The Generation of Scenes in Mixed Reality Environments using the Chromakey Technique

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Abstract

A classic problem in the development of Mixed Reality systems is the registration. The correct alignment between virtual objects and the real elements is extremely important for the coherent composition of the resultant scene. Considering this context, this paper describes an approach for the composition of scenes in Mixed Reality environments using the chromakey technique for the extraction of real objects. After that, the scene is mounted in a coherent way related to the depth in OpenGL framebuffer for posterior rendering.

1. Introduction

There are many difficulties in the Mixed Reality (MR) systems development. The registration is one of the most important among them. In order to have an illusion of coexistence in the same environment, it is necessary that the alignment between virtual and real elements is correct.

The registration goes beyond the simple virtual objects location in a real scene image. It is necessary to reproduce depth notions in the scene because sometimes the virtual objects must be shown in front of the real ones and sometimes the real elements must obstruct the virtual objects.

However, most MR available libraries such as ARToolkit [1], in spite of supporting an useful set of functions for capturing the virtual object pose and position (for example, by fiducial tracking and recognizing markers) don’t analyze the real scene object location. In other words, the real image captured scene is showed as background and the virtual objects are showed as foreground.

Aiming a solution for this problem, this paper presents a 3D scene composition method for MR systems based on ARToolkit library using the chromakey technique to extract the real scene elements. After that, the scene will be correctly rebuilt considering the depth (using an alphamap - transparency map) and rewritten in OpenGL framebuffer [4].

The chromakey technique consists of the foreground image identification through a key color in order to replace it by a background image. Many works in this area are protected by patents and some of them, like the ones proposed by Petro Vlahos [3] are pioneers in image combinations. In video productions, this process is made by hardware devices that support a high quality composition. Besides, some situations doesn’t require a expensive hardware chromakey and a software implementation would be preferable [2].

2. The Problem and the proposed solution

As mentioned previously in the Section 1, several MR systems (and libraries), including ARToolkit [1], solve the positioning and orientation problem of the virtual object satisfactorily, but they treat the real scene elements as a texture (or wall paper), that is showed as background. To solve this problem, a marker was introduced in this element.

Supposing that the MR application allows the use of an arbitrary color screen (for example, blue) as a background, it is possible to extract the foreground elements (not blue). The extracted alphamap is used to mount the image as shown in Figure 1.

Firstly, there is a real environment composed, for instance, by a real element, two or more fiducial markers (one marker is introduced in the real element) and a blue background screen. Using some ARToolkit functions it is possi-
to capture the real scene frame by frame. This image, in the BGRA format, is stored in a buffer (Buffer #1). Then, the chromakey technique is applied. The image in the buffer is analyzed aiming to identify the blue pixels (background) and the not blue (foreground). After that, it is possible to change the background to a static or a dynamic image.

During the image analysis, a copy of it is made to another buffer (Buffer #2). In this buffer, the background alpha component is set to 0 (transparent) and the foreground is set to 255 (opaque) creating, that way, an image alphamap in Buffer #2.

Using the detection and recognition ARToolkit functions, the fiducial markers position and orientation are obtained and it is possible to generate the virtual objects if their markers are more distant from the observer than marker introduced in the real element. These objects are generated on a new background (Buffer #1), that is transferred to the framebuffer and then transferred back (glReadPixels()) to Buffer #1. Now, the pixels of the image in Buffer #2 are analyzed, and the ones of alpha value equals to 255 (not the blue ones from the original image) are searched.

When they are found, these pixels are written in Buffer #1 and the contents of this buffer is transferred to the OpenGL framebuffer using the glDrawPixels() function. Thus, the real element will be in a front plan, in relation to the virtual object. Finally, the markers must be analyzed again. The virtual objects closer to observer than the real element are generated and copied to the framebuffer to be shown later.

3. Results

The final results are shown in Figure 2. It is possible to observe the real environment and three markers in the scene. The location of virtual objects is determined by the detection of the lateral markers and the real actor is located by the center marker detection. The scene depth control can be observed.

![Figure 1. The proposed approach.](image)

![Figure 2. Mixed environment scenes.](image)

4. Conclusion

This paper proposes the use of the chromakey technique to solve the real scene elements extraction problem by accomplishing a coherent composition of the real and virtual objects in MR environments. The technique is entirely implemented by software, using the services provided by the video capture functions of the ARToolkit library.

References


