Simple Frame Marker for Image and Character Recognition*

Hyejin Kim, Woontack Woo
GIST U-VR Lab.
500-712 Gwangju, S. Korea
{hjinkim, wwoo}@gist.ac.kr

Abstract

In this paper, we propose Simple Frame Marker (SFM) which has a rectangular frame and encompasses a planar natural view such as characters, logos and images. In order to support recognition of characters as well as an image, Simple Frame Marker is constructed by square-type and rectangle-type markers. Therefore Simple Frame Marker first distinguishes its content by the marker type and applies a proper recognition method for the content. We describe how to construct Simple Frame Marker and how to discriminate different types of Simple Frame Marker.

1. Introduction

In upcoming ubiquitous computing environment, intelligent services which augment information gathered from various sensors including a camera will be wide spread. Also, the various target of augmentation will make more interesting application scenarios possible. For this to be realized, it is necessary to recognize and track various targets such as characters, logos and images.

For the last several years, recognition and tracking for augmented reality have been studied. There are two kinds of method: marker based and marker-less method. ARToolkit [1] and ARTag [2] extract a square marker and recognize the pattern within the marker by using cross-correlation matching. Then it gets an ID and direction information. After that, it gets the pose between the marker and camera by exploiting the vertices of a square marker. Marker-less method [3][4] extracts local feature points in a whole image and gets a patch centered on the extracted feature points. Then it recognizes and tracks feature points by matching the patch with the result of patch information learning. Evidently, marker-less method has a disadvantage in the processing speed which is quite slower than marker based method. In addition, marker based and marker-less methods are inadequate for the recognition of characters and images at the same time, because two methods focus on recognition of an image.

Therefore, in this paper, we propose Simple Frame Marker (SFM) which has a rectangular frame and includes a natural view such as characters, a logo or an image. Also, the SFM has direction indicator in itself to reduce processing time. Although our method is applied in planar objects and is sensitive to occlusion due to its usage of frame, SFM can be specialized in the applications where occlusion does not occur and target objects are planar, e.g., like numerous signboards in the building.

Our approach has following advantages. First, its unique and non-disruptive appearance of frame makes it easier for users to identify the target of information-augmentation service in the real environment. This appearance of SFM can be made into a formal specification for standards and general uses. Second, it supports recognition of characters as well as images by distinguishing different SFM types. Third, it improves the speed of recognition by searching feature points only in Simple Frame Marker region instead of searching the whole image. Moreover, when we use an ID of a marker in a previous frame, it makes pose estimation possible without a matching step since we already know direction information from SFM itself.

In next section, we describe how to construct SFM and the overall processing procedures of SFM. In the third section, we show implementation of SFM prototypes. We conclude this paper by giving directions for the future work.

2. Simple Frame Marker

In this section, we describe different types of SFM and give details on overall processing procedures of SFM.

* This research is supported by the Foundation of UCN Projects, the MKE, and the 21C Frontier R&D Program in Korea as a result of subproject UCN 08B3-O1-20S

978-0-7695-3259-2/08 $25.00 © 2008 IEEE
DOI 10.1109/ISUVR.2008.24

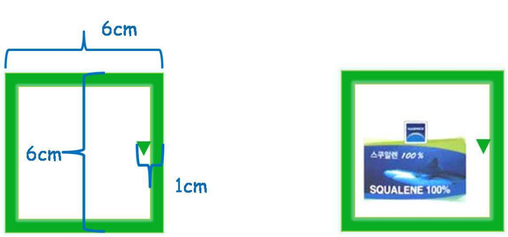
2. 1 Construction of SFM

Simple Frame Marker can be categorized as physical SFM and virtual SFM according to application domains like figure 1. Physical SFM is used by attaching it to objects as other visual markers to help distinguish a target of information-augmentation service. However, this category of markers is not recognized when marker frame is occluded. On the other hand, virtual SFM is free from frame occlusion problems. The virtual SFM is provided by mobile device which shows virtual frame and users can use this virtual frame to select a target of interest. Then matching processing is carried out only in virtual SFM region. Virtual SFM is conceptual and isn’t described in detail, we plan to make it as future work as one of solutions of marker occlusion.

