Image Segmentation and the Projections of Graphic Centred Approaches in Medical Image Processing

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Abstract – Medical image segmentation is considered the most precarious element in the analysis and processing of real-life images in the clinical sector. Actually, segmentation effects affect the subsequent procedures of image evaluation, life object illustration and description, feature dimensions and the subsequent considerable task levels such as object categorization. In that case, medical image segmentation is the most essential and crucial aspect for aiding the visualization, delineation and depiction of regions of interest for any particular image. The aspect of physical segmentation of a picture is not just challenging and time-consuming task to do, but also problematic to assure accuracy considering the wide-range image modalities and unguided image quantities which have to be observed. In that case, it now becomes fundamental to evaluate the present approaches of image segmentation based on the application of computing algorithms which require the interaction of users with evaluating medical images. In the process of image segmentation, an anatomic classification requires to be extracted or defined to be projected effectively and independently. In that case, this contribution is focused on image segmentation to extract details for decision-making in the clinical sector. The paper presents generalized and relative techniques that have been categorized into three groups: pixel-centre, edge-centred and region-centred techniques. The paper also provides a highlight of the strengths and weaknesses of these techniques in reference to the appropriateness of a wide-range application in medical image segmentation.

Keywords – Medical Image Segmentation; Pixel-Centre; Edge-Centred; Region-Centred.

1. Introduction

Medical image segmentation in general can be illustrated as a process of defining and subdividing digital images into many pixels or regions. This process is capable of separating images into different parts without forming overlaps. Every part is known for various characteristics such as texture, intensity and colour including statistical characteristics. The vital purpose of image segmentation is to transform and simplify image representations into an element which can be comprehensive and simple to evaluate. The results of the process are either a collection of pixels which collaboratively cover up the complete image or structure contours retrieved from a particular image. Based on the foregoing overall definition of the process, a more defined explanation can be provided, the procedure of separating and delineating the anatomical model (which is the region of interest), so that it might be visualized individually to attain fundamental objectives such as radiotherapy planning, patient diagnosis and more graduated surgical research and planning. In that case, TRUS is considered more popular for biopsy and screening guidance, especially for the diagnosis of prostate cancer [1]. This model is considered the safest method of imaging in the human body due to the fact that it emits non-ionized radiation. Apart from that, it makes use of sound waves of minimal power. It is also comparatively transportable and contemptible to deal with. In case the domain of images has been known by Image 1, the image segmentation issues are focused on determining the various sets whose union is considered as the finished image 1.

Segmentation is known to divide images into parts of objects or components as an essential tool in clinical image processing. As fundamental step segmentation, it might be utilized for compression and visualization. By recognizing all the regions and pixels (for two dimensional images) and the three-dimensional images (voxels) for a certain object, segmentation of a certain image is attained. In clinical imaging, the process of segmentation is fundamental for characteristics extractions, image display and image evaluation. Image segmentation of the brain structures is based on magnetic resonance images (MRI) that has considerably received paramount significance since the framework distinguishes itself from the various MRI and modalities [2]. This can be applicable in volumetric evaluation of brain tissues for diseases such as cerebral atrophy, Alzheimer's disease, Parkinson's disease, epilepsy, schizophrenia and multiple sclerosis. Graphs cut is considered as one of the medical image segmentation methods that was launched based on automated and interactive identification of a single or multiple point that is

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a representation of one object. In this methodology, a single or multiple point signifying the background are known as seeds act as segmentation constraints whereby soft constraints signify the pixel or boundary data. An essential element of this method is its capacity to interactively enhance the retrieved segmentations in a more effective manner.

