3 and 4). The proposed method is intended to distinguish between normal and brain tumour (benign or malign). Brain magnetic resonance imaging (MRI) is used to study certain forms of brain tumours, such as metastatic bronchogenic carcinoma tumours, glioblastoma, and sarcoma. Different wavelet transforms and support vector machines are used in the identification and classification of MRI brain tumours. Manually detecting a brain tumour by doctors is a complex and time-consuming operation. To prevent misclassification and save time, brain tumour identification and classification could be performed automatically.

Keywords: Brain tumor, SVM classification, otsu method.

I. INTRODUCTION

Cancer is becoming a more serious health issue as the world's population grows. According to statistics, the population of cancerous people in India is about 12.7 million every year, with 7.6 million people dying as a result of cancer [1]. Most normal cells die as they age or become damaged, and new cells replace them. This procedure may sometimes go wrong. When the body doesn't need new cells, they form, and old or damaged cells don't die as they should. A growth or tumour is a mass of tissue formed by the accumulation of extra cells. There are two types of primary brain tumours: benign and malignant. Benign brain tumours do not contain cancer cells. Benign tumours can usually be removed, and they seldom grow back. Benign brain tumours typically have a distinct edge or border. Benign tumour cells rarely enter the tissues around them. They are not infectious and do not spread to other areas of the body. Cancer cells are present in malignant brain tumours (also known as brain cancer). Malignant brain tumours are more dangerous and also pose a life-threatening threat. They are likely to spread quickly and crowd or invade healthy brain tissue nearby. Malignant brain tumours may cause cancer cells to break free and spread to other parts of the brain or the spinal cord. They only spread to a few other areas of the body in exceptional cases.

Basic block diagram of brain tumour classification is as shown in figure 1. The basic block diagram consists of four modules

1. Image pre-processing
2. Image Segmentation
3. Feature extraction
4. Classification

The obtained images of medical imaging are very noisy because of the physical process of imaging. The presence of noise will cause the images to be misclassified, lowering the classifier's output. Image pre-processing is a method of enhancing an image using a filtering technique.The quantitative measurement of the images is called feature extraction. Image data is transformed into a statistical numeric value during feature extraction. Contrast, homogeneity, correlation, energy, and entropy are some of the features that can be extracted from an image.

The classifier analyses the characteristics of the input data and categorises the images accordingly. Support vector machine (SVM), k-nearest neighbour KNN, artificial neural network (ANN), Hidden Markov Model (HMM), and Probabilistic Neural Network (PNN) are some of the examples of learning classifiers. Every classifier has its own set of advantages and disadvantages. ANN is fast and reliable, but it has a high computational cost, so it uses a lot of the CPU's primary physical memory. SVM outperforms other algorithms in terms of accuracy [1]-[[20].

II. RELATED WORKS

In [21]-[25] presented a method for automatically classifying medical images. The KNN classifier is used to separate medical images into two categories: normal and abnormal. KNN is a straightforward approach with a low computational cost. In [26]-[30] suggested a thesis on the brain tumour prediction algorithm and its position in the brain. ANN is a statistical problem inspired by the biological nervous system. The GLCM technique was used to isolate a function, and the extracted features were then identified using an artificial neural network [31]-[40]. A SVM classifier-based MRI image classification technique was proposed. Support Vector-based advanced classification techniques. A supervised learning algorithm is the help vector machine. Quadratic programming is used to execute classification in SVM [41]-[44]. SVM, KNN, ANN, and other classifiers have a wide range of implementations, including handwritten character identification, facial identification, iris detection, text classification, and so on.

