IMPROVED TK-FCM ALGORITHM FOR BRAIN TUMOR DETECTION

A Project report submitted in partial fulfilment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted by

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ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES

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Sangivalasa, Bheemili mandal, Visakhapatnam Dist.(A.P)

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CERTIFICATE

This is to certify that the project report entitled "**IMPROVED TK-FCM ALGORITHM FOR BRAIN TUMOR DETECTION**" submitted by **S. Sai Venkatesh (318126512175), B. Harshavardhan (318126512124), P. Joy Grace (318126512165)** and **M. Dileep Kumar (316126512093)** in partial fulfilment of the requirements for the award of the degree of Bachelor of Engineering in Electronics and Communication Engineering of Andhra University, Visakhapatnam is a record of bonafide work carried out under my guidance and supervision.

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ABSTRACT

In the Modern Era of fast-moving technology, we can do things which we never thought we could do before but, to achieve and accomplish these thoughts there is a need for a platform which can automate all our tasks with ease and comfort. In recent decades, human brain tumor detection has become one of the most challenging issues in medical science.

In this paper, we propose a model that includes the improved combination of template-based K means and fuzzy C means (TKFCM) algorithm for detecting human brain tumors in a magnetic resonance imaging (MRI) image.

In this proposed algorithm, firstly, the template-based K-means algorithm is used to initialize segmentation significantly through the perfect selection of a template, based on gray level intensity of image; secondly, the updated membership is determined by the distances from cluster centroid to cluster data points using the fuzzy C-means (FCM) algorithm while it contacts its best result, and finally, the improved FCM clustering algorithm is used for detecting tumor position by updating membership function that is obtained based on the different features of tumor image including Contrast, Energy, Dissimilarity, Homogeneity, Entropy, and Correlation.

Simulation results show that the proposed algorithm achieves better detection of abnormal and normal tissues in the human brain under small detachment of gray-level intensity. In addition, this algorithm detects human brain tumors within a very short time—in seconds compared to minutes with other algorithms. So, we are designing a model that detects human brain tumors in a magnetic resonance imaging (MRI) scan. Keywords: magnetic resonance imaging, T-means clustering, fuzzy C-means clustering, template-based K-means and modified fuzzy C-means (TKFCM), feature extraction, gray level intensity.

CHAPTER-1

INTRODUCTION

INTRODUCTION

1.1 INTRODUCTION

Nowadays computer technology has been growing and expanding its use in helping to resolve the problems on various aspects of human life. In the field of medicine, image processing techniques have been widely used. It is an interesting topic that offers to multimodal systems the capacity to see and understand their environment in order to interact in a natural and more efficient way. Doing so minimizes memory usage and yields efficient data transfers. Magnetic resonance imaging (MRI) is the newest, and perhaps most versatile, medical imaging technology available. Using MRI, doctors can get highly refined images of the body's interior without surgery. By using strong magnets and pulses of radio waves to manipulate the natural magnetic properties in the body, this technique makes better images of organs and soft tissues than those of other scanning technologies. MRI is particularly useful for imaging the brain and spine, as well as the soft tissues of joints and the interior structures of bones. This entire body is visible to the technique, which possesses few known health risks.

Brain diseases are one of the major causes of cancer related deaths among children and adults in the world. Brain diseases like brain tumors are characterized as a gathering of abnormal cells that become inside the brain and around the brain. Among all imaging techniques, MRI is widely used for the detection of brain tumor. MRI is a safe, fast and non-invasive imaging technique. The proposed scheme develops a system in which improved Template based K means and Fuzzy C means are used for the identification or presence of brain tumors through MRI images. Our aim is to mark the presence of a brain tumor if any, or express the absence of the tumor. The proposed technique has the potential of assisting clinical diagnosis by utilizing the MR images.

1.2 HUMAN BRAIN

The cerebrum is the largest part of the human brain. It is divided into two cerebral hemispheres. The cerebral cortex is an outer layer of gray matter, covering the core of white matter. The cortex is split into the neocortex and the much smaller allocortex. The neocortex is made up of six neuronal layers, while the allocortex has three or four. Each hemisphere is conventionally divided into four lobes- the frontal, temporal, parietal, and occipital lobes.

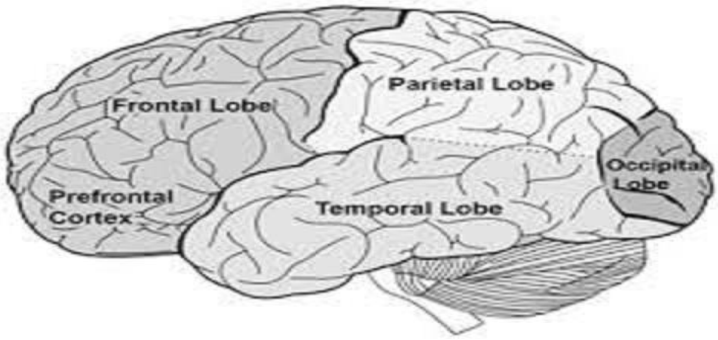


Fig. 1.1 Lobes of Brain

Lobes of Brain:

- **Frontal lobe** tumors may cause behavioral and emotional changes, impaired judgment, and impaired sense of smell, memory loss, and paralysis on one side of the body, reduced mental abilities, and vision loss.
- **Parietal lobe** tumors may cause impaired speech, inability to write, lack of recognition, and spatial disorders.
- **Occipital lobe** tumors may cause vision loss in one or both eyes.
- **Temporal lobe** tumors may cause impaired speech and memory difficulty.
- **Brainstem** tumors may cause behavioral and emotional changes, difficulty speaking and swallowing, drowsiness, hearing loss, muscle weakness on one side of the face (e.g... head tilt, crooked smile), muscle weakness on one side of the body, uncoordinated gait, drooping eyelid or double vision, and vomiting.
- **Pituitary gland** tumors may cause increased secretion of hormones, a stop in menstruation, abnormal secretion of milk, and decreased libido.

1.2.1 Brain tumor type

A primary brain tumor is an abnormal growth that starts in the brain and usually does not spread to other parts of the body. Primary brain tumors may be classified as follows.

- Benign
- Malignant

Benign tumor

A benign (non-cancerous) brain tumor is a mass of cells that grows relatively slowly in the brain. Non-Cancerous brain tumors tend to stay in one place and don't spread. It won't usually come back if all of the tumor can be safely removed during surgery. If the tumor can't be completely removed, there's a risk it could grow back. In this case, it'll be closely monitored using scans or treated with radiotherapy.

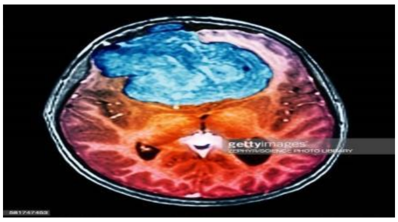


Fig. 1.2 Benign tumor

Malignant tumor

The word malignant is Latin for "badly born." This type of tumor has the ability to multiply uncontrollably, to metastasize (spread) to various parts of the body and invade surrounding tissue. Malignant tumors are formed from abnormal cells that are highly unstable and travel via the blood stream, circulatory system, and lymphatic system.

Malignant cells do not have chemical adhesion molecules to anchor them to the original growth site that benign tumors possess. A benign brain tumor grows slowly, has distinct boundaries, and rarely spreads. A malignant brain tumor grows quickly, has irregular boundaries, and spreads to nearby brain areas.

Fig. 1.3 Malignant tumor

Table 1.1 compares about the functions of benign and malignant tumor cells.

S. No.	BENIGN TUMOUR	MALIGNANT TUMOUR
1	They are the starting stage of a tumor. They are not cancerous.	They are severe stages of a tumor. They are cancerous.
2	They grow slowly and do not spread to other parts of the body.	They grow rapidly and spread to other organs and to the bones.
3	A benign tumor is one that may be a nuisance, but does not result in death.	A malignant tumor is dangerous and leads to death immediately.
4	13,000 deaths in U.S per year are due to benign tumors.	Approximately 5,75,000 deaths per year are due to malignant tumor.
5	It can be cured by surgery alone.	It needs chemotherapy and radiation therapy along with some additional treatments.

1.2.2 Symptoms of Brain Tumors

Tumors can affect the brain by destroying normal tissue, compressing normal tissue, or increasing intracranial pressure. Symptoms vary depending on the tumor's type, size, and location in the brain. A tumor (also called a neoplasm or lesion) is an abnormal tissue that grows by uncontrolled cell division.

Normal cells grow in a controlled manner as new cells replace old or damaged ones. For reasons not fully understood, tumor cells reproduce uncontrollably.

