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Image Segmentation Technique: A Systematic Literature Review

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Abstrac:- **According to a human observation image segmentation is the process of dividing the image into non-overlapping meaningful regions. The main objective if an image segmentation is to divide an image into many sections for the further analysis, so we can get the only necessary or a segment of information. The partitioning the image will be based on some image features like color, texture, pixel intensity value etc. The goal of this paper is to study the image segmentation techniques. It is a process of dividing the image into multiple parts, which are used for identifying objects and other relevant information. Image segmentation bridges a gap between the low-level image details and high-level image components. The role of segmentation is crucial for the tasks that require image analysis.**

Keywords : OCR, Multispectral,pixel,GIF,

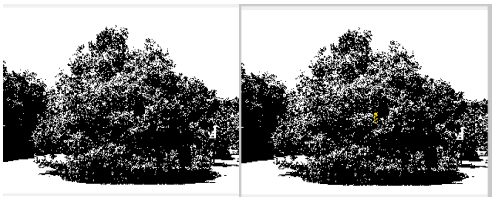
I. INTRODUCTION

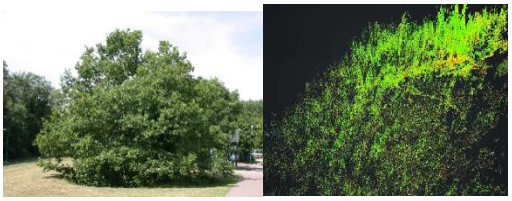
Image segmentation is a branch of digital image processing which focuses on partitioning an image into different parts according to their features and properties. The primary goal of image segmentation is to simplify the image for easier analysis. In image segmentation divide an image into various parts that have similar attributes. The parts in which dividing the image are called Image Objects. By using image segmentation techniques, can divide and group-specific pixels from an image, assign them labels and classify further pixels according to these labels, can draw lines, specify borders, and separate particular objects (important components) in an image from the rest of the objects. Every image is a set of pixels and the process of dividing or partitioning that pixel on the basis of similar characteristics is known as segmentation.

Types of Digital Images: -Following are the type of images.:

1) binary 2) gray -scale

3) color 4) multispectral.





1.Binary image: Binary images are the simplest type of images and can take on two values, typically black and white, or 0 and 1. A binary image is referred to as a 1-bit image because it takes only 1 binary digit to represent each pixel. These types of images are frequently used in applications where the only information required is general shape or outline, for example optical character recognition (OCR). Binary images are often created from the gray-scale images via a threshold operation, where every pixel above the threshold value is turned white (‘1’), and those below it are turned black (‘0’)

2.Gray-scale images: Gray-scale images referred to as monochrome (one-color) images. They contain gray-level information, no color information. The number of bits used for each pixel determines the number of different gray levels available. The typical gray-scale image contains 8bits/pixel data, which allows us to have 256 different gray levels. The figure below shows examples of gray-scale images. In applications like medical imaging and astronomy, 12 or 16 bits/pixelimages are used. These extra gray levels become useful when a small section of the image is made much larger to discern details.

3.Color images: Color images can be modeled as three-band monochrome image data, where each band of data corresponds to a different color. The actual information stored in the digital image data is the gray-level information in each spectral band. Typical color images are represented as red, green, and blue (RGB images). Using the 8-bit monochrome standard as a model, the corresponding color image would have 24-bits/pixel (8-bits for each of the three color bands red, green, and blue).

4.Multispectral images: Multispectral images typically contain information outside the normal human perceptual range. This may include infrared, ultraviolet, X-ray, acoustic, or radar data. These are not images in

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the usual sense because the information represented is not directly visible by the human system. However, the information is often represented in visual form by mapping the different spectral bands to RGB components.

Digital image file formats

Types of image data are divided into two primary categories: bitmap & vector.

Bitmap images (also called raster images) can be represented as 2-dimensional functions *f(x,y)*, where they have pixel data and the corresponding gray-level values stored in some file format.

Vector images *:* Refer to methods of representing lines, curves, and shapes by storing only the key points. These key points are sufficient to define the shapes. The process of turning these into an image is called rendering. After the image has been rendered, it can be thought of as being in bitmap format, where each pixel has svalues associated with it.

