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A REVIEW ON MARKER-CONTROLLED WATER SHED

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***Abstract*— The marker-based watershed segmentation algorithm is the main topic of this study. Because the watershed segmentation method over segments the image and produces noise, As a result, numerous academics have put forth various solutions to this challenge, but marker-controlled watersheds are by far the greatest option. Finding the gaps in the body of literature is the main goal of this paper. Reviewing the various segmentation strategies, it was discovered that marker-based segmentation is optimal in most situations since it labels the regions before segmenting them. Yet further research is needed to optimise the marking zones.**

***Keywords*— Markers, Marker Controlled Watershed, Image Segmentation.**

I. INTRODUCTION

Image segmentation is a technique that divides a digital image into various subgroups known as Image segments, which serves to simplify future processing or analysis of the image by decreasing the complexity of the original image. In plain English, segmentation is the process of giving pixels labels. Each pixel or piece of a picture assigned to the same category has a unique label. Take this issue as an illustration: It requires a photo to be provided as input for object detection. Instead of analysing the entire image, a segmentation algorithm-selected portion can be entered into the detector. This will stop the detector from processing the entire image, cutting down on the amount of time needed for inference.

IMAGE SEGMENTATION TECHNIQUES

A. Threshold based segmentation

A straightforward type of picture segmentation is image thresholding segmentation. It is a technique for converting an original image into a binary or multi-color image by applying a threshold value to the pixel intensity. We shall take into account the intensity histogram of each pixel in the image during thresholding. After that, we will choose a threshold to segment the image. For instance, we used a threshold of 60 when taking into account image pixels with a range of 0 to 255. Therefore, all pixels with values of 0 (black) or greater will be delivered, and all pixels with values of larger than 60 will be provided with a value of 255. (white). We can segment an image into sections based on the brightness of the object and background in an image containing an object and backdrop. But to separate an image into an object and a backdrop, this threshold must be precisely calibrated.

B. Edge Based Segmentation

Edge-based segmentation uses a variety of edge detection operators to locate edges in a picture. These borders identify areas in an image where the grey levels, colour, texture, etc. diverge. The degree of grey may vary as we walk from one area to another. Therefore, we can locate the edge provided we can identify that discontinuity. There are several edge detection operators available, however the generated image is an intermediate segmentation result and shouldn't be mistaken for the segmented image as a whole. In order to segment the image, we must execute additional processing on it. In order to limit the number of segments rather than chunks of small borders that can impede the process of region filling, additional procedures include integrating the edges segments that were obtained into one segment. To give the object's boundary a seamless appearance, this is done. In order to obtain the final segmented image, region-based or any other type of segmentation can be applied on the intermediate segmentation result obtained through edge segmentation.

C. Region-Based Segmentation

A region is a collection of related pixels that are joined together. Pixels can be similar in terms of brightness, colour, etc. A pixel must go by a set of predetermined rules in this sort of segmentation in order to be grouped with other pixels of a similar size. In the event of a noisy image, region-based segmentation approaches are recommended over edge-based segmentation methods.

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D. Clustering- Based Segmentation

Unsupervised machine learning algorithms include clustering. It is extensively used for picture segmentation. KMeans Clustering is one of the most used clustering-based segmentation methods. Segments in a coloured image can be created using this kind of clustering.

II. LITERATURE SURVEY

Ahmad el Allaoui and M'barek Nasri Labo Matsi, esto, b.p 473, University Mohammed I Oujda, morocco has presented an approach to "medical image segmentation by marker controlled watershed and mathematical morphology" (2012) [1]. The segmentation stage of the processing of pictures and interpretation is crucial. The border technique and the region approach are the two basic segmentation methods. Both strategies are combined in the segmentation by watershed. This is an effective method for quickly detecting both edges and areas. The watershed transform's main issue is over segmentation. In fact, this technique prefers to define the lines of the watershed transform where any local minimum gives rise to an area, making it sensitive to any local minimum in the image. In order to prevent this issue, strong solutions tailored to various issues have been put out in the literature: Either fewer minima should be calculated, or fewer areas should be calculated. After applying the watershed's spectral and spatial parameters, move on to either filtering procedures or combining the regions in accordance with similarity criteria. Markers have been employed to cut down on the number of regional minima. Image segmentation using the watershed technique is given in Section 2. Section 3 presents the suggested approach. The approach is validated in section 4, and experimental results are achieved using medical imagery.

K. Parvati, B. S. Prakasa Rao, and M. Mariya Das has presented an approach to "Image Segmentation Using Gray-Scale Morphology and Marker-Controlled Watershed Transformation" (2008) [2].

A fresh approach called segmentation is put forth for colour, grayscale MR medical pictures, and aerial images. The approach is based on morphology in grayscale. Watershed segmentation with function edge and marker control is part of the edge detection algorithm. It uses a straightforward algorithm created in MATLAB. For both contour detection and region-based segmentation, the watershed segmentation method has been shown to be an effective and quick method. In theory, ridges are necessary for proper segmentation in watershed segmentation; this requirement is frequently met in contour detection, where object boundaries are portrayed as ridges. By computing an edge map of the picture, it is feasible to turn the edges of the objects into ridges for region-based segmentation. In order to prevent oversegmentation, watershed is typically implemented through region growth.