2. Background Analysis

In the process of image segmentation, the dimension to which the aspect of subdivision of images is considered into constituent objects and regions are carried dependent on the issue of being mitigated. In more defined explanation whenever the focused object has been separated the process of image segmentation has to be stopped. The vital purpose of image segmentation is to conduct a graduation of images into more defined segments with firm correlation along with the regions or interest in the images. Segmentation might basically be categorized as partial and complete. The complete segmentations amount to a collection of disjointed parts that correlate to the input image elements or objects [3]. On the other hand, partial segmentation is based on resultant parts that do not correlate in a more direct manner to the input image. The medial image segmentations are typically handled as pattern recognition issue due to the fact that segmentation necessitates pixel categorization. In clinical imaging for evaluating anatomical models such as tissue types, bones, blood vessels and pathological parts such as multiple sclerosis lesion and cancer tissues, it is fundamental to divide the images into segments such as gray matter, white matter and cerebrospinal fluids. In the aspect of medical image segmentation, the processing of MRI brain images is fundamental as the MRI is certainly fundamental for brain analysis due to its critical definition of the non-invasive features, soft tissues and spatial resolutions [4]. The graph cuts are considered one of the emergent image segmentation methods for the processing and identification of brain tissues.

The Graph cuts have been introduced for the analysis of images since its advent in 2001 through the international power minimization campaign. The technique was utilized with different algorithms for quantitative evaluation and the content-centred image assessment. The effective graphic cut algorithms are considered to undertake accurate and optimal segmentation with maximum flow and minimum cut. Medical image segmentation is a fundamental tool in clinical image evaluation and it is applied in different medical applications. For instance, in clinical imaging field, it is possible to detect multiple sclerosis lesions, surgical planning and quantification, locate tumors, evaluation of tissue volumes, evaluation of anatomical structures and brain MRI processing. Addition application of the process includes traffic control frameworks, machine vision, fingerprint recognition and the location of objects in satellites. The process of image segmentation with graph cut method has significant application in everyday life such as image colorization and cropping alongside the multiple analyses of image stitching, image reconstruction, video evaluation and the dimensional image segmentation.

3. Challenges and Problems of Brain Image Segmentation

In medical image segmentation, there are various methods to divide images into parts which are considered homogeneous. Not every method is considered useful for clinical image evaluation due to issues of inaccuracy and complexity. There are no standardized image segmentation methods which are useful for producing suitable results for basically wide-range image applications such as brain cancer diagnosis and MRI. The optimal choice of characteristics, brain elements and tissues are termed as the vital obstacles for brain image processing. Correct segmentation over complete field-of-view is also another obstacle [5]. The manual thresholding and operator supervision are other potential obstacles that have to be considered in the segmentation of brain images. During the process of segmentation, the verification of the potential results is another factor that determines the level of difficulty throughout the process.

4. Research Scope and Objectives

Different clinical imaging methods such as the MRI and computing tomography are capable of providing various perspectives of the brain structure in humans. Various segmentation methods such as graph cuts, water shed, region development, mean shift and fuzzy connectivity are present for clinical imaging mostly for the brain MRI. The graphical cuts are considered as one of the most prominent segmentation approaches to effectively mitigate various brain tissue identification issues. The minimization of energy alongside the smoothing of images is done using the process of the graphical cuts. Various forms of algorithms such as the novel maximum flow and minimum cut, augmenting path and the push relabel are utilized in the process of the graphical cut which also includes the normalized cuts. The purpose of this contribution is to undertake the brain MR and image segmentation process which also applies the minimum cut and maximum flow algorithm of the graphical cut process. In that case, there are various sets which contribute to the image segmentation that have to be satisfied.

$$l = U^k S_k \tag{1}$$

Whereby K = 1.

Whereby $S_k \cap S_j = \emptyset_1 \forall k \neq j$ and every S_k is linked.

The above elements are all considered in the connected image region. Actually, the segmentation approach illustrates those groups belonging to the distinct anatomical regions and structures of the images. One direct manner to properly segment images is through the application of edge detection approach, mostly if images include clear objects on various intensity backgrounds. Nonetheless, this approach can have some drawbacks if images have some noises. It is typically fundamental to carry out validation testing to evaluate and quantify the performance of the segmentation approach. This can properly be done through the measurement of automated segmentation whereby an

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expert is segmented manually. Alternatively, the computational or physical phantoms can be used to segment the experts. Nonetheless, there is no standardized or single segmentation approach which operates effectively for wide-range images. This paper provides a critical evaluation of image segmentation approaches that have been categorized into three broad categories: pixel-centred, edge-centred and graph-centred.