Most of the types of file formats fall into the category of bitmap images,for example:

- PPM (Portable Pix Map) format
- TIFF (Tagged Image File Format)
- GIF (Graphics Interchange Format)
- JPEG (Joint Photographic Experts Group) format
- BMP (Windows Bitmap)
- PNG (Portable Network Graphics)
- XWD (X Window Dump)

II APPLICATION OF IMAGE SEGMENTATION

1 Remote sensing

The remote sensing is one of the major growing area of detecting the data. Remote sensors detects energy which is reflected by earth and getting the data from it. We can take an example of satellite. The satellites capture the data from the surface of the earth and then it can be analyzed in many ways like which area is green or where is the water present also we can also check in which areas population is increased.

2.Segmentation is nothing but making the part of image or any object.

Segmentation process mainly deals with the pixels of an image, how the regions can be divided and how the neighbor pixels [2] can be mapped with the first selected pixel. Image segmentation process consigns a tag to every pixel of the image, images with similar tags shares the definite features. Image segmentation is a large aspect of computer vision and has many applications in numerous industries. Like Face Recognition.

3. The facial recognition technology present in your iPhone and advanced security systems uses image segmentation to identify your face. It must be able to identify the unique features of your face so that any unwanted party cannot access your phone or system.

4. Number Plate Identification

Many traffic lights and cameras use number plate identification to charge fines and help with searches.

III RELATED WORK

In 2000 within the Journal of Journal of Theoretical and Applied Information Technology
published entitled " Current methods in medical image segmentation &moving toward region based image segmentation technique A study". In this paper segmentation of the image is very useful in medical applications to diagnose the anomalies in the image [1] [2], satellite imaging and in computer vision. The criteria for segmenting the image is very hard to decide as it varies from image to image and also varies significantly on the modality used to capture the image.

In 2001 within the International Conference on Computer Vision", Vancouver, Canada, Vol.I, P.105" Interactive Graph Cuts For Optimal Boundary & Region Segmentation Of Objects In N-D Images. In this paper new technique for general purpose interactive segmentation of N-dimensional images using graph-cut method proposed by Yuri and [3]. In their proposed method the user marks certain pixels as "object" or "background" to provide hard constraints for segmentation, claiming that their method gives best balance of boundary and region properties compared to other segmentation methods and also that it provides optimal solution for n -dimensional segmentation.

In 2012 within the International Journal of Electronics and Computer Science Engineering **"**A Multilevel Automatic Thresholding for Image" In this paper Rakesh Kumar proposes Segmentation using Genetic Algorithm and DWT. An automatic multilevel thresholding method for image segmentation using a combination of Genetic Algorithm with Discrete Wavelet Transform (DWT) to make[4] segmentation faster and adequate. DWT is used to reduce the length of the histogram and next to the number of thresholds and the threshold value are determined by the Genetic Algorithm.

In the 2005 within the International Journal of computer vision [5] propose an approach for identifying regions where this approach can only be shown effective on text and faces**.**

In the 2016 within the International Conference IEEE "An efficient and robust approach for satellite color image segmentation" Author Bora et al. propose an [[6] efficient and robust approach for satellite color image segmentation, AERASCIS. They have given importance on three major facts here: first color space selection, a proper local contrast management of the input satellite image, an efficient technique for a number of clusters detection and a proper distance measure for K-Means clustering of the enhanced image. The experiments prove the superiority of the proposed method.

In the 1993 within the journal "A review on image segmentation techniques" Author Sumengen and Manjunath[7] propose a multiscale edge detection technique for segmenting natural images. In this paper approach is

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quite efficient to annihilate the necessity of explicit scale selection and edge tracking methods. Also segment color and multispectral images. The histogram analysis for each band is applied to generate the seeds automatically and an instance-based learning process is used as a distance criterion.

In the 2000 within the Journal of Theoretical and Applied Information Technology" current methods in medical image segmentation". The segmentation of the image is very useful in medical applications to diagnose the abnormalities in the image [8][9], satellite imaging and in computer vision as well as in ANN. The criteria for segmenting the image is very hard to decide as it varies from image to image and also varies significantly on the modality used to capture the image.