Brain tumors are named after the cell type from which they grow. They may be primary (starting in the brain) or secondary (spreading to the brain from another area). Treatment options vary depending on the tumor type, size and location; whether the tumor has spread; and the age and medical health of the person. Treatment options may be curative or focus on relieving symptoms. More than 120 types of brain tumors, many can be successfully treated. New therapies are improving the life span and quality of life for many people.

1.2.3 Medical Imaging Techniques

The image test for brain tumor is made using two techniques, one is CT scan and another one is MRI scan.

- Computed Tomography - CT
- Magnetic Resonance Image-MRI

Computed Tomography:

Computed Tomography (CT) is an imaging procedure that uses special x-ray equipment to create detailed pictures, or scans, of areas inside the body. It is also called Computerized Tomography and computerized axial tomography (CAT).

Magnetic Resonance Image:

Magnetic Resonance Imaging (MRI) scan is a non-invasive test that uses a magnetic field and radio frequency waves to give a detailed view of the soft tissues of the brain.

It views the brain 3-dimensionally in slices that can be taken from the side or from the top as a cross-section. A dye (contrast agent) may be injected into your bloodstream. MRI is very useful to evaluate brain lesions and their effects on surrounding brain as showed in Fig. 1.4.

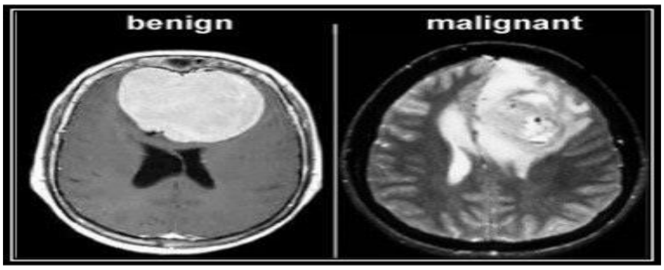


Fig. 1.4 MR Images of Benign and Malignant Tumors

1.3 DETECTION OF TUMOR IN MR IMAGES

Automated classification and detection of tumors in different medical images is motivated by the necessity of high accuracy when dealing with a human life. Also, the computer assistance is demanded in medical institutions due to the fact that it could improve the results of humans in such a domain where the false negative cases must be at a very low rate.

It has been proven that double reading of medical images could lead to better tumor detection. But the cost implied in double reading is very high, that's why good software to assist humans in medical institutions is of great interest nowadays. Conventional methods of monitoring and diagnosing the diseases rely on detecting the presence of particular features by a human observer. Due to large number of patients in Intensive Care Unit (ICU) and the need for continuous observation of such conditions, several techniques for automated diagnostic systems have been developed in recent years to attempt to solve this problem. Such techniques work by transforming the mostly qualitative diagnostic criteria into a more objective quantitative feature classification problem. In this project, the proposed scheme develops a system in which k-means clustering is used for the brain tumor segmentation of MRI images.

The proposed technique has the potential of assisting clinical diagnosis by utilizing the MR images.

Segmentation of brain tissues in gray matter, white matter and tumour on medical images is not only of high interest in serial treatment monitoring of disease burden in oncologic imaging, but also gaining popularity with the advance of image guided surgical approaches. Outlining the brain tumour contour is a major step in planning spatially localized radiotherapy (e.g., Cyberknife, iMRT) which is usually done manually on contrast enhanced T1-weighted MRI in current clinical practice. On T1 MRI acquired after administration of a contrast agent (gadolinium), blood vessels and parts of the tumor, where the contrast can pass the blood-brain barrier are observed as hyper intense areas. There are various attempts for brain tumor segmentation in the literature which use a single modality, combine multi modalities and use priors obtained from population atlases.

1.4 EXISTING TECHNIQUES

There are some approaches for detection of tumors in MRI images,

(1) Edge detection technique

(2) Thresholding method

1.4.1 Edge Detection in Brain Images

Edge detection is a critical element in image processing, since edges contain a major function of image information. The function of edge detection is to identify the boundaries of homogeneous regions in an image based on properties such as intensity and texture. Many edge detection algorithms have been developed based on computation of the intensity gradient vector, which, in general, is sensitive to noisy image. In order to suppress the noise, some spatial averaging may be combined with differentiation such as the Laplacian of Gaussian operator and the detection of zero crossing.

1.4.2 Thresholding:

The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image. The key of this method is to select the threshold value (or values when multiple-levels are selected). Several popular methods are used in industry including the maximum entropy method, Otsu's method (maximum variance), and c-means clustering. Recently, methods have been developed for thresholding computed tomography (CT) images.

1.5 SEGMENTATION

Segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is basically used to locate objects and boundaries (lines, curves, etc.) in images.

More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image.

Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics. When applied to a stack of images, typical in medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions.

1.6 OBJECTIVE OF THE PROJECT

Brain disease is one of the major causes of cancer related death among children and adults in the world. The brain images generated by the MRI (Magnetic Resonance Imaging) are more accurate for the examination of the brain diseases, if any are present and for the further analysis of the tumor area.

The physician also needs the help of computer and image processing techniques for the same. Our aim is to determine the presence or absence of the tumor through a combination of several techniques like k-means clustering for image segmentation, feature extraction, feature reduction, identification and marking respectively. The proposed technique has the potential of assisting clinical diagnosis by utilizing the MRI images.

1.7 MOTIVATION OF THE PROJECT

Nowadays, the computer technology has been growing and expanding its use in helping to resolve the problems on various aspects of human life. In the field of medicine, image processing techniques have been widely used.

It is interesting that it offers a multimodal system the capacity to see and understand their environment in order to interact in a natural and more efficient way, doing so minimizes memory usage and yields efficient data transfer. The demand for biomedical image processing is growing more, the usage and its implementation is present each and everything everywhere.

The MRI process does not use radiation and the its results are applied to the input of the proposed system. Some defects might be present for some of the MRI Images which come from the process of different types of MRI Scan. In order to detect these defects, the process might be inaccurate and might need excessive time. Thereby, the process might be delayed by using the manual system.

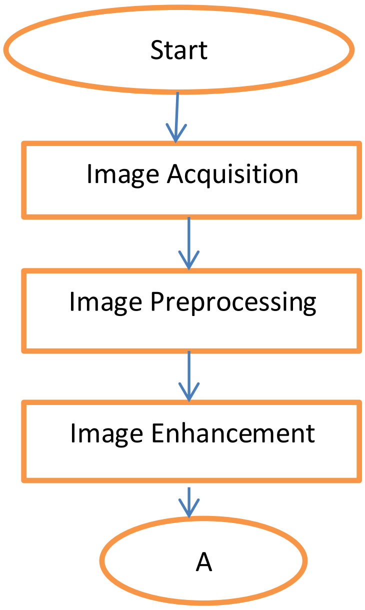
1.8 METHODOLOGY USED IN IMPLEMENTING THE WORK

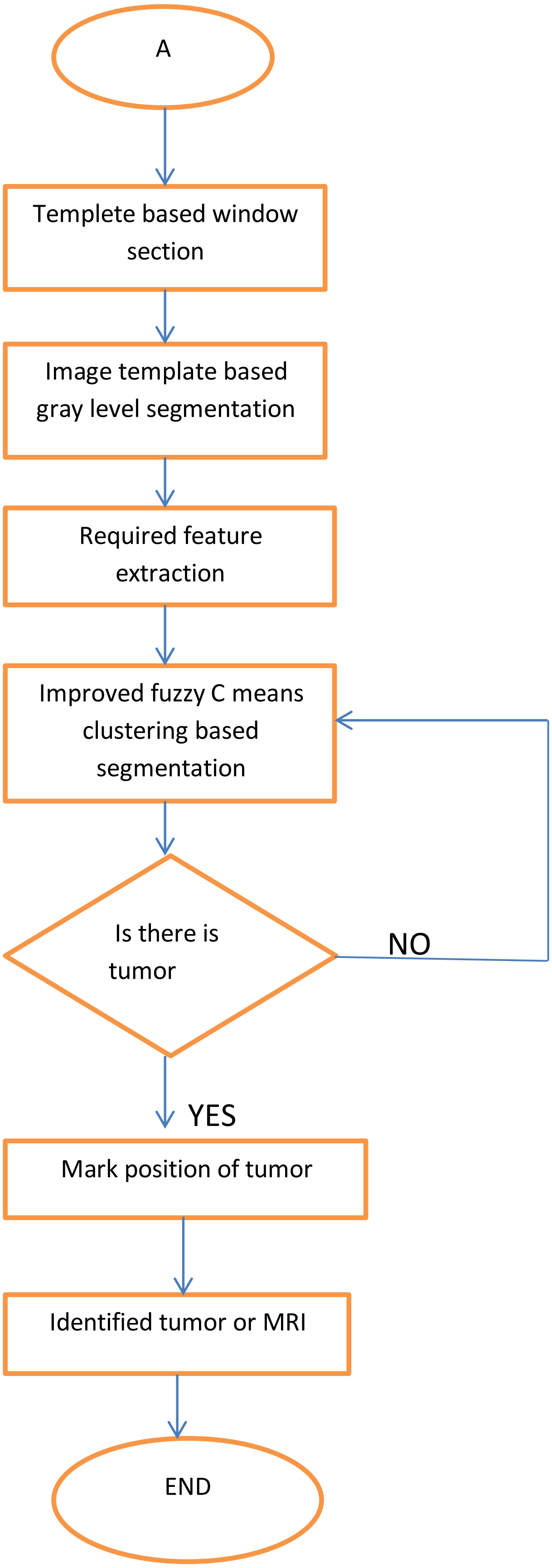
In the methodology, initially, the MR image of the human brain is acquired. This input image is pre-processed and enhanced. Furthermore, the template -based window is selected and the output of the window is segmented using the improved template-based K-means clustering segmentation. The required features are extracted. Finally, the tumor is detected by marking it with a red line around the area containing the tumor using the improved fuzzy C-means algorithm. This is committed through the clustered image which is automatically chosen from the image features.

