

# Region Separation Techniques for Medical Images

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**ABSTRACT:** Image segmentation is often described as partitioning an image into a finite number of semantically non-overlapping regions. In medical applications, it is a fundamental process in most systems that support medical diagnosis, surgical planning and treatments. Generally, this process is done manually by clinicians, which may be time-consuming and tedious. To alleviate the problem, a number of segmentation methods have been proposed in the literature. In this paper, we present an overview on segmentation techniques for medical images. This review provides details of automated segmentation methods, specifically the edge detection technique for segmentation discussed in the context of CT images.

**KEYWORDS:** edge detection, computed tomography, image segmentation, magnetic resonance imaging, medical image artifacts.

## I. INTRODUCTION

Image segmentation is an indispensable step in image analysis. Segmentation separates an image into its component parts or objects. The degree to which the separation is taken depends on the problem being resolved. When the objects of interest in an application have been inaccessible the segmentation must stop. Segmentation algorithms for images generally based on the discontinuity and similarity of image intensity values. Discontinuity approach is to partition an image based on abrupt changes in intensity and similarity is based on partitioning an image into regions that are similar according to a set of predefined criteria. Hence the selection of image segmentation technique depends on the problem being considered. Edge detection is a part of image segmentation. The strength of many image processing also computer vision tasks depend on the perfection of detecting meaningful edges. It is one of the techniques for detecting intensity discontinuities in a digital image [3].

The process of classifying and placing sharp discontinuities in an image is called the edge detection. The discontinuities are immediate changes in pixel concentration which distinguish the boundaries of objects in a scene. Classical methods of edge detection engage convolving the image through an operator, which is constructed to be perceptive to large gradients in the image although returning values of zero in uniform regions. There is a very large amount of edge detection techniques available, each technique designed to be perceptive to certain types of edges. Variables concerned at the selection of an edge detection operator consist of Edge orientation, Edge structure and Noise environment. The geometry of the operator establishes a characteristic direction in which it is most perceptive to edges. Operators can be optimized to look for vertical, horizontal, or diagonal edges. Edge detection is a difficult task in noisy images, since both the edges and noise hold high- frequency content. Efforts to reduce the noise result in unclear and distorted edges. Techniques used on noisy images are typically larger in scope; therefore they can commonly enough data to discount localized noisy pixels. These effects in less perfect localization of the detected edges. Not all edges involve a step change in intensity. Matters such as refraction or reduced focus can result in objects through boundaries defined by a regular change in intensity. The method wants to be chosen to be receptive to such a regular change in those cases. So, there are some problems of fake edge detection, edge localization, missing true edges, problems due to

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noise and high computational time, etc. Hence, the objective is to do the comparison of a variety of edge detections and analyze the performance of the different techniques in various conditions [3].

Due to the restrictions imposed by image acquisition, pathology, and biological variation, the medical images captured by various imaging modalities such as X-ray computed tomography (CT) and magnetic resonance imaging (MRI) are generally of high complexity and ambiguity. Image segmentation is typically used to locate objects of interest and their boundaries to make the representation of a volumetric image stack more meaningful and easier for analysis. Traditionally, this process is manually done, slice by slice, which requires expert knowledge to obtain accurate boundary information for the regions of interest. This editing process may take a lot of time as well. A number of computer-aided segmentation techniques have been developed for medical images, which can usually be distinguished as automatic (unsupervised), interactive (semi-supervised), and supervised methods [6].

Supervised segmentation methods [17-20] require manually labelled training data for detecting specific objects in images, which may limit the scope of these methods. Unsupervised (automatic) methods (e.g., thresholding [21], watershed [22], edge detection [23], morphological operation [24], neural network [25], region growing [26], and shape analysis [27]) provide segmentation results without prior-knowledge about the images and do not require user interaction. These methods are usually applicable for the segmentation of well-circumscribed objects. When applied to a stack of medical images, they are able to generate rough segmentation results. These results can be further refined by the intervention of human experts. In computer-aided diagnosis, therapy planning and treatment, interactive segmentation [28-30] have become more and more popular in recent years, as the combination of human experts and machine intelligence can provide improved segmentation accuracy and efficiency with minimal user intervention [31]. The improved segmentation results can be used to reconstruct the 3D structures of tissues and enhance the real-time visualization on the screen for clinicians to navigate through the data. This can provide great benefits to many applications including locating tumors, measuring tissue volumes, surgery, and diagnosing diseases.

