INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, ALLAHABAD

IIVP632C PROJECT

Multiple Object Detection and Segmentation of an image using Histogram of an image.

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ABSTRACT

Segmentation refers to the process of partitioning a digital image into the multiple segments. The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and easier to analyze. Multiple object Detection is the process to identify the objects present in the image from its background. For this, analysis of image histogram can be done,in order to cluster out different pixels of image on the basis of their similarity to identify the background from the foreground of an image.

Keywords:

Object Detection, Segmentation, Background Detection, Histogram Thresholding, Otsu Method, K-Mean Clustering, Global Thresholding.

INTRODUCTION

Image thresholding is an important technique for image processing and pattern recognition. Thresholding is one of the most commonly used image segmentation technology.Its characteristics are simple operation, and the segmentation results are of series of continuous regions. Thresholding based image segmentation requires finding a threshold value T that establishes the "border" among graylevel image range corresponding to objects and a range equivalent to background. After thresholding the graylevel image is changed to binary. There exist algorithms that use more than one threshold value, which enables to assign pixels to one of a few classes instead of just two.We have approached towards the problem with the help of Otsu Method along with image histogram, making it run recursively until all the objects have been identified.Further, we also have used Global Thresholding using histogram and K-Means method for comparison.

Methodologies

A) Global Thresholding:

Global (single) thresholding method is used when there the intensity distribution between the objects of foreground and background are very distinct. When the differences between foreground and background objects are very distinct, a single value of threshold can simply be used to differentiate both objects apart. Thus, in this type of thresholding, the value of threshold T depends solely on the property of the pixel and the grey level value of the image. This method only applies for single object detection.

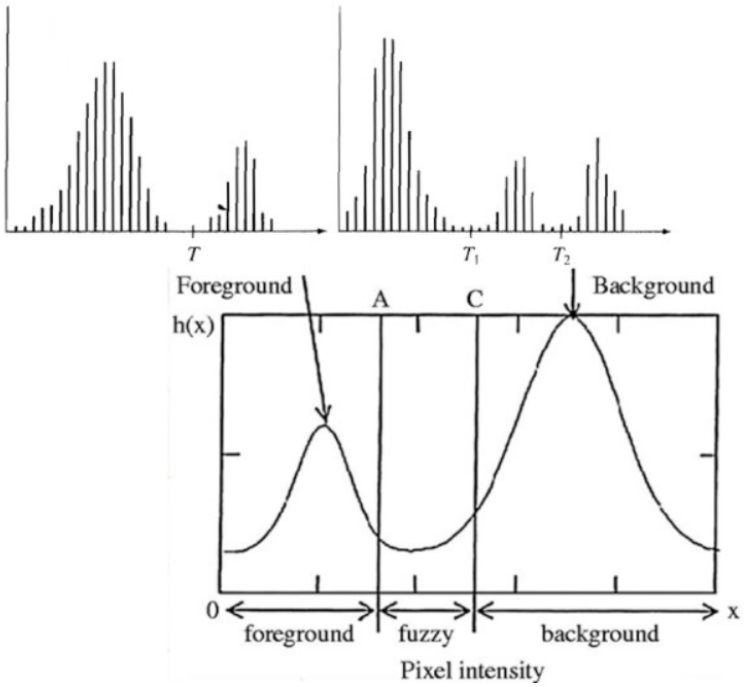

FIGURE 1: Intensity histogram that can be partitioned using Global Thresholding

B) Otsu's Method:

In image processing, segmentation techniques can be generally categorized into two frameworks, edge-based and region based approaches. As a segmentation technique, Otsu's method is widely used in pattern recognition, document binarization, and computer vision. Otsu's method searches for a threshold that minimizes the intra-class variances of the segmented image and can achieve good results when the histogram of the original image has two distinct peaks, one belongs to the background, and the other belongs to the foreground or the signal. The Otsu's threshold is found by searching across the whole range of the pixel values of the image until the intra-class variances reach their minimum. As it is defined, the threshold determined by Otsu's method is more profoundly determined by the class that has the larger variance, be it the background or the foreground.

C) Our Approach (modified Otsu's method)

To detect multiple object, we have used the concept of detecting more than one local minima that are present in the image histogram when multiple objects are present.Firstly, we detect background with the help of histogram by simply looking at the pixel with highest grey-scale value frequency. Then, on the first iteration, after finding the threshold using variance, we detect the first object, display it and then merge it with the background ,thus resulting in a new histogram and hence again calling for the second iteration and so on. This process will be terminate only when no more further objects can be detected or if we have defined priory number of iterations that will occur.

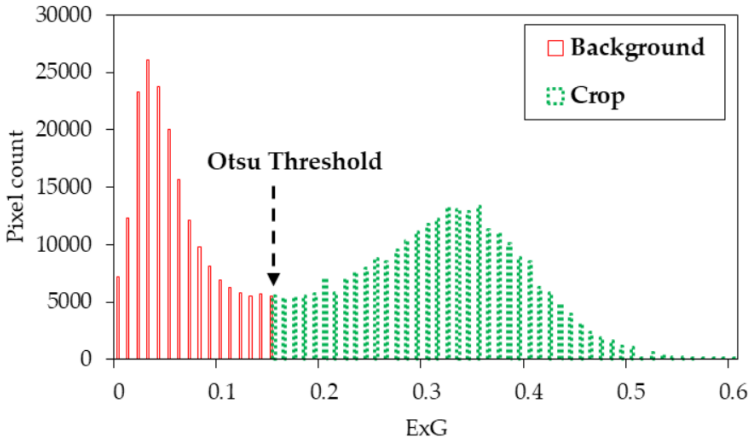

FIGURE 2: Threshold detected using Otsu's method

D) K-Means Thresholding:

K-Means algorithm is an iterative algorithm that tries to partition the data set into K pre-defined distinct non-overlapping subgroups (clusters) where each data point belongs to only one group. It tries to make the inter-cluster data points as similar as possible while also keeping the clusters as different (far) as possible. It assigns data points to a cluster such that the sum of the squared distance between the data points and the cluster's centroid (arithmetic mean of all the data points that belong to that cluster) is at the minimum. The less variation we have within clusters, the more homogeneous (similar) the data points are within the same cluster.We have used this method for comparison with global thresholding and Otsu's method.

ANALYSIS AND COMPARISON

Methods	Advantages	Disadvantages
Global Thresholding	Computationally inexpensive, fast and simple for implementation	Selection of threshold is crucial, wrong choice may result into over or under segmentation.
Otsu's method	Does not require prior information of the image.	For an image with broad and flat valleys or without any peak, it doesn't works well.
Our approach	Can detect multiple objects without expensive computations.	Fails to detect multiple object when there is overlapping present in image histogram.
K-Means method	Eliminates noisy spots and reduces false blobs.	Difficult to predict k with fixed number of clusters.

CONCLUSION

On application of the above methods on the same data, we have observed the following results :-

1. Global Thresholding method is easy to implement and requires less computation. But it is less accurate in selection of threshold, which results in poor performance in presence of noisy data.

2. Otsu's method is a extension of global thresholding method. It is easy to implement and computationally less expensive. But Otsu's method works on assumption of binary classes, so multilevel segmentation is slightly difficult to achieve with this method. We need to modify it in an iterative manner in order to achieve the detection of multiple objects. There is further scope of work in this method to make it more efficient.

3. K-Means works by partitioning the data into K pre-defined distinct non-overlapping classes. This method is difficult to implement and requires high amount of computation. But as it divides the data in K classes, it gives good results for multilevel segmentation and noisy data.

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