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RESEARCH ARTICLE

A GLANCE REPORT ON SEGMENTATION METHODS FOR IMPLEMENTING THERMAL IMAGE

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ABSTRACT

Thermography is a method of recognizing invisible heat radiation reflected by objects. Thermography produces thermal images that helps to identify intensity of color. The intensity of color helps to recognize meaningful object in the image, image segmentation plays a significant role to discover the region of interest in the image. The goal of segmentation is to decompose an image into different areas for further analysis and another is to perform a change of the representation of an image for faster analysis. On the basis of application, a single or a combination of segmentation techniques can be applied to solve the problem effectively. Segmentation is performed by mark off an object on an image using pixel - level or object - level properties of the object. These properties can be edges, texture, pixel intensity distinction inside the object, shape, size and orientation. There are many segmentation techniques are available that segments the thermal image. The segmentation techniques in particular are watershed segmentation, thresholding segmentation, clustering based segmentation and artifitial neural network. These segmentation technique uses algorithm namely global thresholding, watershed transform, k-medoids, k-means clustering, otsu thresholding, kapur thresholding. This paper involves the literature review on pioneering segmentation techniques and applicable algorithms used for segmentation of thermal images.

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INTRODUCTION

Human eyes are wonderfully complicated and intricate organs. They're made for seeing visible light. This light reflects objects, making them visible. A thermographic camera detects infrared light or heat invisible to the human eye. These characteristic makes the cameras incredibly useful for all sorts of applications, including security, surveillance and military. We can use thermal imaging devices to detect the heat signature of any object. Somewhere all matter emits heat, even very cold objects like ice. Thermal cameras more or less record the temperature or light of various objects and then assign each temperature a shade of a color, which is very useful to identify the objects form surrounding environment. Cold temperatures might have a shade of blue, purple, or green, while warmer temperatures can be assigned a shade of red, orange, or yellow. Some thermal cameras use a grayscale instead. Segmentation is essential for image analysis tasks. It is the critical component of image analysis. Some application need preprocessing of the image. Different techniques or tools are used for preprocessing of the image. Image segmentation is the process of segregating an image into parts or regions.

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This separation into parts is often based on the characteristics of the pixels in the image. The image segmentation is a very necessary part in image processing as segmntation helps to identify the region of interest in the image. But some specific segmentation methods are used for thermal image segmentation. Based on the applications requirement color palne and segmentation techniques are used. The remaining of this paper organized as follows. The section II describes the different segmentation techniques that are applied to the different application. Section III conclude different techniques of segmentation followed by acknowledgement and references.

Different Segmentation techniques: The goal of the image segmentation is to remove the noise at the background, By separating the object from the background the Region of Interest is get highlighted. Distinct segmentation techniques are described in this section.

Global Thresholding: Global thrsholding is technique in which a single threshold value is applicable to all the region in the image we term this to be global thresholding in image processing, It means pixel value lower than threshold will be set 0 and higher will be 255. Global thresholding is used when the pixel values of background are fairly consistent in over the entire image. Recently Optimum global thresholding, global

thresholding based on boundary selection these kind of technique is used. Carlos et al. [1] proposed the method of thresholding. In this method of segmentation black pixel replaced with each pixel in image, if the intensity of image is smaller than some fixed constant U, or a white pixel if the intensity of image is more than the constant U. In the experiment U is selected with value 0, For removing false positive regions. After thresholding, the objects in the image are labeled. If the number of objects (N) in image is unity, i.e. N = 1 the leaf is categorized as healthy leaf and if the number of objects is more than unity, i.e. N > 1 the leaf is categorized as unhealthy leaf. In the preprocessing of the image the H and V value of the HSV color space of the image are get separated for clear view of the diseased part. This experiment is performed on cherry leaves to identify the disease called powdery meldew. The threshold is applied using otsu adaptive method and some post processing tools are applied and the leaf disease is extracted. This algorithm proves with 99% accuracy.

