Providing a real-time implementation system for implementing virtual studio software

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***Abstract*— This article provides a way to implement a real-time system for implementing a virtual studio software for using alongside the Video Mixer and removing the hardware curtain special for using in live programs. Using this method, the cost of producing video products is reduced because the bulk of the cost of producing visual products is the cost of the decor and studio. Despite the fact that using a hardware curtain, you can create a variety of studios in one studio, but it also costing a lot of studios that with using this technology to remove the hardware curtain is prevented from the same cost. On the other hand, Agile technology will also be used in this approach, one of the benefits of which is to receive customer feedback in short and continuous intervals. As you know, the path of a software project can not be planned for a long time for two reasons: first, the environment is likely to change the requirements, and secondly, the requirements of the customers will be changed; therefore, the soft project should be flexible enough to accept changes in the level of technology.**

Keywords-real-time; virtual studio; agile; blender; virtual reality; augmented reality

I. INTRODUCTION

Nowadays, visual media has become an influential arm in various cultures, policies, sports and other interactions, and with the expansion of social networks, a new platform for the distribution of these products has been provided. Considering the importance of the issue every day, new technologies are developed to produce better and simpler products until in addition to improving the quality of these products, the cost of producing visual products is also reduced. One of the bulkiest parts of the cost of producing video products is the cost of decor and studio, which particularly, in special programs imposes a lot of costs on the programmer. Hence, several technologies have been considered for this department, one of the most popular of these techniques is the use of virtual studio or Krumaky. Advantages of using virtual studio software include cost reduction, speed and variety production and attractiveness, which makes the use of virtual studio software both economically and operationally affordable. The work we do to produce this software is divided into three parts: research - studies, programming and operational work. The section research – studies consists of two basic and advanced parts; the base part must be sufficiently fluent in programming with the C and Python languages as well as the OpenGL API. In the advanced section, you must have complete control over the structure of data and graphic algorithms, graphic mathematics and real-time rendering. In the programming section we use Blender software to design and implement a virtual studio; so at this stage, we need to obtain the necessary information and documentation on how to use the mathematics and data structure and the graphic algorithm in the coding of this software provides the necessary information. In the functional and operational section, we introduce the design of the software that we use Agile technology in this design; so that we can add the capabilities of this technology to this software, in order to achieve the desired purpose. Therefore, we can reach the desired state from the current state. Finally, we test the designed software to ensure that the target is going to be achieved.

II. VIRTUAL REALITY

Virtual reality is the human effort to remove the boundaries between real space and virtual space. This technology, known as VR, simulates an environment for the user that does not exist in the real world. In fact, with the help of a headset or a hardware device, the user can see himself in an environment that does not exist in reality but gives him a real sense. Environments that exist in virtual reality are more visual, but sometimes they have audio or touch sensors. These environments are often 3D or 360 degrees. Virtual reality, also is referred to as a multimedia environment, is a computer simulation environment that can simulate the physical presence in one place in a real world or virtual world. Virtual reality is a new technology that allows the user to interact with a computer simulation environment. Simulated environments can be as real or different as real life environments, as seen in computer games. In addition to headsets, there are other technologies for become more realistic of virtual reality and interact with the user, such as hand controls and smart gloves. The controllers have tactile feedback capabilities that allow the user to interact with objects in the virtual world, another

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ability of controllers, is to detect hands open and close, which allows you to capture or drop things in the world of virtual reality. Virtual reality's smart globes are capable of tracking hand movements and making tactile feedback, such as vibration and heat. [1]

III. AUGMENTED REALITY

Augmented Reality (Briefly, AR) is an illustration of a physical environment in real-word that is integrated with digital information. Unlike virtual reality, which creates a completely artificial view of the environment, the augmented reality adds new information to the real environment around the individuals. Augmented Reality is a technology that by special headphones combine the virtual world and real world, and virtual objects are added in the world around us. In augmented reality, elements are usually written in real-time and intelligently related to environmental elements. One of the main goals of AR pursues is to provide useful information and to help the user to get a better understanding of the surrounding environment. Today, the use of AR in various areas of everyday and professional life such as architecture, education, interactive publication, game, medicine, military, routing, translation, etc has found many uses. The most famous platform for augmented reality is Google Glass. With Google Glasses only a constant environment is observed. Using Google Glasses, you can take pictures or capture video through a glasses or optical display, use voice commands, and search the web. The augmented reality allows the user to view the real world and to import digital information into the real world. This is while virtual reality interrupts our communication from the real world and provides a fully simulated environment. [2]

