

DEVELOPMENT OF AUGMENTED REALITY VIDEO APPLICATION

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Abstract: The subject of this paper is the development and design solution of an augmented reality application for marketing purposes. The main goal of the study is to examine the functionality of Unity software and Vuforia software development kit, as well as create an application that will allow the user to play video content using augmented reality technology. The application's primary goal is to give the user more information about the Company behind the Augmented Reality target image. The development of the application was preceded by research in the field of immersive technologies and software for Augmented Reality development. The aim of this research is to set up an intuitive system in the form of a mobile application that would identify the image and play and control the video content on the mobile device screen using Augmented Reality technology.

Key words: Augmented Reality, application design, user experience design

1. INTRODUCTION

New technology is a term generally used to describe new technology, but it can also refer to the ongoing development of existing technology. It can have slightly different meanings when used in various areas of society, such as the media, the business sector, science, environmental protection, or education. New technology allows us more real and concrete experiences with all our senses (Marshall, 2018). Extended reality is a virtual extension of our current reality. Subgroups of extended reality are (Marr, 2021):

- Augmented Reality (AR),
- Virtual Reality (VR),
- Mixed Reality (MR).

Perhaps all of these technologies can be better understood in their proper context within the "virtuality continuum," a term defined in 1994 by Paul Milgram, Haruo Takemura, Akira Utsumi, and Fumio Kishino. The continuum of virtuality is essentially the span between the real world and physical reality on the one hand and entirely virtual reality on the other (Figure 1) (Gutiérrez, Vexo & Thalmann, 2021).

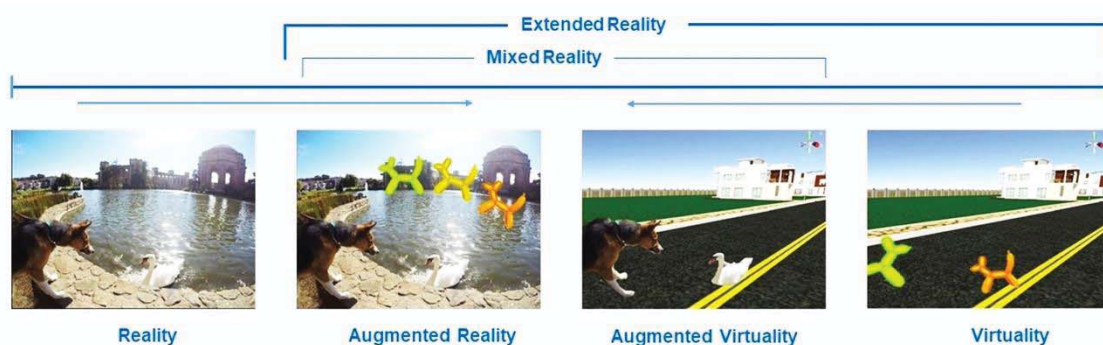


Figure 1: Virtuality continuum

Augmented reality is an interactive experience of a real-world environment in which objects in the real world are augmented with computer-generated perceptual information, usually via multiple sensory modalities, including visual, auditory, haptic, somatosensory, and olfactory (tom Dieck & Jung, 2019). Marker-based augmented reality was used for the development of this application. This type of AR works on the principle of tracking and recognition. In this type of AR, a marker must be used to perform the augmentation process. Tracking and recognition are features of computer vision. Recognition is nothing but the identification of any object/media, such as a barcode. Our devices have barcode scanning and recognition software, similar to human facial recognition through security systems. Tracking in AR creates

a specific pattern or image that the AR application can recognize. Once the app finds the pattern, it constantly tracks the position of the pattern in the real world so that the app can precisely place the digital object on the tracked marker. Markers are generally square and may also use a black-bordered image within the white main frame. It helps to separate the marker from the background frame. Internal marker graphics often appear distorted or pixelated. Unwrapping an image is returning a part of an image to its original position. When recognizing images, it is necessary to apply image unwrapping (Linowes, 2021). Similar research on the topic of augmented and virtual reality has been conducted by Đurđević and associates (2019), as well as Đurđević, Novaković and Zeljković (2020) in their papers (Đurđević et al., 2019; Đurđević, Novaković & Zeljković; 2020).