Watershed Transform: Segmenting an image by the watershed transformation is a two-step process, first step is Finding the markers and the segmentation criterion, the criterion or function which will be used to split the regions - it is most often the contrast or gradient and second step is performing a marker-controlled watershed with these two elements. Akash Singh et al. [2] have proposed the image segmentation based on watershed transform. It is an efficient technique to determine to area of interest in an image. When a landscape is flooded by water with holes in local minima, catchment basins will fill up with water. The water will stop filling when apex of landscape has reached as a result image is partitioned into regions or basins dissevered by dams called watershed ridge lines. The catchment basins correspond to regions of an image and watershed ridge lines correspond to the edges of an image. Marker approach is used to avoid problem of over-segmentation in watershed transform [6]. Watershed transform is a popular technique utilized for image segmentation. Application of watershed transform technique in thermal images gives the desired pseudo-coloured segmented thermal image. The heated areas in thermal images are mapped with each of the grey levels of a black and white image into an assigned color. For better analysis of segmented thermal image this algorithm is used. When watershed transform is directly applied to thermal images without any pre-processing then thermal image leads to over-segmentation. Watershed transform implement marker based approach to reduce over-segmentation. This algorithm is performed on infra-red thermal images of solar panels and battery for visualization of heat. The features extracted from binary image of heated portions for solar panel and battery are obtained in terms of area, perimeter, major axis length and minor axis length, which are measured in image pixels. The thermal images show heated area only in terms of temperature but in order to know the depth of heat image segmentation is used. The extracted features like area, perimeter, major axis and minor axis are also calculated (in terms of image pixels) from segmented binary image to indicate seriousness of heated portion of component. The result come across to the reduction in over segmented area may come with 85% accuracy.

K-means clustering: *K* -means clustering algorithm is an unsupervised algorithm. Using this technique interest area is fragmented from the background. K-Means is a least-squares partitioning method that segregates an accumulation of objects into K groups. The algorithm iterates over two steps. First step is to compute the mean of each cluster. The second step is to compute the distance of each point from each cluster by computing its distance from the corresponding cluster mean and assign each point to the cluster it is nearest to. In K-means clustering a membership function is used for distance measure and it lies approximately between 0 and 1. Each data object belongs to only one cluster or do not belong to the cluster is valued with 0 and if belong to the cluster is assigned to 1, designate that whether the data point belong to the cluster or not. In the subsequent steps, the data points that belong to a set are moved towards the most proximate centroid so that no point remains unmoved. Yung-Yao et al. [3] have proposed an approach on usage of k-means clustering method. In this approach the initial image segmentation is performed in the grayscale thermal image. In this segmentation method a feature space is constructed based on the pixel value. Classification of all samples in the feature space into K Clusters is performed by using the K-means algorithm. The value of K is set within the range of three to six times the desired number of groups. For example, in the case of two foreground objects and one background, the desired number is three. After that each pixel in the thermal image is labeled using the Kmeans result. The thermal image labeled by a cluster index based on temperature information. K-means clustering algorithm is performed the maximal similarity-based region merging this method is being used to reduce the over-segmentation problem, to successfully segment the object from the background in a thermal image. The execution time of K-Means algorithm is depends on volume of data. The K-means clustering algorithm is resulted with 50% accuracy.

K-medoids: K-medoid minimizes the absolute distance between the selected centroid. It is based on centroids (or medoids). The medoids are culled out of the cluster elements. Centroid as its name says that, it is the most centrally located object of the cluster, with minimum sum of distances to other points. A medoid is an entity in a cluster. Hence, medoid has the average disparity is minimal among the objects in the cluster. The design of algorithm is first compute the K representative objects which are known as medoids. Each object of the data set is assigned to the nearest medoid, only if set of medoids discovered. So, K-medoid algorithm has greater average time for normal distribution as compare to the average time for the uniform distribution. The aspect of this algorithm is that it requires the distance between every pair of objects only once, so that it will uses this distance at every stage of iteration. Arti N et al. [4] propound a k-medoids segmentstion method for detecting the leaf disease by identifying the region of interest. In k-medoids segmentation method images are segmented using k-medoids clustering methods. K-medoids clustering is partitioning based clustering method. K-medoids also known for PAM (Partition around medoids). In Partition around medoids every cluster is represented by one of the objects in the cluster. K-medoids reduce the noise and outlines; because a medoids is less influenced by outlines or other extreme values than a mean. K-medoids performs reasonably better than the K-Means algorithm. Compared to K-means, k-medoids is not sensitive to noisy data, outlines and effective for gray scale too. The execution time of K-medoids algorithm is better for large data. This method is applied on leaf images to detect the diseases or identify the infected areas of the diseases on the leaf. The diseases experimented are early scorch, cottony mold, late scorch, brown spot, Bacterial-

Fungal. The experimental results indicate that it support an accurate detection of leaf diseases with 60% accuracy.

