As per UGC guidelines an electronic bar code is provided to seure your paper

International Journal for Modern Trends in Science and Technology, 8(06): 452-457, 2022

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0806077
Available online at: http://www.ijmtst.com/vol8issue06.html

Segmentation Technique for Images Using K-means Clustering

Sanjeeva Rao Sanku[1*], Pranitha Reddy Chimmula[2], Revani Pavan Kumar[2], Narahari Manideep Reddy[2]

[1]Assistant Professor in Department of CSE, Teegala Krishna Reddy Engineering College
[2]Department of CSE, Teegala Krishna Reddy Engineering College
[*]Corresponding Author : ssanjeevarao@gmail.com

To Cite this Article
Sanjeeva Rao Sanku, Pranitha Reddy Chimmula, Revani Pavan Kumar and Narahari Manideep Reddy. Segmentation Technique for Images Using K-means Clustering. International Journal for Modern Trends in Science and Technology 2022, 8(06), pp. 452-457. https://doi.org/10.46501/IJMTST0806077

Article Info
Received: 18 May 2022; Accepted: 15 June 2022; Published: 20 June 2022.

ABSTRACT

Digital image processing supports strong research program in areas of image enhancement and image based pattern recognition. Among the various image processing techniques image segmentation plays a vital role in step to analyse the given image. Image segmentation is the fundamental step to analyse images and extract data from them. This work deals on the basic principles on the methods used to segment an image. Segmentation has become a prominent objective in image analysis and computer vision. To segment the images, from segmentation techniques edge detection, threshold region growing and clustering are taken for this study. Segmentation algorithms are based on two properties similarity and discontinuity. We intend to apply K-Means to achieve the segmentation. K Means is a clustering algorithm. Clustering algorithms are unsupervised algorithms which means that there is no labelled data available. It is used to identify different classes or clusters in the given data based on how similar the data is. Data points in the same group are more similar to other data points in that same group than those in other groups

1. INTRODUCTION

Digital image processing supports strong research program in areas of image enhancement and image based pattern recognition. Among the various image processing techniques image segmentation plays a vital role in step to analyse the given image. Image segmentation is the fundamental step to analyse images and extract data from them. This work deals on the basic principles on the methods used to segment an image. Segmentation has become a prominent objective in image analysis and computer vision. To segment the images, from segmentation techniques edge detection, threshold region growing and clustering are taken for this study. Segmentation algorithms are based on two properties similarity and discontinuity. We intend to apply K-Means to achieve the segmentation. K Means is a clustering algorithm. Clustering algorithms are unsupervised algorithms which means that there is no labelled data available. It is used to identify different classes or clusters in the given data based on how similar the data is. Data points in the same group are more similar to other data points in that same group than those in other groups.

Image segmentation is an important step in image processing, and it seems everywhere if we want to analyze what's inside the image. For example, if we seek to find if there is a chair or person inside an indoor image, we may need image segmentation to separate objects and analyze each object individually to check what it is. Image segmentation usually serves as the pre-processing before pattern recognition, feature extraction, and compression of the image.

Image segmentation is the classification of an image into different groups. Many kinds of research have been done in the area of image segmentation using clustering. There are different methods and one of the most popular methods is K-Means clustering algorithm.

Image Segmentation involves converting an image into a collection of regions of pixels that are represented by a mask or a labeled image. By dividing an image into segments, you can process only the important segments of the image instead of processing the entire image. A common technique is to look for abrupt discontinuities in pixel values, which typically indicate edges that define a region.

Another common approach is to detect similarities in the regions of an image. Some techniques that follow this approach are region growing, clustering, and thresholding.

A variety of other approaches to perform image segmentation have been developed over the years using domain-specific knowledge to effectively solve segmentation problems in specific application areas.