## II. RELATED WORK (REVIEW)

There are different type of method available for medical image segmentation; Here we provide the brief review of the work which already done in the field of medical image segmentation. A challenging problem in medical image segmentation is to segment regions with boundary insufficiencies, i.e., missing edges and/or lack of texture contrast between regions of interest (ROIs) and background. To address this problem, several segmentation approaches have been proposed in the literature, with many of them providing rather promising results. Neeraj Sharma [1] proposes comparison among various automatic segmentation algorithms; and also describes the various imaging modalities. M S sonawane [55] gives a survey of various image segmentation techniques. This paper gives a summary of work with their benefits and limitation. S Patel [4] proposes clustering algorithm for medical image segmentation using IQI. This paper discuss C-mean clustering algorithm and found RFCM was better than other classical segmentation method. Wen-Fen g Kuo [2] proposes a hybrid segmentation method that uses combination of watershed and Fuzzy C mean clustering algorithm for minimization of undesirable over-segmentation due to noise or local irregularities in the gradient image. Muthukrishnan R [3] proposes edge detection techniques for image segmentation. This paper do test for building images but can also be used for medical image segmentation. Anamika [5] provide the study of medical image segmentation techniques and statistical test for region classification. Feng-Zhao [6] provide an overview of interactive medical image segmentation techniques. Gradient Vector Flow Snake (GVF Snake) is the newest interactive medical image segmentation techniques, which can detect the tumor region effectively in brain CT image. Tenn Francis Chen [11] proposes level set method for medical image segmentation. Sanjivani Shantaiya [8] provides a survey on approaches of object detection. This research paper presents the extensive survey of the state-of-the-art detection of object from video and also classifies the detection approaches into different categories. Detection is generally performed in the context of higher-level applications that require the location and/or shape of the object in every frame. Waseem Khan [10] provides a survey on image segmentation techniques. Fari Muhammad abubakar [7] provides study of image segmentation by using edge detection techniques. This is all about segmentation technique which was used by various researchers. In field of medical image, we cannot say that this particular technique can give good result for all type of medical images.

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## III. MEDICAL IMAGE MODALITIES

Medical imaging is performed in various modalities, such as MRI, CT, ultrasound, positron emission tomography (PET), etc [1]. In the present review, we are focusing primarily on the segmentation of MR and CT images only.

### A. Magnetics Resonance Imaging

MR imaging is the most widely used technique in the field of radio imaging [32, 33]. MR is a dynamic and flexible technology that allows achieving variable image contrast by using different pulse sequences and by changing the imaging parameters corresponding to longitudinal relaxation time (T1), and transverse relaxation time (T2), and signal intensities on T1 and T2 weighted images relate to specific tissue characteristics. The contrast in MR image is a factor dependent on pulse sequence parameters. The most common pulse sequences are T1weighted and T2weighted spin echo sequences. MR imaging of the body is performed to get the structural details of brain, liver, chest, abdomen and pelvis which helps in diagnosis or monitoring the treatment [1].

**Brain MR Imaging:** MR is generally more sensitive in detecting brain abnormalities during the early stages of disease, and is excellent in early detection of cases of cerebral infarction, brain tumors, or infections. MR is particularly useful in detecting white matter disease, such as multiple sclerosis, progressive Multifocal leukoencephalopathy, Leukodystrophy, and post-infectious encephalitis.

Table I. Type of Pathology and its Contrast in T1 and T2 Weighted Image[1]

Pathology	Contrast in T2 Weighted image	Contrast in T1 Weighted image
Solid Mass	Bright	Dark
Fat	Dark	Bright
Cyst	Bright	Dark
Acute and Chronic blood	Dark	Gray
Sub Acute Blood	Bright	Bright

In contrast, CT scan fails to detect white matter abnormalities. In case of MR images of the brain, the primary determinants of signal intensity and contrast are the T1 and T2 relaxation times. The contrast is distinctly different on T1 and T2 weighted images. Also, brain pathologies have some common signal characteristics[1]. Pathologic lesions can be separated into five major groups by their specific signal characteristics on the two basic images: T2weighted, and T1weighted [Table 1].

**MR Liver imaging:** MR provides outstanding intrinsic soft contrast that can enhance subtle differences between normal and pathologic tissues and tissues of different histologic subtypes. Nonionizing radiation is used and MRI contrast agents are not nephrotoxic. MRI images may be acquired with multiplanar capabilities which are especially useful in depicting various anatomic relationships. MRI system is specifically used in characterization of metastases and primary liver tumors, e.g., benign lesions such as focal nodular hyperplasia (FNH), adenoma, hemangioma and malignant lesions (cancer) such as hepatocellular carcinomas (HCC) [1].