Otsu thresholding: This type of thresholding is global thresholding. The intensities of the pixels are stored in an array. By using the total mean and variance threshold value is calculated. The threshold value of each pixel is set to either 0 or 1 i.e. background or foreground. Thus here the vicissitude of image takes place only once. It is used to mechanically execute histogram shape-based image thresholding or, the decrease of a gray level image to a binary image. The algorith m take for granted that the image to be thres holded consists two groups of pixels or bi-modal histogram (for instance, foreground & background) and then evaluates the optimum threshold partitioning those two classes so that their joint spread (intra-class variance) is negligible .The expansion of the basic method to multi-level thresholding is addressed to as the Multi Otsu method. Salvador et al. [5] propound the most popular thresholding technique proposed by Otsu [9]. This unsupervised technique segments the image by maximizing the difference between various classes. Otsu's thresholding method iterates through all the possible threshold values and calculate a measure of spread for the pixel levels each side of the threshold pixels are either foreground or background. The main goal is to find the threshold value by calculating the sum of foreground and bachground. Otsu's thresholding is used with other segmentation technique based on the application requirement.

Kapur thresholding: *Entropy based optimization methods namely maximization of entropy [6] and minimization of cross entropy methods [7] are the proficient image segmentation techniques. The maximum entropy criterion approach is introduced by proposed by Kapur et al. [8] named as Kapur's entropy. Kapur et al. [8] introduced the entropy-based method to maximize the entropy of the segmented histogram so that every separate region has a more centralized distribution. At the earlier stage, bi-level thresholding method is presented to identify the thresholds in the histogram to extract the object from background. Salvador et al. [5] propound an entropy-based method. In this method, the selection criteria suitable for threshold is the maximization of the Kapur's entropies based on gray-level histogram. Kapur's original method is very time-consuming due to the inefficient formulation of the entropy and the exhaustive search in multilevel thresholding. In entropy based approach, the overall entropy is increased by optimizing threshold in segmentation process. It is used to find optimal threshold values is the one presented by Kapur [8]. Generally, each entropy is computed independently based on the particular threshold value. The method is based on the probability distribution of the image histogram and the entropy. This method is use to analyze the thresholding problem of FLIR image. Statistical data of the Kapur's method applied to the selected evolutionay computation techniques.. The analysis of the result is a higher value of the mean of the objective function which shows a better segmentation. Kapur thresholding is avery rarely used technique. The entropy method is broadened to multilevel thresholding*

Conclusion

This literature describes the various segmentation techniques used for segmentation of thermal image. Thermal imaging helps to identify the defects in the objects. To clarify the region of Interest of object the segmentation method is applied. In this research the segmentation methods may get used for thermographic image. Based on threshold value, gray scale image, Color image the segmentation method gets vary. This research work helps to identify the suitable segmentation method for thermal images. The clustering segmentation techniques K-means and k-medoids – both the methods find out clusters from the image. K-means drawback is sensitivity to noisy data outlines, where the k-medoids is able to overcome these kind of problem. Among the Otsus image thresholding techniques, Otsu's method which works on the principle of between-class variance and Kapur's method which works on the principle of entropy are proved to be two best thresholding methods. In order to choose the optimal threshold values, maximization of between class variance of gray levels of histogram is used in Otsu's method whereas maximization of the histogram entropy is used in Kapur's method. But segmentation techniques proves to be good are global threshoding used with otsu and watershed transformation techniques are resulted with accuracy and might be the most suitable techniques for thermal image segmentation based on their calculated accuracy level.

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