Digital Composting using Chroma Keying

1. Heena .T. 2. Bhavana.V. 3. Jinelle. D. 4. Fabian .K. 5. M.Mani Roja 6. Ashwini Kunte, Ph.D
Thadomal Shahani Engineering College, Mumbai
maniroja@yahoo.com

Abstract
In television and movie industry a so-called “blue box” technology is used, when an object in the foreground (e.g. a person) needs to be placed on a different background (e.g. a computer-generated 3D scene). However, it is often not economically justifiable to build a “blue box”, therefore other methods can be used to extract the foreground object and remove or replace background. Task will be to develop a method for automatic background removal (with a calibration procedure) that will work on a live video feed from a webcam.

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 co- existence 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 some times the real elements must obstruct the virtual objects.

However, most MR available libraries such as AR Toolkit [1], in spite of supporting an useful set of functions for capturing the virtual object pose and position (for example, by fiducially 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 the chroma key technique to extract the real scene elements. The chroma key technique consists of the foreground image identification through a key color in order to replace it by a background image. In video productions, this process is made by hardware devices that support a high quality composition. Besides, some situations do not require an expensive hardware chroma key and a software implementation would be preferable. [2]

2. Proposed Solution
The main objective of this paper is to develop an algorithm in MATLAB software for compositing two video streams together. The main idea is to take any video shot on a blue/green screen background and add another video of any other background using the MATLAB code. This is hence a special effects technique used heavily in many fields to remove a background that is not required and then adding a background of interest from the subject of a photo or video-particularly used in news-casting, motion picture and videogame industries.

As mentioned previously in the Section 1, several MR systems (and libraries), including AR Toolkit, 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 alpha map is used to mount the image as shown below.

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 back- ground screen. Using a webcam it is possible to capture the real scene frame by frame. [3]Then, the chroma key technique is applied considering each frame as a separate image. 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.

A mask is made of the foreground image wherein masking the blue pixels and keeping only the required parts of the image. The resultant mask is then multiplied to the background frames. It should be seen that the size of both frames should be the same. Thus the resultant frames are then combined to form a video [4-8]. In this paper the results are depicted by use of a green screen rather than blue.

Green is currently used as a backdrop more frequently than any other color because image sensors in digital video cameras are most sensitive to green, due to the bayer pattern allocating more pixels to the green channel, mimicking the human eye's increased sensitivity to green light. Therefore, the green camera channel contains the least "noise" and can produce the cleanest key/matte/mask. Additionally, less light is needed to illuminate green, again because of the higher sensitivity to green in image sensors. Bright green has also become favored as a blue background may match a subject's eye color or common items of clothing, such as jeans, or a dark-navy suit.

Blue was used before digital keying became commonplace because it was necessary for the optical process, but it needed more illumination than green. However, it is also further in the visual spectrum from red, the predominant color in human skin. The most important factor for a key is the color separation of the foreground (the subject) and background (the screen) – a blue screen will be used if the subject is predominately green (for example plants), despite the camera being more sensitive to green light

The *green screen effect* is a type of chroma key. The idea is to create a pure green background which is then replaced with whatever background image you want.

Figure 1. The proposed approach

2.1 Green screen technology

This section shows the techniques to set up a green screen (cheaply if necessary) and how to use it in video productions [9-10]. This section includes:

- Planning the studio setting
- Green screen material
- Lighting the green screen
- Incorporating green screen footage into the videos

There are numerous variations on the standard green screen technique and it is necessary to develop the system based on the resources available. While setting up the screen, the following points are considered.

- The colour and lighting of the green screen needs to be as even as possible.
- There should not be anything in the foreground (i.e. part of the subjects) which is the same colour as the green screen
- Use a solid material such as cardboard or wood, painted green.
- Use flexible or spongy material such as foam, spandex, etc.
- Use some sort of fabric.

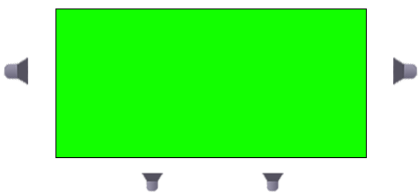

Figure 2. Setting up the green screen

2.2 Selection of Fabric

The section of fabric depends upon the following parameters

- The material should not be too reflective — this tends to create lighter "hotspots".
- Lighter, brighter green is better than dark green.
- Material which is crease-resistant is very desirable.
- Heavy material is good for providing consistent colour, especially if there is any possibility of anything behind the screen showing through. However it can be prone to more creasing.