2. MATERIALS AND METHODS

For creating design and interaction through an application, the program Unity was used in combination with SDK (Software Development Kit) Vuforia (Wise, 2018).

The idea was to create an application that will enable the user to control video content augmented in augmented reality. Recognizing the target image will provide video content about the company compared to the basic information that can be found in real-world images. After scanning the target image, the application will load a specific video with a complete description, such as a company marketing video. Also, the user can stop, pause or play this video content using provided user interface.

To understand the application development process, we need to understand the architecture of augmented reality (Figure 2). In this architecture, the camera image is sent to the tracking module and then to the rendering module, where the real and augmented objects are combined. And the output is the enlarged image that appears on the screen. The virtual and real-world components are merged in the Rendering module. Capture Module - captures the image from the camera. Tracking Module is the core of the AR system, and it calculates the relative position of the camera in real-time. The term "position" basically means 6 degrees of freedom, i.e., the 3d location and orientation of the object. The Rendering module helps us to combine the virtual components and the real image into one image using the calculated position, and after all that, it displays the enlarged digital object on the image, projective geometry is a mathematical model for estimating the position (Doerner et al., 2022).

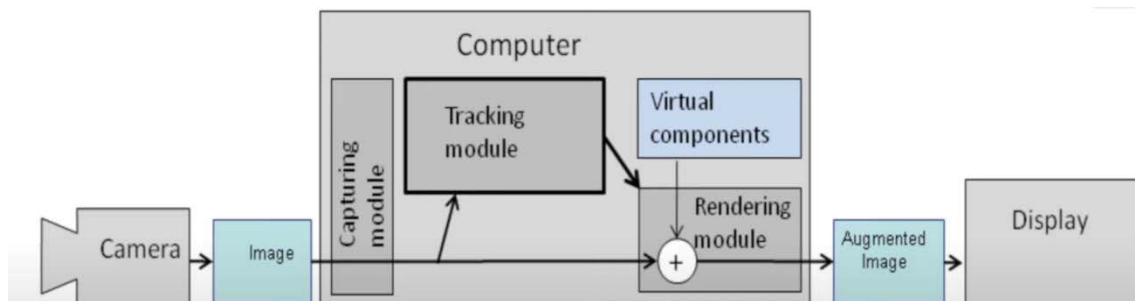


Figure 2: Augmented Reality Architecture

2.1 Vuforia

To create an Augmented Reality application, we have visited the website <https://developer.vuforia.com/> and we created an Vuforia account. We Logged in and visited the Downloads section [8]. After downloading, it was necessary first to set everything essential in the web version of Vuforia. We have opened the Develop section, and there was the License Manager, Target Manager, and Credentials Manager. License Manager is for editing licenses, which are specific lines of code that help Vuforia connect to backend services and confirm which type of service we use, Basic or Premium. The basic service is free to use. Here we can get part of the code that we enter in Unity to activate Vuforia. We have started the Basic service by clicking Get Basic. The page opened where we enter the name of the license and accepted the terms of use. We clicked on the created license, where we get the license status and the code that needs to be copied. Then we went to Target Manager. Target Manager – stores markers that we will use in applications. The marker base is created as follows: By clicking on Add Database, defining the name, choosing the Device type and by clicking on Create.

Now it was necessary to click in the list on the appropriate base in which we will upload images of markers. It is essential to have quality markers because it depends on the quality of the image we upload, which will affect the performance of our AR application and the quality of recognition. We clicked on Add Target, and a window opened where we selected the type of marker, where the file is located, the width of the marker, and the name. We clicked on Add button. After the marker has been added, we have check it by clicking on the marker.