2. LITERATURE SURVEY

The traditional image segmentation algorithm mainly includes the segmentation method based on the threshold value [1], the segmentation method based on the edge [2] and the segmentation method based on the region [3]. Because image segmentation technology is closely related to other disciplines in the field of information, such as the mathematics, pattern recognition artificial intelligence, computer science, and other disciplines in the production of the new theory and technology, a lot of segmentation technology combing special theory appeared. The improved algorithm proposed in this paper utilizes the theory of cluster analysis [4]. Cluster analysis is an important human behavior. As early as childhood, one can learn how to distinguish different kinds of things by constantly improving the subliminal clustering pattern. Various clustering methods are constantly proposed and improved. This proposed algorithm is based on classical K-means cluster analysis. Because of the high efficiency of the algorithm, it is widely used in the clustering of large-scale data [5]. At present, many algorithms are extended and improved around this algorithm. Compared with the traditional K-means method, the improved algorithm we proposed in this paper will transform the image into the LAB color space before segmentation and set the luminance l to the fixed value to reduce the interference caused by the background. In addition, for the selection of K value, creatively put forward the number of connected domain images meet requirements comparing with iterative variables, and when the two are equal, the value of K is the value of iterative variable. The improvement of the above part can greatly improve the accuracy of image segmentation and also optimize the optimization of algorithm structure to a certain extent.

2.1 Adaptive K-means segmentation

K-means algorithm is the most classical partition-based clustering method, and it is one of the ten classical data mining algorithms. The basic idea of K-means algorithm is to cluster the objects closest to them by clustering the K points in the space. Iteratively, the values of centroid of clusters are updated one by one until the best clustering results are obtained. K-means algorithm is a typical representative of the clustering method based on the prototype function. It takes the distance from the data point to the prototype as the objective function of optimization. The adjustment rules of iterative operation are obtained by the method of finding extreme values of functions. The K-means algorithm takes Euclidean distance as the similarity measure, which is to find the optimal classification of an initial cluster center vector, so that the evaluation index is minimum. The error square sum criterion function is used as a clustering criterion function. Although the algorithm of K-means is efficient, value of K should be given in advance, and the selection of K value is very difficult to estimate. In many cases, it is unknown in advance how many categories the given data set should be divided into.

As we mentioned, K-means is one of the classical clustering algorithms in the partitioning method. The efficiency of this algorithm is high, but due to the need to determine the number of clusters K, it brings certain difficulties for automated calculations. This method combines the maximum connected domain algorithm to determine K values of the K-means segmentation method adaptively. After extensive experiments, we have found that the value of K is usually between 2 and 10. We use the maximum connected domain algorithm to restore the image containing only the target object, record the number, and compare it with the K value to obtain an accurate K value. The algorithm steps are as follows:

Initialize K from 2 to 10
Randomly initialize K cluster centroids $\mu_1, \mu_2, \cdots, \mu_k \in \mathbb{R}^n$
if $K \leq 10$, repeat{
for each pixel $x^{(i)}$
$c^{(i)}$:= index (*from 1 to K*) of cluster centroid closest to $x^{(i)}$
for k = 1 to K
μ_k:= average (*mean*) *of points assigned to cluster k*

Compare the maximum connected domain results
if right, print results, break;
else K=K+1;
}

As shown in the pseudo code of this adaptive K-means method, when choosing the K value, it starts from 2 and progressively increases to 10. According to our large number of experimental results, the selection of cluster K is mostly between 2 and 10. Determining the correct K value is the key to the success of the K-means method. We start with the selection of K=2, that is, image segmentation starts from two clusters, and then the image is segmented. Finally, we determine the number of segmentation results based on the maximum connected domain algorithm. If the image number of the final segmentation result matches the K value, the K value is selected correctly. If the K value does not match, the K value at the beginning will be increased until the above two values match.

3. EXISTING SYSTEM

There have been many works done in the area of image segmentation by using different methods. And many are done based on different application of image segmentation. So far mean-shift and spectral clustering has shown better results but not the best.

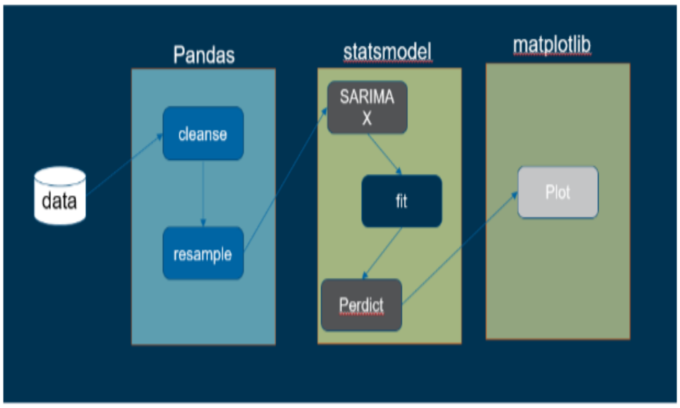
PROBLEM STATEMENTS

1. Complex to apply.
2. Not very effective.

3.3 PROPOSED SYSTEM

We propose to implement segmentation using K-Means. It is one of the most popular clustering algorithm. We are going to use the K-Means Unsupervised Clustering Algorithm to segment images of lunch trays. We are going to cluster pixels based on their spatial and color data only. K-means algorithm consists of two separate phases. In the first phase it calculates the kcentroid and in the second phase it takes each point to the cluster which has nearest centroid from the respective data point.

