DEVELOPMENT GUIDE FOR

FOR VIRTUAL REALITY

PROJECTS IN UNITY

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Introduction

Virtual reality can be a great tool for education: it can provide a hands-on and more interactive experience for learning especially for mathematics, where abstract concepts take form and easier to understand. With this purpouse this project was started.

In this project I took the first steps to setting up a VR project in Unity. The basic mechanics like setting up movement, teleporation, interaction between objects and the creation of my own meshes, like and haxagonal tile and a Moebius band.

In this document the main contents are referneces to guides and tutorials to follow to learn how to set-up your own VR project in Unity as well as generated work I have done during the course of my investigation.

Steps to follow

To develop a VR project we have to be familiarized with the software that we are going to use, in this case Unity. Unity is a game developing software great for VR development as there are a lot of SDK's (Software Development Kit) with tons of resources that greatly facilitate your work. The basics you should know when starting are:

- **C#**: Any code you will write in Unity will be written in C-sharp. It is also useful to know C and C++, as they are also OOP (Object Oriented Programming) languages and similar to C#.

- **Unity**: It is essencial to familiarize yourself with how Unity (and game development in general) work. You can start playing around with small projects to see how **gameobjects** and their components work. In the **Tutorials and studies** section there are links to example projects that can help you get started: like the project "Roll-a-ball".

- **VR**: Get familiarized with your specific VR headset and try out its tutorials: to develop for a specific medium you have to understand its features and limitations. In this project I have used the *Oculus Meta Quest 2*.

- Blender and 3D models: Blender is a 3D modeling tool that can help you edit models for your projects. It's a very good complementary tool for Unity.

But don't expect to create your own 3D models: for that there are links to pages that have free to use 3D models and assets in the **Resources and models** section.

After all of this you can start combining all of your knowledge into a VR project in Unity. The fists steps will be to set up the basic functionalities like movement, hand tracking, teleportation and interaction with other objects. There are tons of tutorials for that in they Unity webpage and YouTube. A recommended playlist is XR development toolkit series by *Valem Tutorials*: this video series uses a Unity SDK with lots of capabilities and a great versatilty since it isn't tied to a specific model or brand of VR headset[1]

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[1] Note that new versions of this SDK have come out since the tutorial series was made so its important to look for the changes made in the latest versions

Generated Work

The main result of this project has been learning how to set-up a VR project and documenting it along the way. But besides that, I have also compiled resources and assets to be used in future projects. With this license-free assets I created a first version of a hub from where to access other content:
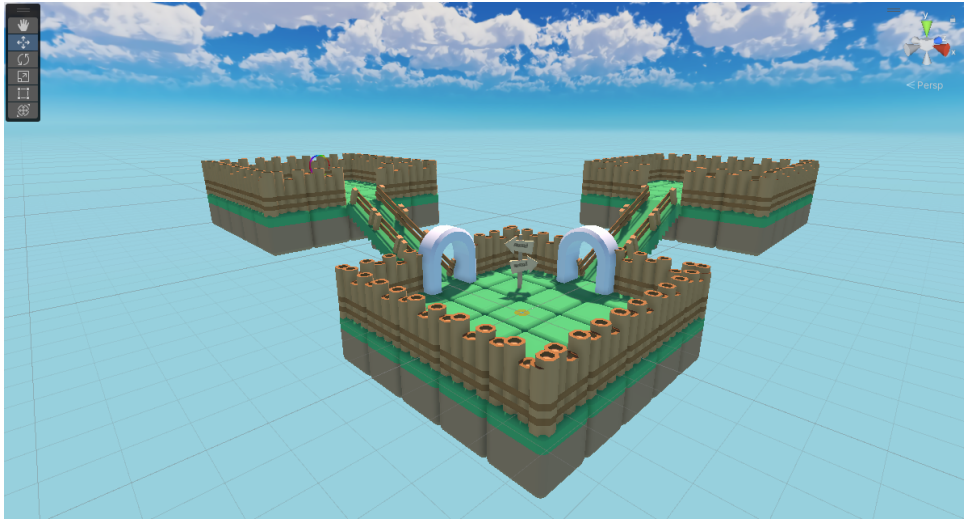
Also, using the parametric function of a Mouebius band I created a script that allows you to create Mouebius' bands the size and detail (the amount of triangles it's made out of) you want.
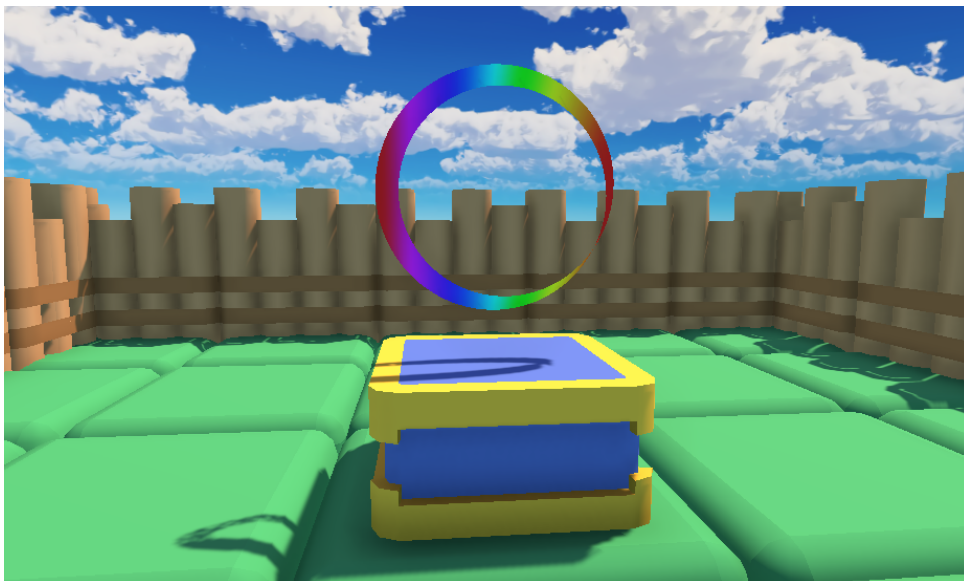
Aside from this project, the main work was done in my TFG (final thesis for my bachelors' degree) which was also a VR project on how to simulate a laparoscopy in VR modeling softbody tissues in Unity. The whole project and research paper are too long to be sumarized in this document, but here's a link to my GitHub page to access all the work created:
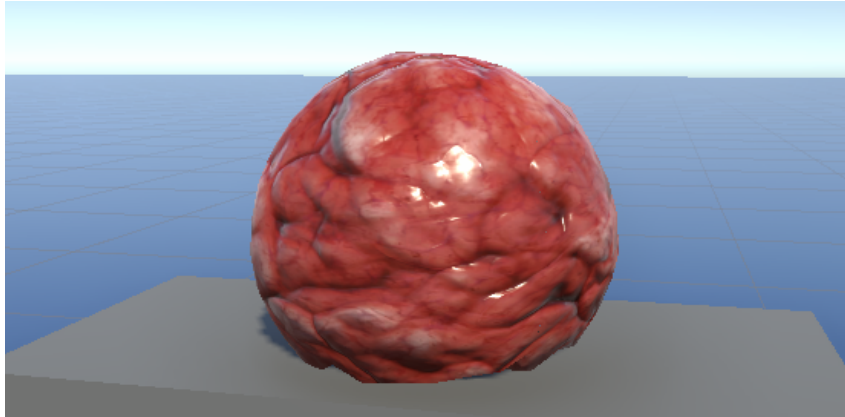
`https://github.com/MarcGabernet/TFG_Softbody`