We notice the stars that represent the quality of the marker. Anything over three stars is good. Five stars mean it's great for tracking. A Four and five stars rating is recommended. Our marker had five stars. Clicking on button "Show Features" shows the points "+" that follow the marker when it moves. Our marker has great contrast so there was a lot of marker points (Figure 3).



Figure 3: Marker points (left), marker image (right)

We returned to the previous window where the marker base is located, after clicking on Download Database (All), we selected Unity Editor, and clicked on Download button. After that, the file was compiled and saved, and we moved to Unity.

2.2 Unity

Initially, it was necessary to choose the platform type because the process takes much longer if we do it after creating the application. So, we go to File menu - Build Settings, selected the platform and clicked on Switch Platform. All platform options were listed. The Unity thumbnail to the right of the platform name indicates that the Windows platform was active. After switching to the Android platform, we imported the Vuforia SDK.

We opened the folder containing the SDK and dragged it into Unity Assets. The Package window appeared, and we clicked on Import. Then, on the next window, we clicked on Update. A folder has now appeared in the Assets Editor. We also imported markers into Assets. After importing, a window appeared on which we pressed the Import button. Now we have everything ready for AR application Development.

First, we deleted the Main camera (This camera is for virtual rendering, so we don't need it for AR). Then we added the AR Camera from the Vuforia Engine menu. This camera will record the real world and place digital objects into it. Next, we added the License from the site by clicking on the AR camera and, in the Inspector panel opened Vuforia Engine Configuration. Finally, we copied the key from the License Manager website in the App License Key section.

We went to the Hierarchy panel and added Image Target from the Vuforia Engine menu. The Target is white and can be changed and added in Unity, but we want to define it from the Vuforia Marker Base. By clicking on Image Target in the Inspector panel, we found Image Target Behaviour for the type we chose From Database, and we have chosen Database. Finally, we have chosen the marker. Since we only have one marker, it was selected by default. Now we added a 3D Object - Plane. We transformed it so that it covers the surface of the marker and is located in front of it (Figure 4).

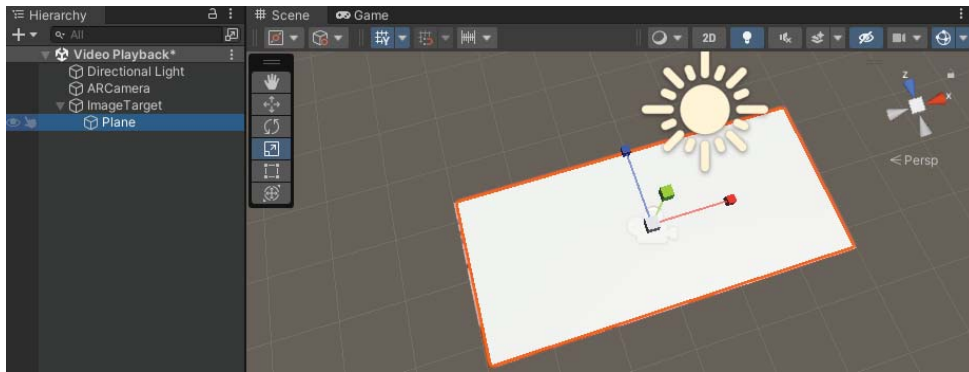


Figure 4: Plane object covering marker image

We selected Plane and added Add Component - Video Player to the inspector panel. We then added the video to Assets. Next, we dragged the video file "GRID Video" into the Video Clip field in the inspector panel while Plane was selected in the Hierarchy panel. When the video is played this way, it is always inverted, so we rotated it using the Rotate Y-axis option to a value of 180.