4. SYSTEM ARCHITECTURE



5. IMPLEMENTATION

5.1 Skimage:

skimage builds on scipy.ndimage to provide a versatile set of image processing routines in Python. This library is developed by its community, and contributions are most welcome! Read about our mission, vision, and values and how we govern the project. Major proposals to the project are documented in SKIPs.

5.2 matplotlib

Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python. Matplotlib makes easy things easy and hard things possible.

- Create publiation quality plots.
- Make interactive figures that can zoom, pan, update.
- Customize visual style and layout.
- Export to many file formats .
- Embed in JupyterLab and Graphical User Interfaces.
- Use a rich array of thirdparty packages built on Matplotlib.

5.3 numpy:

NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, fourier transform, and matrices. NumPy was created in 2005 by Travis Oliphant. It is an open source project and you can use it freely. NumPy stands for Numerical Python. In Python we have lists that serve the purpose of arrays, but they are slow to process. NumPy aims to provide an array object that is up to 50x faster than traditional Python lists. The array object in NumPy is called ndarray, it provides a lot of supporting functions that make working with ndarray very easy. Arrays are very frequently used in data science, where speed and resources are very important. NumPy arrays are stored at one continuous place in memory unlike lists, so processes can access and manipulate them very efficiently. This behavior is called locality of reference in computer science. This is the main reason why NumPy is faster than lists. Also it is optimized to work with latest CPU architectures. NumPy is a Python library and is written partially in Python, but most of the parts that require fast computation are written in C or C++. The source code for NumPy is located at this github repository https://github.com/numpy/numpy

5.4 Pillow:

Pillow is the friendly PIL fork by Alex Clark and Contributors. PIL is the Python Imaging Library by Fredrik Lundh and Contributors. The Python Imaging Library adds image processing capabilities to your Python interpreter. This library provides extensive file format support, an efficient internal representation, and fairly powerful image processing capabilities. The core image library is designed for fast access to data stored in a few basic pixel formats. It should provide a solid foundation for a general image processing tool.

5.5 sklearn:

Sklearn is probably the most useful library for machine learning in Python. The sklearn library contains a lot of efficient tools for machine learning and statistical modeling including classification, regression, clustering and dimensionality reduction. Components of scikit-learn: Scikit-learn comes loaded with a lot of features. Here are a few of them to help you understand the spread:

- Supervised learning algorithms: Think of any supervised machine learning algorithm you might have heard about and there is a very high chance that it is part of scikit-learn. Starting from Generalized linear models (e.g Linear Regression), Support Vector Machines (SVM), Decision Trees to Bayesian methods – all of them are part of scikit-learn toolbox. The spread of machine learning algorithms is one of the big reasons for the high usage of scikit-learn. I started using scikit to solve supervised learning problems and would recommend that to people new to scikit / machine learning as well.
- Crossvalidation: There are various methods
- Unsupervised learning algorithms: Again there is a large spread of machinelearning algorithms in the offering – starting from clustering, factor analysis, principal component analysis to unsupervised neural networks.
- Various toy datasets: This came in handy while learning scikit-learn. I had learned SAS using various academic datasets (e.g. IRIS dataset, Boston House prices dataset). Having them handy while learning a new library helped a lot.
- Feature extraction: Scikit-learn for extracting features from images and text (e.g. Bag of words)

5.6 K-Means:

K-means clustering is one of the simplest and popular unsupervised machine learning algorithms. Typically, unsupervised algorithms make inferences from datasets using only input vectors without referring to known, or labelled, outcomes.

AndreyBu, who has more than 5 years of machine learning experience and currently teaches people his skills, says that "the objective of K-means is simple: group similar data points together and discover underlying patterns. To achieve this objective, K-means looks for a fixed number (k) of clusters in a dataset."

A cluster refers to a collection of data points aggregated together because of certain similarities. You'll define a target number k, which refers to the number of centroids you need in the dataset. A centroid is the imaginary or real location representing the center of the cluster. Every data point is allocated to each of the clusters through reducing the in-cluster sum of squares.

