Immersive Media Programming – Lab 6
VR Setup, Hand Presence, and Teleportation

In this lab, we'll setup a VR project with Oculus XR Plugin and XR Interaction Toolkit. Additionally, we implement hand presence and teleportation features.

Please use Unity version 2020.3.34f1 from now on!

It is quite much work, so please start early! But don't worry because it is going to be fun and we'll help you if you run into problems!

Submission instructions:

- Record a video of the game view for each scene (toggle "Maximize on play" to show it well). The video names should follow the task names. For example, if you take two videos for Task 2, name them as: Task2_1.mp4, Task2_2.mp4
- Place all videos in a separate folder OUTSIDE the project folder.
- Close Unity.
- Make a backup copy of your project folder.
- Remove unnecessary folders from your project folder: Library, Logs, Obj.
- Zip the project folder AND the video folder into a single ZIP file.
- Upload the ZIP file to your Google Drive shared folder.
- Submit a link to the shared folder in AjouBB.

NOTE: Feel free to add more features or make things more creative :)

Deadline: May 24 at 23:59

Maximum points: 21p

Task 1: Setting up VR Project and XR Device Simulator (2p)

Lecture: 2022/05/04 Immersive Media Programming, VR project setup, XR Device Simulator

SETUP: This setup task is critical, so please let us know if you have any problems!

Follow the VR setup lecture to set up a project, with some exceptions:

- Instead of creating a bowling scene, create simple scene with a ground.
- Use XR Ray Interactor for both hands.
- Add some game objects with the GrabInteractable and Rigidbody for testing.
  - Try to grab and throw them.

If you have an Oculus device, follow also this lecture (if you didn't set it up already):

- Week 9 > Oculus Quest 2 Setup

NOTE: if you don't have an Oculus device, you must add the XR Device Simulator to the scene.

- When you use an Oculus device, remove or disable the simulator from the scene.

Task 2: Trash Terminator: Pick up trash (5p)

Lectures: 2022/05/09

Demo video: Lab6_Task2.mp4

The Earth is drowning in trash. The amount of trash generated exceeds our capacity to process it. You are our last hope to save the Earth and restore the balance. But the task is not easy. You are faced with ever increasing mountains of trash. In fact, there is so much trash that your feet are stuck to the ground and you cannot move. But you have one advantage: the Force (i.e. XR Ray Interactor) at your fingertips. Use the Force to pick up the trash and throw them to Trash Buddy, your loyal trash-devouring companion creature.

Create a copy of Task 1 scene and rename it “TrashTerminator_Level1”. Remove any test game objects that you created in task1.

Then, follow the hand presence tutorial in the lecture. Use hand models for both hands.

- NOTE: the latest hand presence script with a bug fix is under Week 11 > Sample code > VRBowling_Balloon_Simulator.zip
  - See the comments beginning with “2022-05-11 UPDATE...”

Following the story, implement the trash collecting feature:

Trash objects

- find/create at least 3 trash models and make sure that trashes have these components:
  - Collider (e.g. BoxCollider)
  - Rigidbody
  - XR Grab Interactable (so you can grab them with the ray)
- place a few copies of each trash model around the player.

Trash buddy

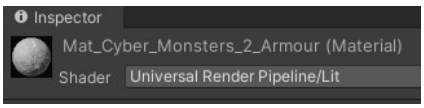
- find a nice model for Trash Buddy (animation is not mandatory).
  - Add a collider
- place your TrashBuddy somewhere within a throwing distance from the player.

Player

- the player can pick up trashes using the XR Ray Interactor.
  - If needed, you can adjust the ray length under XR Ray Interactor > Raycast Configuration > Max Raycast Distance
- when the player picks up a trash, play a sound effect
  - XR Ray Interactor > Audio Events > On Select Entered
- The player throws the trash to TrashBuddy. The trash is destroyed when it collides with TrashBuddy.
  - Add one point to score and show the score
  - Play a sound effect
- When all trashes are collected, show a “Level Cleared!” message in console.

When importing a model/prefab to the project, its materials might be broken (see example on the right). You can try to fix broken materials by: Edit > Render Pipeline >Universal Render Pipeline > Upgrade Project Materials to UniversalRP Materials.

