Chamfer Matching을 이용한 실시간 템플릿 기반 개체 검출 및 추적

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Template Based Object Detection & Tracking by Chamfer Matching in Real Time Video

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Abstract

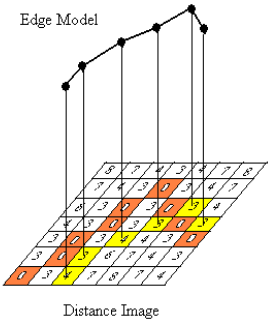
In this paper we describe an approach for template based detection and tracking of objects by chamfer matching in real time video. Detecting and tracking of any objects is the key problem in computer vision. In our case we try for hand and head of human for detection and tracking by chamfer matching technique. Matching involves correlating the templates with the distance transformed scene and determining the locations where the mismatch is below a certain user defined threshold.

1. Introduction

Object detection and tracking is one of the innermost task of digital image processing. Template based matching methods using distance transforms have proven to be fairly thriving in this regard, because of their robustness. In these methods [1], target objects are represented by binary templates containing positional edge information. On-line, a particular scene image is preprocessed by edge segmentation, edge cleaning and distance transforms. Matching then involves correlating the templates with the distance-transformed scene image and determining the locations where the mismatch is below a certain user-defined threshold. These image locations are considered to contain the detected objects.

2. Chamfer Matching & Related Work

Chamfer matching is a technique for finding the best fit of edge points from two different images, minimizing a generalized distance between them [2]. A distance transform (DT) converts a binary image consisting of feature and non-feature pixels into an image where each pixel value denotes the distance to the nearest feature pixel [3]. Distance image gives the distance to the nearest edge at every pixel in the image and it is calculated only once for each frame. Figure 1 shows a edge model translated over distance image. At each translation, edge model superimposed on distance image. Average of distance values that edge model hits gives Chamfer distance.



(Figure 1) Binary pattern of image model and its Euclidean distance transform

$$\text{RMS Chamfer distance} = \frac{1}{3}\sqrt{\frac{1}{n}\sum_{i=1}^{n} v_i^2} \quad \text{..... (1)}$$

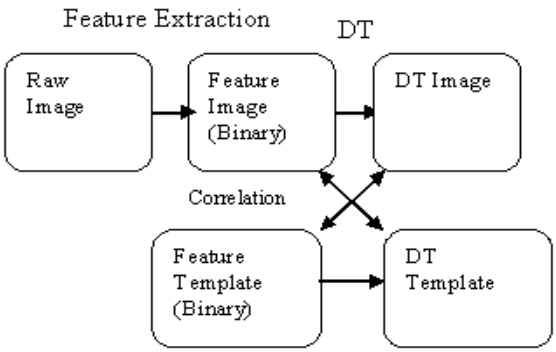
where V_i distance value, n is number of points

The advantage of matching a template with the DT image rather than with the edge image is that the resulting similarity measure will be more smooth as a function of the template transformation parameters. A number of extensions have been proposed [3] to the basic DT matching scheme such features (edge points, corner), distance metric, computation of distance image, matching N template etc.

3. Our Approach

Image edge can be typically represented by a set of feature points, such as Canny edge image. A common approach, when trying to locate a particular object in a scene based on its shape, is to use a prototype object shape and search for its image. In our present work our approach is to search the transformation space explicitly using chamfer matching in which the model template is correlated with a distance transformed image.

To formalize the idea of chamfer matching, the shape of an object is represented by a set of point $A = \{a_i\}_{i=1}^{N_a}$. In our case, this is a set of points on the projected model contour. The image map is represented as a set of feature points $B = \{b_i\}_{i=1}^{N_b}$. In order to be tolerant to small shape variations, any similarity function between two shapes should vary smoothly when the point locations change by small amounts. This requirement is fulfilled by chamfer distance functions [4], which is based on a distance transform (DT) of the edge image map. The typical matching with DT is shown schematically in figure - 2. which involves two binary images, a segmented template and a segmented image.



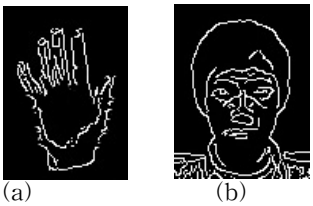
(Figure 2) Matching technique by DT

The distance between a template A and an edge map B can be computed by adding the squared DT values at the template point coordinates and dividing by the number of points Na. The average of the squared distances between each point of A and its closest point in B is given by the equation:

$$d_{cham}(A,B) = \frac{1}{N_a}\sum \min_{b \in B} \| a - b \|^2 \quad \text{.....(2)}$$

4. Experiments and Results

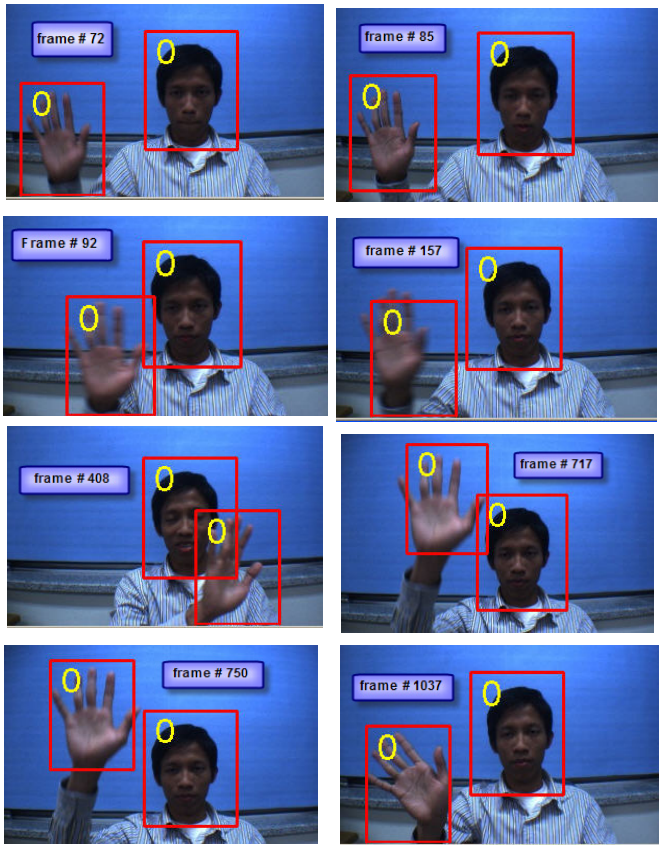
Our present implementation detect and track human hand and head simultaneously in a video by chamfer matching. According to our previous talk, we made a hand and head template as shown in figure - 3 (a)(b).



(a) (b) (c)

Figure 3(a)(b)(c) Hand and head template

And figure - 3(c) represents the conceptual style to make a list of features point on the edge of hand by which the closest near pont should be matched in the video.



(Figure 4) Detection and tracking sequence in a video

Our experiment result sequence is shown in figure 4 of different frame. From our experiment we saw that, detection result in video is very good but tracking is not always good. Actually, with only our present technique is not enough for tracking and detection. One of the possible solution for proper tracking using our

approach is particle filter with object shape information which will be our future work.

4. Conclusion

We presented a novel technique based on chamfer matching which can detect head and hand concurrently in a video. To implement our technique we used some OpenCV library which is very helpful to make computer vision based applications. Next, we try to improve our present technique for tracking and detection with chamfer matching and particle filter.

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