Fig 1: Image segmentation methods

The segmentation of images into fundamental structures and image segmentations is typically a significant step in the representation, analysis, apparition of objects which also include the processing of tasks. We concentrate on the manner in which we can evaluate images to correspond to objects. However, the assumptions in this research have their pixels identifying the objects that are known as objects prior the experiment. In this part, we will focus on the approaches which identify a certain pixel that creates the object [6]. A wide-range segmentation approach has been recommended over the past few decades and a number of categorizations are used to present the approaches in a more appropriate manner. A disjunction classification is not seen to be possible due to the fact that two varied segmentation methods might share the same properties used to defy a single form of segmentation. The form of segmentation in this section is thus considered as a form of categorization concerning the focus on the method instead of strict division. The following classes are utilized: Pixel-centred segmentation is the procedure of partitioning digitalized images into many groups and segmentation of pixels which are considered as super pixels. Threshold-centred segmentation, slicing approaches and histogram thresholding techniques are used to segment images [7].

These are applicable to images in a more direct manner, but might be linked to post-processing and pre-processing approaches. Edge-centred segmentation whereby the edges that are noticed in images are considered to signify object boundaries and utilized to note the various objects, region-centred segmentation. Where the edge-centred approach might focus on identifying the object boundary and locate objects by basically including them in the region-centred approach that is considered to take the opposite approach. Additionally, there are the structural segmentation approaches which are the methods that use data in the structural characteristic of images meant to implement the division on the targeted images. Some typically used structural approaches and incorporate the edge-detection, graphic search, deformable frameworks and the level set.

5. Pixel-Centred Image Segmentation

5.1 Thresholding Techniques

The thresholding approach has been used as an example to define the pixel-centred image division. The technique is considered as the simplest form of image segmentation. It is centred on the assumption and analysis which the background and objects in images are based on bimodal distribution. Normally, these results and assumptions are considered invalid for many images, mostly the clinical ones. The basic aspect of this segmentation approach is to evaluate the intensity degree that is known as the image threshold that is also capable of separating the desired category. The major advantage of deformable frameworks is their capacity to directly produce closed parametric surfaces and curves from the pictures based on their smoothness incorporation constraints which provide the required robustness to spurious and noise edges. Apart from that, they provide sub-pixel precision for the representation of boundaries that might be fundamental to clinical applications [8]. An essential drawback of the snake is that it necessitates more manual interaction to include initial framework and to select effective initial parameters. Other than that, they might not be applied in the non-interactive application, unless they have been initialized next to the structures that have to be segmented due to the fact that they require more interactive frameworks. The thresholding segmentation method changes the input images. I to a more binary form, g through the process of categorizing the pixels with utmost intensity that is more than the projected threshold. More pixels are placed in another class.

0, 1, for i =m1, 2 …..M and

J = 1, 2 ……, N …………………. (2)

The methodology of the threshold is illustrated as

$$g(i,j) = \begin{Bmatrix} 1\ for\ l\ (i,j0 \geq T \\ 0\ for\ l\ (i,j0 \geq T \end{Bmatrix}, \ldots\ldots\ldots\ldots\ldots(3)$$

A number of images might be segmented based on the application of more than a single point of threshold which is known as multiple thresholding (T1 and T2). These are the two thresholds that properly segment image. Hence, there are not binary and include limited gray levels as defined below.

$$g(i,j) = \begin{Bmatrix} 1\ for\ l\ (i,j0 \geq T_1 \\ 0\ for\ l\ (i,j0 \geq T_2 \\ N\ for\ T_n * 1(i,j)TN_g - 1 \end{Bmatrix}, \ldots..(4)$$

N_g Represents the image gray levels whereby the image number is 256.

6. Edge-Centred Image Segmentation

The issue of identifying edges in images is a fundamental element in the evaluation of images. It incorporates the classification of object boundaries in images based on the application of edge data. It therefore makes the process of edge detection considerably handy for image segmentation. The edge-centred detection approaches are widely utilized for the detection of edges in images and to perform the process of segmentation. The ancient edge detection approach typically utilizes the edge detection operators that are centred on the gradations such as Prewitt edge, Robert and Sobel detectors. Typically, edges happen at the intersection points to two different parts with the varied intensities that are dissimilar. The merits of these approaches are that they operate effectively on those images that have more defined quality and disparity between the various parts.