Can Fahrettin Koyuncu, Salim Arslan, Irem Durmaz, Rengul Cetin-Atalay, Cigdem Gunduz-Demir has presented an approach to "Smart Markers for Watershed-Based Cell Segmentation" (2012) [3]. Automated cell imaging devices make it possible to analyse biological events at the cellular level quickly and accurately. Cell segmentation is typically the first stage in these systems, and it has a big impact on how well the succeeding system processes work. Contrarily, cell segmentation is a poorly stated problem that frequently requires the application of domain-specific knowledge to get good segmentations, even by human subjects. This is true of other image segmentation difficulties as well. The segmentation outcomes could be substantially enhanced by methods that can use this knowledge into their segmentation algorithms. In this study, they put out a fresh method for phase contrast microscopy's segmentation of live cells. For a marker-controlled watershed algorithm, for which the identification of its markers is crucial, this method adds a new set of "smart markers." The suggested method relies on defining the markers using domain-specific knowledge, specifically the visual properties of the cells. We test our strategy on 1,954 cells altogether. The experimental findings show that this strategy, which applies the suggested concept of smart markers, is fairly successful in distinguishing better markers from its competitors. A marker-controlled watershed algorithm's segmentation performance will benefit from this, in turn.

H.P. Ng, S.H. Ong, K.W.C. Foong, P.S. Goh, W.L. Nowinski has presented an approach to "medical image segmentation using k-means clustering and improved watershed algorithm" (2006) [4]. For the segmentation of medical images, they have suggested a methodology that uses improved watershed segmentation algorithm and k-means. The traditional watershed algorithm is frequently used for medical image analysis because to its benefits, such as its ability to consistently create a complete division of the image. Its disadvantages, however, include over-segmentation and sensitivity to erroneous edges. By first producing a primary segmentation of the picture using K-means clustering and then applying the modified watershed segmentation algorithm to it, they have overcome the shortcomings of the conventional watershed approach when it is applied to medical imaging. While the improved watershed segmentation approach uses post-segmentation merging on the initial partitions and automated thresholding on the gradient magnitude map to limit the amount of incorrect edges and over-segmentation, K-means clustering is an unsupervised learning algorithm. They demonstrated that our suggested methodology created segmentation maps with 92 percent fewer partitions than the segmentation maps produced by the typical watershed algorithm by comparing the number of partitions in the segmentation maps of 50 photos.

Pinaki Pratim Acharjya, Dibyendu Ghoshal has presented an approach to "A Modified Watershed Segmentation Algorithm using Distances Transform for Image Segmentation" (2012)[5]. An improved version of the watershed segmentation algorithm is provided in this research for picture segmentation using distance transform and image smoothing

approach. Due to the edge information that watersheds contribute, this approach enables better border localisation. As a result, it has been discovered that the suggested strategy can reduce excessive segmentation, which will ultimately make it easier for the machine to handle higher level processing at later stages. On coloured images taken from real life, the algorithm has been evaluated, and it has been discovered to produce acceptable segmentation results.

Pratik P. Singhai, Siddharth A. Ladhake has presented an approach to "Brain Tumor Detection Using Marker Based Watershed Segmentation from Digital MR Images" (2013) [6]. This study describes a technique for identifying brain tumours using magnetic resonance images. The image can be pre-processed so that watershed segmentation can be applied. Image scaling and grayscale conversion are included in pre-processing. Prior to applying segmentation, gradient magnitude must be calculated, and the sobel mask is used to do this. The tumour is found via watershed segmentation. The fundamental watershed technique is well known for being an effective morphological segmentation tool, but a significant drawback of the watershed transformation is that it creates a significant number of segmented regions in the image around each embedded local minimum. Marker-based watershed segmentation offers a solution to this issue. After region borders have been identified, connected component analysis extracts the areas that are not delineated by a boundary. Finally, a connected component analysis is used to calculate the tumor's area.

Mariela Azul Gonzalez, Gustavo Javier Meschino, Virginia Laura Ballarin has presented an approach to "Solving the over segmentation problem in applications of Watershed Transform" (2013) [7]. The Watershed Transform divides an image into the parts that make it up. This transform provides for the differentiation of complicated objects and is easily adaptable for application in other image types. For extremely complicated images, the Watershed Transform implementation actually results in over-segmentation. They have suggested two strategies in this research to address the over-segmentation issue. In order to link the oversegmented regions with statistical data, they establish internal markers using techniques based on clustering and fuzzy logic. Errors against manually segmented images were assessed, and ROC curves were established in order to specify the algorithm parameters and assess their effectiveness. The findings demonstrate that the suggested methods automatically adjust to the various properties of image objects. It is possible to increase accuracy. In picture segmentation where object complexity is large, this analysis will help.