Image of a softbody object

There is also a GitHub repository for the other project with the hub scene and a tutorial scene with differend kinds of interactable objects like blocks, a gun and a sword. You can find the project and the paper describing my expirience choosing it and deploping it as a univerity intership in the link:

`https://github.com/MarcGabernet/PractiquesEmpresa_NF`
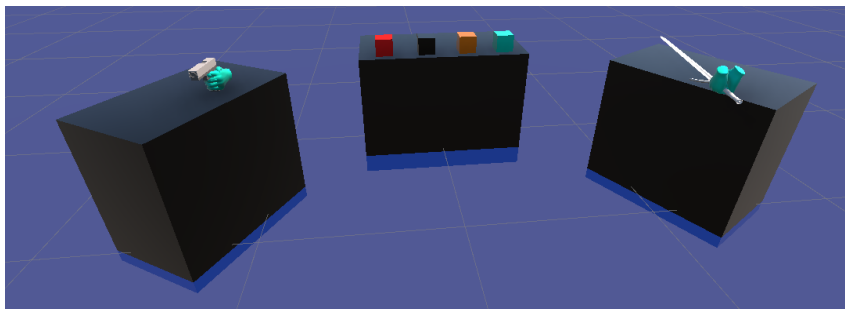
Interactable objects in the tutorial scene

NOTE that both projects and their code are mosty written in catalan!

Tutorials and studies

1. **Unity**
   https://unity.com/es/download

2. **freeCodeCamp.org - YouTube**
   L·Learn Unity - Beginner's Game Development Tutorial"
   https://youtu.be/gB1F9GOJXOo?si=CyzyocptvEFFwo6r

   Great introductory tutorial for Unity's interface and basic functionalities. There is also a
   segment about the basics of C#.
   The video focuses on the development of a 2D videogame but it's still a great way to get
   used to the basic tools and how scipting works if you decide to follow it along.

3. **Unity Asset Store**
   "Roll-a-ball"
   https://assetstore.unity.com/packages/essentials/tutorial-projects/unity-learn-roll-a-ball-completed-project-files-urp-77198

   Good introduction to 3D Unity. Also great to get familiarized with the basics and scripting
   in a hands-on approach: try modifying the project.

4. **Valem Tutorials - YouTube**
   "VR Tutorials"
   https://www.youtube.com/@ValemTutorials/videos

   This channel has an extensive library of tutorials series on how to implement different
   SDK's (Software Development Kit) related to VR development. A very good series is the
   "XR development toolkit series", which tends to update when new versions of the SDK
   are released[2]. A link to this series:
   https://www.youtube.com/playlist?list=PLpEoiloH-4eP-OKItF8XNJ8y8e1asOJud

5. **Trabajos Fin de Master Universidad de Almería - Mateo Piñol, Andrés**
   "Realidad virtual en la enseñanza de las Matemáticas"
   https://repositorio.ual.es/handle/10835/8225

6. **Blender**
   "3D Modeling"
   https://www.blender.org/

   In case you need modeling for your project Blender is a great option.

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[2]Make sure that the information in the videos are up to date: some of the newest tutorials might be more
updated. Also make sure the tutorials apply to your specific VR headset.

Resources and assets

These resources, mostly 3D models, are great for testing features and building your project. In the Unity Asset Store not all the assets are free but if you look aorund you can find great models that will improve the quality of your project and ave time in modelling, which sometimes isn't even an option.

1. **Unity Asset Store**
   https://assetstore.unity.com

2. **Free 3D**
   https://free3d.com/3d-models/obj

3. **Kenney**
   https://www.kenney.nl