If materials are not fixed automatically, you can try to change their shader to one of the shaders under Universal Render Pipeline (e.g. URP/Lit):



Task 3: Trash Terminator: Shoot’em up (6p)

Lecture: 2022/05/16

Demo video: Lab6_Task3.mp4

Oh no! The battle has taken so long that TrashBuddy became full and some of the trash have become alive. The trash have mutated into aggressive, bloodthirsty enemies that seek for an opportunity to destroy you. But fear not! The Gods of Waste Management have gifted you with a powerful weapon against the enemies. Use the TrashMaster 3000 gun (or another model) to exterminate the enemies!

In this task you continue previous task by creating enemies that move toward the player and that the player can shoot at.

Scene setup

- Copy Task2 scene and name it “TrashTerminator_Level2”
  - Remove TrashBuddy

Gun model

- Instead of the “LeftHandPresence” and “RightHandPresence” models on the XR controllers, you will use a gun:
  - Find a gun model of your choice from Asset Store.
  - Create an empty game object and add the gun model under it as a child (like we did with “cube” hands in the video).
    - Scale down the gun to an appropriate size (and rotate if needed).
    - Save the gameobject as a prefab, remove from the scene.
  - Drag the prefab to both left and right hand XR Controllers’ Model Prefab field.

  NOTE: later we’ll learn how to grab and hold a gun to shoot, but here we use use the gun as our hands.

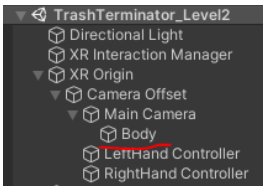
Enemies

- To create enemies, you can either reuse the same trash prefabs or find new prefabs.
  - If you reuse the same trash prefabs, remove GrabInteractactable.
  - If you use new prefabs, add a collider and a Rigidbody.
- For each enemy prefab:
  - Add XR Simple Interactable (see lecture)
  - Add script “EnemyController”
    - Make the enemy move towards the player (XR Origin).
      - each enemy type has a different speed

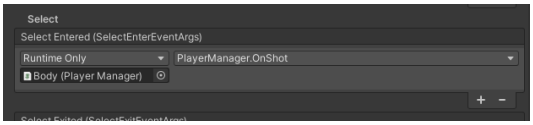
- Place at least 10 enemies (use different types) around the scene in front of the player.

Player

- Add a Capsule game object “Body” as a child of Main Camera
  - Scale it and position it under the camera to represent the player’s body
  - Disable Mesh Renderer (to make the body invisible)



- Player can “shoot” enemies with XR Ray Interactor
  - Call a shooting method (implement in the next step) when a ray interactor Select event happens:



    - Do this for both hands.

- Add “PlayerManager” script to Body

  - Write a method (in my case “OnShot()”) that destroys an enemy when it is shot (selected) with the ray interactor (see example in the 2022/05/16 lecture)
    - Play a sound effect when shot happens
      - use Ray Interactor Audio event!
    - If all enemies are killed, show “Level cleared!” in the console.
  - Show points and the count of remaining enemies in the console after shooting an enemy.
  - If the enemy touches the player, the game is over
    - To do this, detect collisions between enemies and the Body capsule.
    - Pause the game and show a Game Over message.
    - Play a sound effect to indicate a premature end of the poor player’s life.

BONUS (+1p):

- Instead of manually distributing enemies around the scene, write code to spawn at least 10 random enemies at random locations in front of the player (use a min distance so the player has enough time to start shooting).
- Add hit points: the number of times the enemy must be shot before it is dead
  - use different HPs for each enemy type.

Task 4: Trash Terminator: Teleport to Ultimate Trash Solution (6p)

Lecture: 2022/05/16

Demo video: Lab6_Task4.mp4

You have fought bravely but new trashes just keep coming and coming. Your trigger fingers have blisters and the psychological stress of always having to watch your back is weighing heavily on you. The battle feels futile and never-ending. You certainly have better things to do than fight the trash, like learning to become a professional VR developer. Just when you are about to give up and get back to your IMP homework, you notice something in the distance. It is the Ultimate Trash Solution (UTS)! There is just one problem. Between you and the solution lie hordes of trash enemies ready to devour you. What to do? Luckily the Gods of Waste Management offer their helping hand and equip you with the power of teleportation. Use this power to jump to the UTS before the enemies get you.

