COLOR IMAGE SEGMENTATION USING K-MEANS CLASSIFICATION ON RGB HISTOGRAM
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ABSTRACT:-The paper presents the approach of Color Image Segmentation Using k-means Classification on RGB Histogram. The k-means is an iterative and an unsupervised method. The existing algorithms are accurate, but missing the locality information and required high-speed computerized machines to run the segmentation algorithms. The proposed method is content-aware and feature extraction method, which is able to run on low-end computerized machines, simple approach, required low quality streaming, efficient and used for security purpose. It has the capability to highlight the boundary and the object. The proposed approach used the unsupervised clustering technique in the paper in order to detect the image feature extraction, color and region identification. The proposed technique has solved the missing of the locality information problem and presents the image in distinct colors and clearly identify the objects of the image. At first, the image is read and then it is adjusting in a standard size. In another step the pixels are divided into different clusters based on their color, texture and region, then cluster values are calculated by using the k-means clustering algorithm. If there is no pixel remaining, in another phase all the clusters are combined and finally the image is presented in the form of segments such as segmented image.

Key Words: Image, Digital image, Image segmentation, Clustering, K-means algorithm

1. Introduction:
The image segmentation is a technique of image processing which divides the image into segments depending on the image measurement, i.e. color, gray level, texture, motion or depth. The basic purpose of segmentation is to extract the attributes from the images. There are three methods for segmentations i.e. Thresholding, Edge-based method and Region-based method. Thresholding is the image segmentation technique, which is used to isolate the foreground image from the background, and to convert the gray level image into a binary image by selecting the suitable Threshold value $T$ as mentioned in [1]. A single image is composed of a group of pixels. There are many categories of pixels. Therefore, those pixels belong to the same category have similar values, and must be different from other categories. So, within a cluster same group of pixels are combined. Then cluster values are calculated based on features selections. The method is called k-means or (Lloyd’s algorithm). After cluster value calculation, three histograms have been used in RGB. Peak calculation is used for each histogram and calculate the peak value in Red histogram, Green histogram and Blue histogram.

2. Objective of The Paper:
The main problem in the image segmentation is that how to segment an image in an efficient way using locality information and other visual features. The aim of this work is to find an accurate way which analyzes each and every pixel of the image and to extract the Region of Interest (ROI) from the image.

3. Background:
An image is the composed of pixels (picture elements) which are the combination of rows and columns. Image processing is the study of an algorithm that accepts an image as an input and produces the output of the image. A digital image is the combination of digital values called picture-elements or pixels that are mostly organized into a two-dimensional matrix. A digital image is used as an input to the digital computer. The term ‘Digitizer’ is used to convert a digital image into numerical form i.e. digital image. Examples are image scanners, digital cameras and video frame grabbers, etc. The first digital image was used in the newspaper agency at 1920s [2]. Digital image processing (DIP) improves the image quality and
removes noise. DIP is a technique which enhances the features of interests in the image, and then extracts the relevant information about the scene from that enhanced image. A digital image is the combination of pixels, which are stored in digital memory and processed from any digital machine. Binary image is made from the combination of two colors White and Black. The representation of White color is 1 and Black is 0. Binary image is used in industry and for edge detection. The term ‘segmentation’ means to divide anything into small parts and image segmentation means to divide the image into sub parts in order to separate the object from the background and to extract the Region Of Interest (ROI). Image segmentation is the basic part of image analysis, i.e. to analyze each and every part of the image and to collect the data about the image [3]. Clustering is the process that classifies the similarities among the objects which belong from the same group and dissimilarities about the objects that are associated from other groups. The clustering approach is the compression technique which reduces the size of the large dataset. K-means (Macqueen, 1967) is the nonhierarchical clusters, which are used for the cluster value calculations. K-means is the cluster analysis method, which calculates the value of the clusters by using the kmeans function. Cluster mean is a term that is used for the centroid of the clusters [4]. K-means clustering techniques calculate the mean value by reducing the distance between the centroid and values. K-means clustering is the statistical and data mining techniques, which is used for cluster analysis and then divide the n data points with k clusters. The clustering procedure first extracts the features of the image and then to combine similar pixels in one group and dissimilar pixels in another group. The proposed approach has been tested for 100 images.