The TKFCM algorithm is an accumulation of the K-means and fuzzy C-means with some modification. On the basis of temper or gray level intensity in the brain image, the template is selected along with the conventional K-means.

On the other hand, in FCM, the Euclidian distance and the membership function is modified by the image features.

1.9 FLOW CHART




A
Templete based window section
Image template based gray level segmentation
Required feature extraction
Improved fuzzy C means clustering based segmentation
Is there is tumor
NO
YES
Mark position of tumor
Identified tumor or MRI
END

CHAPTER-2

IMAGE PROCESSING AND LITERATURE REVIEW

IMAGE PROCESSING

2.1 INTRODUCTION TO IMAGE PROCESSING:

Image processing is a method of converting an image into digital form and performing some operations on it, in order to get an enhanced image or to extract some useful information from it. Image processing is one form of signal processing in which the input is a photograph or video frame; the output may either be an image or a set of characteristics or parameters related to the image. An image contains sub-images sometimes referred to as regions-of-interest, or simply regions which imply that the images contain collections of objects, each of which can be the basis for a region.

In image science, image processing is a form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may either be an image or a set of characteristics or parameters related to the image. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. The acquisition of images (producing the input image in the first place) is referred to as imaging.

Most of the image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. An image may be considered to contain sub-images sometimes referred to as regions-of-interest, ROIs, or simply regions. This concept reflects the fact that images frequently contain collections of objects each of which can be the basis for a region. Thus, we have chosen image processing for identifying the defects on the surface, where the defective part will be the area of interest. It is among rapidly growing technologies today, with its applications in various aspects of business. Image Processing forms core research area within engineering and computer science disciplines too. Image processing basically includes the following three steps:

- Importing the image with optical scanner or by digital photography.
- Analysing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
- Output is the last stage in which result can be altered image or report that is based on image analysis.

2.2 PURPOSE OF IMAGE PROCESSING:

The purpose of image processing is divided into 5 groups. They are:

1. **Visualization** - Observe the objects that are not visible.

2. **Image sharpening and restoration** - To create a better image.

3. **Image retrieval** - Seek for the image of interest.

4. **Measurement of pattern** – Measures various objects in an image.

5. **Image recognition** – Distinguish the objects in an image

2.3 BASIC TERMS IN IMAGE PROCESSING:

2.3.1 Digital Image Processing:

Digital Image Processing deals with manipulation of digital images through a digital computer. Digital Image Processing focuses on developing a computer system which is able to perform processing on an image. The input of that system is a digital image and the system process that image using efficient algorithms, and gives an image as an output.

2.3.2 Processing Images:

Image processing has been developed in response to three major problems concerned with pictures:

- Picture digitization and coding to facilitate transmission, printing and storage of pictures.
- Picture enhancement and restoration in order to interpret easily.
- Picture segmentation and description as early-stage machine vision.
- The most requirements for image processing of images are that the images should be available in digitized form, i.e., arrays of finite length binary words. For digitization, the given image is sampled on a discrete grid and each sample or pixel is quantized using a finite number of bits and the digitized image is processed by a computer. To display a digital image, it is first converted into analog signal, which is scanned onto a display.

Pixel:

Pixel is the smallest element of an image. The value of a pixel at any point corresponds to the intensity of the light photons striking at that point. Each pixel stores a value proportional to the light intensity at that particular location.

Calculation of Total Number of Pixels:

We have defined an image as a two-dimensional signal or matrix. Then in that case, the number of pixels would be equal to the number of rows multiplied with number of columns. This can be mathematically represented as below (or) we can say that the number of (x,y) coordinate pairs is equal to the total number of pixels.

Total number of pixels = (number of rows) x (number of columns).

Resolution

The term resolution refers to the total number of count of pixels in a digital image. For example, if an image has M rows and N columns, then its resolution can be defined as M x N. If we define resolution as the total number of pixels, then pixel resolution can be defined with set of two numbers. The 1st number is the pixels across columns, and the 2nd number is the pixels across its rows. We can say that, the higher is the pixel resolution, the higher the quality of the image.

Size of an image = (pixel resolution) x (bits per pixel).

2.4 TYPES OF IMAGES:

An image may be defined as a two-dimensional function, f (x, y), where x and y are spatial (plane) coordinates, and the amplitude of 'f' at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. When x, y, and the amplitude values of 'f' are all finite and discrete quantities; we call the image a digital image. The field of digital image processing refers to processing digital images by means of a digital computer. Image digital processing encompasses processes whose inputs and outputs are images and, in addition, encompasses processes that extract attributes from images, up to and including the recognition of individual objects. As a simple illustration to clarify these concepts, consider the area of automated analysis of text.

The processes of acquiring an image of the area containing the text, pre-processing that image, extracting the individual characters, describing the characters in a form suitable for computer processing, and recognizing those individual characters are in the scope of what we call digital image processing.

1. Binary images

2. Gray scale images

2.4.1 Binary Image:

Binary image is stored as a logical array. Binary images are also called bi-level or two level (the name black and white, B&W used for this concept). Some input/output devices such as laser printers, fax machines and bi- level computer displays can only handle bi- level images. A binary image will be shown in Fig. 2.1. In a binary image, each pixel assumes one of only two discrete values: 1 or 0

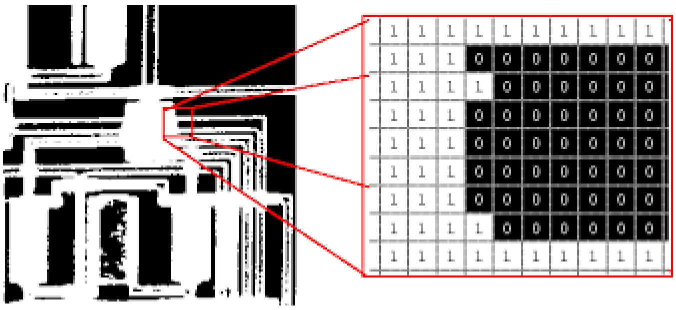


Fig. 2.1 Pixel values of a binary image

2.4.2 Gray Scale Images:

A gray scale or a gray level image in which the value of each pixel is a single sample, displayed images of this sort are typically composed of gray shades varying from black at the weakest intensity to the white at the strongest. Grayscale images are often the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum (e.g., infrared, visible light, ultraviolet, etc.).

Gray scale images are often the result of measuring the intensity of images at each pixel. Gray scale images that are intended for visual displays are typically stored with 8 bit per sample pixel, which allow 256 intensities i.e., shades of gray to be recorded. A gray scale image is shown in Fig. 2.2.

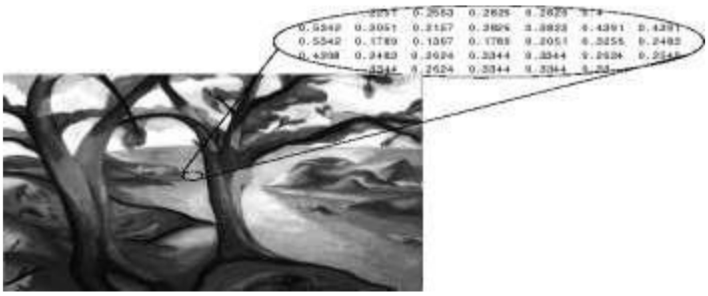


Fig. 2.2 Pixel values of a gray scale image with defined gray levels

2.5 TYPES OF IMAGE PROCESSING

The two types of image processing used are:

- Analog image processing
- Digital image processing

2.5.1 Analog Image Processing:

In electrical engineering and computer science, analog image processing is any image processing task conducted on two-dimensional analog signals by analog means (as opposed to digital image processing).

Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The image processing is not just confined to area that has to be studied but on knowledge of analyst. Association is another important tool in image processing through visual techniques. So, analysts apply a combination of personal knowledge and collateral data to image processing.

2.5.2 Digital Image Processing:

Digital Processing techniques help in manipulation of the digital images by using computers. Raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing.

The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement and display, information extraction. In this case, digital computers are used to process the image. The image will be converted into the digital form using a scanner-digitizer and then processed. It is defined as the subjecting numerical representation of objects to a series of operations in order to obtain the desired result. It starts with one image and produces a modified version of the image. It is therefore an image that takes one image into another. The term image processing generally refers to processing of a two-dimensional picture by a digital computer, in the broader context, it implies digital processing of a two-dimensional data.

2.6 IMAGE PROCESSING TECHNIQUES

Digital Image Processing deals with manipulation and analysis of images by using computer algorithm, so as to improve pictorial information for better understanding and clarity. This area is characterized by the need for extensive experimental work to establish the viability of proposed solutions to a given problem. Image processing involves the manipulation of images to extract information to emphasize or de-emphasize certain aspects of the information, contained in the image or perform image analysis to extract hidden information.

2.6.1 Image re-sizing:

Re-sizing of an image is performed by the process of the interpolation. It is a process which re-samples the image to determine values between defined pixels. Thus, resized image contains more or less pixels than that of original image. The intensity values of additional pixels are obtained through interpolation if the resolution of the image is increased.

fig 2.3 Image resizing

2.6.2 Image filtering:

Uncertainties are introduced into the image such as random image noise, partial volume effects and Intensity Non-Uniformity artifact (INU), due to the movement of the camera. This results in smooth and slowly varying change in image pixel values and lead to information loss, SNR gain and degradation of edge and finer details of image. Spatial filters are used for noise reduction. These filters may be linear or non-linear filters.

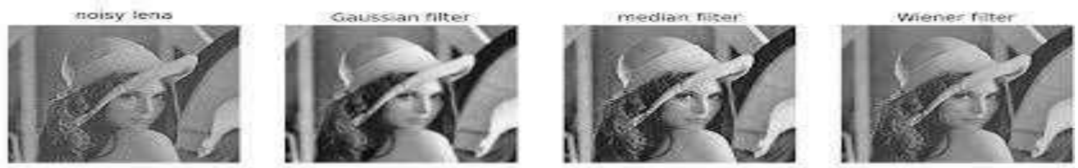


Fig 2.4 Image Filtering

2.6.3 Image segmentation:

Depending on type of input image samples, segmentation can be classified as Gray scale single image segmentation and Histogram based segmentation. Here the image is converted to digital form. Digitization includes sampling of image and quantization of sampled values. After converting the image into bit information, processing is performed. This processing technique may be, image enhancement, image restoration, image compression, and image segmentation.

As far as our project is concerned, we used the image segmentation techniques. Image segmentation is the process of dividing or partitioning an image into multiple parts.

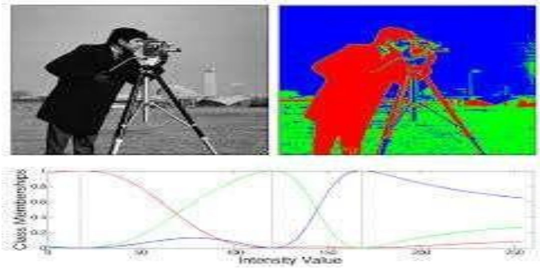


Fig 2.5 Image Segmentation

Gray Scale Single Image Segmentation:

In gray scale segmentation, a single image is used for feature extraction and segmentation. The gray scale single image segmentation methods can be subdivided as:

1. Edge based segmentation method: Edge detection schemes suffer from incorrect detection of edges due to noise, over and under segmentation and variability in threshold selection in the edge image.

Fig 2.6 Edge based segmentation methods

2. Region growing segmentation method: This segmentation requires an operator to select seeds and thresholds. Pixels around the seeds are examined and included in the region if they are within the thresholds. Results obtained with seed growing are generally dependent on the operator settings.

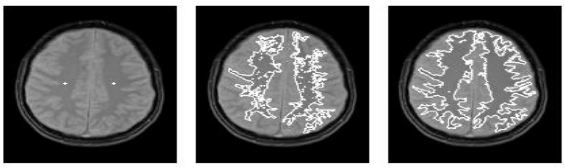


Fig 2.7 Region growing segmentation methods

3. Threshold based segmentation method: The most intuitive approach to segmentation is global threshold, which has been performed on various types of images. One common difficulty with this approach is to determine the value of the thresholds. Gray scale segmentation methods are generally limited to relatively simple structures.

Thresholding is probably the most frequently used technique to segment an image. Thresholding maps a gray valued image to a binary image. After the thresholding operation, the image has been segmented into two, identified by the pixel values 0 and 1 respectively.

If we have an image which contains bright objects on a dark background, thresholding can be used to segment the image. Since in many types of images the gray values of objects are very different from the back ground value, thresholding is often a well-suited method to segment an image into objects and background.

4. Clustering based segmentation method: In cluster-based segmentation, data is combined into groups such that the data with similar features will fall in one group whereas the data clusters are being different from each other. The k-means algorithm is commonly used for determining the organization of the data. This unsupervised clustering approach has a strong affinity to get trapped into local minima while generating an optimal solution and hence it makes clustering wholly dependent on the primary cluster centre's distribution. Hence, the proper choice of correct initial parameters is most challenging as well the clustering algorithms needs thorough study to identify correct input parameters for getting optimal or sub optimal clustering results.

Image Processing:

Character Recognition: Optical Character appreciation, usually abbreviated to OCR, is the mechanical or electronic alteration of scanned or photo images of typewritten or printed text into machine-encoded i.e., computer-readable text. It is generally used as an appearance of records access from a little kind of original data source, whether papers, invoice, bank statement, receipts, business cards, a number of printed records or mail.

It is an ordinary technique of digitizing printed manuscripts such that they can be by electronic means edited, searched, store more closely used in machine processes such as machine translation and displayed online, text-to-speech, key data extraction and text mining. OCR is a meadow of research in intelligence, pattern and computer vision. Early versions required to be automated with images of each character, and functioned on one font at a time. "Intelligent" structures with a great degree of gratitude accuracy for most fonts are now regular. Some marketable methods are skilled of duplicating formatted output that very much resembles the original scanned sheet including columns, images and other non-textual components.

Signature Verification: A digital signature is a mathematical scheme for representing the legitimacy of a digital communication. A legal digital signature affords a receiver reason to consider that the message was created by a recognized sender, such that the sender cannot reject having sent the message with non-repudiation and authentication and the message was not changed in transfer. Digital signatures are commonly used for software allocation, financial communication, and in further cases where it is vital to detect imitation or tampering.

Fig 2.8 Signature verification

Bio-metrics: Biometrics (or biometric verification) refers to the automatic identification of humans by their behaviours or characteristics. Biometrics is recycled in computer science as a type of identification and access control. It is also used to recognize individuals in groups that are under surveillance. Biometric identifiers are the exceptional, accessible characteristics used to label and describe individuals, examples include fingerprint, face recognition, Palm print, DNA, hand geometry, iris recognition, retina and odour/smell.

Behavorial characteristics are related to the pattern of performance of a person, including but not limited to typing rhythm, voice and gait. Some researchers have coined the term behaviour metrics to describe the latter class of biometrics.

Fig 2.9: Biometric Verification

Agriculture: Applications towards agriculture providing the earth observation data which supports increased area under agriculture, increased crop intensity and productivity, etc. RS data can provide the data related to groundwater helping in irrigation, flood management. Applications like environment assessment and monitoring, disaster monitoring and mitigation, weather climate, village resource centre, etc.

Fig 2.10: Applications of Image Processing in Agriculture

Automatic Target Recognition: Automatic Target Recognition (ATR) is the skill for an algorithm or device to distinguish objects or targets stand on data gained from sensors. The function of regular target recognition technology is a serious element of robotic warfare. ATR machines are used in unmanned aerial vehicles and cruise missiles. Electric affords an ATRU (Automatic Target Recognition Unit) to the Land Attack Missile of Standoff, which processes post-launch and pre-launch aiming data, allows high quickness in video comparison, and permits the SLAM-ER i.e., Standoff Land Attack Missile - Expanded Response, "Fire-and-forget" missile. The fundamental version of an ATR system is the IFF transponder. Other applications of ATR include a proposed security system that uses active UWB radar signals to recognize objects or humans that have dropped onto channel tracks of rail. It is also possible to detect the damaged infrastructures caused by the earthquakes using satellite.

