Border Code: an Efficient Code System for Augmented Reality

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Abstract. Augmented reality services are widely used to providing information efficiently. To connect virtual world with real world, various indicators such as GPS signals and images are used for augmented reality services. Vision-based indicator is easy to recognize because it has based on basic shapes such as a rectangle. The vision-based indicators should exist independently of the contents in real world. This paper proposes the Border Code that is an efficient vision-based indicator for augmented reality services. Border Code is naturally merged with the contents in real world, because this code is inserted around the contents in real world. That is, Border Code can contain the contents therein.

Keywords: Augmented Reality, Marker-based Augmented Reality, Code-based Augmented Reality

1 INTRODUCTION

Augmented Reality (AR) describes technologies that enable users to see and interact with virtual computer generated content which is superimposed on the real world. It enhances users' perceptions of the world by mixing a view of it with virtual elements relevant to their context [1].

To connect virtual world with real world, various indicators such as GPS sensor and Image are used. In recent years, vision-based registration methods with vision-based indicators have become actively used with the improvements of the processing performance of computers. Since vision-based methods do not need any special sensors except a capturing camera, realizing an AR system is quite easy [2]. Common example is the marker. A marker is a shape of rectangle with a black border, which is used as a visual-based indicator. This structure is easy to recognize markers because it is strong on visual distortion by light and rotation. Markers should exist independently of the reality contents. AR system provided to service using only marker without other reality contents.

This paper proposed Border Code that is an efficient vision-based indicator for AR services. It has shape of rectangle that marker placed at the four corner. So the code

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can contain the contents therein. And, Border Code contains bit-stream in between marker and marker. The remainder of this paper is organized as follows. A discussion of related work follows in section 2. In section 3 explain overall Border Code and in section 4 experiment Border Code System. Finally, in section 5 draw our overall conclusions.

2 RELATED WORK

A marker is a shape of rectangle with a black border, which is used as a visual-based indicator. And a marker is identified by the pattern inside the marker. The AR system provides AR services by overlapping AR contents on the marker. For example, the ARToolkit is a widely used application library to implement AR systems. Square-shaped ARToolkit markers are used to calculate camera pose and identify their Identification Data [2].

This structure is easy to recognize markers because it is strong on visual distortion by light and rotation. Furthermore, the structure needs less computational cost than complex structure.

3 BORDER CODE

Figure 1 illustrates an example of Border Code, which looks like a rectangular shape divided into three parts.

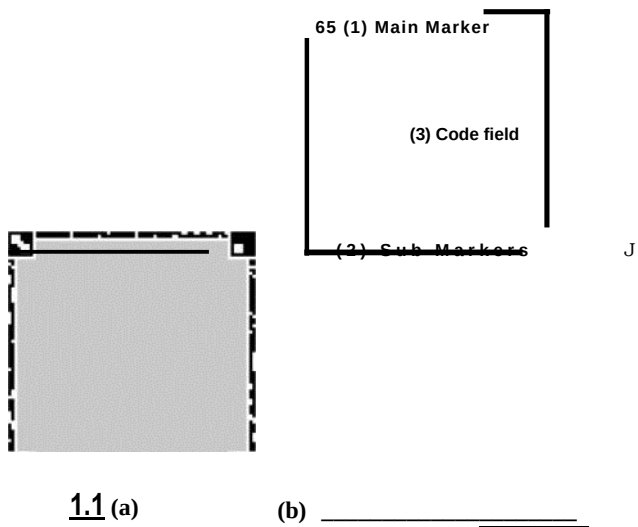


Fig. 1. a) Example of Border Code b) Border Code detail

First part is white border. Border Code wrapped with a white border field in order to differentiate between real world content and Border Code. The second part is the four markers. Four markers to recognize the code exists. One main marker and consists of three sub markers. The main marker allows you to get the amount of rotation and when you extract the data to specify the starting position. The marker helps to recognize their position indicated. Finally, the third field is the data field. This field is

 edge for recording to binary data

structure. The structure will be written in the form of bits for each of two lines on a corner has a variable size.

Fig. 2. Border Code recognition process

The figure 2 shows the process of code recognition in the image. First, makes grayscale images. And then this image change into binarization through Otsu algorithm. Next step is detecting marker candidates from the result that labeling in black and white image. The detector detects a main-marker and sub-markers in marker candidates. The checker calculates the amount of rotation and checks that marker exists on right place [3, 4]. The extractor extracts data by access data fields sequentially. This service provides virtual contents on marker. This is based on four points of Border Code.

4 EXPERIMENT

For the experiments, we used a USB camera (resolution: 640 x 480 pixels, frame rate: 30 fps). We have developed a system using C++ language and OpenCV 2.3 that external library. OpenCV (Open Source Computer Vision) is a library of programming functions for real time computer vision. OpenCV is released under a BSD license. It has C++, C, Python and Java interfaces running on Windows, Linux, Android and Mac.

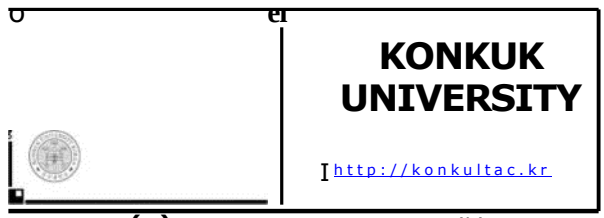
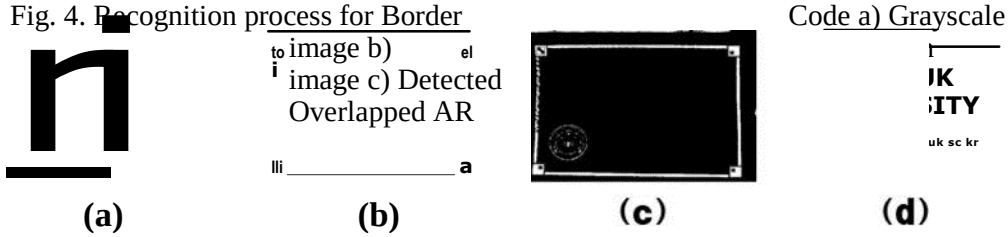


Fig. 3. a)Is the Border Code used in the experiment b)Expected outcome with experiment

Fig. 4. Recognition process for Border Code a) Grayscale image b) image c) Detected Overlapped AR



We use the Code as shown in figure 3-(a) in experiment to obtain the results as figure 3-(b). This code is size of a4 size and has data of 128 bit. Figure 4 shows Experimental procedure that used Border Code. Border Code system to handles input on webcam sequentially like recognition process. Figure 4-(d) shows merge reality contents with AR service contents. Depending on the state of reality contents can showed that also provide AR services contents.

5 CONCLUSON

This paper has proposed Border Code of marker-based. Border Code is easy to recognize because it has features of marker to visual based indicator. Border Code can offer various AR service for user, because these code has bit-stream and variable size. And then, Border Code merges with reality contents. Experiments showed the recognition process for Border Code and showed how the provided AR service also.

However, Border Code has several weaknesses. First, Border Code does not represent only a small amount of data. Second, Border Code has a problem with respect to the range of viewpoint movement. In future, we are developing a system with consider to problem.

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