

TIA - Project Description – 2023/2024

This document contains the description of the noted project that which will be delivered at the end of the course. The tools used to develop this project are the same as the ones used during the previous TPs: Unity 3D and Vuforia. The goal of the project is to create an augmented reality application in order to solve simple 3D physics game. You have to choose one of these options:

(A) **Obstacle Race:** A 3D object (e.g. steel ball) has to travel from a starting position to a final destination in a constrained virtual/real playground. In this game, the user has to build a path using predefined pieces (e.g. slopes, springs, elevators, etc.) which will enable the ball to reach a final destination.

(B) **Rube Goldberg Machine:** The game will enable the user to design a Rube Goldberg machine¹. The goal is to activate a simple mechanism (e.g. push a button, unroll a poster, trigger an explosion) in a virtual/real playground. In order to activate the mechanism, the user will have to build the machine using a set of predefined building blocks provided by the system (e.g. magnets, steel balls falling through a slope, springs, levers, ropes, etc.).

In both cases, the following features must be implemented:

1. Using an image target, the application should display the virtual playground (e.g. a static virtual environment in which the game will take place). At the beginning of the application, the virtual objects, that the user can interact with will be randomly displayed in the playground. Other modalities can be envisioned, such as placing them in a box or through a 2D GUI.
2. Provide selection and manipulation techniques to enable the manipulation of the virtual objects. Different manipulation modalities can be considered, from constrained transformation restricted to a plane, to full 6 degree of freedom manipulations.
3. The game has to provide two different game modes. In the first mode (easy), help information will be provided to the user. This information can have various forms, semi-transparent objects will provide hints on how the puzzle can be solved or simulations of how the machine will work can be displayed (e.g. show the mechanisms in action). In the second mode (hard) no information will be provided. The game can have one or multiple solutions.
4. At least one object will have to be controlled using an AR marker. The controlled object can be a piece of the game attached to an AR marker.
5. The augmented reality content has to be integrated with a real object and should enable physical interactions with real objects (e.g. a piece falling on a real table). AR markers can be used to identify which real objects can interact with virtual objects.
6. The system will provide a 2D GUI interface in order to manage the state of the game: start (e.g. enable the physics), pause or reset the simulation. When the simulation is running, the user will not be able to modify the playground.
7. Once the game is finished (e.g. the target object reaches the final goal), the application will provide information about the time required to find the solution, the number of objects used in the solution and the time the ball required to reach the final target.
8. The application must integrate all the components in a single application and it has to run in an android device (tablet / smartphone).

We recommend you to first **sketch** the different interface elements and decide the best interaction modalities for each task before implementing your application. The different interactive elements can be extended in order to provide **additional functionalities**. When designing your interaction

¹ https://en.wikipedia.org/wiki/Rube_Goldberg_machine

techniques be imaginative, use and try different interaction modalities when possible, from 2D GUI elements, image targets, virtual buttons or touch gestures.

The **grading** of the project will be based on the quality of the implemented features and the diversity/originality of the interaction modalities.

By the 31/01/2024 each group will have to deliver:

1. The entire **Unity project** in a zip file (delete the Library and obj folders to reduce the file size), or in a git repository (add a .gitignore)
2. The **android apk**, which should run on the tablet/phone.
3. A **report** describing the developed application. First, the report has to describe the design rationale and the different functionalities that were envisioned during the design phase (this part will represent the 33% of the final score). Second, it has to detail the developed application, detailing the implemented functionalities. Finally, it has to include and a user manual, detailing how to use the application. We recommend you to provide screenshots of your application in order to better illustrate the interface and its workflow.
4. **Short video** showing the gameplay