**Chest MRI** is used to detect following disorders: thymus tumor, lung masses, esophageal mass, other masses (aggregations of cells) or tumors of the chest, abnormal lymph nodes, swollen glands and enlarged lymph nodes in any location of the chest, staging of tumors including invasion of blood vessels, alveolar bullae (COPD), bronchial abnormalities, bronchiectasis, cystic lung lesions, pleural abnormalities, including thickening or pleural effusion, abnormal pulmonary vessels, aortic stenosis, etc[1].

**Abdominal MRI** may reveal many medical conditions, including: abscess, acute tubular necrosis, adrenal masses, cancer, enlarged spleen or liver, gallbladder or bile duct problems, gallstones, bile duct stones, hemangiomas, kidney infection, kidney damage, lymphadenopathy, obstructed venacava, pancreatic cancer, tumor of the gallbladder, abdominal aortic aneurysm, ovarian cancer, etc.

MR Angiography is used to detect blockages or enlargements of blood vessels, including the aorta, renal arteries, and arteries in the legs, renal artery obstruction, renal vein thrombosis, etc.

The following artifacts are present in MR imaging: (i) Partial Volume, (ii) RF Noise, (iii) Intensity inhomogeneity, (iv) Gradient, (v) Motion, (vi) Wrap Around, (vii) Gibbs Ringing and (viii) susceptibility. These artifacts are shown in Fig.1.

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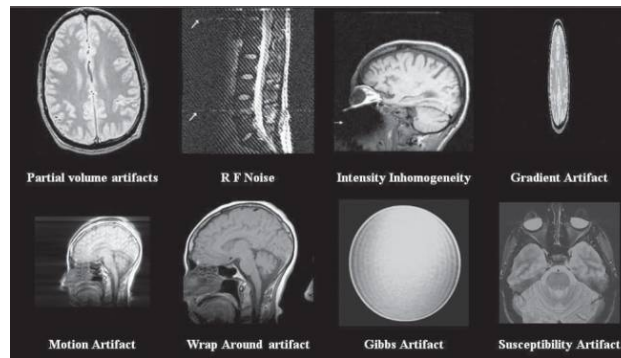


Fig. 1. Artifacts in MR imaging[1]

**Advantages of MR imaging:** (i) It has an excellent capability for soft tissue imaging, (ii) It has very high resolution of the order of 1mm cubic voxels, (iii) It has a high signal to noise ratio, (iv) Multi channel images with variable contrast can be achieved by using different pulse sequences; this can be further utilized for segmenting and classifying different structures.

**Disadvantages of MR imaging:** (i) MR acquisition takes a considerably longer time as compared to CT and (ii) In case of MR it is more difficult to obtain uniform image quality.

## B. Computed Tomography Imaging

The word tomography is derived from two Greek words; Tomos, which means slice or section, and graphia, which means description. CT scan is an imaging mode which uses x-rays to obtain structural and functional information about the human body [1]. The CT image is the reconstructed image and is reconstructed on the basis of an x-ray absorption profile. X rays are electromagnetic waves and used in diagnosis based on its property that all matters and tissues differ in their ability to absorb X-rays [32]. Dense tissues such as the bones appear white on a CT film while soft tissues such as the brain or liver appear gray. The cavities filled with air such as lungs appear black. CT performs better in cases of trauma and emergent situations. It provides better bone detail and delivers high sensitivity for acute bleeding. CT has become an important instrument in medical imaging to supplement X rays, medical ultrasound (USG) and MR imaging. Although it is still rather expensive, it is the gold standard in the diagnosis of a large bit of different disease entities. It is, more recently, been used in the early screening of diseases, for example CT colonography for patients with a high danger of colon cancer. CT scans are especially employed in imaging and the diagnosis of follow body parts: brain, liver, breast, abdomen and pelvic girdle, spine and also for CT based angiography.

**Brain CT imaging:** In case of brain imaging, CT scans are typically applied to detect: bleeding, brain damage and skull fracture in patients with head injuries; bleeding caused by a ruptured or leaking aneurysm in a patient with a sudden severe headache, blood clot or bleeding inside the brain shortly after a patient displays symptoms of a stroke, brain tumors, cyst, diseases related to malformations of the skull, enlarged brain cavities (ventricles). CT scanning is fast and simple, provides more detailed information on head injuries, and stroke; can reveal internal injuries and bleeding fast enough to help save lives in emergency events.

**Liver CT imaging:** In case of liver imaging, CT is the most commonly used imaging technique for evaluation of hepatic lesions. Large hepatocellular carcinomas tend to be heterogeneous, and may present a typical mosaic appearance on CT. There are relative advantages and disadvantages of both hepatic MR and CT. In general, CT is less costly than MR, more promptly available, and most radiologists and many referring physicians receive a comparatively high degree of confidence in looking at CT images. Some works, however, have found that CT is less sensitive and specific than MR for detection and characterization of focal hepatic disease.

**Chest Imaging:** Chest CT is used to detect: tumors in lungs, pneumonia, tuberculosis, emphysema, diffuse interstitial lung diseases, firing or other diseases of the pleura, the tissue layer covering the lungs.

**Abdomen and Pelvis CT Imaging:** It is used to detect: abscesses in abdomen, inflamed colon, cancers of (i) colon, (ii) liver and (iii) pancreas, pancreatitis, lymphoma, diverticulitis, appendicitis.

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**Spine CT Imaging:** It is used to detect various types of tumors in the vertebral column, herniated inter-vertebral disk, fractures and other injuries and measure bone density and level of osteoporosis.

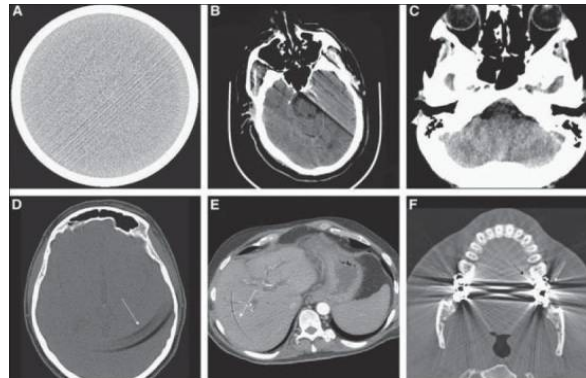


Fig. 2. Artifacts in CT imaging (A) Streak, (B) Motion, (C) Beam-Hardening, (D-E) Ring, (F) Bloom [1].

CT based angiography is used to identify a small aneurysm or arteriovenous malformation inside the brain, detect thrombosis in the veins, atherosclerotic disease in the carotid artery and indicate disease in the renal artery.

The artifacts present in CT imaging are [34]: (i) partial volume effect, (ii) streak artifacts, (iii) motion artifacts, (iv) beam hardening artifacts, (v) ring artifacts, and (vi) bloom artifacts. These artifacts are shown in Fig. 2.

**Advantages of CT imaging:** (i) Less expense and wide availability, (ii) High spatial resolution with modern multi slice scanners, (iii) Short scan time, (iv) Higher sensitivity than MR for subarachnoid hemorrhage, (v) Higher sensitivity in detecting intracranial calcifications.

**Disadvantages of CT imaging:** (i) Inferior soft tissue contrast compared to MRI as it is Xray based, (ii) Radiation exposure. Despite the disadvantages, CT scans are extensively used in the radiographic study of brain, liver and thorax.

## C. Representation of Medical Images

Images are presented in 2D as well as in 3D domain. In the 2D domain each element is called pixel, while in 3D domain it is called voxel. In some cases we represent 3D images as a sequential series of 2D slices [1]. The advantages associated with this type of representation include requirement of lower computational complexity and lesser memory [35, 36].

## IV. SEGMENTATION

Segmentation is the process dividing an image into regions with similar properties such as gray level, color, texture, brightness, and contrast [14-16]. The role of segmentation is to subdivide the objects in an image; in case of medical image segmentation the aim is to: (i) Study anatomical structure, (ii) Identify Region of Interest i.e. locate tumor, lesion and other abnormalities, (iii) Measure tissue volume to measure growth of tumor (also decrease in size of tumor with treatment), (iv) Help in treatment planning prior to radiation therapy; in radiation dose calculation.

Automatic segmentation of medical images is a difficult task as medical images are complex in nature and rarely have any simple linear feature. Further, the output of segmentation algorithm is affected due to: (i) partial volume effect, (ii) intensity inhomogeneity, (iii) presence of artifacts, (iv) closeness in gray level of different soft tissue [1].

Artifacts present in MR and CT images can be divided into three categories on the basis of image processing technique needed to rectify them: (i) artifacts needing appropriate filtering technique. For example, noise artifact, susceptibility artifact and presence of non sharp edges in the image (ii) artifact needing appropriate image restoration techniques for example motion artifacts and (iii) artifact needing specific algorithm are; partial volume, intensity inhomogeneity.

Although a number of algorithms have been proposed in the field of medical image segmentation, medical image segmentation continues to be a complex and challenging problem. Different researchers have done the classification of segmentation techniques in one or another way [12, 13].



