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# MRI Brain Tumour Classification Using SURF and SIFT Features

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## ABSTRACT

*The features of an image are very important to classify different images. The classification of images is done by feature extraction using Speeded Up Robust Features (SURF) and Scale Invariant Feature Transform (SIFT) methods for extraction. SIFT method is used to detect the images with larger corners and extract them. SURF, the name itself represents a speed method to extract the features when compared to SIFT. KNN classifier is used to classify the images based on the features extracted from both techniques. So these combined processes are applied to classify tumour and non-tumour images more accurately.*

**KEYWORDS:** *SURF, SIFT, KNN classifier, Brain tumour classification, image classification.*



## I. INTRODUCTION

In Artificial Intelligence to related Image classification plays an important role to classify images based on their image features. These techniques deals with classifying images on the basis of their respective algorithms. Classifying images can be done by different methods, but the minimum error rate is the satisfactory element to get accurate classification. Several images are taken from different data bases. The images dealt in this paper are tumour and non-tumour brain images. Brain tumours are generally abnormal. If there is tumour present in brain it can be detected as one of the cancer.

A tumour is an abnormal tissue that grows in uncontrolled manner in a brain. Normal cells grow in a controlled manner and if there is any damage then the cells are replaced by the new cells. There are two types of situations present in the tumours a) primary b) secondary. Primary means which is in the starting stage and the secondary means spreading to the other cells in the brain. Due to the presence of this tumour there is blockage of Cerebrospinal fluid which passes throughout the skull. This causes swelling of brain and many other symptoms.

## II. RELATED WORKS

A lot of approaches are done to know the volume and the grade of the brain tumour. EI papageevgious et.al proposed a method to find out the volume of the brain in their works called Fuzzy Cognitive Maps (FCM). Several authors used this FCM method and model expert's knowledge based method for finding the grade of the brain tumour and the results are 90.23% accuracy & 93.26% accuracy. So the next method is best for the grading. They calculate this only on the characterisation and accuracy determination of grade [1].

*Shafab Ibrahim, Noor Elaiza* proposed an implementation of evaluation method called image mosaicing for knowing the details of any brain abnormalities. To design the mosaic image the brain abnormalities are cut into various shapes and sizes. Then the small pieces are pasted on the normal brain. Then the normal brain will detect the brain abnormalities by moving into further steps [2].

*K.P Shanmugapriya et al.,* gives many applications on data mining. The data mining is very useful for predicting of any disease. In this process, there is also pre-processing occurs for the normalisation. The brain images can be classified using different data mining methods. They tried to find out the structure and formation difference through task activation. The main aim is to find out the any abnormalities in image like tumour and searching for any similarities to find the solution [3].

*Ajala Funmilola A* proposed a method to extract features from PCA method and then classify them with using PCA and SVM classifiers. Using PCA CLASSIFIER they got 26% accuracy and using SVM classifier they got 76% accuracy. When compared to the recognition time the PCA is better than the SVM classifier because it is only 6sec. Finally they conclude that PCA out performs the SVM classifier [4].

*V.P.Gladis Pushpa Rathi* and *Dr.S.Palani* in their work proved that the LDA and SV*M* classifiers classified brain images with 96% accuracy and with only LDA classification it gave 98.87% accuracy. And the results are compared with various methods and he got accuracy greater than other methods [5].

## III. Image Classification Database

The database contained of all 101 brain tumour and non-tumour images. There are 92 brain tumour images and 9 non tumour images. All the images of size 256X256 pixels are obtained from the databases MR-TIP and overcode.yak.net. The below figures are the examples of brain tumour and non-tumour images.

