Detection Skin Cancer Using SVM and Snake Model

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Abstract— The reporting causes of death in Thailand. The cancer is most common cause of death in Thailand, including colon cancer, lung cancer, breast cancer, cervical cancer, etc. The skin cancer is one of cancers that increases every year. Considering and analyzing features of cancer image, which includes Asymmetry, Border Irregularity, Compact Index, Fractal Dimension, Edge Abruptness, Color variation and Diameter, is popular technique of analysis the patients with skin cancer. To extract and analyze such features, image segmentation plays important role for automatic skin cancer detection system. In this paper, we propose the image segmentation scheme based on Support Vector Machine (SVM) and Snake active contour. SVM is used to help finding the appropriate parameters for snake algorithm.

Keywords— Support Vector Machine, Snake Model, Skin Cancer.

I. INTRODUCTION

The skin cancer is found in people of age 40-60 years and in males rather than females [1]. To cure the skin cancer, surgery, radiation and photodynamic therapy are alternative ways, while surgery including Mohs microsurgery, laser surgery, and electro desiccation and curettage currently becomes acceptable as effective way with less pain. However, surgery basically depends on skillful medical doctors whose number is quite limited, and it is normally costly [2] so that an automatic system of skin-cancer surgery is really required in order to reliably cure the patients as assistant of medical doctor.

Recently, several automatic skin cancer detection systems have been developed for preliminary analysis [3-4]. Such systems are also used in remote areas where doctors or experts are unavailable. Image segmentation is important part in such system since it is almost the first process that is required to be done before further analysis. In general, there are 7 main features in conditions of screening and treatment the skin cancer patients such as Asymmetry, Border Irregularity, Compact Index, Fractal Dimension, Edge Abruptness, Color variation and Diameter [5]. Determining and analyzing the size of the skin cancers is the most important in the beginning of treatment. To be able to perform efficient analysis, image segmentation algorithm must be able to properly and effectively separate suspected moles or scars out of normal skin.

There are a huge variety of image segmentation algorithms currently. Previous research works of segmentation, especially for automatic skin-cancer surgery, can be divided into three groups, statistic & probability, machine learning, and active contour model. The research works in the first group of statistic & probability [6] work well against high contrast images, but may not be appropriate for some with overlapping of two regions. Other works in the second group of machine learning [7] which utilize statistic data as feature for learning work effectively and robust in segmentation. However, in case of skin cancer, its boundaries may have complicate contour with many tiny curves and angles needed to accurately segment and recognize, especially in automatic cancer surgery. Otherwise, all skin-cancer is not taken out in case of less segmentation, and some flesh is cut off instead of skin-cancer if segmentation is performed too much. So the algorithms in active contour model are considered as another appropriate approach to solve this kind of problems which work strongly in those complicate and special contours. One of algorithm categorized as active contour model called snake algorithm is frequently used in medical applications [2-7].

In this paper, we propose the segmentation scheme based on the combination of snake model and SVM [8]. It is well known that to be able to perform snake algorithm efficiently, the initial curve and snake's parameters must be chosen carefully. This task is sometimes difficult and is required skilled to finding the proper such initial conditions. Hence, in this work, we apply SVM in finding the proper initial curve and parameters for snake algorithm. The initial curve is strict to be only 3 simple shapes: circle, eclipse, and rectangle. These simple shape are chosen to reduce the complexity required in SVM implementation without any degradation which can be seen experimentally.

The outline of the paper is as follow: description of Equation of SVM and snake model section (II), detail of the proposed method (III) and (IV), section (V) contains experimental results of the proposed method and conclusion.

II. Support Vector Machine and Snake Model

SVM developed from the theory of Structural Risk Mini mization [9]. In a binary classification problem the decision function of SVM is

$$f(x) = \langle w, \phi(x) \rangle \quad b \tag{1}$$

978-1-5386-2615-3/18/$31.00 ©2018 IEEE

Where $\phi(x)$ a mapping of sample $\phi(x)$ x from the input space to a high-dimensional feature space. The optimal values of w and b can be obtained by solving the following optimization problem:

$$\text{minimize: } g(w,\xi) = \frac{1}{2}\|w\|^2 \quad c\sum_{i=1}^{n}\xi i + \tag{2}$$

$$\text{subject to: } y_i(\langle w, \phi(x_i)\rangle + b) \geq 1 - \xi_i, \xi \geq 0, \tag{3}$$

where ζ_i is the *i*lh slack variable and *C* is the regularization parameter. According to the Wolfe dual form the above minimization problem can be written as

minimize:

$$W(\alpha) = \sum_{i=1}^{N}\alpha i \quad \frac{1}{2}\sum_{i=1}^{N}\sum_{i\ 1\ =}^{N} y_i y_j \alpha_i \alpha_j k(x_i, x_j) \tag{4}$$

$$\text{subject to: } \sum_{i=1}^{N} y_i \alpha_i = 0, \forall\ i: 0 \leq\ \alpha_i \leq\ C, \tag{5}$$

where $\alpha_i\ b$ is a Lagrange multiplier which corresponds to the sample $x_i, k(.,.)$ is a kernel function that implicitly maps the input vectors into a suitable feature space.