III. SYSTEM ARCHITECTURE

A. PROPOSED SYSTEM

The flow chart for proposed brain MRI classification technique is as shown below

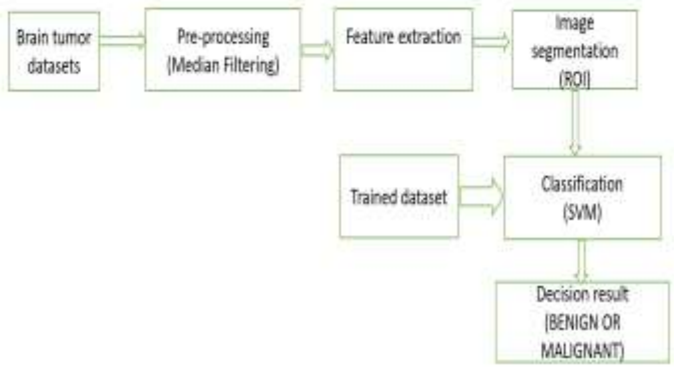

Figure 1: Block Diagram

B. INPUT IMAGE

MRI images were obtained from a number of hospitals, including the Cancer Institute WIA in Adyar, Chennai. The doctor double-checked the photos. We used 100 images for training purposes and 20 images for testing.

C. FILTERING

Median filtering is a nonlinear technique for reduce impulsive noise, also known as salt-and-pepper noise. It is also useful in preserving edges in an image while reducing random noise. The median filter produces a value of 10 at the current pixel spot, which is the median of the five values.

The median filter examines each pixel in the image individually and compares it to its neighbours to determine if it is representative of its surroundings. Rather than actually replacing the pixel value with the mean of neighbouring pixel values, the median of those values is used. The median is determined by numerically ordering all of the pixel values in the surrounding neighbourhood and then replacing the pixel being considered with the middle pixel value.

D. OTSU'S THRESHOLDING

The algorithm assumes that the image comprises two classes of pixels (foreground pixels and background pixels) based on a bi-modal histogram, and then determines the best criterion for separating the two classes such that their combined spread (intra-class variance) is minimal, or, equivalently (because the sum of pairwise squared distances is constant), so that their inter-class variance is maximal.

Figure 2: Original image

Figure 3: Image thresholded using otsu method

E. FEATURE EXTRACTION

Haar wavelet is a most efficient way to perform both lossless and lossy image compression. It works by averaging and defencing values in an image matrix to create a sparse or nearly sparse matrix. A sparse matrix is one in which the majority of the entries are zero. A sparse matrix can be efficiently processed, resulting in smaller file sizes. The twelve features are enlisted below:

1. Mean
2. Standard deviation
3. Entropy
4. RMS
5. Variance
6. Smoothness
7. Kurtosis
8. Skewness
9. IDM
10. Contrast
11. Correlation
12. Energy
13. Homogeneity

These characteristics are extracted from the image and fed into the classifier as data.

F. CLASSIFICATION

The support vector machine algorithm's goal is to find a hyper plane in an N-dimensional space (N — the number of features) that distinguishes between data points. There are several hyper planes from which to pick to distinguish the two types of data points. Our aim is to find a plane with the greatest margin, or the greatest distance between data points from both groups. Maximizing the margin gap provides some reinforcement, making it possible to distinguish potential data points as shown below.

