The extracting of shirt composition using Canny edge detection with close contour

Lanjakorn Sewata  Salil Boonbrahm
School of Informatics
Walailak University
Nakorn Si Thammarat, Thailand. 80160
lsewata@me.com, salil.boonbrahm@gmail.com

Abstract
In this paper, we present the procedure that extracting image of a shirt into several components in order to reuse this component in the future. Canny edge detection is used to identify edge of the image and close contour is then used to identify components of the shirt where the shirt library is used as reference together with intercorrelation and autocorrelation functions.

Keywords: Image Segmentation, Close Contour, Edge Detection, Shirt Extraction.

1 INTRODUCTION

The objective of this research is to provide tool to manipulate with shirt images that will be inputted into the system. With this tool, we will be able to enhance the image of shirt to reduce noise, to recognize the shirt edge and then extract the shirt image into different parts such as neck, right sleeve, left sleeve, and so on.

The first part of the article contains reviews of definitions and algorithms in image enhancement, edge detection and image segmentation. These algorithms are applied to use on our problem domain where we try to segment the shirt image. The second part is the proposed model that designed to extract the shirt image by using shirt library and close contour of small elements of the shirt.

2 RELATED WORKS

2.1 Image Enhancement

In image enhancement, the goal is to accentuate certain image features for subsequent analysis or for image display. Examples include contrast and edge enhancement, pseudo coloring, noise filtering, sharpening and magnifying. Image enhancement is useful in feature extraction, image analysis and visual information display.

Image enhancement techniques such as histogram equalization, contrast stretching, grey level into another grey level by a predetermined transformation. An example is the histogram-equalization method, where the input levels are matched so that the output grey level distribution is uniform. This has been found to be powerful method of enhancement of low contrast images. Other enhancement techniques perform local neighborhood operations as in convolution; transform operations as the discrete Fourier transforms.

The best known order-statistics filter is the median filter, which replaces the value of a pixel by the median of the gray levels in the neighborhood of that pixel

\[ \hat{I}(x,y) = \text{Median}\{I(a_j)\} \]

\[ j = 1,2,...,9 \]

(1)

The original value of the pixel is included in the computation of the median. Median filters are quite popular because, for certain types of random noise they provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size [5][6].

2.2 Image Segmentation
Image segmentation, one of the fundamental problems of early computer vision, has been intensively studied in the past. The existing automatic image segmentation techniques can be classified into three approaches, namely, 1) thresholding techniques, 2) boundary-based methods, and 3) region-based methods.

1) Thresholding techniques are based on the assumption that adjacent pixels whose value (grey level, color value, texture etc.) lies within a certain range belong to the same class. Thresholding techniques can obtain good segmentation of images that include only two opposite components. Since these techniques neglect all the spatial relationship information of the images, they are inefficient for images that blur at object boundaries, or for multiple image component segmentation.

2) Boundary-based techniques use the assumption that pixel values change rapidly at the boundary between two regions. Edge detectors used in these techniques can be simple ones such as the Sobel or Roberts operators, or more complex ones such as the Canny operator. The output of most existing edge detectors can only provide candidates for the region boundaries, because these obtained color edges are normally discontinuous or over-detected. However, the actual region boundaries should be closed curves. Therefore, some post-procedures, such as edge tracking, gap filling, smoothing, and thinning, should be performed to obtain the closed region boundaries. All of these post-procedures are very time-consuming; converting the edge candidates to the region boundaries is thus not an easy task. The time-consuming post-procedures can be avoided by integrating the results of the boundary-based approach and those of the region-based approach.

3) Region-based techniques rely on the assumption that adjacent pixels in the same region have similar visual features such as grey level, color value, or texture. A well-known technique of this approach is split and merge. Obviously, the performance of this approach largely depends on the selected homogeneity criterion. Instead of tuning homogeneity parameters, the seeded region growing (SRG) technique is controlled by a number of initial seeds. Given the seeds, SRG tries to find an accurate segmentation of images into regions with the property that each connected component of a region meets exactly one of the seeds. Moreover, high-level knowledge of the image components can be exploited through the choice of seeds. This property is very attractive for semantic object extraction toward content-based image database applications. However, SRG suffers from another problem: how to select the initial seeds automatically for providing more accurate segmentation of images.