SVM classifier is employed for forgery detection after calculation the hash values for extracted features [10-12]. SVM can model complex, real-world problems such as text and image classification hand-writing recognition and bioinformatics and bio-sequence analysis design a simple process consisting of two phases which are training phase and testing phase. The model description is as follows:

A. Database
B. Pre-processing
C. Feature extraction
D. Hash values
E. SVM classifier

Snake Model

A Snake model is an active contour which evolves under the influence of internal forces emerging from the curve itself and external forces present in the image data. Snakes were first proposed by Kass et al. [2]

2D snake is a curve *X(s) = [x(s), y(s)]* that evolves in the spatial domain of an image *I* to minimize the energy functional

$$E = E_{\text{int}} + kE_{ext} + \eta E_{\text{def},}$$

(k and η are constant weighting factors), where the classic internal energy is

$$E_{\text{int}} = \int_0^1 \frac{1}{2}\left[\alpha\left\|X^{'(s)}\right\|^2 + \beta\left\|X^{"}(s)\right\|^2\right] ds. \tag{6}$$

(α and β are constants balancing the two components), and the classic external energy is

$$E_{ext}(x,y) = -\left\|\nabla I(x,y)\right\|^2 \tag{7}$$

E_{def} is an additional deformation energy (∇ is the gradient operator). Snake that minimizes E must satisfy the Euler-Lagrange equation

$$\alpha X^{"}(s) - \beta X"(s) - \kappa\nabla E_{ext} - \eta\nabla E_{def} = 0 \tag{8}$$

Which can also be viewed as a force balance equation

$$F_{\text{int}} + \kappa F_{ext} + \eta F_{\text{det}} = 0 \tag{9}$$

Snake is typically used for image segmentation in paper we aspire to extend the snake functionality to the more difficult task of registration. Segmentation means just identifying a shape in an image, while registration means capturing some of the detailed semantics of the shape. The semantics is usually conveyed through corresponding points between some generic template shape, in which these points have some semantic meaning and the shape extracted from the image.

III. PROPOSED METHOD

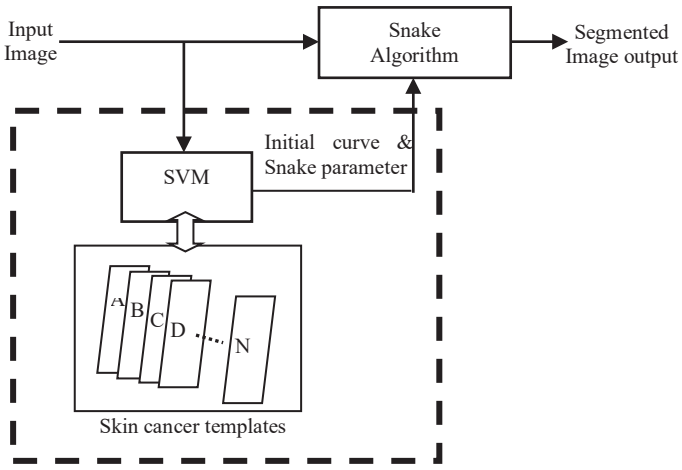


Fig. 1 System Process

Figure 1 shows how to solve problems. When an image is inputted into the system, SVM is used to choose which image to fit in the template. There are 3 types of initial curve:

circular, ellipse, and rectangular, and when SVM selects a template type from A..... N template, it is appropriate to look at the size, color, and shape of the rails. Similar to the input image in the system.

PROPOSED SCHEME

The proposed segmentation scheme is shown in Fig. 1 where the detail is as follow:

1) N skin cancer images of various shape and sizes are chosen as "Template" for SVM. For each image (Initial curve) is then segmented using snake algorithm offline. The proper information carefully selected for clear and effective skin cancer area which is output of the segmentation. For each template, the information of proper initial curve stored in database, there are several parameters to determine the value of snake Algorithm.

2) Input or target image will be compared with the N templates in 1) using SVM, the skin cancer in each template will be considered compared with target image, the best template will be chosen, say template i. The best template is considered based on the similarity of shape, size, or color of its skin cancer and skin cancer of target image.

3) The initial information of template I will be used in snake algorithm to segment the target image.