In the 2012 within the Journal of Information Engineering and Applications "Fuzzy k-c-means Clustering Algorithm for Medical Image Segmentation" In this paper Journal of Information Engineering and Application "[10] the clustering methods had discussed for medical image segmentation in particularly for MR Images of brain and are successful in combining fuzzy c means and k-means to get novel fuzzy-k means algorithm. Few limitations of the obtained algorithm also stated.

In the 2005 within the International Publishers" "Computer Vision and Image Processing" One of the simplest approaches to segment an image is based on the intensity levels and is called as threshold based approach. Threshold based techniques classifies the image into two classes and works on the postulate that pixels belonging to certain range of intensity values represents one class and the rest of the pixels in the image represents the other class. Thresholding can be implemented either globally or locally. Global thresholding distinguishes object and background pixels by comparing with threshold value chosen and use binary partition to segment the image. The pixels that pass the threshold test are considered as object pixel and are assigned the binary value "1" and other pixels are assigned binary value "0" and treated as background pixels. The threshold based segmentation techniques are inexpensive, computationally fast and can be used in real time applications with aid of specialized hardware [11].

Hybrid technique for medical image segmentation is suggested in [2] and mainly works on fuzzy-c means and otsu‟s method after applying on vector median filter, for segmentation and have tried to prove the robustness of their method few kinds of noise have been added to image and have obtained satisfactory results.

Roopali R. Laddha et al said that MRI images are regular to identify the tumor since it has excessively measure of information for understanding and analysis. In this paper essential framework used is Segmentation, which is finished using a procedure in light of division, watershed Segmentation and morphological operations.

In 2015 within the International Journal Of Innovative Research In Electrical, Electronics, Instrumentation And Control Engineering, "Brain Tumor Detection Using MRI Images "Author Pranita Balaji Kanade has recognized the mind tumor and group the phases of the tumor by utilizing testing and preparing the database. Segmentation for testing[12] purpose is done by spatial Fuzzy C-means(FCM) The statistical analysis of the experimental results has indicated that the developed algorithm can segment brain MR images with good accuracy.

In 2010 within the journal of computing ,volume 2 "Image Segmentation by Using Threshold Techniques",Journal Of Computing, Salem Saleh Al-amri et al.(2010) attempts to undertake the study of image segmentation techniques by using five threshold methods as Mean method, P-tile method,[13] Histogram Dependent Technique (HDT), Edge Maximization Technique (EMT) and visual Technique. they are compared with one another so as to choose the best technique for threshold segmentation techniques image[7].

In 2009 within the journal of Image and Vision Computing "Watershed segmentation using prior shape and appearance knowledge "Ghassan Hamarneh et al(2009)proposed a novel method for enhancing watershed segmentation by utilizing prior shape and appearance knowledge. The method iteratively aligns a shape histogram with the result of an improved k-means clustering algorithm of the watershed segments.[14]. The method is composed of a training stage and a segmentation stage. In the training stage, a shape histogram‟ and image intensity statistics are used to model prior shape and appearance knowledge, respectively.

In 2014 within the International Journal of Mitteilungen,Klosterneuburg" Hybrid Color Image Segmentation By Active Region Growing And Statistical Region Merging Algorithm" Jeyakumari proposed to hybrid color image segmentation by active region growing And Statistical region merging algorithm . It gives the complete grown regions along with color information. Statistical Region Merging is used to combine regions with similar characteristics and reduce over segmentation during the process.[15].

In the 2014 within the International Conference on Advances in Electronics Computers and Communicatio*n"* Brain tumor segmentation using thresholding, morphological operations and extraction of features of tumor," A modification of thresholding segmentation method is called Otsu Thresholding. Otsu thresholding classifies the image into two different classes naming foreground and background. The different intensity value pixels in the image are iterated on either side until the inter-class variance is minimal. This technique was used by the authors in research [14] for detection and extraction of brain tumors from MRI scan of the patient. In another research paper, efficient and accurate brain tumor detection and segmentation is carried out using thresholding and some morphological operations [17].