In other words, the K-means algorithm identifies k number of centroids, and then allocates every data point to the nearest cluster, while keeping the centroids as small as possible. The 'means' in the K-means refers to averaging of the data; that is, finding the centroid.

5.7 felzenszwalb segmentation

Felzenszwalb and Huttenlocher developed an approach for the above- mentioned segmentation problem in their paper, Efficient Graph-Based- Image- Segmentation, which is commonly referred to here as Felzenszwalb's Algorithm.Their goal was to develop a computational approach to image segmentation that is broadly useful, mush in the way that other low-level techniques such as edge detection are used in a wide range of computer vision tasks.

They believed that a good segmentation method should have the following properties:-

- Thesegmentation should capture visually important groupings or regions, which often reflect global aspects of the image.
- The method should be efficient, meaning it should run in almost linear time in the number of image pixels.

Image Segmentation has long been an interesting problem in the field of image processing as well as to object detection. It is the problem of segmenting an image into regions that could directly benefit a wide range of computer vision problems, given that the segmentations were reliable and efficiently computed. For example, image recognition can make use of segmentation results in matching to address problems such as figure-background separation and recognition by parts.

Felzenszwalb and Huttenlocher developed an approach for the above-mentioned segmentation problem in their paper, Efficient Graph-Based- Image- Segmentation, which is commonly referred to here as Felzenszwalb's Algorithm. Their goal was to develop a computational approach to image segmentation that is br oadly useful, mush in the way that other low-level techniques such as edge detection are used in a wide range of computer vision tasks.

They believed that a good segmentation method should have the following properties:-

The segmentation should capture visually important groupings or regions, which often reflect global aspects of the image. The method should be efficient, meaning it should run in almost linear time in the number of image pixels.

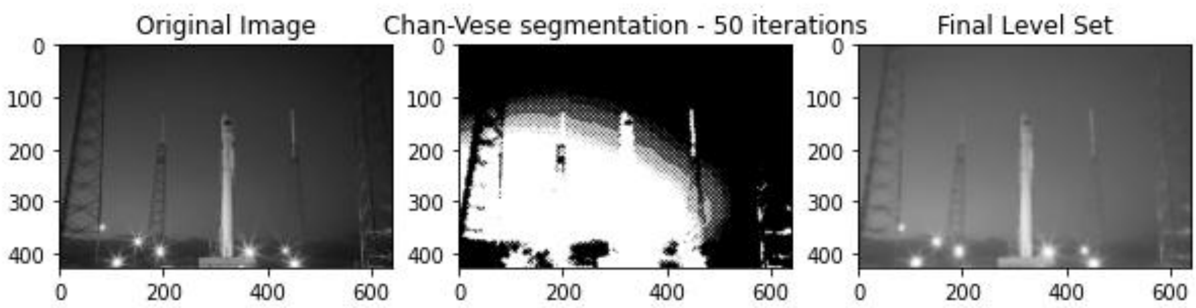
Although many methods had made considerable advances in segmenting images, most were slow and did not take into account that an object might have invariance in intensity and therefore would incorrectly segment that area. To overcome the problems faced by previous methods, Felzenszwalb and Huttenlocher took a graph-based approach to segmentation. They formulated the problem as below:-

Let G = (V, E) be an undirected graph with vertices $v_i \in V$, the set of elements to be segmented, and edges $(v_i, v_j) \in E$ corresponding to pairs of neighboring vertices. Each edge $(v_i, v_j) \in E$ has a corresponding weight $w((v_i, v_j))$, which is a non- negative measure of the dissimilarity between neighboring elements v_i and v_j .