The combination of VR and AR technologies is MR (Mixed Reality). MR technology is closer to AR technology and tries to add artificial environments to the real world. MR technology interacts with the surrounding environment and according to the surrounding environment displays the digital information. [2]

IV. OPENGL API

In the Direct X User Interface (API), there are two layers called HEL: Hardware Emulation Layer, and HAL: Hardware Abstraction Layer. HAL is like a metal layer that prevents direct access to hardware; on the other hand, it directly communicates with hardware. This layer is usually a driver, built by the hardware manufacturer and you communicate with it by using DirectX generic calls. Therefore, HAL is used when your requested attribute is directly supported by the hardware, for example, when you request to draw a bit of a bit, this action is sent directly to the hardware through HAL and hardware runs it. The HEL layer is used when the hardware does not have the feature you want, for example, when you want to use a graphics card to perform a rotation operation on the bit of your choice, and the chip you are looking for does not have the capability, HEL simulates this operation. If the requested feature has hardware as well as the software simulator layer, it is natural that hardware implementation is much easier and faster than software implementation, and the use of the HAL layer is far more affordable than HEL. While DirectX was created, another product called OpenGL was also created by Silicon Graphics company from nVidia company's productive graphics card, which it's name is derived from the Open Graphics Library. [3]

In OpenGL there are no HEL or HAL layers. The OpenGL graphics engine does not belong to a particular operating system and can also be used on many consoles at various times. DirectX technology is a general-purpose technology that plays a role in a variety of computer environments, from both input and output to two-dimensional and three-dimensional rendering and audio and so on, but OpenGL is just a graphical interface. [3]

V. REAL-TIME RENDERING

Real time Rendering makes images on a computer at a fast pace. This is the most interactive part of computer graphics. A screenshot appears, the viewer shows a reaction and this feedback affects what will be produced in the next step. This cycle of reaction and rendering is performed at a proper speed so that the viewer does not see the distinct images but is relatively immersed in a dynamic process. The display of images in frames per second (fps) or Hz is measured. In a frame per second, there is a small amount of interaction; the user is heavily aware of the arrival of any new image. At around 6 fps, an interactive concept begins to grow. The program displayed at 15 fps is really real-time; the user focuses on action and reaction. However, there is a useful limitation. From about 72 fps onwards, differences in display rates are effectively unrecognizable. [4]

Rendering in real-time usually means three-dimensional rendering. Interaction and some concepts related to 3D space are sufficient conditions for real-time rendering but the third element has become part of its definition which is hardware accelerator graphics. While dedicated hardware for 3D graphics on professional workstations has been available for many years, recently use of such accelerators is possible at the customer level. While graphics accelerator hardware is not completely needed for real-time rendering, it has become a requirement for most real-time apps. [4]

VI. VIRTUAL STUDIO

Virtual Studio is a television studio that allows users to combine images of people or other real objects inside the studio with a real-time computer-generated virtual environment. In such programs, the performer or other real objects are mostly are shooted in a blue or green curtain studio. The key point of virtual studio is the possibility of a real camera move in comparison to traditional TV krumaky programs. This is while the corresponding virtual camera moves in cyberspace and render the appropriate three-dimensional view in output. If we want to restrict TV production to studios, the production of these types of programs is generally done in two ways: using real decor and using the Krumaky's method.

Krumaky's method : In the Krumaky's method, the actor or presenter stands front a color blind (usually blue) and their

image is captured by the camera but using video techniques, it tries to split the video signal from this view into two parts:

- Foreground: Picture Player or Executor (and other opposite color elements with a curtain)
- Background: Blind picture (and other similar color elements with it)

By sending the background color information (the key signal) the command is given to a switcher so that at certain moments of the presence of a certain color, it replaces another video signal, which again is combined with the Foreground signal in the next step. Thus, if we take into account the initial image of a presenter standing in front of the blue curtain, after the processing stages, it is observed that the blue curtain has been deleted and instead of its the image of the mountain has been placed in a way that it looks the presenter standing in the mountains. The set of features required by the Krumaky's system includes the equipment (camera, keyer and mixer) plus an space with lighting possibility and a blue curtain.