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Methods of Image segmentation can be mostly categorized in 2 kinds; Local segmentation and Global segmentation. Global segmentation is related with segmentation of entire image. Typically it is related with segment parts comprising comparatively huge number of pixels [37, 38]. This constructs estimated values of parameter for global segment parts mainly robust. Segmentation of an image could be and approach from 3 diverse viewpoint. Namely Region approach, Boundary approach, Edge approach. When any pixel fits in object, that pixel represents one value else represents zero value. Segmentation [39, 40] is the working in threshold between image analysis and low level image processing. Subsequent to the whole segmentation, pixel [37, 38] feel right to an object. Structural methods [39] exercise a few information about the structure of the region for segmentation. Stochastic methods are applied on isolated pixels without knowing or bearing in mind any structural knowledge of area. Statistical analysis is one of the methods on which stochastic method depends. Hybrid method comprises those methods which have the features of structural as well as stochastic methods. Fig 3 shows the classification of medical image segmentation techniques with example of that technique.

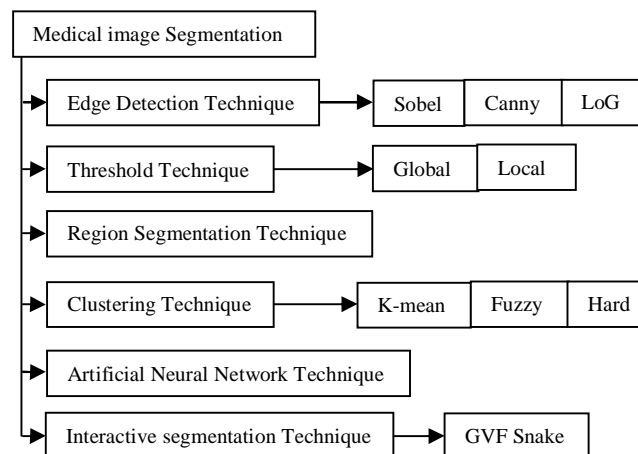


Fig. 3. Various Medical image Segmentation Techniques.

## A. Edge detection techniques

Image's intensity facts simply give incomplete, tentative data regarding position of edges. Edge detection method [37] is discovering pixel on the region boundary. Edge detection method tries to determine image segmentation by noticing the pixels or edges between diverse regions that have quick transition in intensity are extracted [41, 42] and coupled to create closed boundaries of object. The outcome is a binary image [43]. One cause of uncertainly appears from the presence of noise established in imaging process and afterwards in transmission, process of sampling. Another cause of uncertainly appears from the fact that any measurement piece of equipment is defective and their outcomes are merely partial inspection. It says that methods of edge detection are normally ill-posed, that is they are under-constrained and therefore might not have single solutions. The simplest approach to find edges in image is to watch for locations in an image where intensity alters speedily using one of two conditions; Locations at which earliest intensity derivative bigger in magnitude than some threshold, Locations at which second intensity derivative has a zero crossing. Edge detection method [45] is one of structural method of the image segmentation method. Depends on theory there are 2 chief edge based segmentation methods; gradient based method, gray histogram [44]. In an edge approach, edges are acknowledged first, then they are joined together to create required boundaries. Edge detectors have diverse operator for edge detection like canny operator, Laplace operator, Sobel operator, LoG (Laplacian of Gaussian) operator etc. Edge detection technique needs a superior quality of an image therefore it wants to eliminate the noise or diminish the noise.

**Sobel edge Detection:** The Sobel edge detection method is introduced by Sobel in 1970. The Sobel method of edge detection for image segmentation finds edges using the Sobel approximation to the derivative. It precedes the edges at those points where the gradient is highest. The Sobel technique performs a 2-D spatial gradient quantity on an image and so highlights regions of high spatial frequency that correspond to edges. In general it is used to find the estimated

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absolute gradient magnitude at each point in  $n$  input grayscale image. In conjecture at least the operator consists of a pair of  $3 \times 3$  complication kernels as given away in Fig 4. One kernel is simply the other rotated by  $90^\circ$ .

-1	-2	-1
0	0	0
1	2	1

-1	0	-1
-2	0	2
-1	0	1

Fig. 4. Sobel Edge detector operator.

**Canny edge Detection:** In industry, the Canny edge detection technique is one of the standard edge detection techniques. It was first created by John Canny for his Master's thesis at MIT in 1983, and still outperforms many of the newer algorithms that have been developed. To find edges by separating noise from the image before find edges of image the Canny is a very important method. Canny method is a better method without disturbing the features of the edges in the image afterwards it applying the tendency to find the edges and the serious value for threshold. The algorithmic steps are as follows:

- Convolve image  $f(r, c)$  with a Gaussian function to get smooth image  $\hat{f}(r, c) = f(r, c) * G(r, c, 6)$ .
- Apply first difference gradient operator to compute edge strength then edge magnitude and direction are obtain as before.
- Apply non-maximal or critical suppression to the gradient magnitude.
- Apply threshold to the non-maximal suppression image.