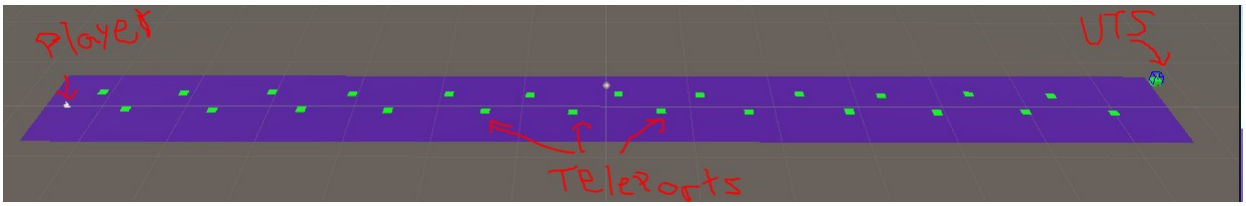
In this task, the left hand will be used for teleportation (and grabbing) and the right hand for shooting.

Scene setup

- Make a copy of "TrashTerminator_Level2" and rename to "TrashTerminator_Level3".
  - Change the left XR Controller model back to LeftHandPresence prefab.
  - Remove the following components from LeftHand Controller:
    - XR Interactor Line Visual
    - Line Renderer
    - XR Ray Interactor

- Scale the ground so that it is like a long avenue. Move the player to the other end of if so that there is plenty of space in front of the player.
  - It should be so long that it requires at least 10 teleportation jumps from one end to the other.

  Example (yours can be shorter):



Enemies

- Use the same enemies than in Task 3.
- Distribute enemies around the ground manually (OR automatically if you have time/energy).
  - There should be more enemies than in Task 3!

Teleportation

- Follow the teleportation lecture (2022-05-16) to implement teleportation
  - Your reticle can be simple – using Shader Graph and Particle System is optional.
  - Play a sound when teleportation happens (XR Ray Interactor's Audio events)
  - Add teleportation targets between the player's start position and the UTS game object. Use both:
    - Teleportation areas
    - Teleportation anchors
    - Lift some of the teleportation areas/anchors higher so that the player can rest there.

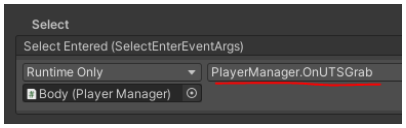
Player

- In PlayerManager, implement a method (in my case: OnGrabUTS()) that executes when the player grabs the UTS.
  - This method is called by an interactor event (see UTS below).
  - Destroy all remaining enemies, and show a level cleared message.
- On LeftHand Controller, add:
  - XR Direct Interactor
  - BoxCollider with trigger "on"
  - These are needed for grabbing the UTS.
- Like in Task 3, count/show points and show a message if the player collides with an enemy and dies.

UTS

- Find a prefab for the UTS.
  - Add XR Grab Interactable
  - Add Rigidbody
  - Add Collider

- Move the UTS on a teleport area at the opposite end of the ground.
- When the player grabs UTS with left hand, all remaining enemies are destroyed and “Level Cleared!” shown.
  - Use Interactor event either on the UTS’ XR Grab Interactable or on the LeftHand Controller to run your code.
    - In my case, I used the following event setup on the UTS’ XR Grab Interactable:



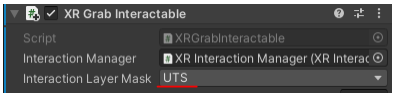
IMPORTANT: use Interaction Layer Masks on interactors and interactables to enable/disable interactions.

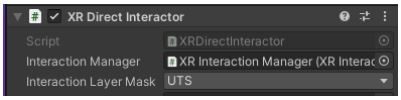
- The gun interacts only with enemies
- The teleport ray interacts only with teleport areas and teleport anchors.
- Left hand (direct interactor) interacts only with the UTS.

So you can create three interaction layers for these interactions.

Example: In my case, the UTS’ XR Grab Interactable and LeftHand Controller’s XR Direct Interactor use the “UTS” interaction layer.

- This means that the player can only grab the UTS with her/his left hand.





Task 5: Reflection (2p)

Write a short reflection text based on your lab experience (e.g. a text file or a Word file) using the questions below. The positivity or negativity of your answers does not affect scoring.

Please answer to these questions (at least):

- What did you learn? What did you know already?
- What was difficult in the assignment? How did you overcome it?
- What was good about the assignment?
- Do you have any suggestions to improve the assignment? Please tell us!

Save your reflections as Reflections.txt/docx to the root of your project.