Image Segmentation and Recognition

A. Abirami Shri
SCSE
VIT University
Vellore, TamilNadu, India.

E. Aruna
SCSE
VIT University
Vellore, TamilNadu, India.

Ajanthaa Lakkshmanan
SCSE
VIT University
Vellore, TamilNadu, India.

ABSTRACT
Image segmentation refers to segmenting or dividing an image which corresponds to objects or different parts of an object. The segmentation is carried out using K-means clustering algorithm, which is a fast and efficient way to segment an image. K-means is one of the most widely used algorithm. We have implemented a color based image segmentation using K-means clustering technique. The K-means algorithm is an iterative technique used to partition image into K clusters. It improves the process of segmentation with respect to both time and quality.

After segmentation of the image, Edge Reocgnition in an image is done,which refers to the recognition of the edges separately of the image. Edge recognition is carried out using Sobel Filter, which is used to detect edges based on applying a horizontal and vertical filter in sequence. In this project, Both filters are applied to the image and summed to form the final result.

Keywords
Segmentation, K-means clustering, Sobel Filter

1. INTRODUCTION
1.1 Segmentation
Image segmentation is the splitting up of an image into regions or classes, which direct to different entities or fractions of the entity. Every pixel in an image is allocated to one of a number of these categories. A good quality segmentation is one in which the pixels in identical class have analogous grayscale of multivariate values and form a connected region and neighboring pixels which are in different classes have disparate values.

Segmentation is often the pivotal step in image analysis. It is the stage, at which we shift from considering each pixel as a unit of observation to working with objects (or) parts of objects in the image, comprising of many pixels. If segmentation is performed properly then all other stages in image analysis are made simpler. But, as we shall see, accomplishment is often only partial when automatic segmentation algorithms are used. However, manual intercession can usually trounce on these problems, and by this stage the computer should already have done most of the work.

Segmentation algorithms can either be applied to the images as originally traced or after the application of transformations. There are three universal approaches to segmentation, named thresholding, edge-based methods and region-based methods.

1.2 K-means Clustering
K-means clustering is a method of organizing items into k factions (where k is the number of pre-chosen factions). The categorizing is done by curtailing the sum of squared distances (Euclidean distances) between items and the corresponding centroid.

A non-hierarchical technique of forming fine clusters is to stipulate a preferred number of clusters, say, k, then allocate each case (object) to one of k clusters so as to reduce the measure of dispersion within the clusters. A very familiar measure is the sum of distances or sum of squared Euclidean distances from the mean of each cluster. The problem can be identified as an integer programming problem but because solving integer programs with a huge number of variables is time taking, clusters are often worked out using a quick, heuristic scheme that normally generates good (but not necessarily most favorable) solutions. The k-means algorithm is one such technique.

K-Means Training is initiated by a solitary cluster with its center as the mean of the data. This cluster is divided into two and the means of the new clusters are repeatedly trained. These two clusters are further divided and the same method continues until the particular number of clusters is achieved. If the previously mentioned number of clusters is not a power of two, then the nearest power of two greater than the number specified is taken into consideration and then the slightest significant clusters are discarded and the remaining clusters are again trained iteratively to obtain the ultimate clusters.

1.3 Sobel Filter
The Sobel operator is employed in image processing, predominantly in edge detection algorithms. Precisely, it is a discrete differentiation operator, calculating an estimate of the gradient of the image intensity function. At every point in the image, the outcome of the Sobel operator is either the corresponding gradient vector or the norm of this vector. The Sobel operator is founded on convolving the image with a small, discrete, and integer valued filter in horizontal and vertical direction and is therefore comparatively inexpensive in terms of computations. On the contrary, the gradient estimation that it generates is relatively basic, in particular for high frequency disparity in the image.

Since the intensity function of a digital image is only determined at distinct points, derivatives of this function cannot be defined unless we presume that there is an underlying uninterrupted intensity function which has been sampled at the image points. With some further supposition, the derivative of the intensity function can be evaluated as a function on the sampled intensity function which is the digital image. It is found that the derivatives at any exacting point are functions of the intensity values at all image points. Nevertheless, estimates of these derivative functions can be evaluated at lesser or larger degrees of precision.