Unlike Sobel, the Canny operation is not very susceptible to noise. If the Canny detector worked well it would be superior.

## B. Threshold Techniques

One easiest advance of image segmentation is depends upon values of pixels. The method is to use segmentation depends on thresholding which may assist to simple region growing steps. Thresholding algorithms could be elected physically as per an advance comprehension or robotically by image information. Thresholding algorithms additionally separated to region based, edge based, or hybrid. Edge based algorithms are associated with edge data. The object composition could be illustrated by edge points. Regular edge detection algorithms like Laplacian edge detector, canny edge detector could be categorized to this sort of regions. These algorithms are utilized to search edge pixels while removing influence of noise. Thresholding is elderly, straightforward, well accepted method for segmentation of image. Segmentation of image by thresholding is an easy but commanding approach for image segmentation comprising light objects on gloomy surroundings [41]. Thresholding method is depends upon image space areas that is on image characteristics [44]. Action thresholding translates multilevel image into a binary one that is, it selects an appropriate threshold  $T$ , to split pixels of an image in numerous areas then detaches objects apart from background. Thresholding operation utilized to decide intensity value known as threshold, which disconnects the desire classes. Segmentation is achieved by combining the entire pixels with intensity greater than threshold in one class, remaining pixels in another class. Depending on threshold value selection, 2 kinds of thresholding techniques are existed [45] that are local thresholding, global thresholding. Also thresholding could be categorized in bi-level thresholding, multi-thresholding. If value of  $T$  is steady, then the technique is known as global thresholding else it is known as local thresholding. Global thresholding techniques might be unsuccessful if background enlightenment is irregular. In case of local thresholding, several threshold values are utilized to compensate for irregular enlightenment. Choice of threshold usually happens interactively though; it is probable to obtain automatic threshold selection algorithms. Drawback of thresholding technique is merely 2 classes are produced, and it can't be useful to multichannel images.

## C. Region Segmentation Techniques

$R$  indicates region of image and is stated as a connected homogenous subset of an image with respect to some criterion like texture or gray level. Image regions are cluster of connected pixels with analogous belongings. In this approach, every pixel is assigned to specific area or an object. As evaluated with edge detection technique, region dependent segmentation algorithms are quite effortless and more unaffected with noise [44]. Edge dependent techniques divide an image based on speedy alterations in intensity near edges while region based techniques; divide an image in regions that are analogous according to a set of pre-specified criteria. In segmentation that depends on regions,

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pixels corresponding to object are assembled together and marked. Region based segmentation in addition requires the utilization of suitable thresholding methods. The vital principles are value likeness which comprises variance in gray value, differences in gray value and spatial proximity which comprises Euclidean distance, region compactness. Region based segmentation algorithms mostly contains following techniques; Region Growing, Region splitting and merging. Region growing [13] is a procedure for dig out an image region that is joined based on some pre-specified criteria. This criterion depends on information of intensity. Region growing is approaches to segmentation of image in which adjoining pixels are inspected and inserted to a region class of no edges are found. This procedure is repeated for every boundary pixel in area. If adjacent areas are detected, a region merging algorithm is utilized in which fragile edges are melted and strong edges are left intact. Split and merge method is the contradictory of region growing. This method works on the entire image. Region splitting is a top-down style. It starts with an entire image and splits it up so that the isolated elements are more homogenous than the entire. Only splitting is inadequate for sound segmentation as it strictly limits the segments shapes. So, a merging stage later than the splitting is for all time advantageous, which is expressed as split and merge algorithm. Every region could be divided into sub regions, and the suitable regions could be merged into a region.

Instead of selecting seed points, client can split an image into a set of random unconnected regions after that merge the regions in an effort to suit the circumstances of reasonable segmentation of image. Region splitting and merging is typically employed with theory depends on quad tree data. Region splitting and merging is a method for segmentation of image which obtains spatial information into thought. In region splitting technique, let R stand for the whole image. Select a predicate P. Partition the image consecutively into minor and minor quadrant regions. The splitting method has a suitable depiction in the form of structure known as a quad tree. In quad tree, tree's root represents whole image and every node represents section. In region merging technique, merge any adjoining regions that are analogous enough. Reiterate above steps until no further splitting or merging happens. This method wants the inputted data to be arranged into a pyramidal grid arrangement of regions, with every region organized in groups of 4 in case of 2D, 8 in case of 3D. Physical dealings will not be required in this method. But the drawback is, it needs the inputted data to be organized into a pyramidal grid arrangement which might be tricky.