In the inspector panel, there is an option to Play on Awake. This option means that when the application is started, the Video will also be started. We have turned off this option. Selected the Image Target and noticed the On Target Found and On Target Lost options in the inspector. We have added the On Target Found function with the "+" button. Into the None field, we dragged the Plane representing Video and changed the name of the Plane to Video Player. We selected Video Player - Play() for the function from the drop-down menu. Now we set that when the Target is recognized, the video starts. We repeated the procedure for the On Target Lost() function, connected the Video Player object, and set the Pause() function. We tested the application and noticed that the sound was also played, which signifies that we have set everything right.

We then created similar options using UI Canvas. In the hierarchy panel, by clicking on Image Target - UI - Canvas, we made a window for the 2d interface. We clicked on the Canvas in the hierarchy panel, and then, in the inspector menu, we changed the UI Scale Mode to Scale With Screen Size (this helps the UI to be more responsive). Next, we switched to a 2D view and added UI - Button Text Mash Pro to Canvas. It was necessary to import TMP Essentials for the text to be visible and the font to be assigned. We selected the button in the hierarchy and then, in Rect Transform, clicked on the desired field and, holding Alt (Option) key, selected the position of the interface at the bottom left. We duplicated the button twice and arranged them in the same way, down the centre and downright, naming them PAUSE and STOP (Figure 5).

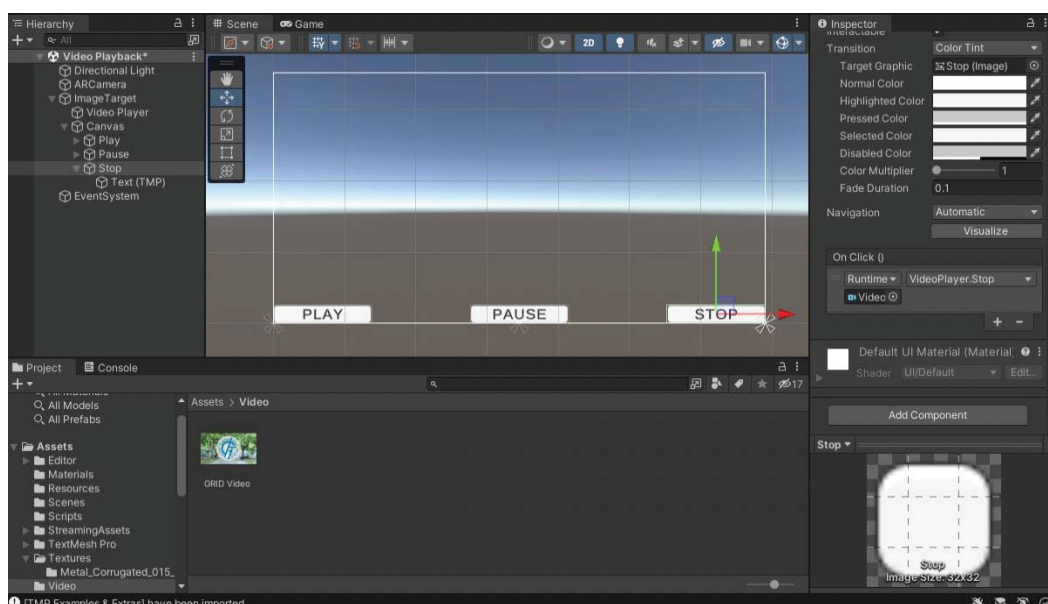


Figure 5: The user interface, play, pause and stop buttons

Then we set the functionality. We selected the Play button, and at the bottom of the inspector panel, we found the On Click() function and added it with the "+" button. Next, we dragged the Video Player object into the None field. Finally, we added the function Video Player - Play(). We repeated the procedure for Pause and Stop.

After testing our application, we were able to augment video content and control it via the created user interface (Figure 6).



Figure 6: The final application testing

3. CONCLUSION

There is a growing need of the user for technologies that more easily and quickly lead the user to the desired and additional information. In addition to these benefits, the user becomes dissatisfied with the basic information we can find in the real world printed products and thus augmented reality becomes a platform to overcome that. In combination with the newly created application, more detailed and extensive information is offered. Unity with Vuforia SDK are becoming a revolutionary combination to create augmented reality content.