Their demerits incorporate the detection of wide-range edges. In that case, it is challenging to identify the connection between the regions of interest and the edges. Moreover, those algorithms are considered more sensitive to noises. The edge-centred segmentation approach connects to the significant category of approaches centred on the data related to the image edges. Edge-centred segmentation is dependent on the kind of edges identified in images based on the operators of edge detection. The edges are capable of sporting the image locations and discontinuities in gray levels, texture and color. The images amounting from the approach of edge detection might not be utilized due to the process of segmentation [9]. The inclusive processing actions have to follow the merged edges into the chains which correspond to enhance according to the image borders. The final desire is to attain at least the fractional segmentation which is to bunch the closer edges into images whereby the edge chain with the connection to the present image parts and things are considered in attendance. The more data that is present in the process of segmentation, the more the results of the process of image segmentation can be obtained. The most generalized approach of edge-centred image division is the edge occurrence in the parts with no edge or border existing in the actual border.

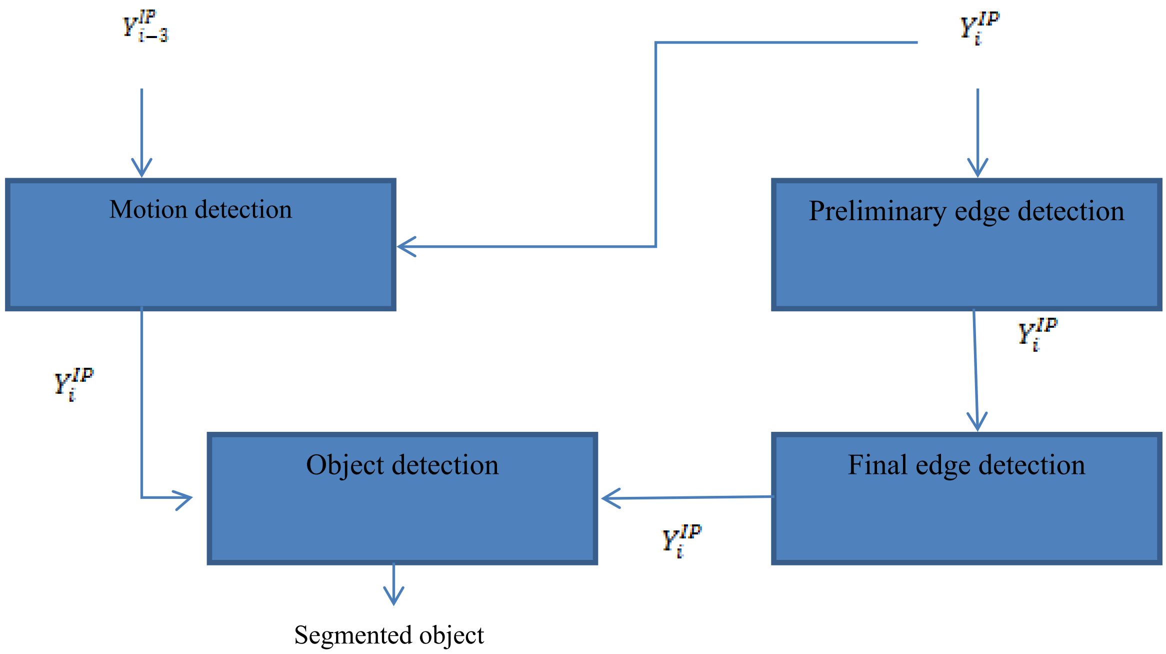

Fig 2: The flow of the edge-centred image segmentation approach

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7. Region-Centred Techniques