## D. Clustering Techniques

In image processing clustering is a crucial task. Clustering [46, 47] is an unsupervised learning job, at which there are requirements to see a finite set of categories called as clusters to recognize pixels [48]. No training stages are used in Clustering; instead train themselves by means of existing information. Clustering is mostly utilized when classes are acknowledged in prior. A correspondence criterion is described between pixels, afterwards analogous pixels are assembled collectively to create clusters. Pixels grouped into clusters is depends upon the law of exploiting the intra class likeness and curtailing the inter class likeness. Clustering method tries to use the affiliation among patterns of the set by organism the patterns in clusters or groups so that pattern inside a cluster are extra analogous to each other as compare to patterns of diverse cluster. Clustering outcome quality relies on similarity measure utilized by method and its execution. Superior clustering technique [49] will create top quality clusters with high intra-class likeness and low inter-class likeness. The excellence of a clustering technique is also deliberated by its capability to discover. Clustering is nothing but categorization of objects in groups according to certain belongings of these objects. In clustering methods, an effort is carried out to dig out a vector from local image regions. A usual process for clustering is to assign every pixel to the nearby cluster mean. Clustering algorithms are categorized like; k- means clustering, fuzzy clustering, hard clustering etc. An admired well famous hard clustering algorithm [50] is the k-means. In the hard clustering, a membership value 0 or 1 is given to every pattern data. Working is very straightforward, provides early hard c-partition, it calculates c center and assigns every object to its nearby center in order to reduce the within-cluster variation. After every iteration it carries out experiment comparing the current and the precedent partition, if the outcome of the diversity is lesser than a prefixed threshold, it stops otherwise it go on. Algorithm k-means [51, 52] is nothing but statistical clustering algorithm. Clustering data is technique that produces object groups. Algorithm k-mean is depends on index of likeness or unlikeness between couples of component data. Algorithm k-mean is unsupervised, iterative, numerical, non-numerical and technique. This form of algorithm is admired for straightforwardness, accomplishment and it is universally utilized for pixels grouping in an image. The clustering technique with the spatial, shape information is mounting. Fuzzy clustering technique could be believed to be finer as compare to their hard equivalents because they can show the affiliation between the input pattern information, clusters more unsurprisingly. Fuzzy c-means [51] is a well-liked soft-clustering technique, whose usefulness is mostly limited to spherical clusters. In number



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of situations, it is very flexible as compare to the equivalent hard-clustering algorithm. Clustering technique can be separated into 2 types; hierarchical, partitional. In every category, there exist numerous kinds of algorithms for searching the cluster. Hierarchical clustering method depends upon the utilization of a proximity matrix demonstrating the likenesses between each couple of data points that be clustered the final outcome is clusters tree showing the nested patterns group and similarities levels at which groupings vary. The resulting clusters are usually produce as the internal tree node, where as the root node is kept for the whole database and nodes at leaf for individual data samples. Clustering depends on partition utilizes iterative optimization produce that aims at lessening objective function  $f$ , which determine the kindness of clustering. This sort of clustering are consist of 2 learning steps; partitioning of every pattern to its closed cluster and cluster centroids calculation.

## **E. Artificial Neural Network Techniques**

The Neural Network is nothing but artificial demonstration of human brain this attempts to imitate its learning procedure. Artificial Neural Network [53, 54] frequently known as a neural network or merely neural net. Up to date, neural nets are broadly utilized to answer the crisis of image segmentation in medical stream. It is dependent on life imitation, particularly learning process of human brains, comprises a huge number of parallel nodes. Every node could carry out some fundamental computing. Learning process could be accomplished through moving the node connections and weights of connection. Its major significant benefit is not dependent on the function called as probability density distribution function. It could also verifies segmentation consequences whenever the data divergence from the usual condition. Neural net could also diminish the expert intervention requirements while doing process of image segmentation. This crisis is common in lots of age segmentation techniques. Initially, the problem of image segmentation is changed into energy minimization or classification issues, Afterwards issues are answered depending on neural network in this technique. The neural net was trained with set of training sample with aim to decide the connection between the nodes and weights between the nodes. After that with trained neural network new images were segmented. Neural net segmentation technique comprises 2 vital steps: feature extraction and neural network dependent image segmentation.

## **F. Interactive Segmentation Technique**

Interactive segmentation plays an important role in the segmentation of medical images, where user intervention is suggested as an additional source of information. This technique leverages the expert knowledge of users to produce accurate segmentation of anatomical structures, which facilitates measurement and diagnosis of various diseases [6].

