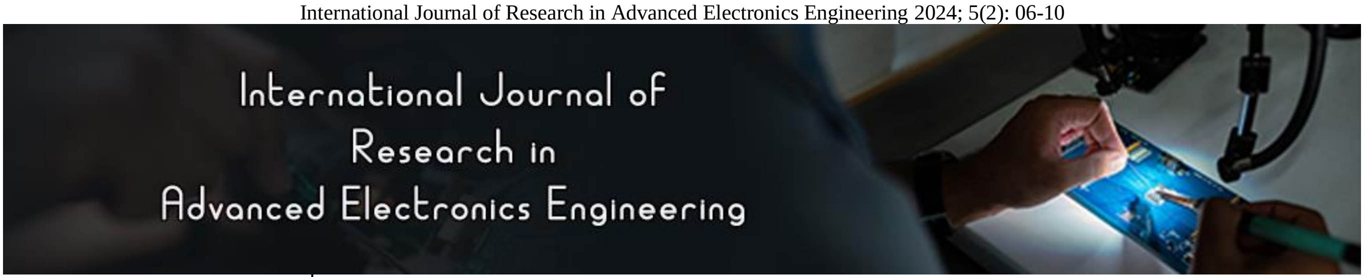

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Brain tumor extraction-based watershed classifier

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Abstract
The process of detecting brain tumors is one of the important issues because it has an important role in improving treatment possibilities and reducing the death rate if treatment is done correctly and early. The danger of cancer lies in the uncontrolled growth of cells due to causes that are not accurately diagnosed, which may be environmental, or due to a specific nutritional system or wrong behavior. There are several ways to detect brain tumors, such as surgical intervention, but detection using Magnetic Resonance Imaging (MRI) is the best method because it is easy and quick to obtain results and is considered less dangerous. In this research, a relatively simple software method used to detect brain cancer was presented based on software that plays the role of diagnosis and accurately detects the location of the brain cancer tumor. The proposed method adopts several stages, starting with receiving the image and processing the noise, and ending with detecting the presence and location of the disease. The MATLAB program and multiple real images from medical centers in the holy city of Najaf were used. The system was tested based on Accuracy, Sensitivity, and Specificity and A comparison with previous works was presented.

Keywords: Image processing, brain tumor, wiener, watershed

Introduction

Brain tumors target the skull and can damage brain cells and lead to death. These tumors may be cancerous and noncancerous. This is very dangerous, as untreated cancer may cause death. Early treatment is very important as it may save the patient's life [1]. The process of finding a patient helps doctors by giving the appropriate medication and thus using the medication that is less harmful than radiation or surgical treatments [2-5]. Early treatment often reduces symptoms and improves health, thus improving the patient's life over time, and this is extremely important for patients' health [6]. The reasons for the appearance of cancer in people are different, some of which are due to genetic factors and others are the result of external environmental causes related to food, certain physical activity, or radiation exposure [7]. The development in the programming aspect, especially artificial intelligence, has made many applications make achievements, especially in the field of technology and medical. In some applications, it may not rely on artificial intelligence due to the high complexity if classical programming can perform the tasks [8-15].

Many researchers have presented different methods that help detect cancer tumors in the brain, away from doctors' diagnosis, as a kind of scientific addition. Some of them are presented as follows: R Kalam and M. Abdul Rahman in 2017, presented a system for detecting tumors using six steps starting from pre-processing to Segmentation used a modified FCM algorithm to assign the presence and location of the tumor with high accuracy [16]. K. Venkatachalam *et al.* in 2017, present a system for retrieval of brain tumor images from the large data Content-Based Medical Image system which combines the Gabor filter with Walsh-Hadamard transform to discover the features from MRI images and used Fuzzy C-Means to compute Minkowski distance that was used to calculate the similarity between the selected image and database images [17]. Digvijay Reddy *et al.* in 2018 used k-means clustering with other operations to extract the tumor remove the noise by the Pre-processing technique and assign the tumor location in the cells [18]. Aashika Suresh *et al.* in 2018 present semi-automated for BRATS 2015 brain tumor detection. To extract the tumor location, relevel thresholding and level-set segmentation. for enhancing the tumor location used Tsallis entropy assisted thresholding [19]. Hein Tun Zaw *et al.* in 2019 [20] presented a method for detecting cancer grade-4 tumor, Glioblastoma multiforme in brain tissues based on Naïve Bayes classification present some steps before performing the classification such as morphological, subtraction, maximum entropy, and feature extraction. Gajendra Raut *et al*. 2020 used CNN to detect brain tumors and Autoencoders to generate the image and then remove the useless features and segmentation of tumor areas by the unsupervised learning K Mean method [21]. K. Venkatachalam *et al*. in 2021 present the Gabor Walsh-Hadamard Transform method for extracting brain tumors from MRI images. It takes place in several stages, starting with removing noise using filters, then extracting features using the Gabor filtering technique and Walsh-Hadamard transform. It used Fuzzy C-Means clustering Minkowski to measure similarity with images in databases [22]. A. Veeramuthu *et al*. 2022 present brain tumor classification based on a combined feature and image-based classifier method, and compare it with another method actual image feature-based classifier, deep convolutional neural networks, and segmented image-based classifier [23]. Soheila Saeedi *et al*. 2023 present a method to detect three types of tumors: glioma, meningioma, and pituitary gland. Convolutional Neural Network with 2*2 kernel function applied to 3264 MRI brain images [24].