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In the 2016 within the EXCLI Journal "Automatic liver tumor segmentation on computed tomography for patient treatment planning and monitoring "Moghbel et. al. [18] proposed a segmentation method which is fully automated with no user interaction for liver tumor segmentation. They proposed a hybrid method combining fuzzy c-means, cuckoo search based optimization and random walkers algorithm. Fuzzy C-means is used for clustering where each pixel is considered to be belonging to more than one cluster in order to improve the performance in images with poor contrast. To further increase the accuracy of the segmentation of liver, a metaheuristic approach called cuckoo optimization is implemented. For proper handling of noisy images and blurred edges of the CT scans, a method based on supervised learning called random walkers algorithm is implemented. This model provides accurate segmentation results and it can be easily included in any CAD system for tumor segmentation from medical perspective.

In 2009 within the Fourth International Conference on Industrial and Information Systems, ICIIS "Comparison of Standard Image "Segmentation Methods for Segmentation of Brain Tumors from 2D MR Images "In this papers, author Gajanayake .[19] compared various standard segmentation techniques for detection of brain tumor and concluded that Otsu's thresholding method is very suitable for segmenting 2D MR images to identify tumor tissues. Author Gupta made an analysis on the comparative study of different medical image segmentation techniques for tumor detection in brain.
In 2015 within the 8th International Congress on Image and Signal Processing (CISP),IEEE "Cell Image Segmentation Based on an Improved Watershed Algorithm" of Sensitivity and accuracy of local based projection method is better than other methods of segmentation. A combination of OTSU thresholding and watershed transform algorithm is proposed to resolve the problems of over segmentation and cell adhesion [20].

In 2015 within the International Conference on Signal Processing, Computing and Control (ISPCC), IEEE "Performance Comparison of Image Segmentation Techniques for Lung Nodule Detection in CT Images" A performance comparison between three segmentations techniques, iterative thresholding, region and fuzzy region-based level set method is done by the authors to identify the best image segmentation technique for lung nodule detection in computed tomography.

In 2012 within the IEEE International Conference On Advances In Engineering, Science And Management (ICAESM "Brain Tumor Segmentation and Its Area Calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm "J.selvakumar [22] proposed a model for detection of range and shape of brain tumors and its segmentation by combining the algorithms of advanced K means and Fuzzy C-means. This method of combining two algorithms has proven to be accurate enough and reproducibility is also high as compared to some manual segmentation approaches. The time duration for image segmentation is also found to be comparatively less in the case of combined advanced K means and Fuzzy C-means algorithms.

In 2011 within the journal of ComputAssist Radio" Liver tumors segmentation from CTA images using voxels classification and affinity constraint propagation," M. Freiman et. al. proposed a new and nearly automatic method for segmentation of liver tumors [23]. SVM (support vector machine) classifier is used to classify the healthy tissues and tumor tissues from the CT images, which lead to the generation of new set of high quality seeds. This proposed method is efficient, robust and is comparable and effective than many other semi-automatic techniques.

In 2016 within the journal of MICCAI "Automatic liver and lesion segmentation in CT using cascaded fully convolutional neural networks and 3D conditional random fields" Author P. F. Christ [24] proposed a CNN to segment liver and lesions in CT images of abdomen of patients. The cascaded FCN approach provides enhancement in segmentation accuracy when its accuracy is compared to single fully convolutional networks.

IV CLASSIFICATION OF IMAGE SEGMENTATION TECHNIQUE

Segmentation techniques are mainly classified into two main categories i.e. Layer- Based Segmentation and Block Based Segmentation Methods.
A. Layer- Based Segmentation Methods By the use of this segmentation method object is defined more clearly on the basis of shape, appearance and depth. Hence evaluate class and instance segment.
B. Block Based Segmentation Method

Block Based Segmentation methods are based on different features present in the image. I could be colour information, information about pixels that helps in fencing off the edges or boundaries. Further, block based segmentation method are divided into two categories i.e. region based and edge or boundaries base

Image segmentation technique

1.Edge based segmentation method
Edge detection techniques convert image to edge image by using the change of grey to one.Edges in the image are significance of discontinuity in the image. It shows rapid change in intensity value and form boundary between two regions. Edges are detected where either the first derivative of intensity is greater than a particular threshold or second derivative has zero crossings. Few popular types of edges are as follows.
1) Step Edge
Image intensity changes abruptly from one value to a different value which shows the discontinuity.
2) Ramp Edge
In real life it is very rare that a digital image has sharp edge. In reality ramp edges are the actual form of step edge.