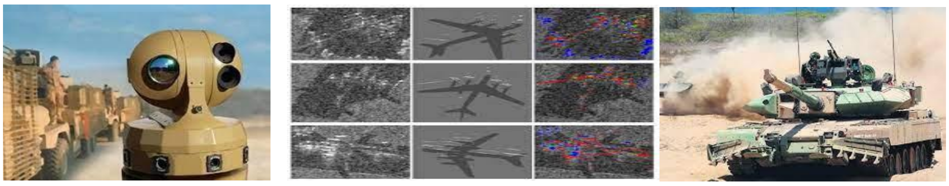


Fig 2.11: Automatic Target Recognition

Traffic Monitoring: The current disclosure relates to a number of inventions heading for, normally to the application of image processing techniques to traffic data acquisition using images/videos. The inventions exist in a system of traffic monitoring, the fundamental job of which is for acquisition of traffic data and detection of incident. Further distinctively, the application of image processing methods for the vehicle detection, from the series of video images, as well as the acquisition of traffic data and detection of traffic incident.

In an individual facet, the present development provides a technique of processing images recognized from a system of traffic monitoring which is video based. In one more feature, the current development is headed to a Region of Interest i.e., ROI for judgment of a vehicle which is moving and an added feature is directed to a technique of detecting day or night position in monitoring a traffic system.

It is the application of a variety of algorithms to a traffic monitoring system based on video is also measured imaginative. Other creative characteristic of the present monitoring of traffic system is sketched in the assert.

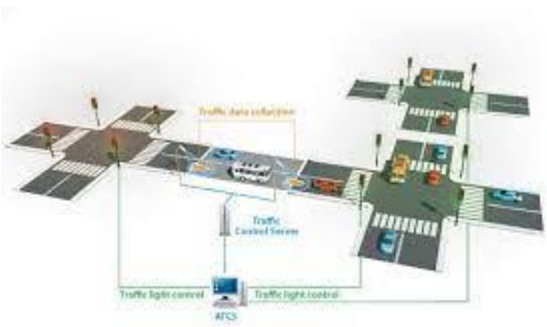


Fig 2.12: Traffic monitoring

Biomedical Application: Biomedical image processing is similar in concept to biomedical signal processing in multiple dimensions. It includes the analysis, enhancement and display of images captured via x-ray, ultrasound, MRI, nuclear medicine and optical imaging technologies. Image reconstruction and modelling techniques allow instant processing of 2D signals to create 3D images.

When the original CT scanner was invented in 1972, it literally took hours to acquire one slice of image data and more than 24 hours to reconstruct that data into a single image. Today, this acquisition and reconstruction occurs in less than a second. Rather than simply eyeball an x-ray on a light box, image processing software helps to automatically identify and analyse what might not be apparent to the human eye.

2.7 REFERENCES:

1. Selkar, R.G.; Thakare, M.

This paper describes Brain tumor detection, Segmentation by using thresholding algorithm and describes the comparative study about the tumor detection. Achieved results finding the boundry extraction of tumor by using canny edge detection operator.

2. Borole, V.Y.; Nimbhore, S.S.; Kawthekar, D.S.S.

In this study Digital Image Processing Techniques are important for brain tumor detection by MRI images. The pre-processing techniques include different methods like Filtering, Contrast enhancement, Edge detection is used for image smoothing. The pre-processed images are used for post processing operations like; threshold, histogram, segmentation and morphological, which is used to enhance the images.

3. Mustaqeem, A.; Javed, A.; Fatima, T.

This research was conducted to detect brain tumor using medical imaging techniques. The main technique used was segmentation, which is done using a method based on threshold segmentation, watershed segmentation and morphological operators.

The proposed segmentation method was experimented with MRI scanned images of human brains: thus, locating tumor in the images.

4. Kaur, H.; Mittal, M.

In this paper region-based segmentation technique has been presented. The result has been compared with watershed algorithm.

5. Patel, J.; Doshi, K.

In this paper various existing segmentation and clustering methods for brain MR image have been discussed like following segmentation techniques: Thresholding and region growing and Clustering techniques: K means and Fuzzy C means Algorithms.

6. Isselmou, A.; Zhang, S.; Xu, G.

In this paper, we presented a method for image acquisition, image pre-processing using median and high pass and label filtering, image enhancement using histogram equalization, segmentation using threshold and morphological operations therefore the detection of the tumor.

7. Dilpreet, K.; Kaur, Y.

In this review of image segmentation techniques, various image segmentation techniques are detailed described and compared. These all techniques are suitable for many medical image applications. These techniques can be used for object recognition and detection. In medical images these can be used to detect cancer. The various image segmentation techniques are:

1. Thresholding Method
2. Edge Based Method
3. Region Based Method
4. Clustering Method
5. Watershed Method
6. PDE Based Method
7. ANN Based Method

8. Wasule, V.; Sonar, P.

In this paper, a comprehensive survey on region growing, shallow machine learning, and deep learning-based brain tumor segmentation and classification methods are presented. These methods are structurally categorized and summarized to give an insight to the reader of the dataset used, pre-processing, feature extraction, segmentation, classification, post-processing, and the reported model performances in the literature. Furthermore, the pros and cons of the methods and the model evaluation metrics have been discussed.

CHAPTER-3

K-MEANS AND FUZZY C-MEANS CLUSTERING ALGORITHM

3. K-MEANS AND FUZZY C-MEANS ALGORITHM

3.1. K-MEANS CLUSTERING ALGORITHM

The K-means clustering algorithm is a very simple, unsupervised, learning algorithm. It provides a very easy way to classify a given data set into a certain number of clusters i.e., a set of data such as x1, x2, x3, ..., xn are grouped into K clusters. The major idea behind this algorithm is to define K centers, one for each cluster. The K cluster centers should be selected randomly. Distance measure plays a very important rule on the performance of this algorithm. Different distance measure techniques are available for this algorithm such as Euclidean distance, Manhattan distance and Chebyshev distance etc. But, choosing a proper technique for distance calculation is entirely dependent on the type of the data that we are going to cluster. However, we will use Euclidean distance as the distance metric because it is fast, robust and easier to understand. Step by step conventional K-means clustering algorithm is described as follows.

Algorithm 1 K-means clustering algorithm:

Assume that, $X = x_1, x_2, x_3, ..., x_n$ the set of data points and $V = v_1, v_2, v_3, ..., v_c$ be the set of centers.

1: Define number of clusters ‘K’.

2: Randomly, define cluster centers ‘ c’.

3: Calculate the distance between each data point and cluster centers.

4: Data point is assigned to the cluster center whose distance from the cluster center is minimum of all the cluster centers.

5: Then, new cluster center is recalculated as follows.

$$Vi = (1/Ci) \sum_{J=1}^{Ci} Xi \qquad \ldots(1)$$

where c_i is the number of data points in i-th cluster.

6: Re-calculate the distance between each data point and newly acquired cluster centers.

7: If no data point was reassigned then stop, otherwise repeat from step 3 to step 6.

The distance which is called Euclidean distance is calculated between each pixel to each cluster centers. All the pixels are compared individually to all cluster centers using the distance function. The pixel is lead to one of the clusters which is shorter in distance among all. Then, the center is re-calculated. Then, every pixel is compared to all centroids again. This process continues until the center converges and the convergence is evaluated through a maximum number of iterations. The quality of clustering of this algorithm is optimized through repetition of K-means several times with different initialization in order to identify best centroids.

It provides improved computational efficiency and supports multi-dimensional vectors. So, this algorithm intends to diminish an objective function which is known as squared error function given by:

$$\boldsymbol{Jv} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{C}} \sum_{\boldsymbol{j=1}}^{\boldsymbol{Cj}} (||\boldsymbol{Xi} - \boldsymbol{Vj}||)^{\boldsymbol{2}}$$

…(2)

where $\|x_i - v_j\|$ is the Euclidean distance between x_i and v_j , c_i is the number of data points in i-th cluster and c is the number of cluster center.

3.2. FUZZY C-MEANS CLUSTERING ALGORITHM

FCM clustering algorithm was introduced by Bezdek which is a technique of clustering that proceeds each pixel of data to belong to two or more clusters. The more the data is near to the cluster center, the more is its membership towards the particular cluster center. It depends on reducing an objective function regarding to fuzzy membership set U of cluster centroids V.

$$Jm(U,V) = \sum_{j=1}^{N} \sum_{i=1}^{C} (Uij)^m (||Xj - Vi||)^2; \quad 1 \le m \le \infty \qquad \text{…(3)}$$

where X = $x_1, x_2, ..., x_j , ..., x_n$ is a P × N data matrix in Equation (3) and m is any real number greater than 1. P, N and C denotes the dimension of each x_j 'feature' vectors, the number of feature vectors (pixel numbers in the image) and the number of clusters, respectively.