Brain Tumor

Cancer detection remains a very complex task, according to a 2019 report by the American Association of Neurological Surgeons, due to the similarity in size, location, and growth patterns. In the absence of apparent symptoms, it may be difficult to determine the disease. Thus, CT scanning is the best method so far in detecting cancer, instead of performing surgical operations that may take time and be dangerous. According to the opinion of the American Cancer Society, MRI is still the best method because of its ability to show tumor features and detect and treat the tumor, because it involves cutting the body and thus is a safer alternative to surgery. However, analyzing resonance imaging data is a very personal matter and requires a high level of skill [25].

Tumors is a genetic term and may be also used in Neoplasm as terminology. Tumor means mass which always refers to benign growths or malignant growths and may refer to non-cancerous or cancerous. The problem of tumors is based on the un controller cell growth hence it poses a threat to human life. Cancer is expected to be the cause of death in 1 out of every 6 cases. In 2016, 8.9 million died from cancer. Many tumors are curable if detected early and treated properly. The probability of a person getting cancer is 1%. Brain tumors constitute the largest portion of central nervous system diseases, reaching 85% to 90%. Based on cancer registries in 2018, 18,078,957 cancer cases were identified, of which 296,851 were in the brain. Figure 1 represents the rate of incidence of cancer for the year 2018 continental-wise. Figure 2 shows the percentage of deaths due to cancer around the world [26].

According to these results, countries with higher populations are more exposed to death from brain diseases due to reasons such as pollution in the environment and exposure to various radiations during the day. According to these results, countries with higher populations are more exposed to death from brain diseases due to reasons such as pollution in the environment and exposure to various radiations during the day. On the other hand, it can be said that the development in diagnosis is one of the reasons for the high rate of infections recorded in these countries, and therefore this field requires more research and scrutiny [27].

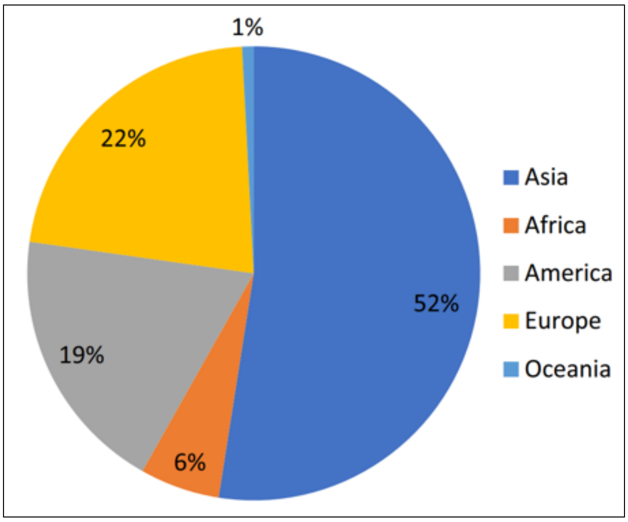

Fig 1: Cancer incidence rate in 2018 [26]