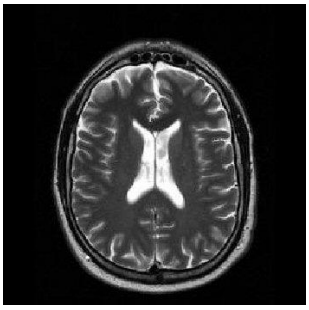

**Fig1: Brain non-tumour**

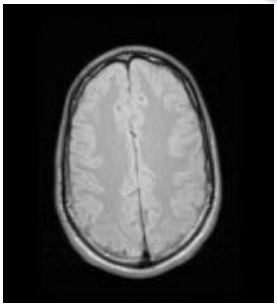

**Fig2: brain tumour**

## IV. Proposed Method

### A. Block Diagram

#### i. Using SURF Features

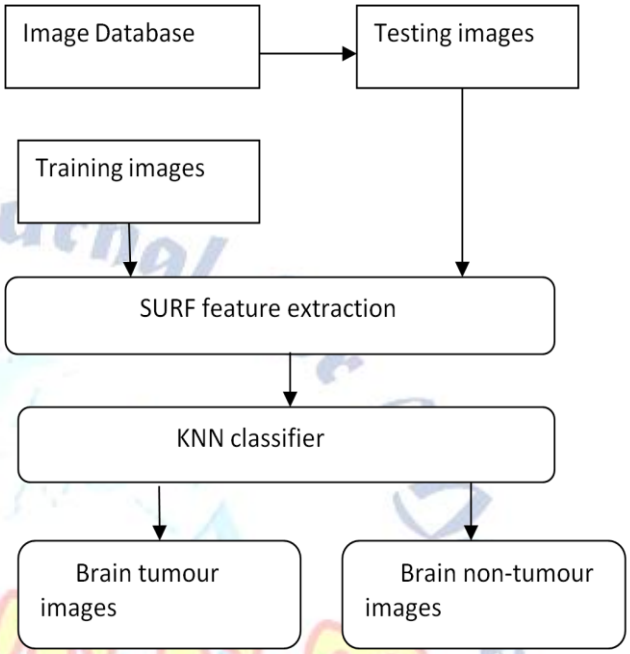


**Fig3: block diagram of MRI brain tumour classification using SURF features**

The images from the database are extracted by the SURF features and then the values are imported to MATLAB and these values are given as input to the KNN classifier. Then the classifier, based on the training images the testing images are classified as the brain tumour and non-tumour images.

#### ii. Using SURF and SIFT Features

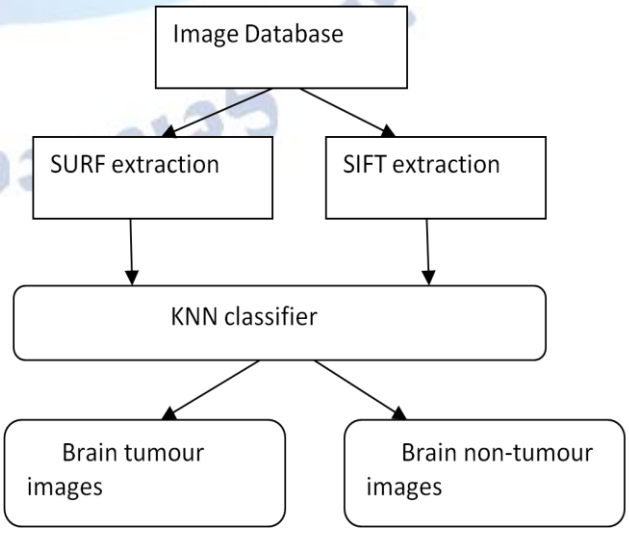

**Fig4: block diagram of SURF and SIFT feature extraction using KNN classifier**

In this block diagram both SURF and SIFT features are used to extract the brain images and then the KNN classifier is used to classify them as brain tumour and non-tumour images. Then the accuracy and the recognition time are calculated and compared with the SURF features.

*B. SURF Features*

SURF generally uses the scale and invariant operation. Due to these operations the image can be recognised by the representation not by the value of it. In 2006 Bay, H., Tuytelaars, T. and Van Gool, L, published about the new topic called Speeded Up Robust Features (SURF) to speed the feature extractions and it is the better version than SIFT. All image systems have some common features like feature extraction. The image features find some interesting feature points based on the type of their program and the subsequent program can give the best features to get the maximum values.

The surf features mainly concentrate on blob like structures. These structures present at the corners of the image or if the reflection of light is maximum. In 1998, Linder berg noticed that these reflections are known by the Monge-Ampere operator and Gaussian derivative operator. He next detected these blobs by convolving the Determinant of the [DOH] matrix with the source image. This metric is now defined by the Gaussian variance,$\sigma^2$ for normalising.

**Methodology of SURF**: In this the surf feature extraction can be done by the three steps. The first step is to understand the surf algorithm and can be applied to the each image. The surf feature extraction algorithm is applied on every image and the detected points may or may not return the descriptor points. The second method is to store the values of features from every image. The third method is to find these values on the figure which are represented on the figure by the mark.