The Sobel operator embodies a rather imprecise estimate of the image gradient, yet is of adequate quality to be of realistic use in many applications. More specifically, it employs intensity values only in a 3×3 region about each image point to estimate the analogous image gradient, and it utilizes only integer values for the coefficients which influence the image intensities to generate the gradient approximation.

2. LITERATURE SURVEY

Clustering algorithms have effectively been used as a digital image segmentation practice in various arena and applications. Nonetheless, those clustering algorithms are only applicable for particular images such as medical images, microscopic images etc. In this thesis, we put-forth a novel clustering algorithm called Image segmentation using K-mean clustering for pronouncing tumor in medical application which could be applied on widespread images and/or specific images (i.e., medical and microscopic images), acquisitioned using MRI, CT scan, etc [3].

Wide-ranging color image segmentation is a challenging and chief issue in image processing associated applications. Nonetheless, few systems successfully tackle this problem within a wide range of images. As a rapid segmentation process, K means centered clustering is employed in feature space first. Then, in image plane, the spatial constrains are embraced into the hierarchical K-means clusters on every level. The two processes are carried out alternatively and repeatedly. Also, an effectual region amalgamation method is proposed to deal with the over segmentation [5].

This thesis presents a novel advance to image segmentation by applying k-means algorithm. The K-means clustering algorithm is one of the most extensively used algorithm in the literature, and several authors successfully evaluate their new proposal against the results obtained by the k-Means. This paper puts forth a color-based segmentation method that uses K-means clustering technique. The k-means algorithm is an iterative method used to divide an image into k clusters. The general K-Means algorithm generates precise segmentation results only when applied to images defined by homogenous regions in terms of texture and color since no local constraints are applied to entail spatial continuity. To begin with, the pixels are grouped based on their color and spatial features, where the clustering process is achieved. Then the clustered blocks are amalgamated to a certain number of regions. This technique thus provides a feasible innovative solution for image segmentation which may aid in image retrieval [1].

This paper projects an innovative approach for image segmentation by applying Pillar-Kmeans algorithm. This segmentation procedure comprises a new mechanism for clustering the elements of high-resolution images in order to improvise exactness and decrease computation time. The scheme applies K-means clustering to the image segmentation after optimized by Pillar Algorithm. The Pillar algorithm takes into account the pillars' placement which should be positioned as far as possible from one another to endure the pressure distribution of a roof, similar to the number of centroids amongst the data distribution. This algorithm is capable of optimizing the K-means clustering for image segmentation with respect to exactitude and computation time. It assigns the initial centroids' positions by computing the accumulated distance metric between every data point and all previous centroids, and then picks the data points which have the maximum distance as new initial centroids [2].

This study aims to segment objects using the K-means algorithm for texture features. Firstly, the algorithm changes color images into gray images. This paper illustrates a novel method for the extraction of texture features in an image. Then, in a group of analogous features, objects and backgrounds are differentiated by using the K-means algorithm. In conclusion, this paper proposes a new object segmentation algorithm using the morphological technique. The experiments described include the segmentation of single and multiple objects featured in this paper. The region of an object can be accurately segmented out. The results can help to perform image retrieval and analyze features of an object, as are shown in this paper [3].

In this paper, two algorithms for image segmentation are analysed. K-means and an Expectation Maximization algorithm are each considered for their momentum, complexity, and efficacy. Implementation of each algorithm is then discussed. Finally, the experimental outcomes of each algorithm are presented and discussed [4].

In this paper, a method for edge recognition in image processing is introduced after K-means clustering for the segmentation of an image, which is rrelatively inexpensive in terms of computations. On the contrary, the gradient approximation that it produces is rather crude, especially for high frequency variations in the image. Implementation of this operator is done and then the final image is generated [6].

Edge Detection using sobel operator is mainly done by two different filters that is horizontal and vertical filters, which gives an image a different output depending upon the filter. Horizontal edges (or lines) are identified in output of horizontal filter and vertical lines in output of vertical filter, as specified in their names. After this, a final image is produced combining both horizontal and vertical filters [7].