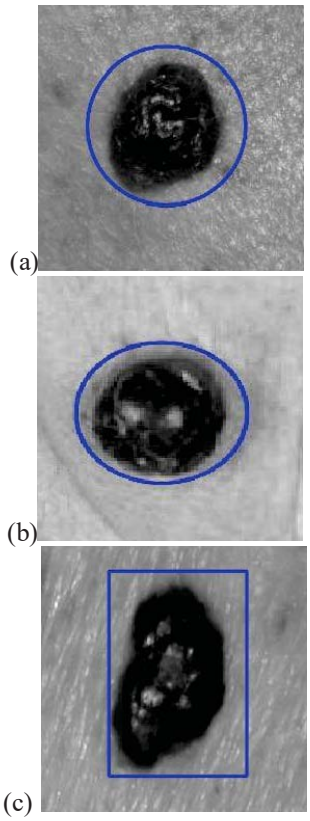
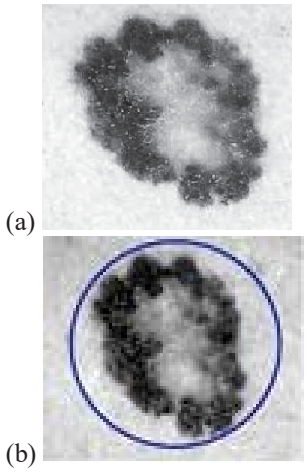


Fig.2 Show Intintial curve (a) Circle, (b) Ellipse, (c) Rectangle

Figure 2 illustrates the initial curve. The proposed circular, ellipse, and rectangular features of the template are presented. template3 A simple geometry that can be easily viewed. And in each template test, there are parameters. In each type of template, there are 3 types,Verbose, Interact, nPoint, Sigma, Wline, Wedge, Wterm, Kappa, Alpha, Beta and Mu, we call the parameter set. These parameters are very important as it helps to find the edges using the Algorithm Snake. Each of the parameters has to work differently. Whether it is the point around the edge. The snake movement Algorithm, with all the selected values. Each Initial curve has parameters in each template that have different values. One template will have all the parameters in each template. The author has collected 30 sample images and selected the parameters to fit each template and have tested the image Unknown into the system and choose to use. Template with the parameters used to test the edge. Currently, there is the preprocessing step that is the edge detection step by defined the edge points around the image manually before employ the snake algorithm. The edge point initialization based on human manually is need a person who has a specific skill of edge detection but there is still result problems when defining the points by human such as cutting over the edge of image need or cutting the edge of skin cancer for not a whole image. So authors propose the templates that have a flexible shape and similar to the input image.

IV. EXPERIMENTAL RESULTS

In this work, due to the captured images obtained from special proposed high quality camera which. For selecting the suitable template for input image, How to choose what image come into system. Choose a template how to handle them property, we see how the work of each loop the template image if the loop is work for us to choose a template that defaults in initial defaults snake algorithms. For characteristic of snake algorithm, we need to initialize the edge of input image first.



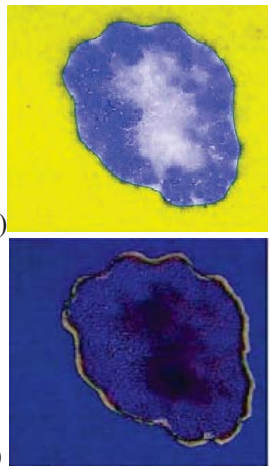


Fig. 3 Experiment results: (a) original image, (b) SVM select for initial template, (c) Initial for skin cancer, (d) Results initial compare expert.

The image above illustrates (a) the skin cancer input used for testing in the planned system. The image (b) is the test result. In this test, SVM is used to decide whether the input image is in the system. It is based on the input image feature and allows SVM to choose which template to fit in the 3 templates, template is Circle, Ellipse, and Square. The image used to display. Have chosen the Circle Templates. As shown in Figure (b). In Figure (c) shows the convergence of the snake Algorithms, which is the edge finder to find the edges of the image and to prove that the edge of the picture is very accurate. We gave the skin cancer expert to find the same edge. With the image used in the test. And compare it as shown in (d). Each template presented within the template has only one parameter. By default, a template will have one set of parameters.

V. CONCLUSION

Based on the SVM test results, it helps to consider the attributes of the template to fit the image. Input of skin cancer Initial curve: circles, ellipses and rectangle. The images used in the test system were selected for use as template circles and for the accuracy of the edges of the images. We find the edge using Snake Algorithm is an aid in finding the edge. Comparison with edge finder by expert. From the output image shown can see that the edge of the picture. When compared to the edges found by professionals, the edges are closer to the expert. However, other unwanted areas are also segmented due to the false classification. Some more elaborate classifications or refinements are required for better segmentation result. Alternatively the proposed method may possibly be used as pre-processing step. Then, more sophisticated methods can be done subsequently, for example, snakes or active contours [2]-[13-14].

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