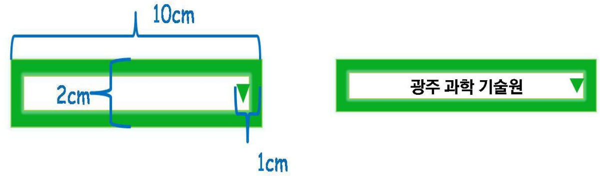
(a) (b)

Figure 1. Physical SFM (a) and Virtual SFM (b)

Simple Frame Marker can be classified as square-type and rectangle-type by its shape. If a ratio between width and height of a marker is 1:1, it is square-type marker and can include logos and images. Otherwise, it is rectangle-type marker and it can include characters. Figure 2 shows a prototype of Simple Frame Marker. Also, it has a region representing a direction by a triangle close to right side of a frame.



(a) Square-type SFM



(b) Rectangle-type SFM

Figure 2. Prototype of Simple Frame Marker

2. 2 Procedure of SFM

Figure 3 shows a processing procedure of Simple Frame Marker. First of all, we extract SFM in input image. Then, we rectify extracted SFM with the size of standards known beforehand. In the next step, we match the region of direction information according to each side of rectified SFM with sample of standards. This matching determines either square-type SFM or rectangle-type SFM and provides direction information.

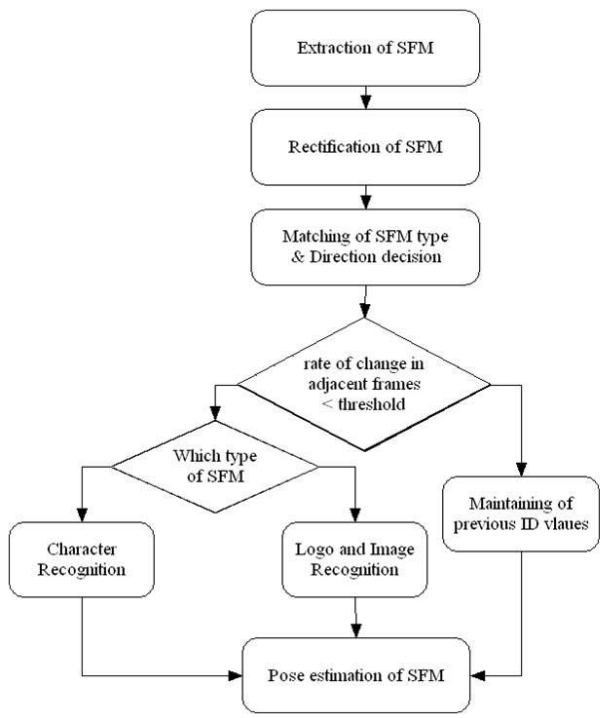
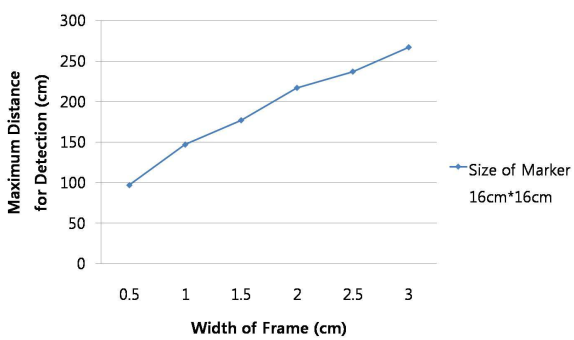


Figure 3. Processing Procedure of Simple Frame Marker

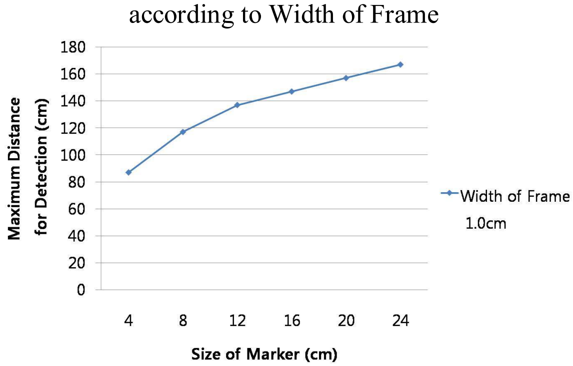
Then if the rate of change in adjacent frame is less than threshold value, it maintains previous ID values and goes to pose estimation step without recognition step. If the rate of change in adjacent frame is more than threshold value, we need to recognize what is inside the marker. Therefore, depending on the type of marker, different processing takes place. If it is a square-type, we assume that the contents inside marker are logos or images and apply template matching based or local feature matching based method in recognition step. If it is a rectangle-type, we assume that the contents inside marker are characters and apply character recognition method in recognition step. Finally, we perform pose estimation by using direction information and four vertices of a marker.