3. DESIGN

The design of the project is very cost effective due to the use of segmentation methods like K-mean clustering and Sobel Filter. This method is low cost and time efficient. Instead of feature extraction of every pixel which is a cumbersome process we group them in clusters. K-means improve the segmentation process both with respect to quality and time whereas Sobel Filter is relatively inexpensive in terms of computations.

4. METHODOLOGY

The basic aim is to segment colors in an automated fashion using L*a*b* color space and K-means clustering. The process can be summarised in following steps:

1. READ THE IMAGE
   Read the image from the source which is in JPEG format.

2. CONVERT IMAGE FROM RGB COLOR SPACE TO L*a*b* COLOR SPACE
   Number of colors one sees in an image ignoring the brightness. We can easily visually distinguish these colors from one another. The L*a*b* color space enables us to quantify these differences. The L*a*b* color space is derived from the CIE XYZ tristimulus values. The L*a*b* space comprises of a luminosity layer 'L*', chromaticity-layer 'a*' indicating where color falls along the red-green axis, and chromaticity-layer 'b*' indicating where the color falls along the blue-yellow axis. All of the color information is in the 'a*'

and 'b*' layers. We can measure the difference between two colors using the Euclidean distance metric. Convert the image to L*a*b*color space.

3. CLASSIFY THE COLORS IN 'A*B*' SPACE USING K-MEANS CLUSTERING
   Clustering is a way to separate groups of objects. K-means clustering treats every object as having a position in space. It finds partitions in such a way that objects within each cluster are as close to each other as feasible, and as far from objects in other clusters as possible. K-means clustering demands that you detail the number of clusters to be partitioned and a distance metric to quantify how close two objects are to each other. As the color information subsists in the 'a*b*' space, your objects are pixels with 'a*' and 'b*' values.

4. LABEL EVERY PIXEL IN THE IMAGE USING THE RESULTS FROM K-MEANS
   For every object in our input, K-means returns an index corresponding to a cluster. Address each pixel in the image with its cluster index.

5. CREATE IMAGES THAT SEGMENT THE IMAGE BY COLOR
   Deploying pixel labels, we have to disconnect objects in image by color.

6. CREATE THE IMAGE THAT RECOGNIZES THE REAL IMAGE BY HORIZONTAL FILTER.
   Using horizontal filter the image is recognized in horizontal levels.

7. CREATE THE IMAGE THAT RECOGNIZES THE REAL IMAGE BY VERTICAL FILTER.
   Using vertical filter the image is recognized in vertical levels.

8. CREATE THE FINAL IMAGE THAT RECOGNIZES THE REAL IMAGE BY BOTH VERTICAL AND HORIZONTAL FILTERS.
   Thus the final image is created by using both the filters.

5. SCREENSHOTS

First 8 images represent the image segmentation by k-means clustering and last 3 images represent the edge recognization by Sober-operator