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3) Line Edge
In such edges intensity changes abruptly then returns to the initial value within short distance
4) Roof Edge
The reality of line edges are roof edge.

2.Region based segmentation method With this method, area segmentation is relatively simple.
The division—using repeated relaxation technology—is based on noise resistance and results in different areas established by pre-defined criteria. The image graph gets all of the information on an image. The classification of each pixel as a container or background is primarily based on maximum self-value through which the criteria for seed determination are determined. Two-pixel classes—the container and the background—are selected from the histogram for the maximum value specified and only one category of the scale size graph—low gradient—is calculated [18–20]. Utilizing spatial data from the classification of the 8 neighbouring pixels, classes develop at first in locales with low gradient magnitude. This allows for a wide and quick
classification whereas smothering classification within the edge districts where the slopes are expansive. In a moment arrange, the classification imperative is loose and classes develop exclusively based on the greatest eigenvalue to define borders between districts [25].

3.Thresholding based segmentation method
In threshold based image segmentation, an input image is partitioned into two or more sub-images by comparing with the predefined threshold value. In threshold based segmentation the current image is compared to the background image and a threshold value decides if the pixel differs enough to belong to the foreground. The threshold technique performs segmentation based on the pixel intensity levels. The various types of threshold methods such as local, global and adaptive are used for segmenting an image based on the various properties of an image include gray level, pixel values and neighborhood. If the threshold operation depends on gray levels, then global threshold is performed. Local threshold is performed based on both the gray level and the local properties of the image. Adaptive threshold is performed based on gray level, neighborhood and pixel coordinate's properties of the image .Thresholding is a basic fundamental step that applied on image for object representation, image analysis and visualization. This technique is used for partitioning the image pixels with respect to their intensity level i.e. in which a pixel lies according to the range of values, are allotted to the categories. It segmented the images that having lighter objects than background. It converts the multilevel image into binary image. The segmented region might be differ(either smaller or larger) from the actual image and the edges should not be connected [9]
Following are categories of thresholding.
Global Thresholding**:** It uses a single threshold value to separate foreground from background of an image. The threshold T depends on the global properties of an image by obtaining the information from it e.g. by using image histogram, texture properties.
Local Thresholding**:** It is used to determine whether the pixel is foreground background using the local information of an image by assigning threshold value to each pixel. The threshold T depends on the local properties of the image pixels and their neighbourhoods.
Dynamic Thresholding: In addition, T depends on the spatial coordinates (x,y).
Multilevel Thresholding**:** This thresholding method is effectively applied when the image is complex and contains multiple objects. It is also used to segment an image by selecting appropriate values of thresholds. Otsu‟s method is used for optimizing the threshold values

4.Watershed segmentation**: -** Watersheds provide a free object-splitting approach that is particularly useful for dividing objects that are in contact with each other. This process understands images as physiological surfaces in which the value of f (x, y) corresponds to elevation. The watershed algorithm finds the watershed basins and hill lines in the[27] image where water would theoretically collect. Suppose that there is a perforated hole at each regional low point and the natural terrain is submerged from below by water rising through these holes at a uniform rate. Pixels are marked as submerged as the water rises. Ultimately, water will rise to a level where two submerged areas become integrated.

V CONCLUSION

The role of image segmentation is very important in image processing. We have surveyed some of the image segmentation approaches. These techniques are mostly used to detect the points, edges, line detection, patterns etc. Each technique has been used based on the data and its quality. The techniques are mentioned in many domains like face identification, medical science to detect the cancerous cells from images, recognizing the pattern, roads, satellite image classification etc. In this paper, we existing relative study on the segmentation techniques of image processing which covers image classification, and segmentation algorithms.

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