*C. SIEF Features*

The features extracted in this method are local features. Generally the SIFT features are used to capture the image or to find the gesture of an image. Then the features are extracted from the sift using its algorithm. And the values are stored on the basis of their extraction. Scale Invariant Feature Extraction means the images are scaled and thus it is difficult to find out the corners because the corners are also scaled. An image can be recognised by comparing every pixel value with the pixels of other images in the Scale space. By this way we can recognise an image which is matched with the input image in the Scale version.

While applying SIFT features to image for category classification or class classification the experimental results show that the better classification is done in dense grids over the sparse interest points. The development of SIFT features done by Bosch et al. (2006, 2007) and now it is used as the state of art for the visual object category classification.

**Methodology of SIFT**: To convert an image into the feature vectors Lowe's method is used to convert them. This is invariant to scaling, rotation, translation unlike of SURF features. The method of SIFT is also processed in three stages. The first step is to understand the algorithm and apply this program to the every image in the database. The second step is to import these values in the Matlab function. And the third step is to find the values on the image and the result is represented as mark.

*D. KNN Classifier*

In this work brain classification is done using K-Nearest Neighbours algorithm. The input consists of k closest training examples and the output depends on those training values. In each class, the object is mainly selected by their neighbours who give votes to that particular object. Likewise, in every class the neighbours give vote to the specific object. The most common object in all the classes which is nearest to the K value is the required object. For example if the value of k=1, then it keeps its result which is most nearest to it. It assigns weight to the contributions of the neighbours then the nearest neighbours are close to the average value not to the more distance values

The KNN classifier is used to classify the images from the given images. In this there are two types of functions: Testing and Training functions. The training function consists of images which are known as inputs and they have some values which are stored by the KNN classifier. Then by these values of training images the testing function is classified based on the classification. The images here are both tumour and non-tumour. After the feature extraction the KNN classifier classifies them as tumour images and Non tumour images.

## V. Results and Discussion

From totally 101 images some are tumoured and some are non-tumoured out of these some images are given as training images to KNN classifier. The images after extraction are given in the following figures.

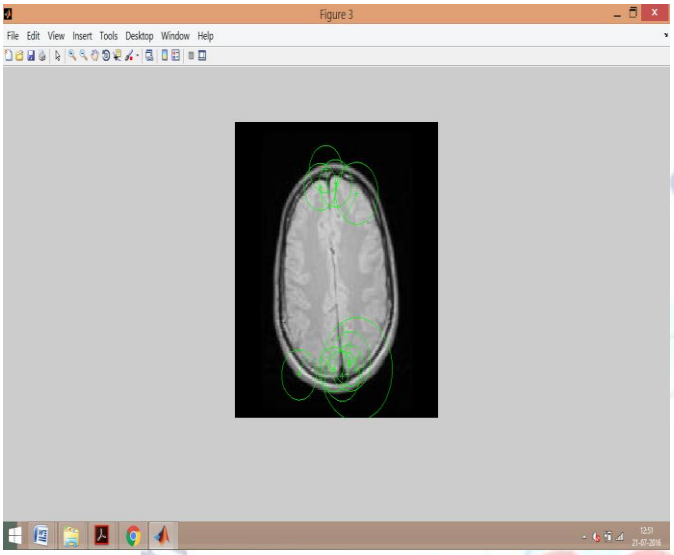


**Fig6: Feature extraction using SURF features**

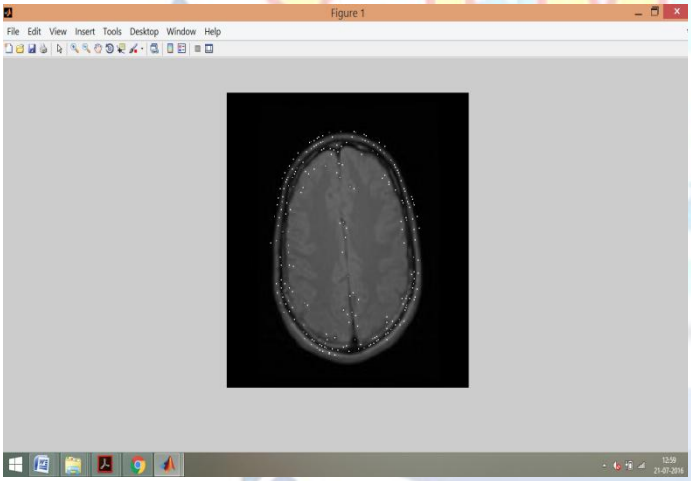


**Fig 7: Feature extraction using SIFT features**

**Performance Evaluation:**

The performance measures used are Accuracy, sensitivity, true positive, true negative, false positive, false negative:

**Accuracy:** It is defined as the accuracy of all the images after classification which equals total sum of correct classification over total sum of correct and incorrect classification multiplied with 100.

**True positive (Tp):** When the image is correctly classified it is true positive. Like if the normal brain is classified as normal brain.

**False negative (Fn):** If the image is not correctly classified then it is false negative. If the normal brain classified as abnormal brain then it is Fn.

**True negative (Tn):** When the image is classified correctly for abnormal brain. If the non-tumour image is classified as non-tumour

**False positive (Fp):** If the image is not classified correctly for abnormal images. If the non-tumour image is classified as the tumour image it is Fp.

$$\text{Accuracy} = \frac{Tn + Tp}{Tn + Tp + Fn + Fp} * 100$$

**Comparison table for SURF features and SURF& SIFT feature extraction**:

**Table 1: comparisons of performance metrics between SURF AND SURF &SIFT features**

| TYPE OF PERFORMANCE | USING SURF FEATURES | USING SURF AND SIFT FEATURES |
|---|---|---|
| ACCURACY | 94.33% | 96.22% |
| SENSITIVITY | 96.76% | 95.74% |
| SPECIFICITY | 81.96% | 85.71% |
| ELAPSED TIME | 14.59 SEC | 1935.76 SEC |

The comparison of performance metrics between SURF and SURF& SIFT feature extractions says that accuracy is good for both feature extraction. But the elapsed time is less for SURF features.

**CONFUSION MATRIX:** It is a table matrix which gives correct classification and misclassification. Correct classification mean when normal brain is classified as normal brain and diseased brain is classified as diseased brain.

A total of 47 Tumour images are taken and 7 non-tumour images are used for testing for using only SURF features only 45 images are detected as tumour and 2 as non-tumour images. In non-tumour images 6 images are detected as non-tumour and1 is detected as tumour image

When taking both SURF and SIFT feature extraction out of 47 tumour images 46 are detected as tumour and 1 is detected as non-tumour. In non-tumour images 6 images are detected as non-tumour.

**Table 2: confusion matrix for SURF features**

| | TUMOUR IMAGE | NON-TUMOUR IMAGE |
|---|---|---|
| **TUMOUR IMAGE** | 45 | 1 |
| **NON-TUMOUR IMAGE** | 2 | 6 |

**Table 3: confusion matrix for both SURF and SIFT features**

| | TUMOUR IMAGE | NON-TUMOUR IMAGE |
|---|---|---|
| **TUMOUR IMAGE** | 46 | 1 |

| | | |
|---|---|---|
| **NON-TUMOUR IMAGE** | 1 | 6 |

**Comparative analysis for different classifiers:**

Table 4: comparative analysis

| USED METHOD | DATA BASE | ACCURACY |
|---|---|---|
| PCA | www.cewebsource.com | 26% |
| SVM | Ibrar MRI & CT Scan | 98.7% |
| FUZZY CONNECTEDNESS | Collected from 20 different patients | 92.4% |
| PROPOSED METHOD | MR-TIP, overcode.yak.net | 96.22% |

From this table by using different classifiers different types of accuracy are obtained. The results are compared to the earlier methods done on different data base and the results show that SURF and SIFT method gives better results for brain tumour classification.

## VI. Conclusion

With the help of MRI brain images the specialists are able to detect the tumour. The features are extracted from the images and there by classified with the KNN classifier and the accuracy with both SURF and SIFT features is 96.22%. In this method Sensitivity, Specificity is also calculated by the help of confusion matrix. When comparing with only SURF features and SURF&SIFT features the elapsed time is very less for only SURF features. The results are compared with previous papers and the accuracy is varied for each method due to the data bases are different. In future there may also increase in accuracy through other several methods or by taking different database.

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