Fig 1. Original Image

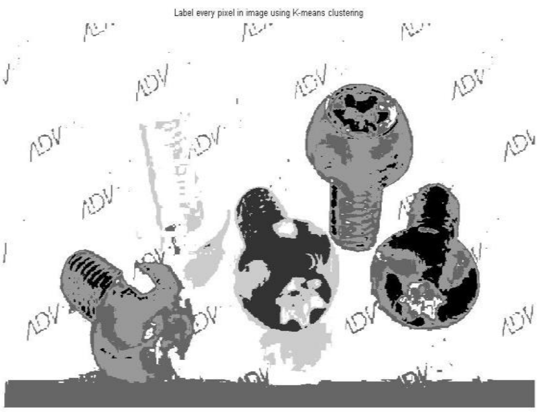

Fig 2. Label every pixel in image using K-means clustering

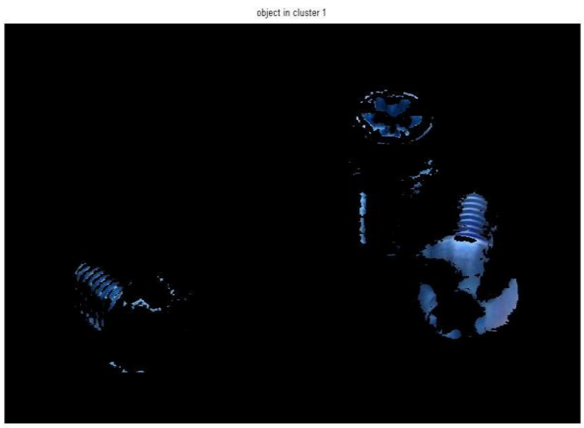

Fig 3. Object in Cluster1

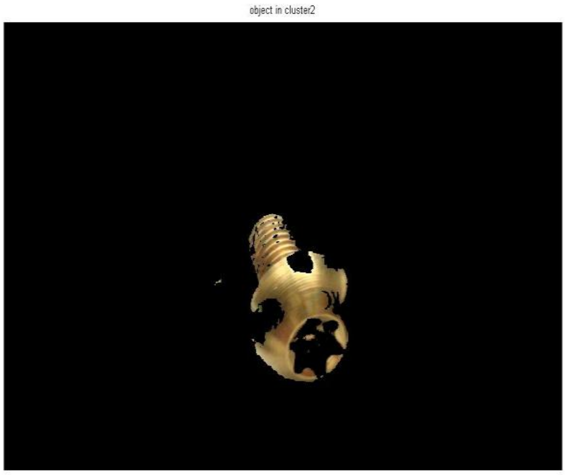

Fig 4. Object in Cluster 2

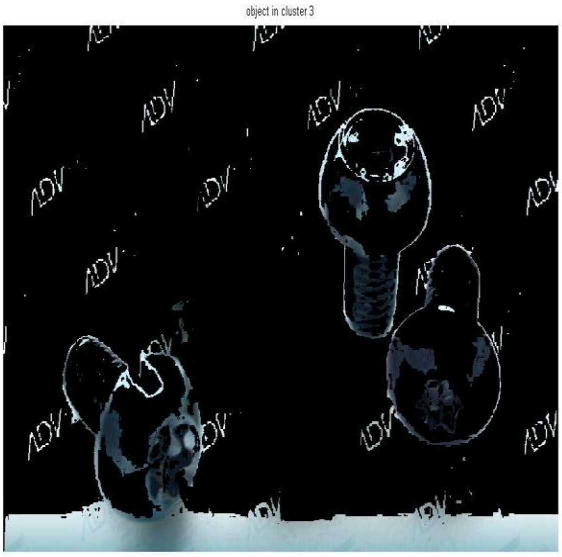

Fig 5. Object in Cluster 3

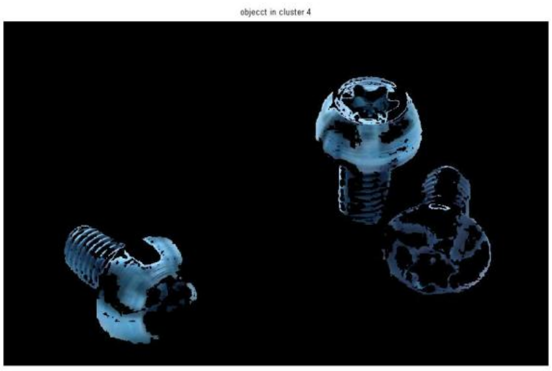

Fig 6. Object in Cluster 4

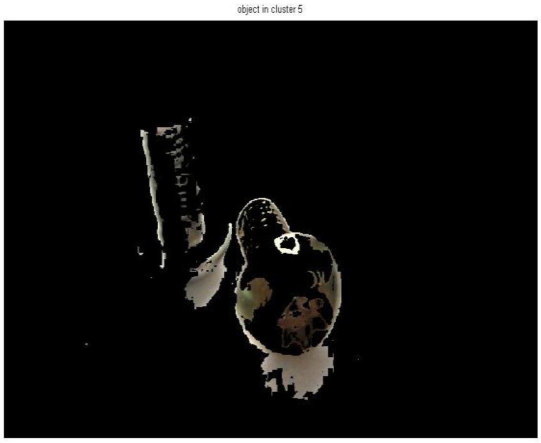

Fig 7. Object in Cluster 5

Fig 8. Object in Cluster 6

Fig 9. Horizontal edge recognition

Fig 10. Vertical edge recognition

Fig 11. Edge recognition

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