2.3 The color spill problem

Removing the background color spill, is a problem that needs special treatment when handling unconstraint backgrounds. Color spill is the contamination of the foreground objects with background colors. This problem is most visible at the edges of foreground objects, where a pixel can accumulate light coming from both a foreground object and the background behind it, or when foreground objects are semi transparent, letting light returning from the background pass through it and reach the camera. There is a need to clean the original background color, before compositing the foreground objects on a new background. For example, suppose the pixel $\boldsymbol{I}(i, j)$ is semi-transparent with a key α $(0<\alpha<1)$. This means that the color of pixel $\boldsymbol{I}(i,j)$ in the original image is a mix of the true foreground color at that pixel, $\boldsymbol{F}(i,j)$, and background color $\boldsymbol{B}(i,j)$, $\alpha*(1-\alpha)>0$ of the old background color.

$$\boldsymbol{I}(i, j) = \alpha*\boldsymbol{F}(i, j) + (1-\alpha)*\boldsymbol{B}(i, j) \qquad (1)$$

$$\boldsymbol{I}_1(i, j) = \alpha*(\alpha*\boldsymbol{F}(i, j) + (1-\alpha)*\boldsymbol{B}(i, j)) + (\alpha)*\boldsymbol{N}(i, j) \qquad (2)$$

Simply compositing this image on a new background $\boldsymbol{N}(i,j)$ with a key of α, results in a wrong composite containing a composite of the original image on a new white background, using the correct matte, but with no background color spill removal. Red residues are clearly visible around the edges of the circle. In order to generate the correct new composite it is necessary to recover the pure foreground color $\boldsymbol{F}(i, j)$, by removing the background color spill.

Estimating the background color is an ill posed problem, since at mixed pixels there are six unknowns ($\boldsymbol{F}(i,j)$, $\boldsymbol{B}(i,j)$), but only 3 equations (for each of the components of $\boldsymbol{I}(i,j)$). The common solution used today in a chroma key scenarios, uses a background of a very limited color. These solutions cannot be applied to the general case of keying in a natural background of varying color.

3. Result

It was started off by making and implementing a code in MATLAB from to change the background in image to image. Hence, any image with a blue/ green background could be changed to an image with any required background, e.g. TV broadcasting; a reporter in front of a weather map, or say tourists in front of the TajMahal.

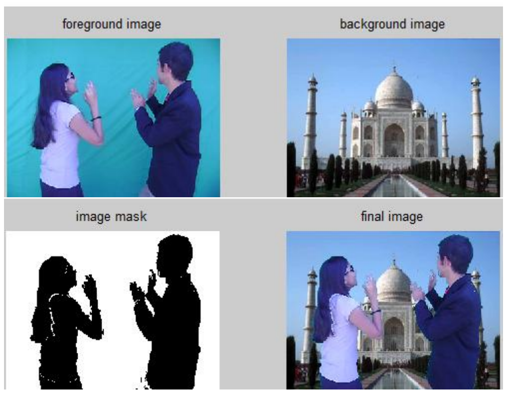

Figure 3. Result: with the Taj Mahal

On successfully implementing the code for image to image conversion, converting video background task is considered. The code has been implemented successfully to combine two video streams hence helping with special effects, like it is possible to show a person walking in outer space or swimming in the deep oceans.

Figure 4. Result: with the US President

4. Conclusion

This paper proposes the use of the chroma key technique to solve the real scene elements extraction problem by accomplishing a coherent composition of the real and virtual objects in MR environments. A green screen technology is considered for mixing the video. The technique is entirely implemented by software, using the services provided MATLAB7.The proposed algorithm was implemented on images first and then on video. It was found out that this method was successful in removing the background video and mixing the object in the foreground was placed on the required background video.

References

[1] Rafael Gonzalez, "Digital Image Processing using Matlab", Pearson Publications, 2012.

[2] Mark Sawicki, "Filming the Fantastic-A Guide to Visual Effects Cinematography"2nd edition, by Elsevier Publications, 2010.

[3] Steve Wright , "Digital Compositing for Film and Video", 3rd Edition 2010, pages 23-27

[4] John Jackman , "Blue screen Composting: A Practical Guide for Video & Movie making", published by Elsevier Publications,2011

[5] Jeff Foster, "The Green Screen Handbook: Real World Production Techniques", Wiley Publications, 2010

[6] R. Gonzalez, R. Woods, "Digital Image Processing", 1st edn.Pearson Education

[7] S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing", by Mc Graw Hill, 2008

[8] Anil K.Jain , " Fundamentals of Digital Image Processing" By Prentice hall ,2006

[9] www.mediacollege.com(date:12/10/2011)

[10] http://www.seanet.com/~bradord/blue _green_screen_visual_effects_1.html(date:15/9/2011)