4. Related Work:
The color image segmentation techniques are based on monochrome images, which has different methods i.e. the histogram, thresholding, characteristics of feature clustering, the edge detection, region-based methods, fuzzy-based techniques and neural techniques so on and so forth. Normally the gray level pixels of image segmentation are extended in color image segmentation techniques, i.e. the histogram, thresholding, clustering, region growing, edge detection, etc. These methods are used for color image segmentation in order to obtain the final segmentation. However, that method has some problems. The first is that how to judge the information about the colors for each pixel of the whole image because the three major components of the color has been converted into multispectral image and human cannot perceive the correct color information and the second problem is encounter about that how to select the best color for image segmentation [5]. There are so many image segmentation algorithms, but a problem is that how to select the best algorithm among them. So the problem for selection of best segmentation algorithm has been resolved by the development of a prototype expert system for best algorithm selection has been developed. [6]. Zhang, et al. Proposed the concept of general framework called “Image Engineering” has been developed for imaging techniques, which has three layers: Low Layer, Middle Layer and High Layer. These layers have been shown in the figure-1 [7].

![Image Engineering and Image Segmentation](image)

In order to improve the performance of image segmentation techniques and to introduce new constraint techniques, here we have the new algorithm has been introduced called Constrained Satisfaction Neural Networks (CSNN) [8]. Here we have a novel concept have been introduced image segmentation which is based on functional model that are composed of five elements are called the iterative model. The functional model based on segmentation operator that control the whole segmentation process and have five basic segmentation elements. The five elements are the Measure, Criterion, Control, Modification and Stop. This segmentation technique creates more enhancements in the field of segmentation [9]. P. Arbelaez et al. [10] proposed the “Semantic Segmentation using Regions and Parts” which used the PASCAL segmentation technique. P. Arbelaez et al. [11] explained the Contour Detection and Hierarchical Image Segmentation" by using the genetic machinery in order to transform the contour detection into the global hierarchical trees. Here is a new concept has been introduced by Yang et al. [12] called the Compression-based texture messages (CTM) algorithm. In this process the author will first detect and then will extract the color-texture
features at pixel level by setting the intensity level within the $7 \times 7$ for the Commission Internationale d’Edairage (CIE) color image information lab. [13]. Dhanalakshmi et al. presented a new approach of image segmentation by developing system architecture. The system architecture first takes an image as input. In the first phase, the image goes through image analysis process. After analysis, the split and merge algorithm is applied on image in order to partition the image into multiple regions and then histogram clustering algorithm will apply which will calculate common features and finally, the segmented image will display as an output [14]. But these methods are not effective and did not provide any locality information and other graphical features which is the major goal of this paper.

5. Proposed Methodology:
The proposed system will first load the image. As there are, only colored images are required for the proposed system. The researcher collected the colored images from the data set of Berkeley University of California (USA). The researcher tested 100 images and then collected the result which is applicable for some specialized tasks, i.e. detection of any object and machine vision, and scene recognition in the images of natural scenes. Image Standardization is followed through image size standardization and enhancement. Images are different in size. Some images are large, others are small, and some other images are in middle size so the proposed algorithm will normalize the image into the standard size i.e. 800×1200.

$$A [800 \times 1200] \leftarrow A [x, y, c]$$

The proposed system will create the temporary and individual clusters in order to find the optimal threshold value. K-means clustering algorithm is used to find the optimal cluster value calculation and feature has been extracted i.e. color space, pixel intensity level and regions. After the feature extraction, three histograms will be created with one each for Red, Blue and Green in RGB domain and then peaks are identified for each histogram. Individual peak values for Red, Blue and Green are calculated. The relative distance of each value on the specified three channels with respect to the peak value is calculated. When relative distance is calculated then mean value is calculated for each cluster. Finally, the image is segmented by using the mean cluster value.