4. ACKNOWLEDGMENTS

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5. REFERENCES

- Doerner, R., Broll, W., Grimm, P. & Jung, B. (2022) *Virtual and Augmented Reality (VR/AR): Foundations and Methods of Extended Realities (XR)*. Springer International Publishing. Available from: <https://books.google.rs/books?id=OL1yZgEACAAJ&dq=augmented+reality&hl=en&sa=X&ved=2ahUKEwiDlNC18Nj6AhXAgf0HHWPeAhgQ6AF6BAGNEAL> [Accessed: 11th October 2022]
- Đurđević, S., Novković, D., Dedijer, S., Kašiković, N. & Zeljković, Ž. (2019) Development of Augmented Reality Application for Interactive Smart Materials. *MATEC Web of Conferences*. 209 (1). Available from: doi: 10.1051/mateconf/201929001002
- Đurđević, S., Novković, D. & Zeljković, Ž. (2020) Development of products state identification application. *10th International Symposium on Graphic Engineering and Design*. 537-541. Available from: doi: <https://doi.org/10.24867/GRID-2020-p61>

Gutiérrez, M.A., Vexo, F. & Thalmann, D. (2008) *Stepping into Virtual Reality*. Lausanne, Switzerland, Springer International Publishing. Available from:
<https://books.google.rs/books?id=yI8o7osCuQoC&pg=PA7&dq=virtuality+continuum&hl=en&sa=X&ved=2ahUKEwjMrMmp79j6AhUDhf0HHYSsAc4Q6AF6BAGEEAI#v=onepage&q=virtuality%20continuum&f=false> [Accessed: 11th October 2022]

Linowes, J. (2021) *Augmented Reality with Unity AR Foundation*. Birmingham, UK, Packt Publishing. Available from: https://books.google.rs/books?id=iBk-EAAAQBAJ&pg=PA301&dq=Augmented+reality+Tracking+and+recognition&hl=en&sa=X&ved=2ahUKEwiC_fLe79j6AhUhhv0HHYarC5EQ6AF6BAGLEAI#v=onepage&q=Augmented%20reality%20Tracking%20and%20recognition&f=false [Accessed: 11th October 2022]

Marr, B. (2021) *Extended Reality in Practice*. Chennai, India, Wiley. Available from:
https://books.google.rs/books?id=WsonEAAAQBAJ&printsec=frontcover&dq=Extended+reality&hl=en&sa=X&redir_esc=y#v=onepage&q=Extended%20reality&f=false [Accessed: 11th October 2022]

Marshall, G. (2018) *New Technology*. Available from: <https://www.encyclopedia.com/social-sciences-and-law/sociology-and-social-reform/sociology-general-terms-and-concepts/new-0> [Accessed: 11th October 2022]

tom Dieck, M.C. & Jung, T. (2019) *Augmented Reality and Virtual Reality*. Manchester, UK, Springer International Publishing. Available from:
https://books.google.rs/books?id=h7SIDwAAQBAJ&printsec=frontcover&dq=Augmented+reality&hl=en&sa=X&ved=2ahUKEwjI05_H79j6AhU7i_OHHZHkAR8Q6AF6BAGKEAI#v=onepage&q=Augmented%20reality&f=false [Accessed: 11th October 2022]

Vuforia (2022) *Vuforia Engine 10.10 is Available!* Available from: <https://developer.vuforia.com/> [Accessed: 11th October 2022]

Wise, D. (2018) *Building AR Applications with Unity and Vuforia*. USA, Packt. Available from:
https://books.google.rs/books?id=k6sgzgEACAAJ&dq=vuforia&hl=en&sa=X&redir_esc=y [Accessed: 11th October 2022]



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