3. Implementation and Discussion

In the application which needs recognition of a target, the performance should be guaranteed for applicable distances. Therefore, we measured maximum distance for detection according to marker size and frame width as shown in figure 4. As we can see in the figure, it is possible to detect a target with the frame width as 0.5cm and marker size as 6cm within 100cm between a target and a camera. Therefore, we can obtain optimal size for detection of marker according to distances by using these graphs. We focused on a target within 100cm and tested SFM with frame width as 0.5cm and marker size as 6cm as previously shown in figure 2.



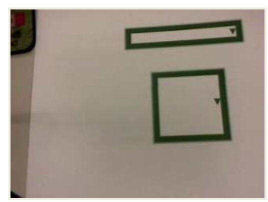
(a) Maximum Distance for Detection according to Width of Frame



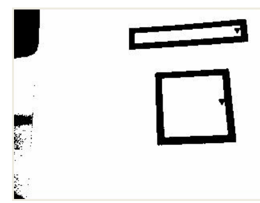
(b) Maximum Distance for Detection according to Size of Marker

Figure 4. Maximum Distance for Detection

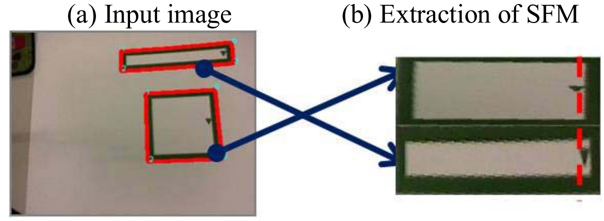
Figure 5 shows processing steps for distinction of marker type and direction decision. First of all, we extract simple frame marker region by using binarization, labeling and checking of a square or rectangle. Next, we rectify extracted simple frame marker region with previously defined A standards known beforehand like figure 5(c). Also, we match the region of direction information which is one of standards with a model according to four sides of SFM. Here we set matched side of SFM as right direction and provide direction information. On the other hand, we can discriminate marker types by matching with previously defined specification of marker types. For example marker type A follows the specification of A and market type B follows the specification of B.



(a) Input image



(b) Extraction of SFM



(c) Matching of SFM with known standard

Figure 5. Matching Processing of SFM

Simple Frame Marker performs recognition processing steps not for a whole image but in extracted marker regions only. So when we use SIFT [4] which is a local feature point based extraction and matching, we can reduce errors in feature point matching through rectification of extracted region.

4. Conclusions and Future work

In this paper, we proposed Simple Frame Marker. Although existing ARToolkit [1] marker can recognize an image, our proposed Simple Frame Marker supports recognition of characters as well as logos and images. Also, Simple Frame Marker itself has direction information and it makes pose estimation possible not through the recognition step but by using an ID of a marker in previous frame and four vertices of a marker. However, usage of a marker still has a limitation when occurring marker frame occlusion. Therefore, we introduced a concept of virtual SFM which is displayed on mobile device of a user and user can select desired targets. In the future work, we will implement virtual SFM and present detailed explanation of its processing steps.

References

[1] H. Kato, M. Billinghurst, and I. Poupyrev, The magicbook - moving seamlessly between reality and virtuality, *IEEE Computer Graphics and Applications*, 21(3):6-8, 2001.

[2] M. Fiala, Artag, a fiducial marker system using digital techniques, *In IEEE Computer Society Conference on Computer Vision and Pattern Recognition*, pages 590-596, 2005.

[3] V. Lepetit and P. Fua, Keypoint recognition using randomized trees, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 28(9):1465-1479, 2006.

[4] D. G. Lowe, Distinctive Image Features from Scale-Invariant Keypoints, International Journal of Computer Vision, 60(2):91-110, 2004.