7.1 Region Enhancement Techniques

We have considered the region enhancement approach as a sample to define the region-centred image segmentation method. The method incorporates the ideology that pixels next to each other have the same gray figures. The vital ideology of this method includes the observations that pixels are designated to a single object element and has the same characteristics, for instance the gray values. In that regard, if the relative pixels have gray figures which are close to the gray value the pixels might be connected to the regions [10]. This method generally includes the following fundamental steps; Firstly, a novel region includes a single pixel that is known as the seed pixel. The pixel is identified by users and is provided as the priori data. The provided pixel identifies the neighbour whereby the various pixels are considerably checked. In case the pixels do not belong to other parts, it might be connected to the provided region, if the variation between the gray values of pixels and the mean gray value of the complete part is minimal compared to the pre-defined, T, threshold. Secondly, whenever the pixels are linked to the parts of the mean gray figure then the region can be calculated. In general, the neighbouring pixels have to be analyzed, novel neighbourhood for the magnified region will be identified and the initial step include:

7.2 Graphic Search Algorithm

Graphs are considered as one of the abstract representations which include a collection of vertices $V = (v1., \ldots. vn)$ and a collection of edges $E = (\ldots.., , \{vi, \ldots. vj\} \ldots..)$ whereby $k = \{vi, vj\}$ shows that the arc (edge) from the 'I' vertex to the 'j' vertex. Every edge has a connected weight that signifies the expense of transition varied from Vi to Vj. In the algorithm, the surfaces and edges can be showed using a graphic representation based on the application of the search algorithm. These algorithms have some merit which might perform effectively when the separations defining the regions have been broken. Their demerit is that of demanding the surfaces to be shown as a graph that might be considered challenging. The graph-centred algorithms are fundamental when it comes to the segmentation. Images mostly in clinical image processing is an emerging topic for more than two decades now.

Clinical imaging is a collection of processes and techniques which are incorporated to formulate images throughout the human body for clinical and medical purposes. Considerably, proliferation and development has transformed the manner in which medicine is administered in the modern age. Clinical imaging permits the medical practitioners and doctors to non-analyze and observe the life-saving information [11]. Clinical imaging has progressed beyond the mere inspection and visualization of the typical anatomical structure. Its incorporation and application have incredibly expanded to encompass the usage of tools for surgical simulation and planning, radiotherapy panning, intra-operative navigations and in the diagnosis of diseases. For instance, in the field of radiotherapy, clinical imaging permits physicians to effectively deliver necrotic dosage of radiations to effectively relate to the surrounding tissues. Each year, a wide-range of images of patients is captured with their varying sizes and dimensions.

A lot of these include the 3D and 4D images of the individuals taken to aid in the process of conducting therapy and diagnosis experiments. There are various clinical imaging modalities: Positron Emission Tomography, Nuclear Medicine, Ultrasounds, Magnetic Resonance and Computed Tomography. Even though the modalities have more exceptional pictures of internalized anatomy, computing technology application to analyze and quantify the structures in images to assure efficiency and accuracy is considered limited. To apply computing for the medical experiments and medical activities, repeatable and accurate quantitative information has to be retrieved effectively [12]. Nonetheless, to-date clinical imaging incorporates significant qualitative characteristics with a lot of observations of clinical images conducted on two dimensional analogical chains which include films. This is normally on the framework of different cross sections and a single modality form at a specific timeframe. The creation of frameworks is meant to support digitalized images of clinical data that has incredibly achieved momentum for a while now. This has amounted to more improved and novel approaches for encrypting clinical images in more digitalized form on the sites of production and with the assistance of high-bandwidth network.

This has opened novel era with the capacity of introducing more powerful and efficient image exploitation via image processing and image analysis. Image analysis defines the process by which data from images is retrieved. The process is basically done on digitalized images that uses image process approaches. The process includes various approaches for characteristics extraction. A number of image processing approaches are distance transformation calculation, skeletonization, eroding, dilating, segmentation and registration. The interpreting quantitative information 2D analogue cross-section is challenging and ineffective. To mitigate that digitalized image analysis and processing has launched 3D objective measurements in the images. As such, this permits precise retrieval of data such as texture, location and size from the 3D pathological and anatomical structure. The aspect of visualization is added to the qualitative evaluation of both the 4D and 3D images [13].

