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DISPLAY OF INTERACTIVE 3D MODELS IN AUGMENTED REALITY ON MOBILE DEVICES

Marko Bergant*[1], Helena Gabrijelčič Tomc[1]
[1]University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of Textile, Graphic Arts and Design,
Chair of Information and Graphic Arts Technology, Snežniška 5, 1000 Ljubljana, Slovenia

Introduction

Mobile Augmented Reality - MAR stands for the display of augmented reality on mobile devices that adds computer-generated virtual content to the real world using a selected mobile platform. Mobile augmented reality systems usually include programs or applications. The combination of augmented reality and various mobile platforms allows the creation of various new mobile applications that include the use of augmented reality. Nowadays, the use of MAR is very wide, research is mainly focused on its use on devices such as smart glasses, smartphones, tablets, PDAs or even in some cases laptops. Mobile phones are considered the most typical MAR device because they contain a camera, sensors, powerful processors and specialized graphics hardware. Despite rapid advances, their capacity for real-time applications is limited. The most popular examples of MAR usage are Pokemon Go, Archeoguide, AR-Quake, BARS, Snapchat, etc. (Kipper & Rampolla, 2012; Furht, 2011; Chatzopoulous et al, 2017; Craig, 2013; Shah, 2018) MAR system programs consist of the following three main components (Chatzopoulous et al, 2017; Shah, 2018): Input components (camera, gyroscope, microphone); Data processing displayed on the mobile device screen; Output components (display screen).

Methods

The working methodology included idea generation, development of initial images with sketches and 2D illustrations of 3D animal models, and final applications. We started in the Blender program, where we fully created all three interactive 3D models of a cat, a horse and a duck. As part of the animation, we created three different movements for each animal. We created idle movements, an example of walking, and an action state. The augmented reality model method was used to represent the creatures in augmented reality mode. In the following, we also planned the design of the whole platform on mobile devices. We carried out the preparation process in the Unity program, where we used prepared interactive cards and created 3D animal figures to set up the entire application platform, which allows it to be displayed in augmented reality mode. Another step was the preparation of the test parameters according to different criteria. We tested according to the following parameters:

- Playback according to the different degree of subdivision on both mobile devices;
- Display from the viewpoint of the camera and the image target in five different lighting conditions;
- Character recognition based on the distance between the mobile device and the image target according to different recognition ranges in two different ways;
- Character recognition based on the detection angle between the image target and the mobile device.

In testing, we used two different mobile devices, namely the Huawei Mate 10 Lite and the Samsung Galaxy A32. Figure 1 shows the entire work cycle.

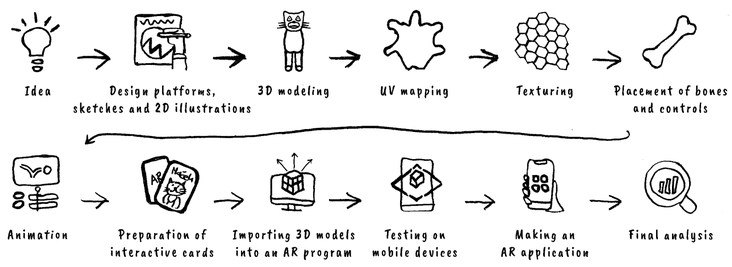

Figure 1

Showing the execution scope of production from idea to finished product.

Results

The final result of the work is a mobile application called Augmented Animals, through which 3D animal models are displayed in augmented reality mode. After launching the platform from the desktop of the mobile device, it first takes us to the start menu, where we have the platform's trademark at the top and three buttons at the bottom, which are Start, Information and Exit. When you click on the Start button, the platform takes you to the application scene, where selected animal characters are shown in augmented reality mode with the help of image targets. In this mode, the user is greeted by three game buttons, which allow switching between three different animations when the selected character is displayed. Figure 2 shows the final result with all three animal models displayed on a mobile device.

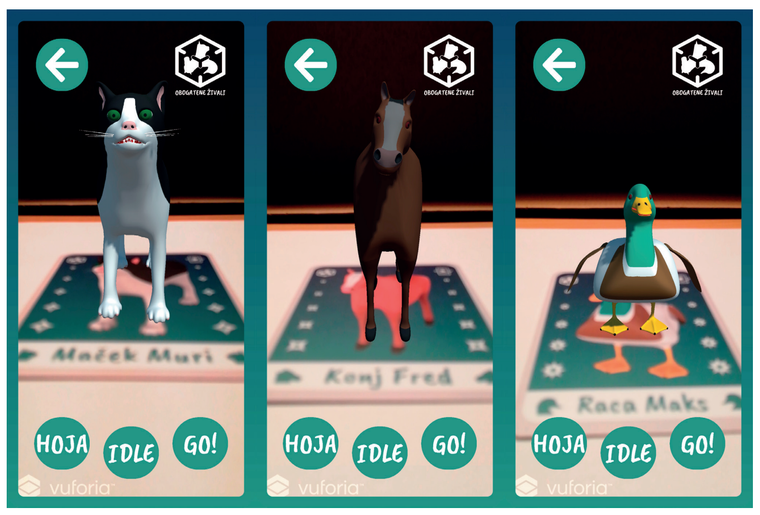

Figure 2

Display of all three animal characters on the image target from a mobile device screenshot

Discussion

First, we analysed how 3D models playback on selected mobile devices according to different subdivisions (levels 0-3). At level 2 we can see the first differences because it did show that the newer mobile device plays the action movements better and more fluidly when playing dynamic animations. The difference was ultimately most noticeable at level 3. It was shown that the processor of a newer mobile device plays selected action animations faster for a certain fraction of a second. This testing has shown that 3D models with higher polygon counts are considered more challenging to render on mobile devices and the difference was most noticeable when playing dynamic movements.

We also analysed the display of animal 3D models under different lighting conditions. Perception analysis was performed under five lighting conditions. In very good lighting conditions (sunlight, cloudy light or artificial light), the camera recognized the interactive card very quickly and successfully displayed the selected animal model. When detecting in darker conditions, the latter is somewhat more demanding, as the camera's light sensors need a longer time to detect the image target and display animal characters. While the mobile device was not able to display the selected animal model in complete darkness as expected.

We also checked the detection according to different distances of the mobile device camera from the image target. In the first part, we checked detection when we did not have an animal character on the screen of the mobile device. The most successful way is to capture an image target at a distance of 15 to 50 cm, in which the mobile device recognizes the image target qualitatively and quickly and displays the associated selected animal character. The most ideal detection distance is thus foreseen in the range between 15 and 20 cm. In the second part, we also checked how the animal figure is preserved depending on the distance of the image target from the mobile device. It can be noted that during the testing of this part, problems appeared only in the part if we approached the image target to a distance of about 5 cm or less.

We ended the testing with an analysis that covers the recognition of the image target according to the inclination of the mobile device. Perception of the interactive card from a bird's eye view was by far the most effective because it did the animal character appeared the fastest in this view. There were more problems in detecting the characters at the right 90-degree angle, as the characters in the vast majority did not want to appear.

Conclusion

In the end, we made it successfully the creation of three different interactive 3D animal models that can be displayed on a mobile device using augmented reality technology. When playing 3D models on mobile devices, we could emphasize that animal characters with a higher level of subdivision or the number of polygons is considered more demanding when playing on mobile devices. The results of our tests also showed that the most successful detection between the image target and the mobile device is in the distance between 15 and 20 cm and from a bird's-eye angle position in good lighting conditions.

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*For more information about this article contact me via: bergantmare@gmail.com