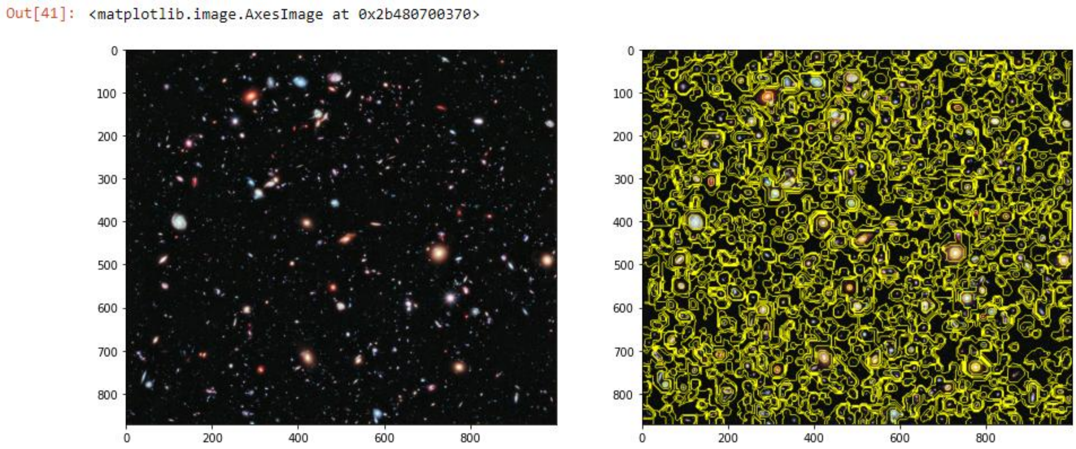
In the case of image segmentation, the elements in V are pixels and the weight of an edge is some measure of the dissimilarity between the two pixels connected by that edge (e.g., the difference in intensity, color, motion, location, or some other local attribute).

S is a segmentation of a graph G such that G′ = (V, E′), where $E' \subset E$. S divides G into G′ such that it contains distinct components (or regions) C.

6. OUTPUT SCREENS



Chan vese segmented image



felzenszwalb segmented image

7. CONCLUSION

Digital image processing supports strong research program in areas of image enhancement and image based pattern recognition. Among the various image processing techniques image segmentation plays a vital role in step to analyze the given image. Image segmentation is the fundamental step to analyses images and extracts data from them. This work deals on the basic principles on the methods used to segment an image Here we addresses problems with existing system and solves them effectively. In the end, we have achieved a process that segments the image efficiently and in less time.

8. FUTURE ENHANCEMENTS

Updates are best to continue the legacy of any applications. For this we propose to integrate micro businesses into the research and try to make the accuracy maximum.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] SS Alamr, NV Kalyankar, SD Khamitkar, Image segmentation by using threshold techniques, "Computer Science". 2(5),83-86 (2010)

[2] J Fan, DY Yau, AK Elmagarmid, WG Aref, Automatic image segmentation by integrating color-edge extraction and seeded region growing. IEEE Trans. Image Process. Publ. IEEE Signal Process. Soc. 10(10), 1454–1466 (2001)

[3] C Li, CY Kao, JC Gore, Z Ding, Minimization of region-scalable fitting energy for image segmentation. IEEE Trans. Image Process. 17(10), 1940–1949 (2008)

[4] Everitt, S Brian, Landau, Sabine, Leese, Cluster analysis. Qual. Quant. 14(1), 75–100 (1980)

[5] M Capó, A Pérez, JA Lozano, An efficient approximation to the K –means clustering for massive data. Knowl.-Based Syst. 117, 56–69 (2017)

[6] MW Schwarz, WB Cowan, JC Beatty, An experimental comparison of RGB, YIQ, LAB, HSV, and opponent color models[J]. ACM Trans. Graph. 6(2), 123–158 (1987)

[7] J Canny, A Computational Approach to Edge Detection, IEEE Transactions on Pattern Analysis and Machine Intelligence, v.8 n.6, p.679-698, June 1986

[8] W Zuo, Research on connected region extraction algorithms [J]. Comp. Appl. Softw. 23(1), 97–98 (2006)

[9] Qazanfari K, Aslanzadeh R, Rahmati M. An Efficient Evolutionary Based Method for Image Segmentation[J]. 2017.

[10] Tan, Pang-Ning; Steinbach, Michael; Kumar, Vipin. Introduction to Data Mining, ISBN 0-321-32136-7. 2005.

[11] P Jaccard, Etude de la distribution florale dans une portion des Alpes et du Jura[J]. Bull. De La Soc. Vaudoise Des Sci. Natur. 37(142), 547–579 (1901)

[12] P Jaccard, The distribution of the flora in the alpine zone.1[J]. New Phytol. 11(2), 37–50 (2010)

[13] A Bieniek, A Moga, An efficient watershed algorithm based on connected components[J]. Pattern Recogn. 33(6), 907–916 (2000)

[14] Xin Zheng, Qinyi Lei, Run Yao, Yifei Gong & Qian Yin, "Image segmentation based on adaptive K-means algorithm", EURASIP Journal on Image and Video Processing volume 2018, Article number: 68 (2018)