$U_{ij} \subseteq U(P \times N \times C)$ is called the membership function of vector xj to the i-th cluster, which satisfies U_{ij} ε [0 1] and $\sum u_{ij} = 1$, j = 1, 2, ..., N. The membership function can be expressed as follows:

$$Uij = \sum_{k=1}^{c} \left(\frac{(||Xj-Vi||)}{(||Xj-Vk||)}\right)^{\frac{-2}{m-1}}$$

…(4)

Where V = $v_1, v_2, v_3, ..., v_i , ..., v_c$ which is a P × C matrix.

Now we calculate the i-th cluster feature center as follows

$$Vi = \frac{\sum_{j=1}^{N} (Uij)^m \times J}{\sum_{j=1}^{N} (Uij)^m}$$

…(5)

Where m is any real number that is greater than 1, controls the degree of fuzziness

$d^2 (x_j , v_i)$. It is a measurement of similarity between x_j and v_i that is defined as follows

$$(Xj, Vi) = ||Xj - Vi||^2 \quad \text{…(6)}$$

Here, || . || can be denoted as either a straight forward Euclidean distance or its generalization like Mahalanobis distance. The feature vector X in MR image presents the pixel intensity

P = k. The FCM algorithm repetitively optimizes $J_m(U, V)$ with the continuous update of U and V, until $\|(U_{ij})^{(k)} - (U_{ij})^{(k+1)}\| \le \epsilon$, ϵ 0 to 1, where k is the number of iterations. The step-by-step conventional fuzzy C-means clustering algorithm is demonstrated as follows:

Algorithm 2 Fuzzy C-means clustering algorithm

Assume that, X = $x_1, x_2, x_3, ..., x_n$ be the set of data points and V = $v_1, v_2, v_3, ..., v_c$ be the set of centers.

1: Fix the number of clusters c, $2 \leq c \leq n$. where n = number of data items. Fix, m where

$1 < m < \infty$. Choose any inner product induced norm metric ||.||.

2: Initialize the fuzzy c partition $U^{(0)}$.

3: At step b, b = 0, 1, 2, ...,

4: Calculate the fuzzy membership function Uij using Equation (4).

5: Then, Compute the fuzzy centers 'V_i' using Equation (5).

6: Repeat step 2 and 3 until the minimum 'J' value is achieved or

$\|U_{ij}^{(k+1)} - U_{ij}^{(k)}\| < \varepsilon$

CHAPTER-4

PROPOSED TKFCM ALGORITHM

4. PROPOSED TKFCM ALGORITHM

The proposed TKFCM algorithm is an accumulation of K-means and fuzzy C-means with some modification. On the basis of temper or gray level intensity in the brain image, the template is selected along with the conventional K-means. On the other hand, in FCM, the Euclidian distance and the membership function is modified by the image features. The equation of template-based K-means and improved fuzzy C-means clustering algorithm for segmentation can be expressed as follow:

$$J = \sum_{i=i+1}^{M}\sum_{j=j+1}^{N} B(Xi, Yj) \times \sum_{i=1}^{K}\sum_{j=i}^{C} Pij||Xi - Cj||^2 \times \sum_{j=1}^{R}\sum_{i=1}^{C} (Uij)^m d^2\,(Xj, Vi)$$

…(7)

Where P_{ij} a binary image matrix and M and N are the row and column of P_{ij} and also R, K and C are described as the centroid of the cluster, number of data points in clusters and number of clusters respectively. The last part of Equation (7) is described as improved fuzzy C-means where Euclidian distance relies on the image features. The middle portion is employed as the conventional K-means algorithm, which is expressed as the distance from each point to cluster center. Here, $B(x_i, y_j)$ is the coarse image and Equation (8) describes the desired template.

$$B(Xi, Yj) = \sum_{i=i+1}^{M}\sum_{j=j+1}^{N} P(Xk, Yl) \times Tmn \qquad \ldots(8)$$

The template-based window is selected by T_{mn} which is expressed as:

$$Tmn = \sum_{i=1}^{M}\sum_{j=1}^{N} P(Xi, Yj) * \sum_{k=1}^{G}\sum_{l=1}^{S} P(Xk, Yl); \qquad k \in M, l \in N$$

…(9)

In Equation (9), the temper-based image matrix T_{mn} with number of gray level intensity, G and number of bins, S is employed to find out the temper of the image $P(x_i , y_j)$.

Herein, the image and convolution of temper-based image matrix T_{mn} aims at attaining the template for the K -means clustering algorithm. In FCM algorithm

the membership function U_{ij} whose value is updated with Euclidian distance d(x, v) that depends on the image features such as entropy, contrast, energy etc., degree of fuzziness m and feature center V = v_1, v_2, ..., v_i, ...v_c is described as below:

$$Uij = [\sum_{k=1}^{C}((\frac{||Xj-Vi||}{||Xj-Vk||})^{\frac{-2}{m-1}})]^{-1} \quad . \qquad .$$

...(10)

Euclidian distance was employed on the basis of only one features for example similarity in the preceding research work, but in our proposed TKFCM method this depends on some features like entropy, dissimilarity, contrast, homogeneity, entropy, correlation etc. Clusters center from where the clusters position and tumor are identified may be outlined as:

$$Vj = \frac{\sum_{j=1}^{N}(Uij)^m \times J}{\sum_{j=1}^{N}(Uij)^m} \qquad ...(11)$$

where i = (1, 2, 3, ..., C).

We have extracted six features for the classifiers. These six features are texture-based features. Texture feature is an important low-level feature in the image; it can be used to describe the contents of an image or a region. A texture can be defined as a set of texture elements or texels occurring in some regular or repeated pattern. Texture provides one of the most significant characteristic that is used to classify and identify objects. Moreover, it is used to find out the similarities between images in multimedia databases.

It Characterizes texture using statistical measures computed from gray scale intensities (or colors) alone. It Can be used for both classification of a given input texture and segmentation of an image into different textured regions. Extracted six features for the classifier are described as follows:

Energy: It is defined as the measurement of finite amount of iterative pixel pairs. It provides the volume of affinity in an image and it is given as follows:

$$ENG = \sum_{i=1}^{G} \sum_{j=1}^{G} |P(Xi, Yj)|^2$$

…(12)

where G is the gray level co-occurrence matrix and $P(x_i, y_j)$ is the image matrix.

Contrast: Contrast is defined as the measurement of pixel intensities and its adjacent neighbour above the image and it is given as follows:

$$CON = \sum_{n=1}^{G} n^2 \sum_{i=1}^{G} \sum_{j=1}^{G} |P(Xi, Yj)| \quad \text{and} \quad |i-j|=n$$

…(13)

Homogeneity: Homogeneity (HOM) is defined as the measurement of similarity in an image. Moreover, it is called as inverse difference moment (IDM) and it is defined as follows:

$$HOM = \frac{\sum_{i=1}^{G} \sum_{j=1}^{G} |P(Xi, Yj)|}{1+|i+j|}$$

… (14)

Entropy: Entropy is the measurement of randomness of textural image which is defined as follows:

$$ENT = \sum_{i=1}^{G} \sum_{j=1}^{G} |P(Xi, Yj)| \frac{1}{log\,|P(Xi, Yj)|}$$

…(15)

Dissimilarity: Dissimilarity is the textural property of the image which is calculated by considering the alignment of the image as a measure in terms of the angle which is defined as

$$DSM = \sum_{i=1}^{G} \sum_{j=1}^{G} |P(Xi, Yj)| \quad |i-j|$$

…(16)

Correlation: Correlation is the feature which describes the spatial dependencies between the pixels and it is defined as follows:

$$COR = \frac{\sum_{i=1}^{G} \sum_{j=1}^{G} (Xi, Yj) P(Xi, Yj) - MxMy}{\sigma x\ \sigma y}$$

…(17)

where M_x and σ_x are the mean and standard deviation in the horizontal spatial domain and M_y and σ_y are the mean and standard deviation in the vertical spatial domain, respectively. The entire methodology which has been introduced for the detection of tumor in human brain MR image utilizing temper-based K-means and improved fuzzy C-means clustering algorithm is represented by the subsequent flowchart shown in Figure 1. At first, the acquisition of the human brain MR image is done and the input image is pre-processed and enhancement of the MR image is also carried out. Furthermore, the template base window is selected and the output of the window has been segmented with the temper-based K-means clustering segmentation. After that, required features are extracted. Finally, tumor is acquired by detecting with red line marked by the improved fuzzy C-means algorithm with the updated membership.