Ying Sun, Guo-jin He has presented an approach to "Segmentation of High-resolution Remote Sensing Image Based on Marker-based Watershed Algorithm" (2008) [8]. The segmentation techniques used for common video or image are inappropriate for high-resolution remote sensing image because of the uniqueness of high resolution remote sensing image, such as Quickbird. They introduced a novel approach that is an enhancement to the Marker-based watershed algorithm in order to address the drawbacks of over-segmentation present in the watershed algorithm. To remove random noise from the high-resolution remote sensing image, median filtering is first done. Gradients are then created using mathematical morphology, and the image is segmented using the Maker-based watershed algorithm. The method is effective and can prevent over-segmentation when the image texture is homogeneous, but it also has certain limits when the image texture is highly complicated, according to segmentation studies done on Quickbird photos with various types of land cover types.

Xiaodong Zhang, Fucang Jiaa, Suhuai Luo, Guiying Liua, Qingmao Hu has presented an approach to "A marker-based watershed method for X-ray image segmentation" (2013) [9]. In hospitals, digital X-ray images are the most popular screening and diagnosing tool. It is preferable to remove image backdrop to make future analysis easier, such as quantification and computer-aided diagnosis (CAD). To separate the backdrop of X-ray pictures, a marker-based watershed segmentation method was suggested. The approach was composed of six modules: background extraction, watershed segmentation from markers, region merging, marker extraction, and gradient computation. The approach was tested on 100 clinical direct radiograph X-ray images. For comparison, the multiscale gradient-based watershed approach and manual thresholding were both used. A dice coefficient of 0.964 ± 0.069 was obtained using the suggested method, beating out the results obtained using manual thresholding (0.937 ± 0.119) and the multiscale gradient-based watershed method (0.942 ± 0.098). A variety of methods were used to reduce the computational cost, including merging regions based on basic grayscale statistics, removing a small number of pixels with the highest grayscale using percentile, calculating the gradient magnitude using straightforward operations, and reducing the number of markers. As a result, the processing time was more than one time faster than that of the multiscale gradient based watershed method, even for a 3072 3072 image on a Pentium 4 PC with 2.4 GHz CPU (4 cores) and 2G RAM. The suggested approach might be useful for diagnosing and quantifying X-ray pictures.

Y.Neeraja , CH.Jyoshna, K.Bhavani, D.Madhu Babu, M.V.Eswar Teja has presented an approach to "A Novel Skin Segmentation Based on Watershed Algorithm" (2020) [10]. In this study, the skin is segmented using the watershed method, which distinguishes between skin and non-skin regions using two levels of colour, i.e., two different hues, one of which stands for the skin region and the other for the non-skin region. The skin region of RGB (Red, Blue, Green) colour photographs is proposed to be segmented using the watershed segmentation technique based on the chrominance component of the YCbCr colour system. Given that the watershed algorithm is ineffective for directly segmenting colour images. Therefore, the input RGB image is first transformed to YCbCr in the pre-processing stage, and then the YCbCr is converted

to the grey image (Cb component). Following pre-processing, edges are found in the images using a variety of edge operators, such as Sobel, Canny, Prewitt, and Roberts, as well as the gradient magnitude, which also finds edges. The image is subjected to a watershed transform for segmentation, and a multi threshold technique is utilised to separate the skin region from other regions using two different colour levels.

III. GAPS IN LITERATURE

The items in the image are divided and labelled during image segmentation to facilitate subsequent analysis. This is often accomplished with the use of numerous picture segmentation algorithms. Each method has benefits and drawbacks of its own. With respect to a specific class of images, the efficacy of a given image segmentation algorithm is assessed. Typically, two or more approaches are combined to produce the required results for a given application. Application-specific factors include the objects that need to be segregated as well as the segmentation scale. It's vital to remember that:

1. There isn't a segmentation method that can be used on every image and be guaranteed to function.
2. No segmentation method is faultless.

However, the objective is to develop an ad-hoc method for high resolution aerial photo segmentation that advances picture analysis. For picture segmentation, a number of approaches have been developed recently. One of them is the watershed technique, which is used on images, but it has a number of shortcomings, such as over segmentation and sensitivity to noise, therefore to get around this, we'll utilise the marker-based watershed technique. With this technique, background and foreground places are "marked." Because it depends on the information included in the image itself, segmentation outcomes are typically quite arbitrary. The criteria that must be taken into account for the assessment of these outcomes varies from image to image. As a result, the process of evaluating the findings is exceedingly difficult. The issue is that it's challenging to define what constitutes appropriate segmentation. It heavily depends on the image's composition, among other factors. Lighting, noise, and texture can all significantly affect the outcomes. Too few (under segmentation) or too many regions being divided up into segments is a major issue with segmentation (over segmentation).

IV. CONCLUSION

The literature review on algorithms for watershed segmentation using markers is offered in this work. This paper's primary goal is to conduct a survey of current systems for marker-based watersheds. Reviewing the various segmentation methods, it was discovered that marker-based segmentation, which first marks the regions before segmenting them, is optimal in most situations. However, there is still study being done on optimising the marking regions. However, it was discovered that the bilateral filter is used by the majority of current approaches. However, as previously stated, the bilateral filter is unable to eliminate salt and pepper noise. In order to improve the performance of the suggested approach, we will incorporate a hybrid median filter with a marker-based watershed segmentation algorithm in the near future to reduce this difficulty.

V. REFERENCE

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