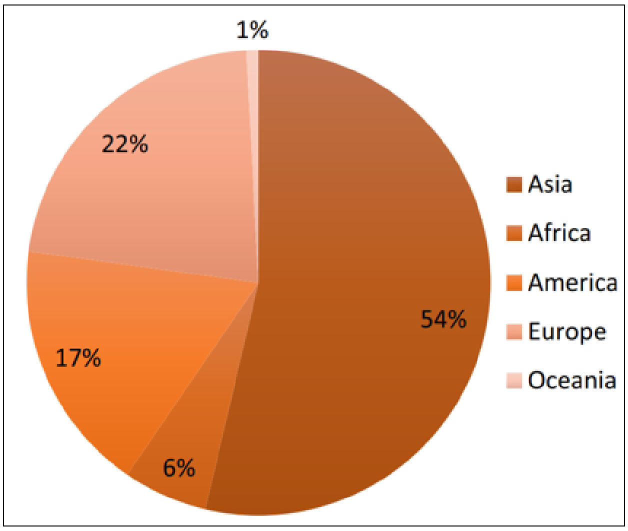

Fig 2: Percentage of deaths due to cancer [26]

Brain Tumor Detection Procedure

The first step is to insert an image from a graphics file to perform brain tumor detection and convert the RGB image to a grayscale. The second step is removing the noise by a Median filter which works as a low low-pass filter. The third step is segmentation-based thresholding to make the visual data easier to analyze. The fourth step enhancing the image by filling the holes region to remove the black pixel in the weight area. Perform the image open and closed operators then remove the unwanted pixel that minimum the threshold size. The fifth step is to apply the watershed algorithm to focus on the tumor region. The sixth step is extracting the features by getting the best feature from the images. In the final step, the proposed system presents the decision about the presence or absence of the tumor and the location of the tumor accurately through precise and prominent identification. The steps of the proposed system are shown in Figure (3). The factors used to test the system are Accuracy, Sensitivity and Specificity shown in Eq. (1-3).

Where:

Accuracy=(TP+TN)/(TP+TN+FP+FN) (1)

Sensitivity = TP/ (TP+FN) (2)

Specificity = TN/ (FP+TN) (3)

TP: True positive (Correctly identified).
TN: True negative (correctly rejected).
FP: False positive (incorrectly identified).
FN: False negative (incorrectly rejected).

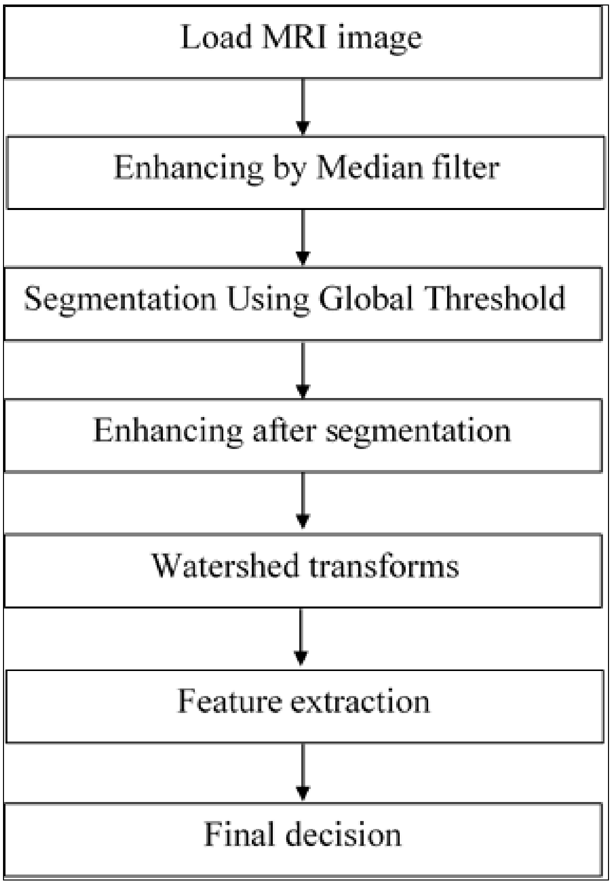

Fig 3: block diagram of the proposed system

Simulation result

The MRI images used to test the proposed system were adopted from several medical centers in the holy city of Najaf, where 128 images were taken to test the system's efficiency. Each MRI images are insert to MATLAB to begin the process of tumor detection as in Figure (4). Then applied the enhancing by Median filter and segmentation using global threshold as shown in Figure (5). The final step as in Figure (6) present the final decision is made in the absence of brain cancer or the specific location of the tumor in the event that it is proven that the patient has cancer. Figure (7) shows the steps of the image stages of brain tumor detection. Table (1) presents the image properties. Table (2) presents the comparison results between the proposed system and other works.