Tips to be taken when working with Krumaky:

- Providing uniform light to the blue curtain: The blue zone should be illuminated uniformly so that it can be distinguished from other areas. Otherwise, the image will be noisy.
- Pay attention to the size of the blue curtain: whatever the more the area of the blue curtain is, the more the actor or performer can get away from it.
- The lack of intersection of Foreground light and the blue curtain: lighting should be made in such a way that these have two light at least the intersection together so that they can be easily repaired or changed without damaging one of them.
- Low delay in Signal Processing Route: It is natural that delays between different paths occur due to the passage of a signal from a different path and performing signal processing operations. But in any case, the delay should be minimized so that there is no problem in terms of the compatibility of the images as well as the coherence of the sound and the image.
- Attention to the problem of back color: the reflection of the light that is shined on the curtain and the floor on the presenter changes the image Hue and creates an abnormal image and thus the color of the image changes (Color Spill) correct illumination and attention to the distances in fixing this problem is effective.
- Lack using of Focus Pulling: One way to get the viewer's attention is on a specific part of image is performing the Focus Pulling so that the target area is focused and other areas of the Eta-focus. This is done using the field depth phenomenon. But in the Krumaky image, if we intend to focus on the image of the presenter and the background will be out of focus, it will not be possible because the background image is provided from an external source and there is no possibility to Eta-focus it to amount that is commensurate with changes in the depth of field of the image.
- Limit of motion of the actor/presenter: Lighting in the Krumaky environment is limited and the actor or presenter is limited for do not out of range of Krumaky's curtains.

In addition to the motion limitations of the actor or presenter, the illustrator or, in other words, the director has also the limitations. This limitation is due to the fact that the background is always a pre-made image (graphics or video image) making motion changes on the Foreground image will not cause the same changes occur on the background image, so the connection that has taken place between the two images in the moment before the camera moves will go awa and the so-called Krumaky be leaks. The reason for this is that while Background images and Foreground are combined on a flat surface, they have no connection in terms of location, so if the Foreground camera moves to the left of a single unit, it is expected that the image of Background also changes. Also, there is no single point of reference for images which for example, if the camera moves forward 2 meters, expect that the background image will change as much as it is. Consequently, even if we are able to create a spatial relationship between two images, it is not possible to calculate the change ratio at any moment. This will cause in the moments of moving the camera we are faced with the scene perspective distortion. To solve this problem, we need to find a way to firstly link the background image with the image of the foreground camera, which allows you to apply motion changes to both which, of course, requires that the background image not a pre-ready image to be able to change with camera changes. As an example, the source is a computer that has been transformed image by receiving information from the foreground camera, thereby allowing perspectives to be preserved. Second, it is clear that in order to satisfy the above, it is essential that all movements of the camera be monitored accurately and that the information about its rate and how it moves into precise spatial parameters of the camera (including the lens) is converted and apply to the source of produce the background image. [5]

For this reason, in this article a real-time rendering system is implemented that is used alongside the Video Mixer, which is able to engage real-time changes made in Foreground for the background image and if a change in Foreground occurred in the form of completely real-time, the background image was also designed to fit into it and in this way creates a completely real-time synchronization between Foreground and Background images.

VII. VIRTUAL STUDIO STRUCTURE

The virtual studio system includes several cameras along with tracking systems that have duty to provide information about the location of the studio camera. While the actual camera produces Foreground video signals, a

visual simulator system, such as a graphics supercomputer, creates Background signals associated with it. Then Background and Foreground signals (oftentimes) are combined using Krumaky's system and the compound outputs (FG + BG) are available to the end equipment of the path such as the monitor DVE mixer and the recording device. [5]