The approaches discussed above are applied in the treatment of anatomical information. To apply image analysis and image processing to the 'ix' therapy, the method of simulation is applied to aid the process of therapy. The virtual patient framework aids in the process of simulation of certain therapy with the assistance of a more standardized simulation of individuals or with the assistance of templates from the individuals themselves. However, this might need a more delicate analysis of the patient's anatomy. The process of image segmentation is one of the most ancient approaches applied in clinical images which is designed in a more digitalized format. The process of segmentation is considered as an approach by which images are properly partitioned into more considerably image regions. There are various methods that can facilitate the process of segmentation. A lot of these methods have been

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borrowed from different concepts e.g. energy minimization, mathematical morphology, graphic theoretic methods and the partial differential equation which might signify the combination of these methods.

There are no novel remedies and a lot of segmentation issues are mitigated using the interlinking of these methods. Minimal-level image process approaches for the process of segmentation such as region enhancement, mathematical morphology operation and edge detection necessitates a more considerable measure of professional interactive guidance. Deformable framework-centred segmentation on the contrary might be applied with no ancient image processing or slice editing methods to mitigate the issues in image segmentation that necessitate more interactive guidance. Based on segmentation, the following image segmentation approach is image registration. The registration of images defines the alignment of images which have been obtained at various moments from various viewpoints and sensors. Image registration might be incorporated in inter or intra patients between both multi and mono modal 3D images.

As a result, this amount both non-rigid and rigid image registration methods which includes multi and mono modal registration methods. A number of feature-centred utilizes the end-results from image segmentation for instance, use raw data from images. Today, there are many registration methods which have been created for various applications that utilizes various mathematical models including sequential and correlation methods. The fourier transformation approach, model-centred and point mapping, including the graph theoretical method use the data from the images for the purpose of contrast and comparison in image registration. Image process also includes motion tracking of 4D model. There are two essential objectives for the motion-tracking of the model: boundary tracking anatomical features that are purposed to evaluate the displacement volume fields, the evaluation and quantification of the general motion with significant but scarce objective parameters. The deformable framework-centred image processing methods are majorly utilized in the process of motion tracking.

The visualization of the clinical information, alongside other approaches to the analysis of data is considered the most common tool for the analysis of data. This approach has gained considerable popularity in medical data analysis over the past few decades. Generally, the process of visualization necessitates the application of prior image segmentation stages before gathering any fundamental data from the approach. This also incorporates the 3D interactive visualization graphics of the 3D anatomical structures [14]. The image processing framework and tool which has broadly been applied in the clinical imaging field is skeletonization. The tool is considered an image process approach which incredibly minimized the foreground in the skeletal remnant and the binary images which significantly preserves the connectivity and extent of the initial region whereas doing away with a lot of initial foreground pixels. The tool basically operates by beginning from the xi-volume boundary before it transverses to the midpoints incorporated in the volume. Additionally, the tool is considered as an interlinked centreline that incorporates the clinical points of the considerable clusters.

Visualization, courtesy of skeletonization can be utilized for the compacted description of shapes and path planning e.g. in motion tracking. The tool is considered to be a 3D volume which basically hosts discrete objects in the tool volume. This also provides effective approaches for analysis and visualization. These approaches include automated navigation, surface generation, feature tracking and feature extraction. The image processing approach included before might be enhanced based on the application of the graphical theoretic method. In the process of image segmentation, for instance, graphic theory has effectively been incorporated based on the application of the graphical search algorithm to identify the edge boundary. In the same manner, in image registration the graphic theory is applicable in the calculation of the picture alignment in relation to the image features or mathematical constraint such as the entropy that applies the minimal span of the tree algorithm to conduct a mathematical evaluation of the minimal deviation value.

The graphic theory is applied in the evaluation of distance transformation of pixels in images whereby the shortest path of algorithms is calculated to evaluate the overall distance between the contour pixels and the interior pixels [15]. With the assistance of the distance transformation evaluation, the volume skeleton can be determined based on the assistance of the minimal span tree to evaluate the minimal distance that defines the outer contour volume from the inner medial point. The graph theory approach has a lot of application in the image evaluation pipeline. Nonetheless, minimal image segmentation toolkit has applied the graphic algorithm in an object-oriented and generic manner which might permit it to be applicable for the clinical image processing. Even those Boost has a graphical library which is xii generic in nature, it did not design its applications to accord to the image processing aspect.