Algorithm 3: TKFCM algorithm for tumor detection in Brain MR image

1: Initialize: Define number of gray level and determine square matrix, $A = \sum \sum P(x_k , y_l)$ and image matrix, $P = \sum \sum P(x_i, y_j)$.

2: Then, define Template $T_{mn} = P \oplus A$

3: Determine coarse image, $B (x_i , y_j)$ from template, T_{mn}

4: Reshape template-based k means segmented image

$$P_1 = \sum_{i=1}^{K} \sum_{j=1}^{C} P||Xi - Cj||^2 \times \sum_{i=i+1}^{M} \sum_{j=j+1}^{N} B(Xi, Yj)$$

5: Repeat step 2 to 4 until, $T_{mn} \leq \sum_{k=1}^{G} \sum_{l=1}^{S} [Tmn(k) - Tmn(l)]$

6: Post process the P_1

7: Determine cluster centroid, C and degree of fuzziness,

8: Initialize membership function $U_{ij}^{(0)}$ of FCM

9: Calculate cluster center, $V_i^{(l)} \Longleftrightarrow U_{ij}^{(l)}$, (i = 1, 2, 3, ..., C) and (l = 1, 2, 3, ...)

10: Determine image features, $F(x_j , v_i^{(l)}) \longleftrightarrow v_i^{(l)}$

11: Update U_{ij} With $d(x_j, v_i^{(l)})$ until $||U_{ij}^{(l)} - U_{ij}^{(l+1)}|| \leq \varepsilon$, ε = 0 to 1

CHAPTER-5

SIMULATION RESULTS

SIMULATION RESULTS

Input Image:

An image is acquired from the database of brain tumor images. We collected these images and pre-processed for the betterment of application in our algorithmic program. Then, we have processed these images by MATLAB 2016(a) and made the database for final use shown in Figure 4.1(a). The tumors in these images are so critical that it is too hard for the common people to detect it so easily.

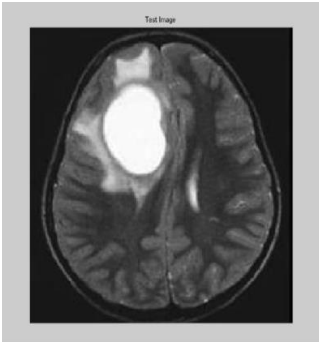


Fig 5.1(a): Input image1

Gray Image:

MR image pre-processing is very significant to ameliorate the visual effect of the image for further processing. Usually, the collected images in the dataset are so poor in quality which requires filtering noise and sharpening the image. In pre-processing step, the acquired image in the dataset is converted into a two-dimensional matrix and the image is converted into RGB image to gray scale image.

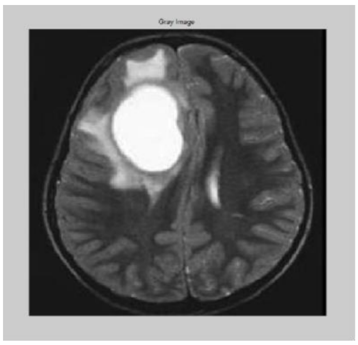


Fig 5.1(b): Gray Image

Filtered Image:

To eliminate the noise in the image, a median filter is used.

Median Filter: The median filter is a non-linear digital filtering technique, often used to remove noise from an image or signal.

Such noise reduction is a typical pre-processing step to improve the results of later processing. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighbouring entries. The pattern of neighbours is called the "window", which slides, entry by entry, over the entire signal.

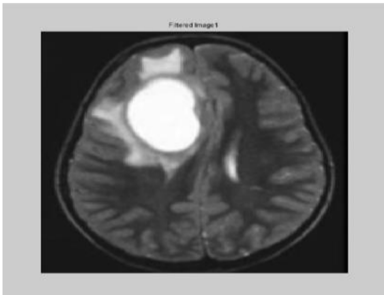


Fig 5.2: Filtered Image1

Sharpened and Enhanced Images:

Then, the enhancement of the image is done by performing adjusted operation, histogram-based operation and adaptive histogram-based operation. Generally, enhancement of an image means improving the contrast of the image. After that, the different features are initially extracted implicitly.

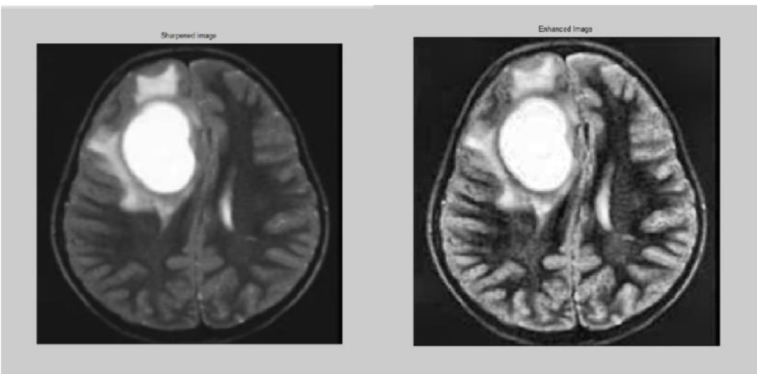


Fig 5.3: (a)Sharpened Image (b) Enhanced Image

Template based reduced gray level Image:

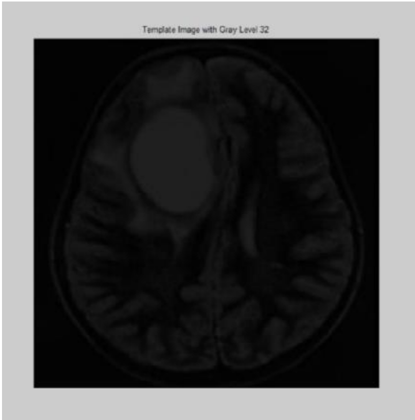


Fig 5.4: Template based reduced gray level Image

Coarse Image:

A coarse image is formed by performing "bitxor" operation between Enhanced image and Template created.

Fig 5.5: Coarse Image

Segmented Image using TK means:

Then, in Figure 4.6, there is initial segmentation of the image using template-based K-means (TK) which is segmented on the basis of their gray level intensity and temper of color. The number of clusters to be formed is given manually.

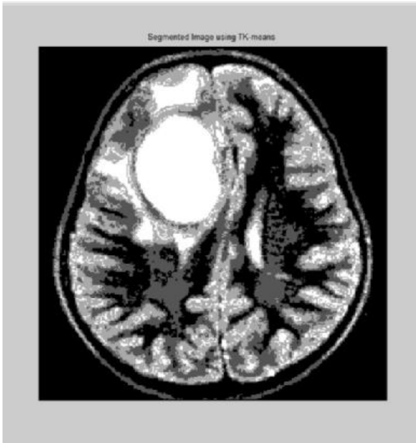


Fig 5.6: Segmented Image using TK means

Filtered Image:

After that the tumor is filtered by wiener filter.

Weiner Filter: The Wiener filter is a filter used to produce an estimate of a desired or target random process by linear time-invariant (LTI) filtering of an observed noisy process, assuming known stationary signal and noise spectra, and additive noise. The Wiener filter minimizes the mean square error between the estimated random process and the desired process.

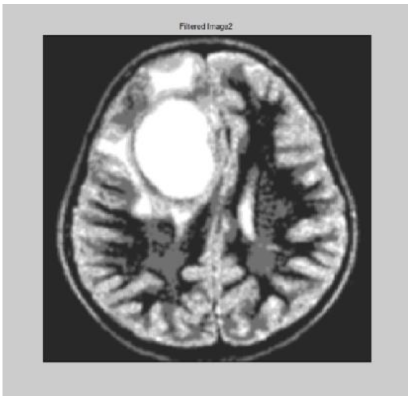


Fig 5.7: Filtered Image2

Clustered Images for the Input Image:

Depending on the grey level intensity the improved FCM is performed for the specified number of clusters. Clustered image is defined as the image with its smallest gray level and separated from each other with their successive color intensity. Here, the tumor portion with different portion of the image is shown in individualize image and from this, depending on features the tumor is chosen.