2.3 Edge Detection

Edge detection is one of the first steps in many pattern recognition and computer vision pipelines. It is an image processing technique that aims at the identification of sharp changes or discontinuities in the image brightness within neighbor regions on the image plane.

The determine threshold value is an important factor in finding the edge because threshold values that are less or too much affect the performance edge detection image and it also helps in reducing the noise of the image in Fig 1.

![Image](image.png)

Figure 1 the determine threshold value

In Fig 1, when the threshold values move to position A, the border area will then reduce that it can reduce the noise of the image. It move to position B is edge region will be increase that the noise of the image is increased accordingly. This research is choose to use the threshold in position B.[1],[2]

The Canny Edge Detection Algorithm is an optimal edge detector having good localization property, such that the marked edges are as close as possible to the edges in the real image and minimal response, so that one image edge should only be marked once, and only when there is strong evidence that it is really an important feature.

The first step on the algorithm is the Canny Edge Detection Algorithm, which performs noise removal, gradient detection and edge strength analysis respectively.
First of all, it is necessary to apply a Gaussian Smoothing to I, expressed as the convolution $J = I * g$ of I with a Gaussian kernel $g$.

After this, the following steps must be done for each pixel $(i, j)$ in $J$:

a) Compute the gradient components $J_x$ and $J_y$

b) Estimate the edge strength $E_s$ in EQ 2.

$$E_s(i, j) = \sqrt{J_x(i, j)^2 + J_y(i, j)^2}$$ (2)

c) Estimate the orientation of the edge normal $E_0$ in EQ 3.

$$E_0(i, j) = \arctan \frac{J_y}{J_x}$$ (3)

The output is a strength image $E_s$, formed by the values $E_s(i, j)$ and an orientation image $E_0$, formed by the values of $E_0(i, j)$.

After that, the non-maxima suppression Algorithm is applied to the strength image, considering the four directions identified by $0^\circ$, $45^\circ$, $90^\circ$ and $135^\circ$, in order to remove non-maxima points in the $E_s$ image and produce a new image $I_n$.

For each pixel $(i,j)$ in $E_s$, it is necessary to find the direction $D_k$, which better approximates the direction $E_0(i, j)$, which is the edge normal. If $E_s(i, j)$ is smaller than at least one of its two neighbors along $D_k$, then $I_n(i, j) = 0$ otherwise $I_n(i, j) = E_s(i, j)$. The output image $I_n(i,j)$ consists of points belonging to thinned edges (i.e. $E_s$ after suppressing non maxima points).

The image produced by the previous step still contains local maxima originated by noise. In order to get rid of such local maxima, the next and last step of the process consists in using the Hysteresis Threshold Algorithm, which uses a minimum and maximum thresholding values $t_L$ and $t_H$.

First, the next unvisited edge pixel, $I_n(i, j)$, such that $I_n(i, j) > t_h$ is located. In the sequel, the algorithm starts from $I_n(i, j)$, following the connected chains of local maxima in both directions perpendicular to the edge normal, as long as $I_n(i, j) > t_L$.

In the next step, all visited points are marked and a list of the locations of all points in the connected contour found is saved. The output is a set of lists, each one describing the position of a connected contour in the image, as well as the strength and the orientation images, describing the properties of the edge points. [3],[4]

3 Methodology

The methodology using in this research contain four processes which are image enhancement, edge detection, image segmentation and image extraction. In order to use these processes the input which is images or patterns of shirts are captured. Then image enhancement is used to reduce the noise of the image using median filter algorithm. Edge detection is indicates the position of the shirt using Canny edge detection algorithm. Images segmentation on the shirt edge used to calculate the area and shape of the edges, which is characterized by the appearance of a closed contour, which is to be compared with the shirt images in library to perform extraction elements picture as an shirt using Intercorrelation function (ICF) and Autocorrelation function (ACF). If ICF value and ACF value than specified value in the system assumes as elements of image in Fig 3.

