Université de Rennes

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# REPORT
# TIA

unity vuforia™

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# I. INTRODUCTION

This report presents the development process of the C-AR Game created as the final project for our TIA class during the 2nd year of our Master's degree program. The tools used to develop this application are Unity 3D and Vuforia. The goal of this project is to create an augmented reality application in order to solve simple 3D physics game.

The requirements were as follows:

- The application should display a virtual playground.
- The application should provide selection and manipulation techniques to manipulate the virtual objects.
- The game must provide two different game modes (easy and hard). Help information will be provided to the user in easy mode.
- At least one object will be controlled using an AR marker.
- The application will provide a 2D GUI interface to manage the state of the game.
- The application will provide information about the time required to find the solution and the number of objects used.

# II. DESIGN PHASE

Quickly after being introduced to the subject, we came up with an idea. We decided on an obstacle race. The goal of our game is simple, the player just needs to drive a car to the finish line while avoiding all obstacles on the way.

We started the development process by sketching the different interface elements and deciding on the interaction modalities for each task.

When launching the application, the user would land on a **menu** (figure 1) that would provide them with options: PLAY and QUIT.


*Figure 1: main menu*

One of the requirements for this game was to have different game modes. Therefore, when selecting the PLAY option, you will be able to **choose between two levels**: EASY or HARD (figure 2).

The EASY option is supposed to consist of a straight road with no predefined obstacles while the HARD option will have multiple obstacles and a crooked road.


Figure 2: level selection

When starting the game, the player will need to place **image targets to display the virtual playground and any desired obstacle**.
Once the player is satisfied with the disposition, they can click on the START button to start the simulation. They can also press the MENU button to go back to the menu (figure 4).


Figure 4: information text

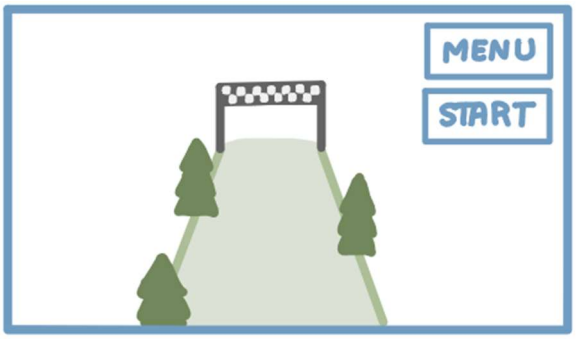


Figure 3: game set up

Regarding the actual game, **four buttons will be available on the screen** (2D GUI interface) at all times **to control the car** (figure 5):

- LEFT button: turns the car to the left.
- RIGHT button: turns the car to the right.
- BRAKE: slows down the car.
- GAS: increases car speed.

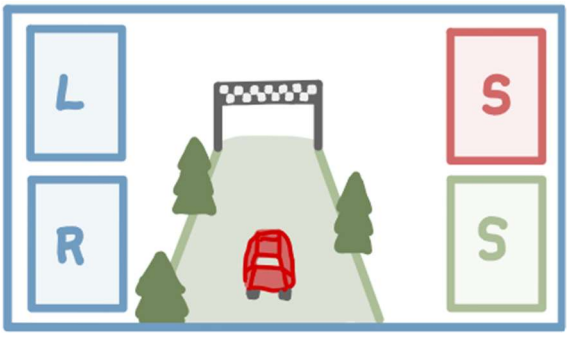


Figure 5: game controls


Figure 6: win message

If the car crosses the finish line, the **end of the game** is triggered, and a message appears on screen as an overlay (figure 6). This screen will also display information such as the **number of image targets used** (playground and obstacles) and the **time** it took to reach the finish line.

# III. APPLICATION

The main difference between the original design and the final application is that rather than providing help to the user in easy mode, we decided to create a separate level that would serve as a tutorial. This tutorial contains the following information:

- The goal of the game.
- Which image targets to use.
- How to control the car.
- The effect of each button.

Otherwise, we had time to implement every functionality that we envisioned. We even added a MENU button at the top of the screen during the game if the player is stuck or wants to go back to the main menu.

Nonetheless, the development process was not easy. Given that it was our first time working with unity we took a lot of time to develop even the simplest functionalities.
With more time, we would have liked to improve some of the functionalities. For example, the car control works perfectly fine when it spawns properly but sometimes, if the image target is not put on a horizontal surface, the car will break completely.

# IV. USER MANUAL

When launching the application, you will land on the **main menu**. Three options are available:

- LEVELS: leads you to another menu to select the level you want to play.
- HOW TO PLAY: launches the tutorial.
- QUIT: closes the application.


Figure 7: main menu

The **levels menu** contains three options:

- EASY: launches the game in easy mode.
- HARD: launches the game in hard mode.
- BACK: goes back to the main menu.


Figure 8: levels menu

The **tutorial** starts with four panels. On each panel are two buttons, NEXT and BACK. The first one will lead you to the next panel while the second one will take you back to the previous panel.
At the exception of the first panel, for which the BACK button is replaced by a MENU button that will lead you back to the main menu.