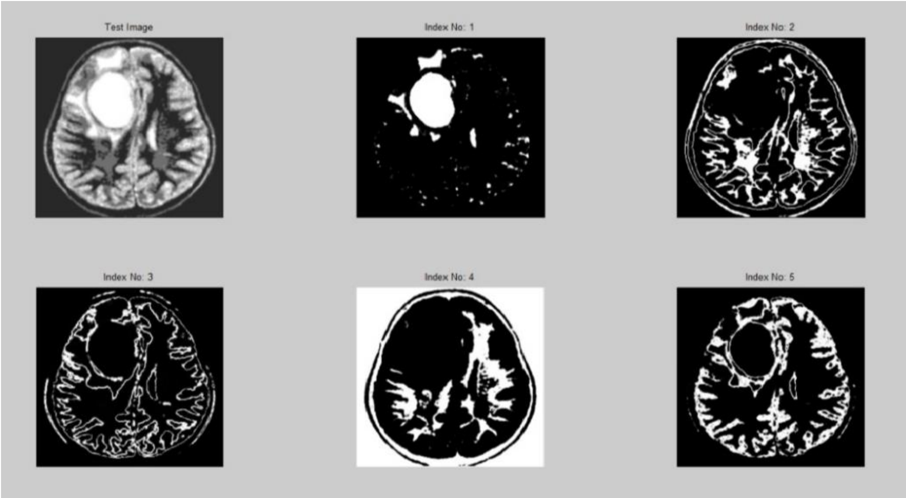


Fig 5.8: Several clustered images for input image

Segmented Image using Modified Fuzzy C means:

From the clustered images we need to enter the image which clearly differentiates the tumor position and remaining part of the image. The actual segmented image is obtained using modified fuzzy c means.

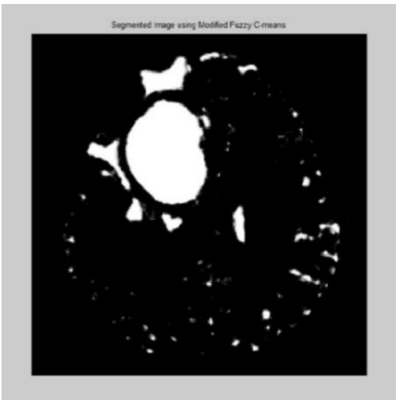


Fig 5.9: Segmented Image using Modified Fuzzy C means

Filtered Segmented Image:

The segmented image is filtered by selecting only the largest required number of main tumor blobs and measurements.

Fig 5.10: Filtered Segmented Image

Final Segmented Image using TKFCM:

Then, the tumor is detected and marked it as red line using improved FCM algorithm based on the Euclidean distance from cluster centre to each data point which primarily depends on the different features. This could be important to grasp the importance of this changed and incorporated technique.

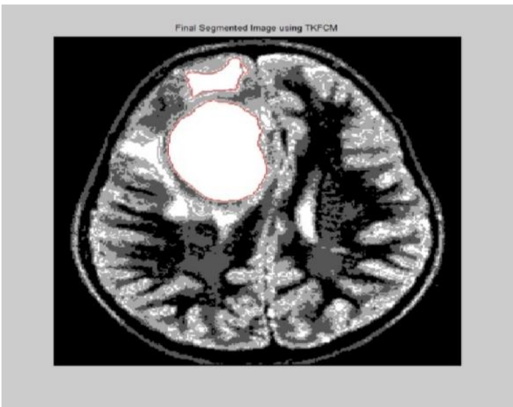


Fig 5.11: Final Segmented Image using TKFCM

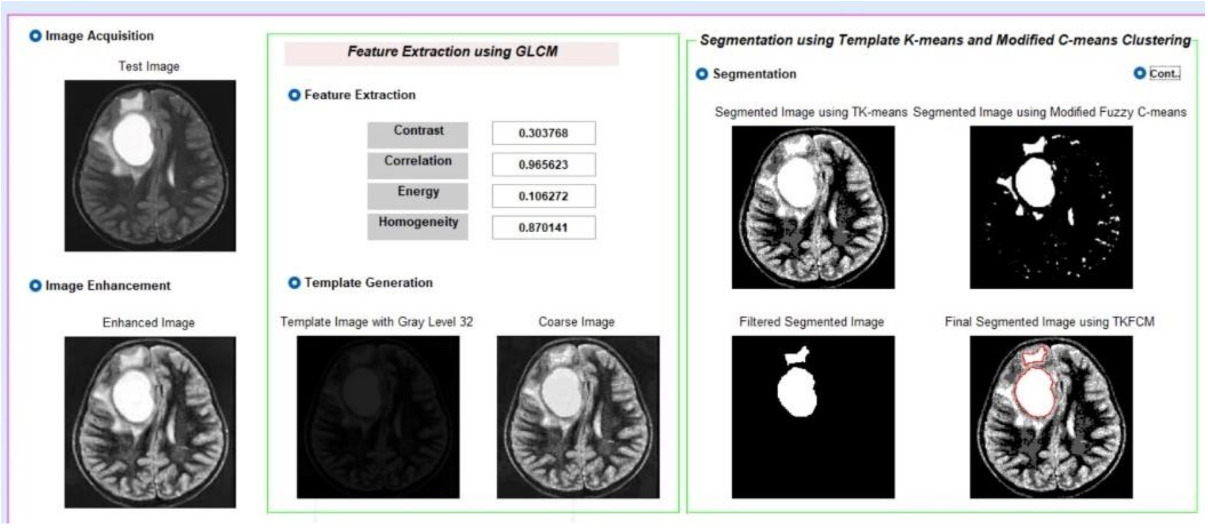


Fig 5.12: Images with parameters

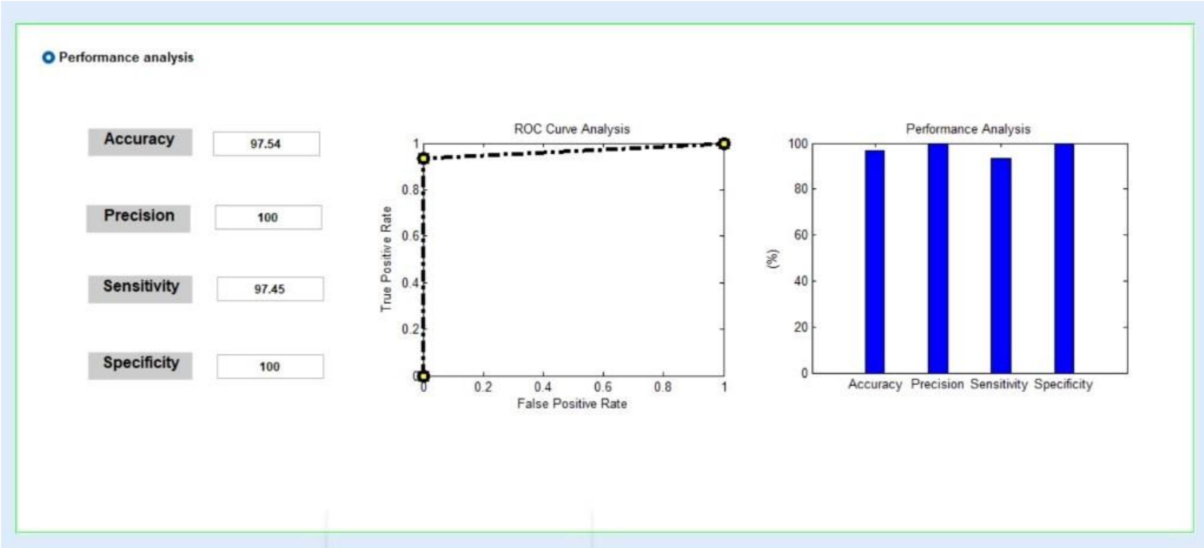


Fig 5.13: Parameter analysis

CONCLUSION

In this paper, we have proposed a new approach namely Template based K-means and modified fuzzy C-means clustering algorithm. It is used to remove the limitation of conventional K-means and conventional FCM algorithm for brain tumor MRI image. The template is selected based on convolution between gray level intensity in small portion of brain image and brain tumor image. K-means algorithm is to emphasized initial segmentation through the proper selection of template. Updated membership is obtained from the distance measurement from centroid to clusters, until it reaches to its best. On the basis of updated membership and automatic selected cluster, a sharp segmented image is obtained with tumor from modified FCM technique. The segmented tumor is shown as red marked with their proper detected position. The performance is analysed through neural network, which shows better accuracy and least error. The accuracy, sensitivity, and specificity show that it is better than other previous conventional methods. Though it is less noise sensitive, but for some images where the gray level intensity difference is very small causes trouble to select perfect template.

For future work, we will analyse features to include more features which can be used for detection and accuracy increment, but the required computational time will be high. Moreover, we will analyse for reducing the required computational time and modify the complexity of the proposed TKFCM algorithm compared to the conventional algorithms. However, more specification and standardization of TKFCM can be used for CT, PET, SPECT and neuro imaging.

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