8. Proposed Framework

The framework projected in this paper for the graphic algorithm has been created based on the generic condition of images utilized by medical pictures and also the certain nature of information being processed. Analyzing is also considered another clinical image segmentation tool which is known for being object oriented but not entirely generic and therefore is known for bearing some limitations. The tool also utilizes the segmentation toolkit and insight registration for a number of its registration and segmentation mathematical evaluations. The Insight Segmentation and Registration toolkit uses an object-oriented and generic framework. The framework includes graphic objects in the data objects and utilizes the object design of factory model that might be generalized with ease by users. Four algorithms, for the graphic theory are projected for the algorithms to be generalized and efficient for the massive multi-dimensional clinical image.

This has been structured to be independent on the meta-information of images. The algorithm applied incorporates the Prim's minimal spanning Tree, Dijkstra short paths, KKruskal's minimal span Tree, Depth initial search and the breadth initial search. All these algorithms have been

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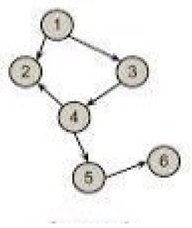
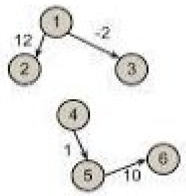
formulated to be in the in-place filters which utilizes the single memory for both the output and input graphs. The outputs are typically the child and parent node map structural list. Different supporting algorithms like the functor aids in the process of determining the logics that have to be applied in the usage of the graphic algorithms or in the transformation of these images in the representational graph. These have been formulated to make it easier in the process of application in a more generalized framework. The functor element follows the design framework of the software mostly known as the visiting design.

Other supporting categories which are considered certain to the application have also been made. Testing has been conducted to determine the efficiency and robustness of the application. As a mean evaluation, the time taken to execute one pipeline from the image conversion process to the graphic process of the object map including the child and parent vertices in the graph was approximately 12-24 milliseconds. The application of this system on the 3D object for the skeletonization tool has indicated its application to the massive volume and its considerable time efficacy.



a)



b)

Fig 3: a) Connected and b) disconnected graphs

9. Results

The findings of this research are represented by the below table and images.

a)

b)

c)

d)

Fig 4: Comparative subdivided images a) initial cameraman image b) pixel-centre image segmentation c) edge-centred image segmentation d) graphic-centred image segmentation

Table 1: Comparisons of the categorized approaches

Approach	Advantages	Segmentation effects
Pixel-centred	More complexity	Normal
Edge-centred	Average complexity	Average
Graph-centred	Very low complexity	Good

10. Conclusion and Future Directions

In this paper, we have critically evaluated the fundamental techniques of pixel-centred, edge-centred and region-centred (graphic) techniques of segmenting images. The systematic contrast and comparison evaluation are fundamental for researchers who are interested in doing analyses on image grounds and image segmentation. The image segmentation approaches are considerably effective. Mostly, the graphic-centred mage segmentation approaches that has been evaluated as the third class (i.e. the region-centred technique). Clinical image processing is considered as one of the major dynamic research themes in image segmentation. A lot of modern research analyses in image segmentation have covered the capacity of the graphic-centred approach for clinical application. To effectively apply the graphic theory when segmenting images in a professional manner, we have to structure the process of implementation between the biological scientists and the mathematical outstanding junior search and define the relevant sketches to structure novel domain tools. In that case, future research should be based on the motivation to research the features of Euler graphs, Fuzzy graphs, Minimal Span Tree and evaluate the relevant ideologies for segmenting images. From this research, we have summarized that there is no generalized method of segmentation which can be structured for the various forms of images. However, various approaches are considered more applicable compared to other forms of image representation techniques due to their healthier performance. For better performance, researchers should focus on developing appropriate algorithms or focus on combining the most suitable approaches of image segmentation.

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