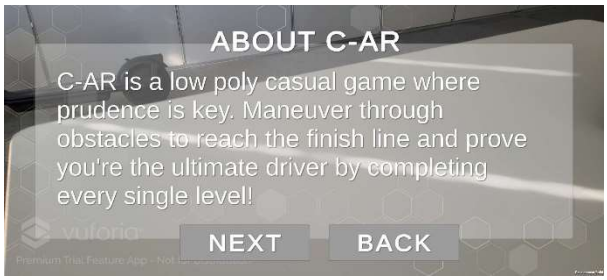


Figure 9.1: game information


Figure 9.2: playground

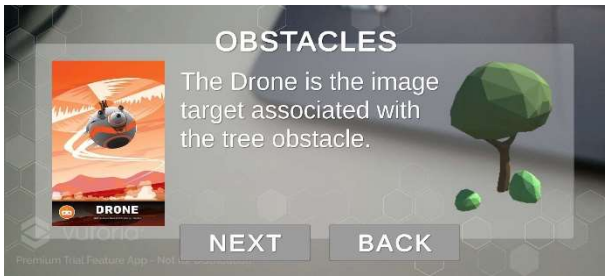


Figure 9.3: tree obstacle


Figure 9.4: rocks obstacle

The first panel (figure 9.1) contains a little explanation of the game and its goal. The second panel (figure 9.2) shows what the playground looks like. The arch at the end is the finish line. It also presents you what image target to use to display it.
The third and fourth panel (figure 9.3, 9.4) both show different obstacles as well as their corresponding image targets.

On the last panel, pressing the NEXT button will lead to the next screen which is the **set-up screen** (figure 10 - 11). From now on, apart from the explanations on the screen, it is the same as launching a game in easy or hard mode.

On this screen, you are supposed to place the fissure image target to create the playground. The shape of the playground varies depending on the level that you are on.

Before starting the game, you should also place an astronaut or drone image target to create obstacles. In hard mode, two obstacles are already present on the track.

When you are ready to start the game, click on the START button or if you want to go back to the main menu, click on the MENU button.


Figure 10: set-up - tutorial

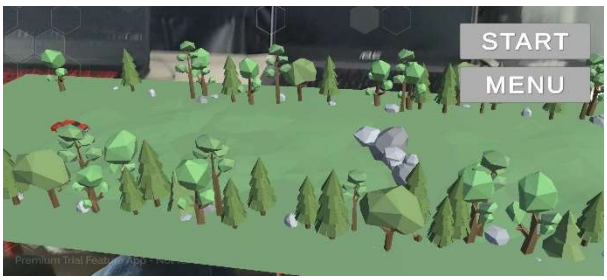


Figure 11: set-up - easy with a rock obstacle

Let it be noted that once the game is started, the obstacles can no longer be moved or removed.

If you start the game, four buttons will appear (figure 12 - 13):

- LEFT button: turns the car to the left.
- RIGHT button: turns the car to the right.
- BRAKE: slows down the car.
- RUN: increases car speed.

Your goal is now to drive the car through the finish line with the help of the controls. If you ever find yourself to be stuck simply press the MENU button.


Figure 12: game - tutorial

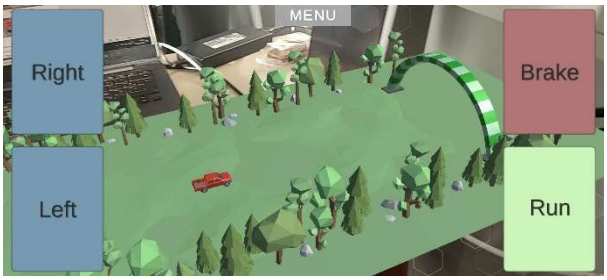


Figure 13: game - easy

The controls are straightforward, the only thing that may need to be noted is that you need to maintain the Run button to keep advancing.

As soon as you reach the finish line (the arch), a message appears on screen. This means that you just finished the game. From then on you can decide to go back to the main menu with the MENU button or leave the game with the QUIT button.

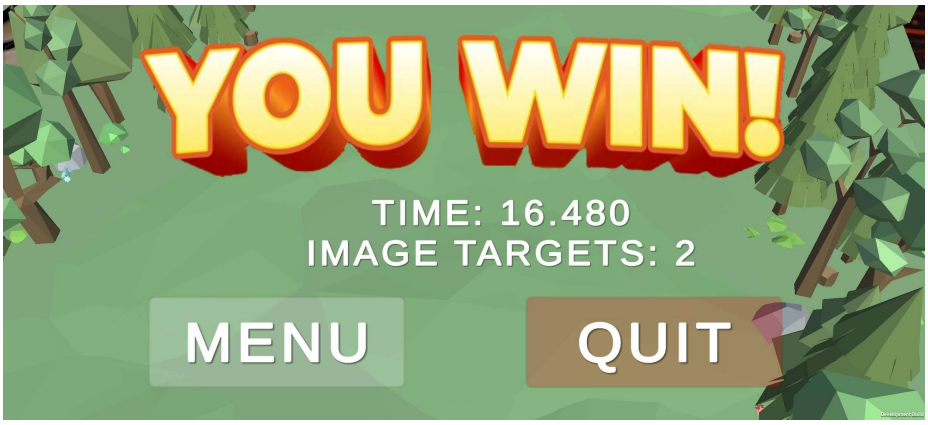


Figure 14: ending screen