In an interactive segmentation framework, user intervention is tightly coupled with an automatic segmentation algorithm leveraging the user's high-level anatomical knowledge and the automated method's computational capability. Real-time visualization on the screen enables the user to quickly validate and correct the automatic segmentation results in a sub domain where the variation model's statistical assumptions do not agree with the user's expert knowledge. The user intervention mainly includes initialization of the methods, checking the accuracy of the results produced by automatic segmentation, and corrections to the segmentation results using specialized interactive segmentation tools. Interactions in the segmentation of medical images can be broadly classified into three types: pictorial input on an image grid, parameter tuning, and menu option selection. The segmentation results obtained with new configurations (e.g., mouse clicking/drawing, new parameter values, another menu option) are visualized on the screen in real time for further user evaluation. Among all the three types of user interactions, menu option selection is most efficient, but it constrains the degrees of freedom for the user's choice to selections. Pictorial input is simple, but it could be time-consuming in case the interaction requires a user to draw precisely on an image grid. Parameter tuning is easy to operate, but it may require specific training for an insight into the automatic computational part. Interactive segmentation techniques are very important for fast and reliable extraction of the regions of interest. The level of user interaction in different methods varies in terms of the amount and type of information provided by the users. Their underlying mathematical framework is a significant factor determining the form of interaction.

## **V. RESULTS AND DISCUSSION**

In this section, the selected medical image is tested on a Pentium 4 2.93 GHz PC using MATLAB 7.8.0. The original image is first converted to gray scale and resized to  $512 \times 512$ . This section presents the relative performance of edge detection techniques such as Sobel Edge Detector and Canny Edge Detector. As from figure (5) and (6) it is

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clear that the Canny edge based segmentation is better than the Sobel edge based segmentation. The Canny edge based segmentation actually generate better boundary detection as compared to Sobel type. Thus desired segmentation for our proposed plan would be canny edge based segmentation.

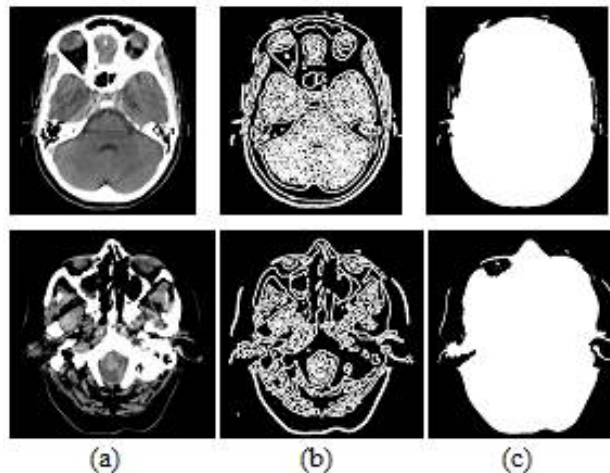


Fig. 5. Canny Edge detector segmentation (a) Original image, (b) Canny edge image, (c) Mask obtained.

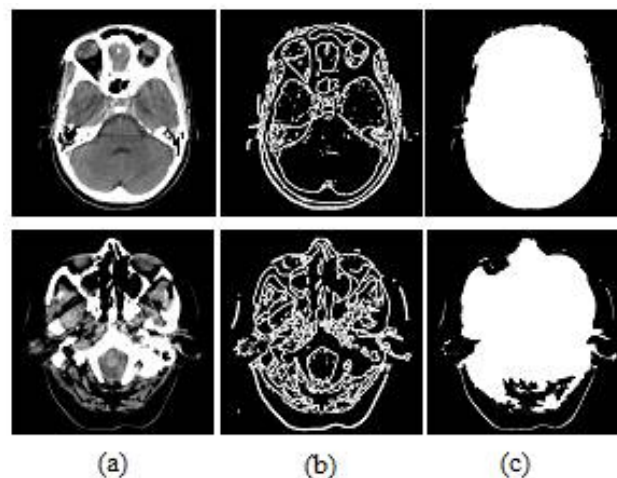


Fig. 6. Sobel Edge detector segmentation (a) Original image, (b) Canny edge image, (c) Mask obtained.

## VI. CONCLUSION

In this paper various methods of image segmentation are studied, the summary of diverse segmentation techniques applied on digital image processing is enlightened shortly. The paper also evaluates some of research techniques applied on image segmentation. These techniques are most significant for pattern detection and recognition by using edges, images, points etc. Techniques of image segmentation stated in this paper are utilized in numerous modern machines for face identification, image identification, pattern recognition etc. Image segmentation has a promising and demanding opportunity as the universal segmentation algorithm and has become the centre of attention of current research. Here is no solitary technique that can be believed superior for all form of images. Not every technique evenly fine for a particular kind of image. Because of all these issues, image segmentation leftovers a demanding crisis in image processing and is still awaiting problem.

Lots of novel image segmentation methods might be designed in upcoming days. Image segmentation is a wide area for researchers to do work in future.

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