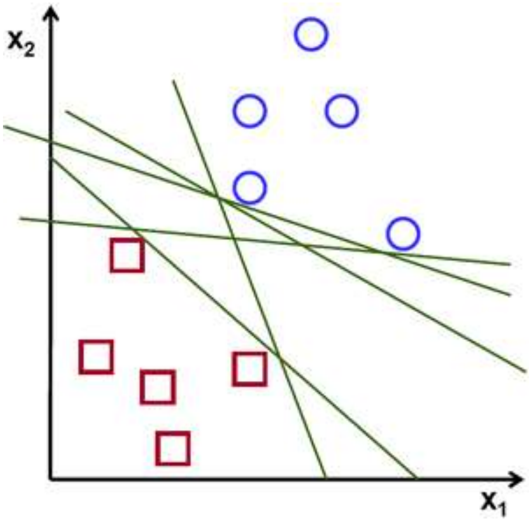

Fig 4: Classified Images

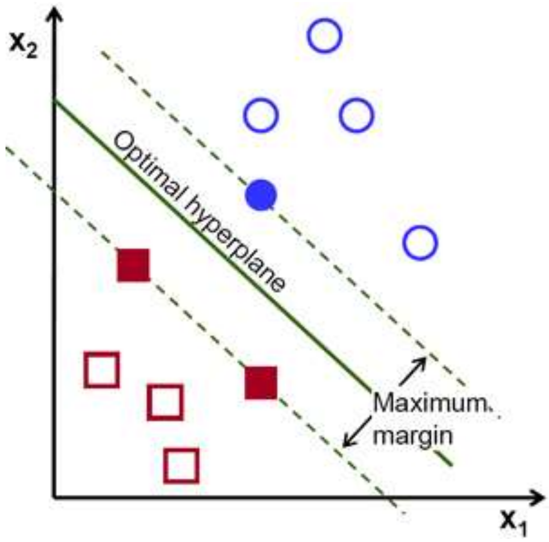

Fig 5:Classified Images

IV. EXPERIMENTAL SETUP

Decisions on pattern detection or grouping in the sense of medical diagnosis have effects that go beyond statistical tests of accuracy and validity. We ought to provide a medical understanding of pattern vector-based mathematical or rule-based decisions. Our study were carried out using actual patient data from the brain tumour segmentation challenge dataset. This dataset includes 30 patient samples for preparation (20 high grade and 10 low grade tumours) and 10 for research (all high grade tumours). The options are as follows: When a test results in a true positive (TP) or a "hit," it means the subject has the disorder. If a diagnosis is negative for a subject that does not have the condition, it is referred to as a true negative (TN). When a diagnosis is negative for a subject that has the disease of interest, it is considered to be a false negative (FN) or a "miss," meaning that the test has failed the situation. A false positive (FP) or false warning happens when a diagnosis results in a positive outcome even if the person being tested does not have the disease.

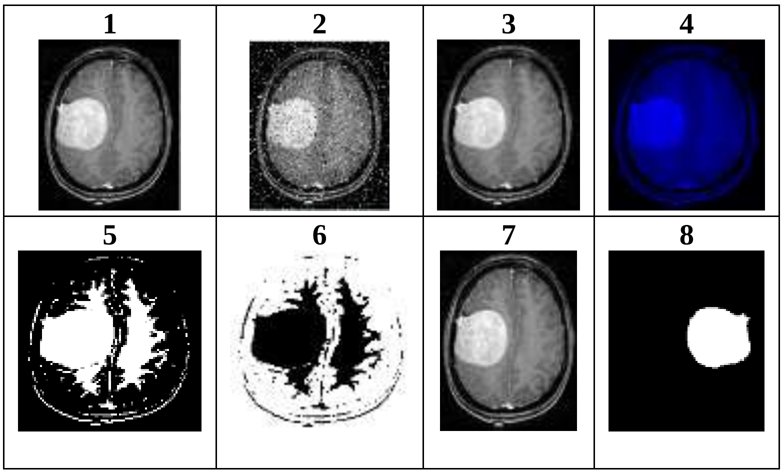

Figure 6: Noise added image

The figure shows the proposed GUI for Brain Tumour Detection from MRI. It has features of calculating various accuracies like linear, polygonal, RBF and quadratic accuracies. The resulting segmentation can be used with highest accuracy of 90%.

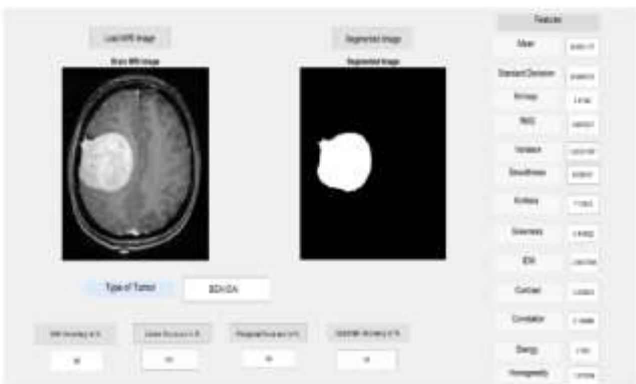

Fig 7: Segmentation Result

V. CONCLUSION

The role of classifying brain MRI images is crucial. Image pre-processing is carried out with median filtering and Otsu's thresholding. It shows better performance. The features were extracted using harr wavelet transform technique and SVM is used as a classifier.

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