Figure 2 (1) Source Image  
(2) Image results by canny algorithm [2]

Figure 3 Shirt extraction proceduce.
### 3.1 Shirt Library

To use the shirt extraction procedure, the shirt library has to prepare first. Shirt library contains the images used for comparison with the close contour. These images are used in the process of image extracting.

![Example of Images in Library](image)

Figure 4 Example of images in library.

### 3.2 Image Segmentation

At first, we define such an object contour. The contour is a boundary of object, a population of points, separating object from a background. In systems of computer vision, some formats of coding of a contour are used - the codes of Freeman, two-dimensional coding, polygonal coding are most known. But all these formats of coding are not used in a contour analysis.

Instead, in a contour analysis the contour is encoded by the sequence consisting of complex numbers. On a contour, the point, which is called as starting point, is fixed. Then, the contour is scanned (is admissible - clockwise), and each vector of offset is noted by a complex number \(a+ib\), where \(a\) - point offset on x axis, and \(b\) - offset on y axis. Offset is noted concerning the previous point in Fig 5.

![Contour Image](image)

Figure 5 Contour Image

Owing to the physical nature of three-dimensional objects, their contours are always closed and cannot have self-intersection. It allows to define unambiguously a way of by-pass of a contour (to within a direction - on or counter-clockwise). The last vector of a contour always leads to the starting point.

Each vector of a contour we will name elementary vector (EV). And sequence of complex-valued numbers - vector-contour (VC).

Thus, vector-contour \(\sigma\) of length \(k\) can be designated as

\[
\sigma = (\gamma_1, \gamma_2, \gamma_3, \ldots, \gamma_{k-1})
\]

Complex coding is close to two-dimensional coding where the contour is defined as a population of the EVs presented in the two-dimensional coordinates. But differences between operation of scalar product for vectors and for complex numbers are various.

The sum of an EV of a closed contour is equal to zero. It is trivial - as the elementary vectors result in starting point, their sum is equal to a zero-vector

\[
\sigma = \sum_{i=0}^{k-1}(\gamma_i)
\]

where \(k\) - dimensionality of a VC, \(\gamma_n\) - n the elementary vector of contour \(\sigma\) is write pseudo code in Fig 6.

![Close contour Function](image)

Figure 6 Close contour Function

### 3.3 Image Extraction

Extraction composition algorithm is a comparison between a close contour with the image in shirt library. Using intercorrelation function
(ICF) and an autocorrelation function (ACF) can be designated as

$$ICF = \max_{\sigma, N} \left( \sum_{i=0}^{n} \sigma_i N_i \right)$$  \hspace{1cm} (6)

ICF is similar of shape between 0-1.  
\(\sigma\) is Vector Contour of Close contour  
\(N\) is Vector Contour of shirt template

$$ACF = (\sigma, N^m)$$  \hspace{1cm} (7)

ACF is similar of length between 0-1.  
\(\sigma\) is Vector Contour of Close contour  
\(N\) is Vector Contour of shirt template

Which close contour is a part of shirt to be considered at the ICF and ACF calculated values should be greater than or equal to ICF and ACF assigned by the system.

4 Experimental Results

This research developed with Emgu CV library and use shirt of different 50 styles stored in formats JPEG and the size of the image is 1024 x 768 pixels defined by the ICF was 0.5 and the ACF was 0.85, with results as shown in Fig 7.

5 Conclusions

To obtain the complete and correct shirt extraction process, there are some factors that should take into consideration. Such factors are as follows:

1) The shirt library. The use of shirt library to compare the components of shirt image plays important role in identifying position of the component correctly and precisely.

2) The values of ICF and ACF. If setting the values of ICF and ACF too low, the precision in identifying the shirt components will be low.

The limitation of this research is that the input shirt images should have sharp and connected lines in order to identify each part or component of the shirt correctly. Further research will be focus on preprocess to enhance the shirt image that contained disconnected line.

References