VIII. VIRTUAL STUDIO TECHNIQUES

Today, instead of a blue or green curtain as a background, that later supplant it with static images, it uses a completely blue (or green) space in which the floor and the walls of the filming location are also blue and by installing the equipment which can with them, in order to determine the location of the camera in the virtual world, track and control the camera's movements, as well use of appropriate software and hardware equipment for the preparation of high-quality 3D graphics and animations which is used as Background and Foreground and the kruma keyer used for image mixing can be granted the other vital into this images. Moving the camera and following the movements of the presenter by the camera's motion tracking system, the motion of the virtual decor also with realistic perspective is simultaneously with moving the camera and by changing the angle of the camera, the angle of view of the virtual decor also changes and these movements in real-time is processed, so that the presenter can greatly interact with the virtual decor or move forward and backward its or even move inside its and thus the virtual space will be greatly real for the viewer. Such a collection is called Virtual Studio. It should be noted that in order to create a live mode in 3D mode, it is necessary that the tracking operation and the combination of images occur in real-time and therefore requires a very powerful computer. It is clear that the studio for this purpose should be equipped with a Krumaky's curtain, appropriate light equipment and technical equipment, which equipment needed for the virtual studio system are: tracking system, rendering system and composite system. [5]

IX. REAL-TIME TRACKING

Real-Time Location Systems (RTLS) are used to identify and track the location of objects or individuals in real-time that are usually in a building or other location. Wireless RTLS tags are attached to objects or are covered by people, in most RTLSs, fixed reference points receive wireless signals from tags to determine their location. [6]

In this article a method is provided that without the need for hardware curtain (green or blue), pay to TV products without the cost and limitations associated with hardware curtain. In this approach, the Foreground image instead of the image relates to the hardware curtain and presenter that be replaced signals from the hardware curtain with the built-in virtual image, a image is including a presenter that uses real-time location systems, wireless RTLS tags be worn by the presenter and through them the executor's location is specified at any time in real-time and from this it is possible to determine the signals of the image of the presenter from the other signals of the Foreground image, finally, the background image, which is made virtual and also used in its production of virtual reality technologies and augmented reality - as previously described, in real-time be changed proportional to the Foreground image in order to coordinate with it - instead of being replaced by signals related to the hardware curtain, they are replaced by signals that are not related to the presenter; in other words, the entire signal related to the Foreground image other than the signals associated with the presenter by the real-time location system are detected and they are replaced by the generated virtual image, that is, the signals of the presenter do not change and signals that are in Foreground but not related to the presenter are replace into the virtual image created. In this way, you can create a variety of television shows at any place without the need to use the hardware curtain and face the limitations and costs associated with it.

Blender software is used to produce virtual images and special effects as Background and since the path to a software project cannot be programmed for a long period of time due to the possibility of changing the environment, as a result of changing the requirements and also changing the requirements of the customers themselves and on the other hand, the software project has to be flexible enough and have capable of accepting changes in the level of technology, in this article, Agile technology has also been applied to this software which is being receive the customer feedback by adding this technology into software and is being made necessary changes for achieve into the desired result so that the software has sufficient flexibility and acceptance of the changes thus, can be arrive from the status quo to the desired state.

X. CONCLUSION

The production of television products using the Krumaky's method is much more cost effective than using real decors because the production of television products using real decors requires the fact that for each program there is at least one separate studio that fits that program. While using the Krumaky's method in a single studio equipped with a hardware curtain (green or blue), each program can be generated because using virtual reality and augmented reality technologies can images associated with the subject matter of the program was created in a virtual way and replaced them with the signals of the hardware curtain but for the use of this method also must attention be paid to the following: giving uniform light to the blue curtain, paying attention to the dimensions of the blue curtain, lock of the intersection of the Foreground light and the blue curtain light and other items that already been said that the lack of attention to any of these elements causes the noise and distortion of the Krumaky's method and the undesired output. Therefore, in this article a method is provided that even without the need for a hardware curtain (green or blue) it is possible to product television

products, it is enough, with follow the motion of the presenter by the camera's motion tracking system in real-time, be detected signals related to the presenter from the signals of other images in Foreground then the virtual images created as Background are replaced with all the signals received from Foreground except the signals related of the presenter. Therefore, can be done the production of TV products at any place, without the need for a hardware curtain.

REFERENCES

[1] P. Tony, Learning Virtual Reality, 2015.

[2] A. Steve, Practical Augmented Reality, 2016.

[3] C. Patrick and R. Christophe, OpenGL Insights, 2012.

[4] A.-M. Tomas, H. Eric and H. Naty, Real-Time Rendering, 2012.

[5] F. Kazuo, H. Masaki and Y. Yuko, "Virtual studio system for TV program production," *SMPTE*, 2015.

[6] J. Alfirido and M. Pedro, developing real-time tracking applications, 2010.