SVM Pixel Classification on Colour Image Segmentation

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Abstract. The aim of image segmentation is to simplify the representation of an image with the help of cluster pixels into something meaningful to analyze. Segmentation is typically used to locate boundaries and curves in an image, precisely to label every pixel in an image to give each pixel an independent identity. SVM pixel classification on colour image segmentation is the topic highlighted in this paper. It holds useful application in the field of concept based image retrieval, machine vision, medical imaging and object detection. The process is accomplished step by step. At first we need to recognize the type of colour and the texture used as an input to the SVM classifier. These inputs are extracted via local spatial similarity measure model and Steerable filter also known as Gabon Filter. It is then trained by using FCM (Fuzzy C-Means). Both the pixel level information of the image and the ability of the SVM Classifier undergoes some sophisticated algorithm to form the final image. The method has a well developed segmented image and efficiency with respect to increased quality and faster processing of the segmented image compared with the other segmentation methods proposed earlier. One of the latest application result is the Light L16 camera.

1. Introduction
When working on a particular image we generally make a specification of a domain in the image based on our requirements or the level of research. For example Ultrasonography. Image segmentation makes a set of segments or contours and classify them in a much simplified manner in computer vision applications.

Image segmentation uses the contours in 3d reconstructions with the help of some interpolation algorithms. It has a typical application in medical imaging and the latest camera technologies. Several algorithms and methods are proposed in order to solve the domain’s algorithm problem more effectively. Some of these methods are listed below.

Thresholding method is used to convert a gray scale image into binary image using a threshold value having an application in computer tomography. The K means algorithm is used to make clusters based on k means algorithm based on pixel colour and textures. In Histogram based methods we compute an histogram from all of the pixels of the image, and the clusters are located with the help of the peaks and valleys.

Now there are several other methods like edge detection, Partial differential equation based method, region growing methods. But all the proposed methods have some drawbacks in their field an only limited to some particular image processing.
SVM classifier higher accuracy in respect to three to four rounds of relevance feedback and trained by the texture features, learning it from the ground level. The method was proposed by Vapnik.

2. **Support Vector Machine**

SVM or Support Vector Machine based learning uses classification and regression based supervision learning algorithm associated with suitable algorithm. The learning is based on a linear classification as well as a non-linear classification process also known as Kernel Trick. Whenever an unsupervised clustering method is needed the SVM maps the new data in attempt to find the natural Clustering algorithm.

![Figure 1. Illustration of Linear SVM](image)

Expression for maximum margin is given as,

$$\text{arg max } l\in D \arg \min x \in D XW + b \sqrt{\sum w_i^2}$$

(SVM representation:

We present the SVM QP formulation for SVM classification in a simple representation way.

SV classification

$$\min ||f||^2 + C \sum_{i=1}^{l} \zeta_i y_i (x_i) \geq 1 - \xi_i$$

, for all $\zeta_i \geq 0$

(SVM classification, Dual formulation:

$$\min \sum_{i=1}^{l} \alpha_i - \frac{1}{2} \sum_{i=1}^{l} \sum_{j=1}^{l} \alpha_i \alpha_j y_i y_j K(x_i, x_j)$$

$$\sum_{i=1}^{l} \alpha_i y_i = 0$$

Soft Margin Classifier:

If any data are non linearly separable, then the Hinge loss function can be introduced.

$$\max (0, 1 - y_i(w.x_i + b))$$

The function gives zero whenever it is on margin and for the wrong side of the margin it is proportional to the distance from the margin

$$\min L = \frac{1}{2} w'W - \sum \lambda k(y_k(WX_k + b) + s_k - 1) + \alpha \sum s_k$$

Another two latest methods are the Sub-gradient descent and coordinate descent method.

3. **Colour pixel & the texture input**

The Pixel feature is based on the effective count of inputs with the information regarding a particular segment. Pixel is the cell unit of the SVM method. Without learning it, we can not conclude the result of the effective image segmentation.

Pixel Color Feature:
The computation of color component $P_{kij}$ ($k=L,a,b$) can construct the Local Image Window. $W_{ij}$ is a size $d \times d$ (for example, $5 \times 5$) window centered at $(i,j)$ for the computation of colour pixel, $d$ is odd the integer having value greater than 1.

Compute the Pixel Color Feature of Component $P_{kij}$. We define the local homogeneity as the pixel-level color feature, which consists of two components: standard deviation and discontinuity of the color component $P_{kij}$. The standard deviation of color component $P_{kij}$ ($k=L,a,b$) calculated as $i, j$ is the mean of color component $P_{kij}$ ($k=L,a,b$) within window $W_{ij}$ and calculated as

$$v_{ij}^k = \sqrt{\frac{1}{d^2} \sum_{m=-\frac{d-1}{2}}^{\frac{d-1}{2}} \sum_{n=-\frac{d-1}{2}}^{\frac{d-1}{2}} (p_{mn}^k - \mu_{ij}^k)^2}$$

(7)

The standard deviation and discontinuity values are normalized to perceive computational consistence: $V_{ijk} = V_{ijk}/V_{maxk}$

The local homogeneity is represented as

$$C_{Fijk} = H_{ijk} = 1 - E_{ij}*V_{ijk}$$

(8)

The window needs to be large enough to allow enough local information to be involved in case of the colour pixel pixel. A large window causes significant processing time to obtain the pixel-level color feature $C_{Fij}$ of the image pixel $P_{ij}$ at location $(i,j)$. To achieve better colour segmentation the colour texture is used with the colour information. We use the Gabon filter in order to achieve the colour texture feature.

A two dimensional Gabon filter $g(x,y)$ is an oriented sinusoidal grating, which is modulated by a two dimensional Gaussian function $h(x,y)$ as follows: This $h(x,y)$ is a two dimensional Gaussian function and it has center at the origin. The $\sigma_x$ and $\sigma_y$ denote its variances in $x$ and $y$ directions, respectively.

The first step is to find out the colour pixels by using these equations. Since the algorithm is to be applied in the colour image, the pixels need to store some of the colour information or the RGB information. The y values are set to +1 and -1 accordingly. The values for the support vectors are obtained from the training procedures. In the training period we perform the following jobs.

Labeling of the pixels.
Taking the colour depending on the + and - value of 1.
The training depends on the type of Kernel used with the C parameter, to obtain the best classification with a reduced number of support vectors.

4. Performance Evaluation
Evaluation Setup:
The natural setup is made to check the result. The classification of pixels is a simple process. It is involved with some subjects in the experimental setup in the data base. The colour of each pixel is used as input of the decision function and the output sets the classification. We do divide the images in two types of colour pixels, gray scale and black and white in order to segment the subjects properly. The segmentation error rate (ER) tells us about the image pixels which are not classified.

Experimental Results
The subjects are compared with each other for better evaluation. The images are segmented and if any one of them are not classified, The training process needs to be repeated again in order to match the desired result.
5. Conclusion
In this method we have proposed the SVM classification method of image segmentation where we have done the colour pixel subjects analysis and the FCM method of training these pixels in the Bekerly Database. The result is compared with one another and the process gives much better and faster result than the other proposed methods. But we will surely try to work further on the topics we are having our drawbacks.

6. References

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Figure 2. Colour image segmentation by SVM