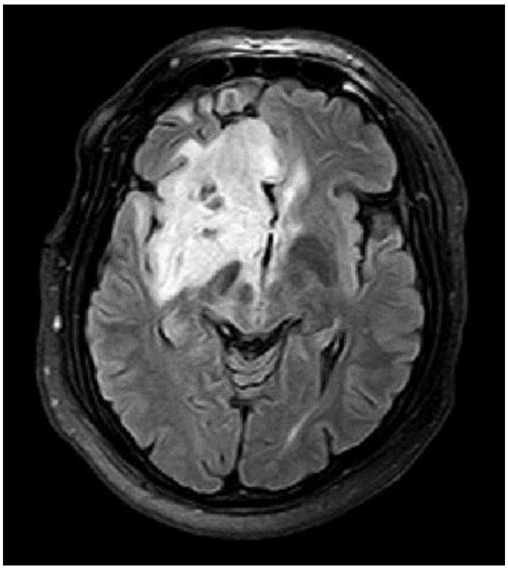

Fig 4: The input image

Fig 5: The image after enhancing and segmentation

Fig 6: The final image with brain tumor

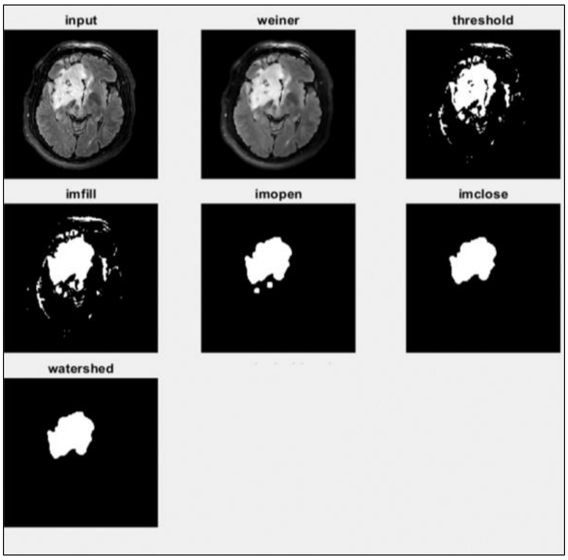

Fig 7: The Brain tumor detection steps

Table 1: Image properties

Area:	60280
Centroid:	[129.6369 130.6120]
Bounding Box:	[1.5000 1.5000 254 254]
Sub array Idx:	{1×2 cell}
Major Axis Length:	302.5722
Minor Axis Length:	300.5888
Eccentricity:	0.1143
Orientation:	25.5719
Convex Hull:	[1017×2 double]
Convex Image:	[254×254 logical]
Convex Area:	64516
Circularity:	0.7707
Image:	[254×254 logical]
Filled Image:	[254×254 logical]
Filled Area:	64516
Euler Number:	0
Extrema:	[8×2 double]
Equiv Diameter:	277.0395
Solidity:	0.9343
Extent:	0.9343
Pixel Idx List:	[60280×1 double]
Pixel List:	[60280×2 double]
Perimeter:	991.3960
Perimeter Old:	1012
Max Feret Diameter:	359.2102
Max Feret Angle:	135
Max Feret Coordinates:	[2×2 double]
Min Feret Diameter:	254
Min Feret Angle:	-90
Min Feret Coordinates:	[2×2 double]

Table 2: No. of references

No. of references	Accuracy	Sensitivity	Specificity
16 2017	96.51%	97.72%	94.20%
17 2017	94%	81.25%	100%
18 2018	99.9%	61%	100%
19 2018	97.93%	96.77%	98.40%
22 2021	94%	81.25%	100%
proposed	98%	99%	96%

Conclusion

Detection and diagnosis of diseases using advanced software systems is a promising and important field because of the great assistance it provides to doctors, and it also keeps pace with tremendous technological development. There are many methods for detecting brain tumors, some of which are complex and require many processing steps to make a decision, while others are simple with high performance.

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