5.1. Histogram Creation
Three histograms are created with one each for Red histogram, Blue histogram and Green histogram in RGB domain. A histogram is a statistical term used for the graphical representation of the data. The histogram mostly used the bar chart for graphical representation. It is often used for the density estimation of the data. The histogram shows the easily visual results of the overall data set.

![Figure 2: Original Image](image1)

![Figure 3: Histogram of the image in 100 bins](image2)

In the proposed methodology, the researcher has used the cluster value calculated by applying the k-means clustering algorithm in order to extract the information from images very efficiently and accurately.

5.2. K-Means Function
The k-means functions are at: IDX = kmeans (X, k) divides the points in the n by p data matrix X into k clusters. This iterative partitioning minimizes the sum over all clusters, the cluster - sums of point-to-cluster - centroid distances . Rows of X correspond to points, the columns correspond to variables. Kmeans provides an n- by -1 vector of the cluster indices IDX from each point . Kmeans uses squared Euclidean distances by default [15,16]. If X is a vector KMeans treats it as an n- by -1 data matrix , regardless of their orientation. [IDX , C , sumd , D]
kmeans (X, k) returns distances from each point to each centroid in the n-by-k matrix D. The total running time required for k-means is the O(n^2).

6. Experimental Results:

The implemented system has been checked as 100 images have been taken from the datasets of Berkeley University of California (USA). The proposed system successfully implemented the k-means clustering algorithm. K-means is a good algorithm but just for smaller values of “k”. The algorithm needs to run several times in order to get the required and relevant results. K-means works well in that environment where clusters are not well separated from each other.

Figure 4 (a) represents the original images (b) represents the segmented steps of the original images and (c) shows the final segmented images. The above figure signifies the accumulative results of the proposed methodology.

6.1. Average Results:

The researcher collected data from observers in order to find the accuracy rate of the proposed method, which was based on the categories such as Good, Average and Poor. The average results are shown in the following table:

<table>
<thead>
<tr>
<th>Table 1: Statistics of results</th>
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</thead>
<tbody>
<tr>
<td>N Valid</td>
</tr>
<tr>
<td>Missing</td>
</tr>
<tr>
<td>Mean</td>
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<tr>
<td>Median</td>
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<tr>
<td>Mode</td>
</tr>
<tr>
<td>Std. Deviation</td>
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<tr>
<td>Variance</td>
</tr>
<tr>
<td>Minimum</td>
</tr>
<tr>
<td>Maximum</td>
</tr>
</tbody>
</table>

The researcher collected a data set, which was comprised of hundred images from different observers. All these observers compared the segmented images with the original images and evaluated the deduced features within these images after segmentation. On collection of data, the individual average for each image was calculated and the later mean value was calculated based on the averages for all. The minimum number assigned to the images, is “1”. The Mod value shows the model number that occurs in the table several times, e.g. in the table the digit “4.4” shows the Mod value. The maximum value assigned to the images is “5”. Recursive testing of the algorithm divides the images into three categories, namely Good, Average
and Poor. Results for the Good category were found to be “54”, Average images occurred as “41” and Poor results were found as “5”. These results show a clear success of the proposed method.

6.2. Accuracy in Features Extraction

![Figure: 5 Accuracy of the Proposed Method](image)

In the above graph, the 5% shows the poor images in the result, 54% represents the good images and 41% indicates the average images.

7. LIMITATION

One of the main limitations of the proposed method is that the k-means clustering algorithms are best for offline images. As this is a slow process, so it cannot be applied for online images. The proposed approach is not applicable for hardware. It is also not a suitable method for noisy data and outliers.

8. CONCLUSIONS:

This report proposes a color image segmentation using k-means classification on RGB histogram. The research work used the k-means clustering technique. The k-means is an efficient and fast algorithm by using the *kmeans* function. The k-means used to partitioned n data points into k clusters. At first, the algorithm loaded the image. Then the size of the image has been standardized according to the proposed method. Then image represented in temporary clusters. In the proposed method, the clusters are combined and then calculated the means of the peaks in the image. At last, the image has been represented in segmented form. Image segmentation is the analysis technique of image processing, which gives the in depth knowledge about the information of the object identification and boundaries.

REFERENCES:


