THE DESIGN AND DEVELOPMENT OF A VR APPLICATION FOR TEACHING ELECTRONIC FUNDAMENTALS TO 1ST YEAR ENGINEERING STUDENTS

By Albin Jacob

X00152632

Introduction

VR is a cutting-edge technological advancement that allows users to interact with computer-generated surroundings. Users can look at it from various angles, reach into it, grab it, and reshape it. Since commercial VR headsets are widely used for entertainment purposes, many people's first experiences with VR came from video games and other widely distributed media. However, thanks to significant advances in technology, this technology is now available in a mobile format, VR now has broader application possibilities. This mobile format enables universities and other third-level education institutes to deploy these VR learning environments at a low cost. This allows students to even go home and immerse themselves in the VR experience, fully understanding the concept of what is being tried to be taught usually through the use of theory.

Introduction

Logic gates are the core elements of any modern device. It is a single-output electronic circuit with one or more inputs. The relationship between the input and the output is ruled by logic. The problem that this project is attempting to solve is to take the theory side of logic gates and create an immersive problem-solving environment that allows the student to understand why a certain type of gate is used in a specific scenario. So, this project can demonstrate to students how each gate has its own properties, what happens if the gate is switched with another and how the output differs.

Introduction

Learning styles are classified into three types: visual, auditory, and kinesthetic. Because VR headsets support complex visual renderings, audio, and movement tracking, all three of these learning styles can be targeted in a single application. To make this learning experience unique while remaining relatable to the audience, the scenarios are designed in the style of an adventure game. In this game, the player will be immersed in an ancient temple ruins environment, where they must explore and find switches that can control the state of input 1 or 2 of a specific logic gate, which will solve a specific problem, such as opening a door.

This project takes the VR advancements, and the learning styles mentioned above and has combined them into a virtual learning experience through an adventure game style to teach electronic engineering fundamentals of logic gates to 1st Year students.

Background

A gaming engine is a software development environment that includes settings and configurations that optimize and simplify the development of video games in a variety of programming languages. Game engines are primarily used by developers to create games for video game consoles and other types of computers.

1. A 2D or 3D graphics rendering engine that is compatible with various import formats.

2. A physics engine that simulates real-world activities,

3. Artificial intelligence (AI) that responds to the player's actions automatically

4. A sound engine that controls sound effects

5. An animation engine

Unreal Engine, Unity, Lumberyard, and Cry Engine are some of the most popular & widely used game engines in the current market.

Unreal Engine (UE)

- Unreal Engine (UE), which is owned by Epic Games. According to (Unreal Engine, n.d.) it is essentially a game development multi-platform engine designed for businesses of all sizes that helps to transform ideas into engaging visual content using real-time technology. The original version was released in 1998.

- UE 4 is the latest version of the platform it is designed for a wide range of platforms such as Windows, macOS, Linux, SteamOS, HTML5, iOS, Android, Nintendo Switch, PlayStation 4, Xbox One, Magic Leap One, and Virtual reality (SteamVR/HTC Vive, Oculus Rift, PlayStation VR, Google Daydream, OSVR and Samsung Gear VR)

- This engine also has some drawbacks, such as a steep learning curve to master to create a highly professional game. If you're working on a large-scale budget game, you'll need a licensed copy of Unreal Engine to make a game for the public, and you'll have to pay a 5% tax once the game is published and profitable.

Unity

- Unity is a multi-platform game engine that simplifies the creation of interactive 3D content. Unity, a gaming engine developed by Unity Technologies in 2005.

- It can also illustrate both 2D and 3D content. Unity's all-in-one editor is compatible with Windows, Mac, Linux, iOS, Android, Switch, Xbox One, PlayStation 4, Tizen, and other platforms. It's especially popular for iOS and Android mobile game development, and it's been used in games like Pokémon Go and Call of Duty: Mobile, among others.

- It only takes two mouse clicks to get your game running on another platform. One will switch platforms, while the other will build and run.

Difference between UE & Unity

- The first significant distinction between Unity and Unreal Engine is their programming languages. C# is used by Unity in both the editor and the additional plugins. Unreal Engine is written in C++, but when creating game code, you'll use a combination of Blueprint a proprietary language exclusive to Epic Games and C++

- Users found Unity to be slightly easier to use, due mainly to its native C# coding language, which should be relatively familiar to all developers, and its overall workspace layout. It's a simpler platform to "dive in" and start creating on than Unreal Engine, which has a slightly steeper learning curve.

- Unreal Engine provides better characteristics for the different types of graphics & environments in multiple amounts of scenarios. It can generate photorealistic visualizations that immerse players and allow them to freely travel through a beautiful new world, as well as incorporate high-quality assets from a variety of sources.

- In terms of pricing, according to Unity Technologies, there is a free version of the software available, but to unlock all its functionality, the user needs to upgrade to the pro version, which has a monthly subscription fee of €75 per month. Unreal Engine, on the other hand, has a distinct pricing model, according to Epic Games. Although the software is free, Unreal Engine is entitled to a 5% royalty fee on all game sales once your game is released.

Applications of VR & VR Technology

- This enables users to use VR in a variety of industries to simulate an immersive understanding such as; Data and Architectural Visualization, Modelling, designing, and planning, training and education, Cooperative working, and Entertainment. Cab simulation is used in training, such as for aeroplane pilots.

- The primary goal of virtual reality is to immerse the participant in a virtual environment that gives the participant the sensation of "being there." This necessitates the integration of the human sensory and muscular systems with the "virtual environment."

- A VR system is made up of three different types of hardware: Sensors, effectors, and reality simulators are the first three main components.

Learning in VR

- VR systems should be utilized to replicate an idea that is difficult for the user to visualize. This could be due to a lack of experience or abstraction, which can be reinforced for the user by utilizing VR's visualisation strength.

- According to the widely used visual-auditory–kinaesthetic learning styles, there are three types of learning styles: visual, auditory, and kinaesthetic. Because VR supports complex visual renderings, audio, and movement tracking, all three of these learning methods can be targeted in a single application.

Design

- This application is intended for use with students who have a rudimentary understanding of logic gates. It could be used as a revision tool or to visualize the outputs of the individual gates. This program can potentially be used as an introduction lab for future virtual reality labs. This application will assist the learner in getting a feel for virtual reality, such as how to move about and interact.

- This project would be built on a character that undertook an adventure with levers and switches that opened doors to different realms. These distinct universes would correspond to three distinct logic gates. The design was chosen since it checks all of the senses that must be stimulated for the best game experience.

- AND, OR & NOR

Map Design
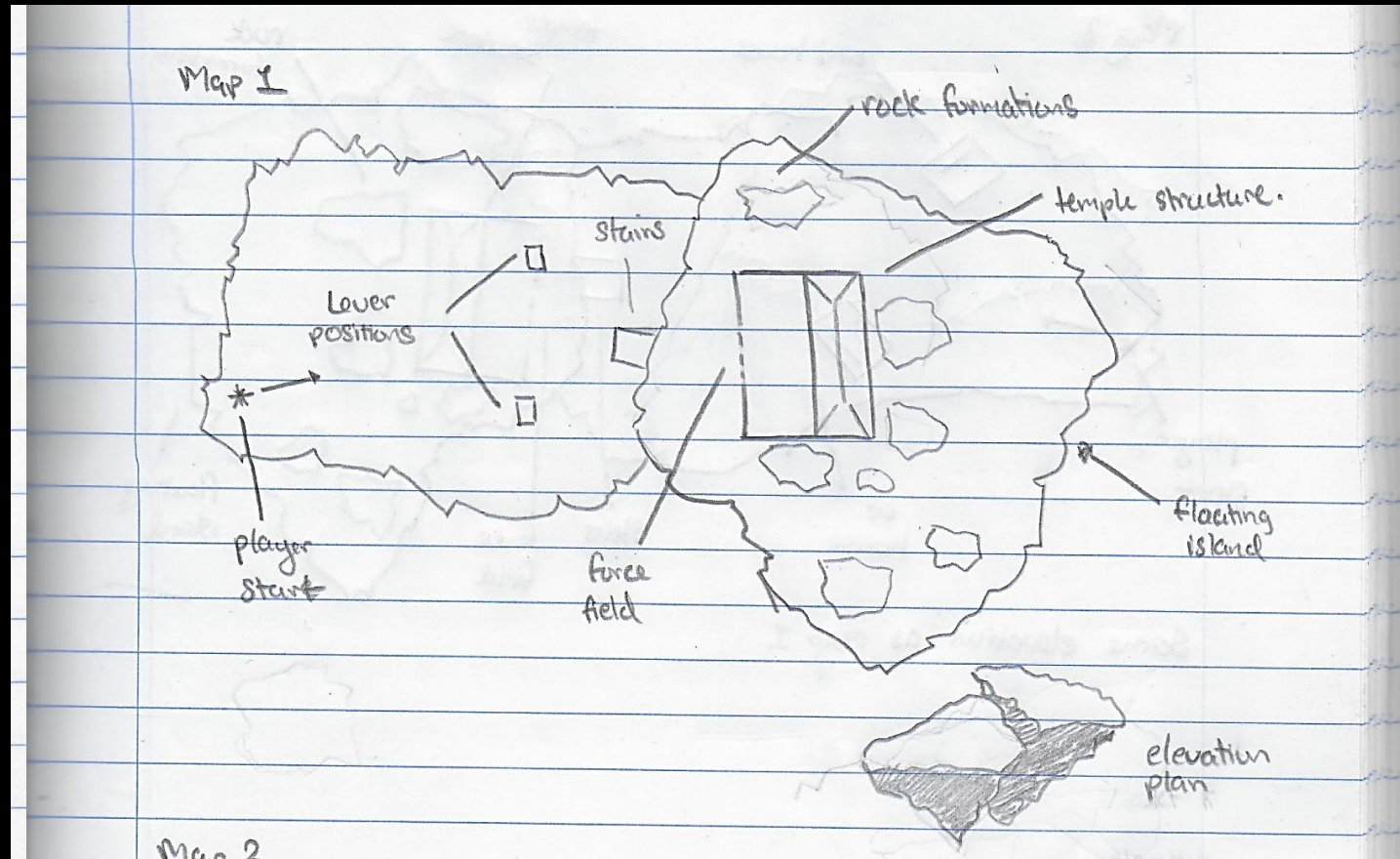
Levers & Switches Design
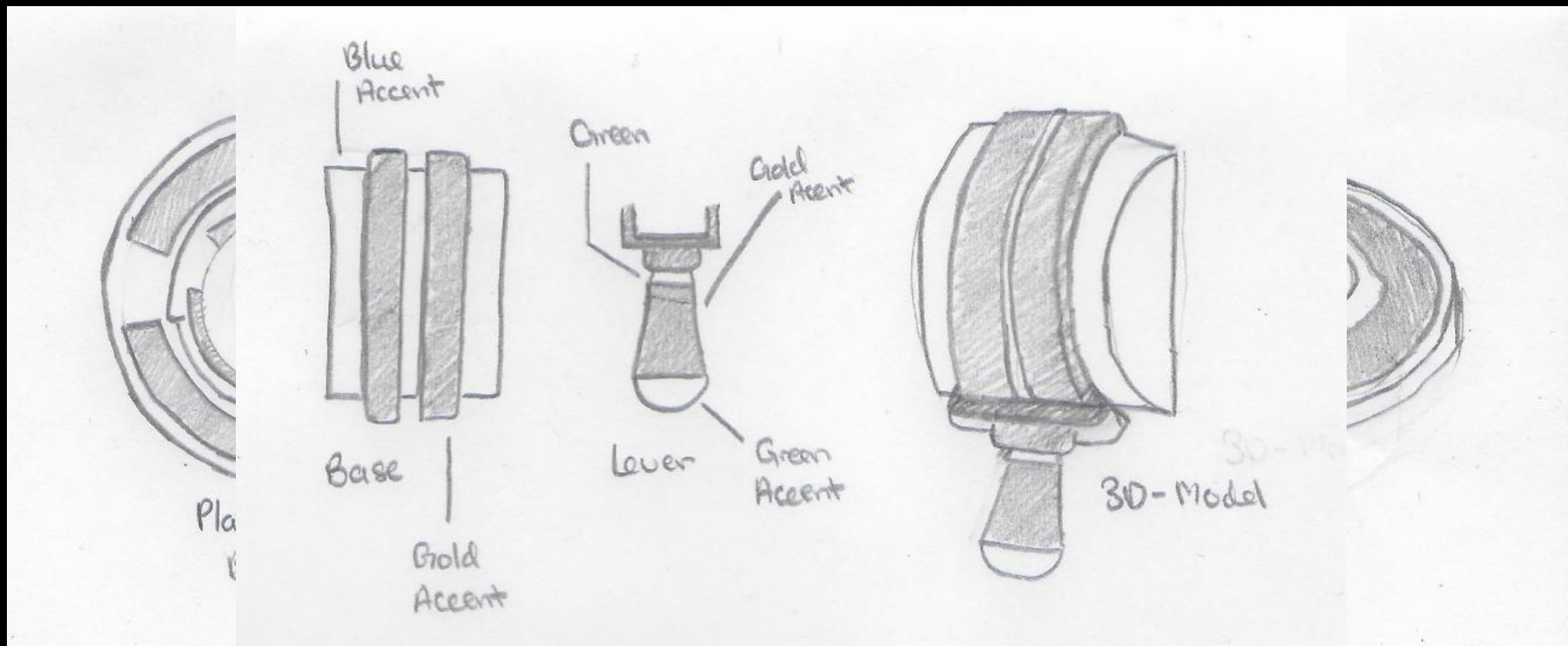
Game Flow Chart
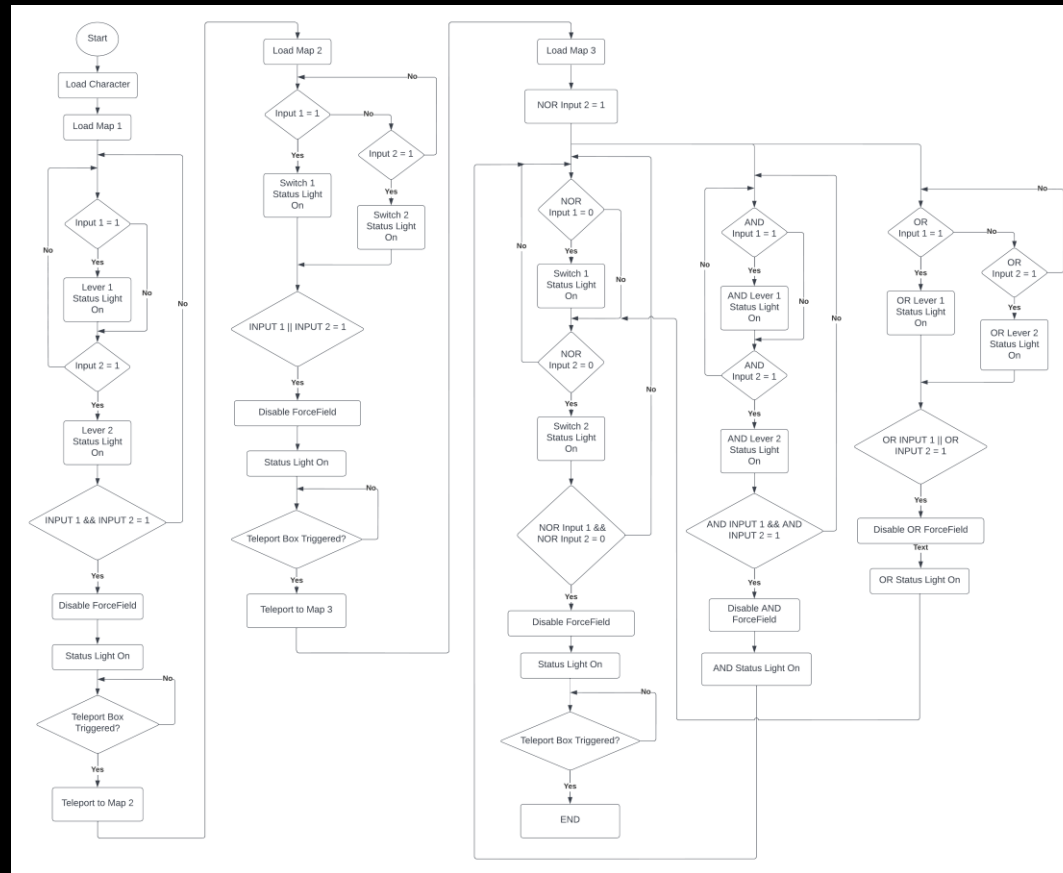
Class Diagram
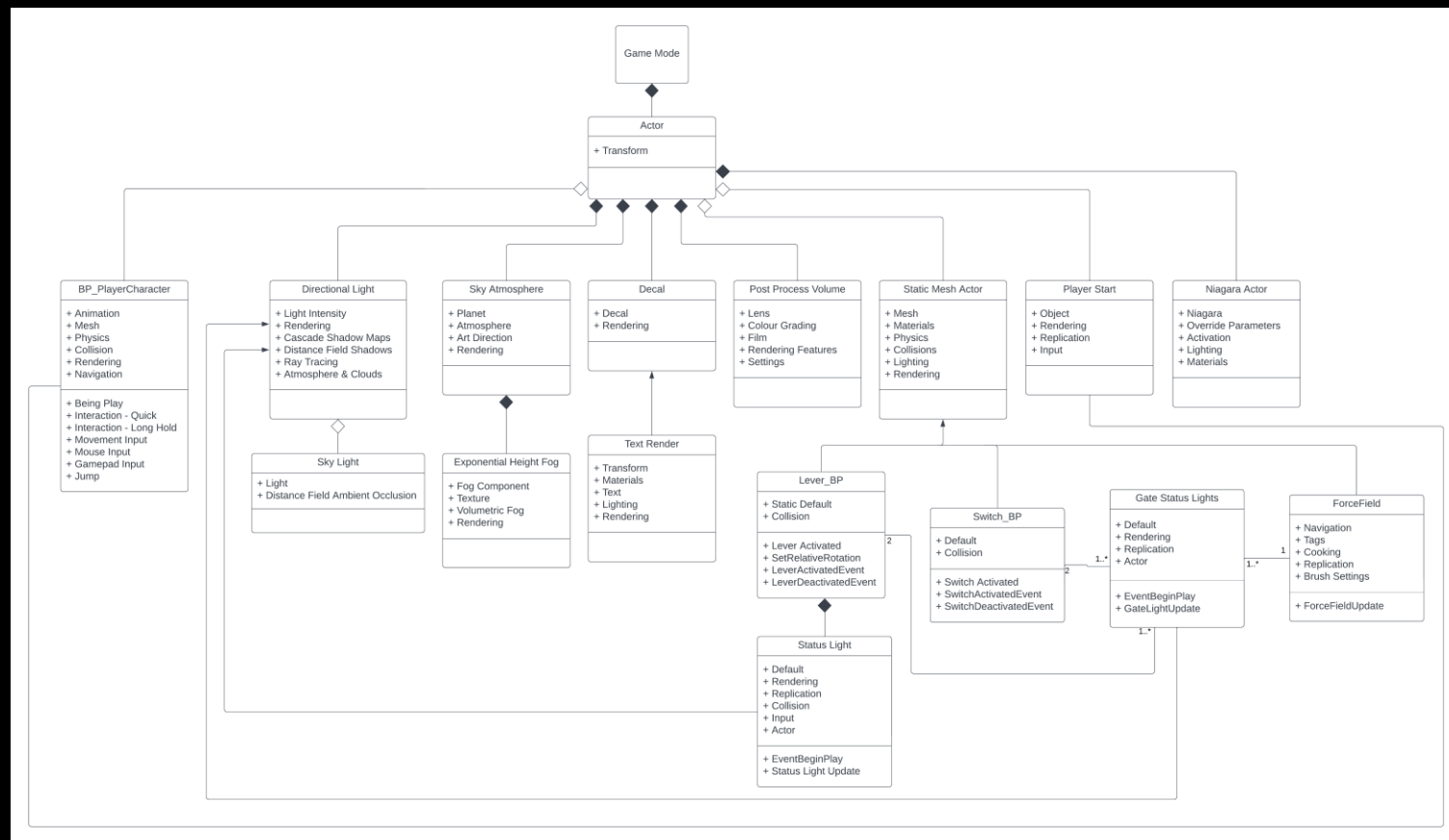
Implementation

- Each map requires an atmosphere, which is made up of fog, sunlight, clouds, and shadows, among other things. These atmosphere characteristics make the VR environment appear more lifelike.

- The physical features that the character will see and experience, such as floating islands, temples, staircases, and so on.

- Following that is the aesthetic part of the design, which includes elements that make the environment look less basic and dull, such as Rock Formations and Post Process Volume.

- The following set of elements is those with which the character interacts or has a role in influencing the properties of the elements. Things like forcefields, levers, switches, status lights, teleporters, and so on.

- Then comes the actual character.

Implementation

Creating Project & Map

FLOATING ISLANDS
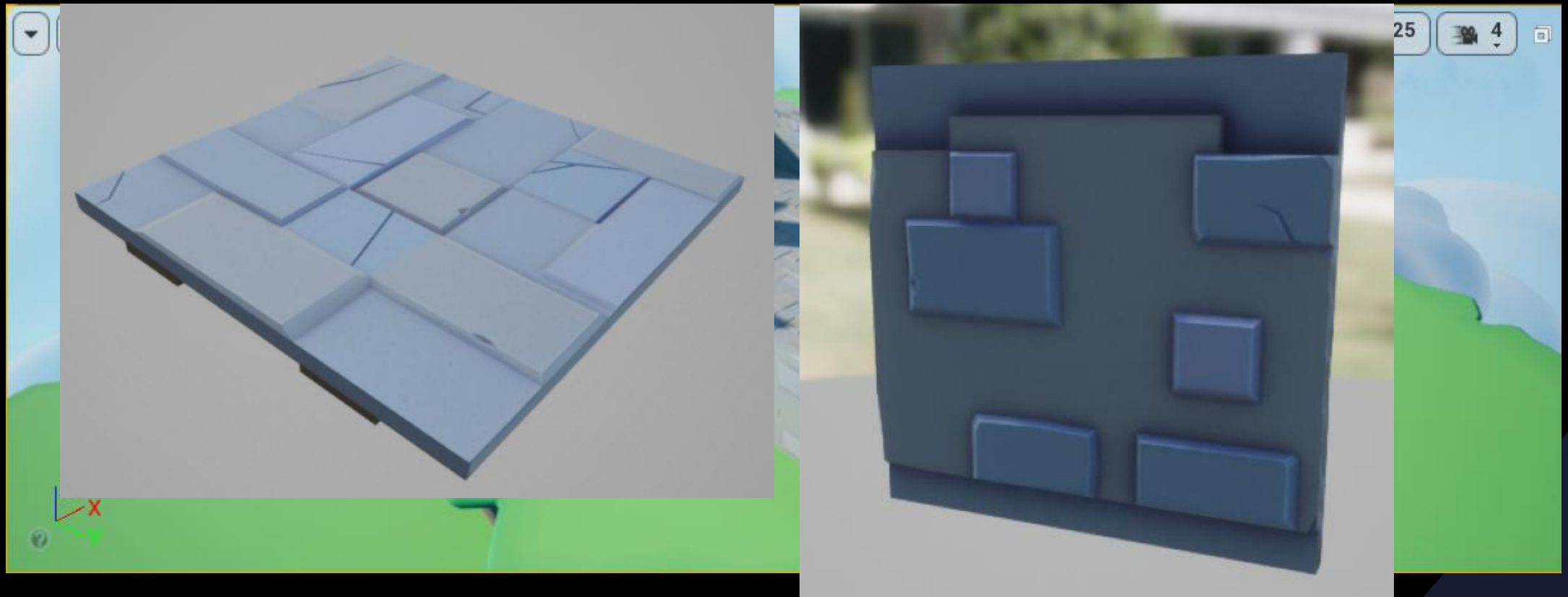
Floating Islands

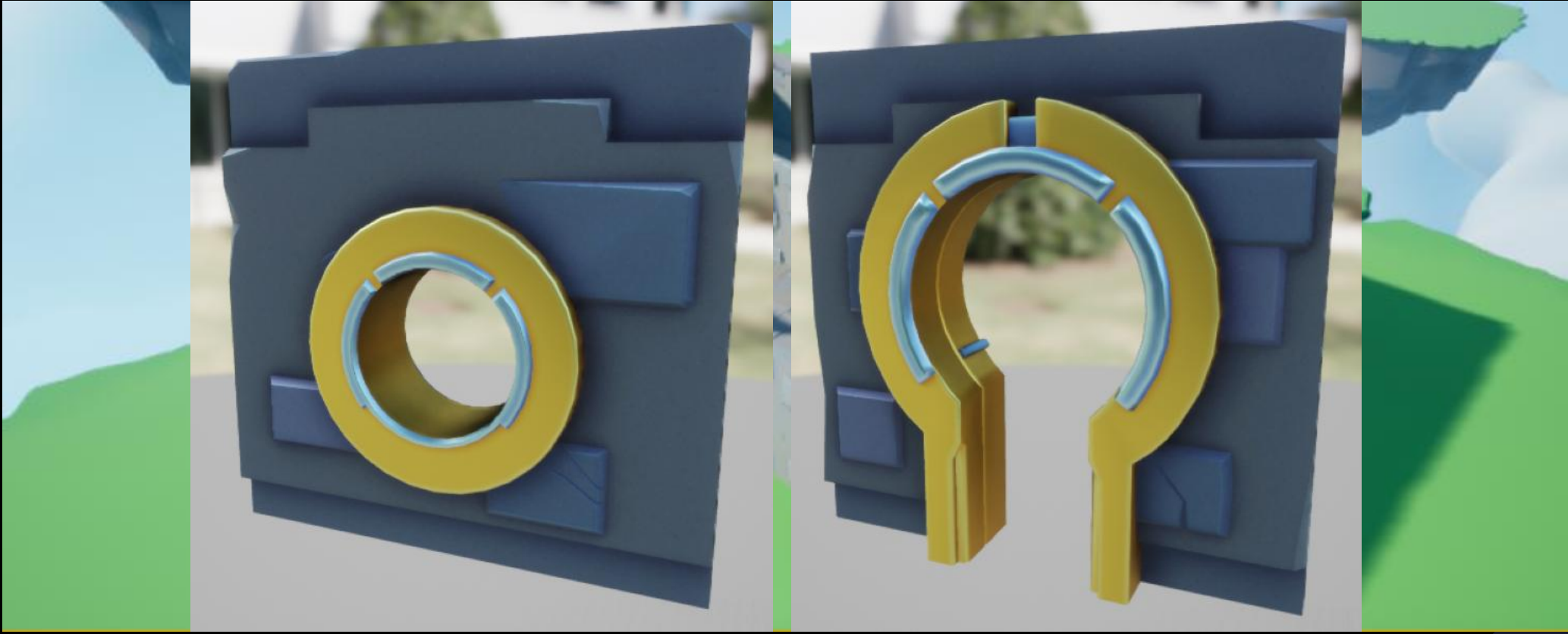LIGHTING & ATMOSPHERE

Lighting & Atmosphere
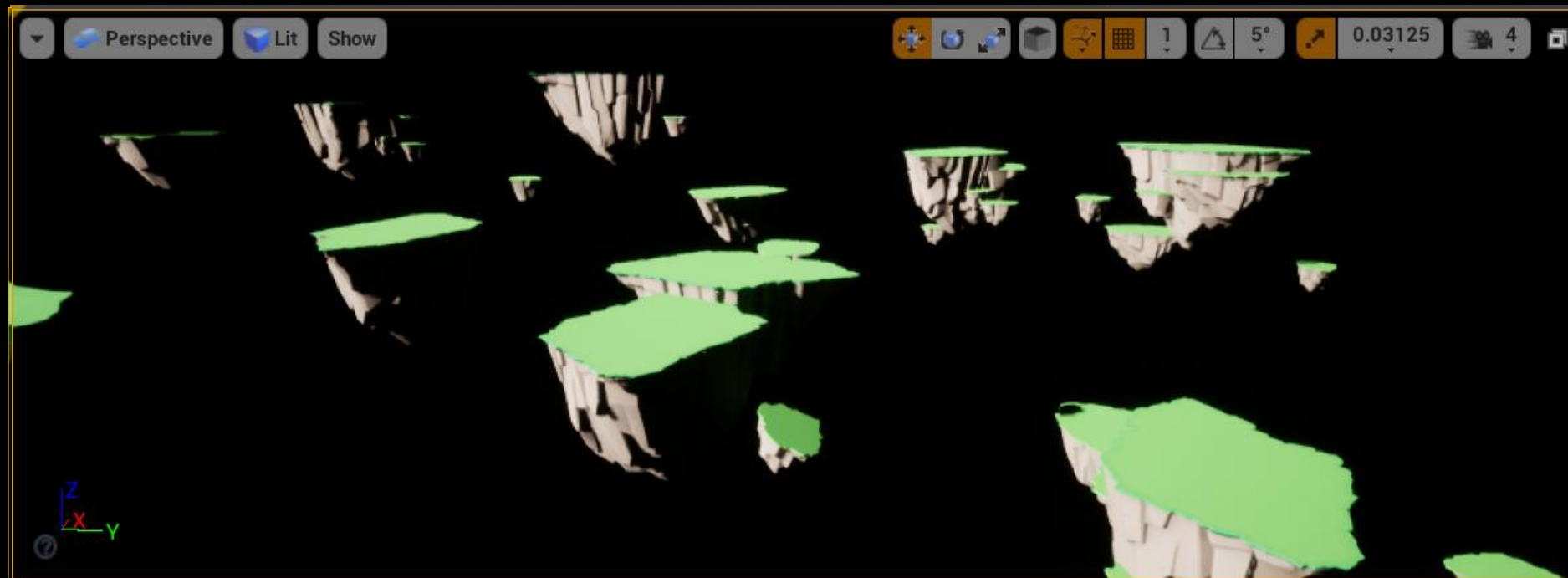
TEMPLE

Temple Architecture - Floor & Walls

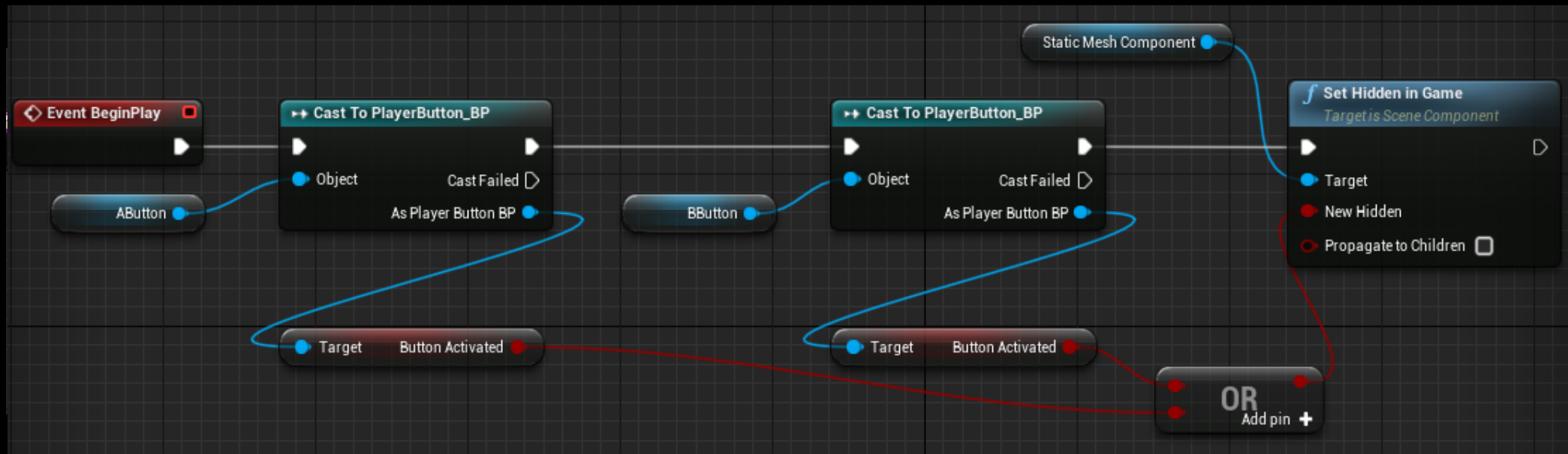# Temple Architecture – Doors & Windows
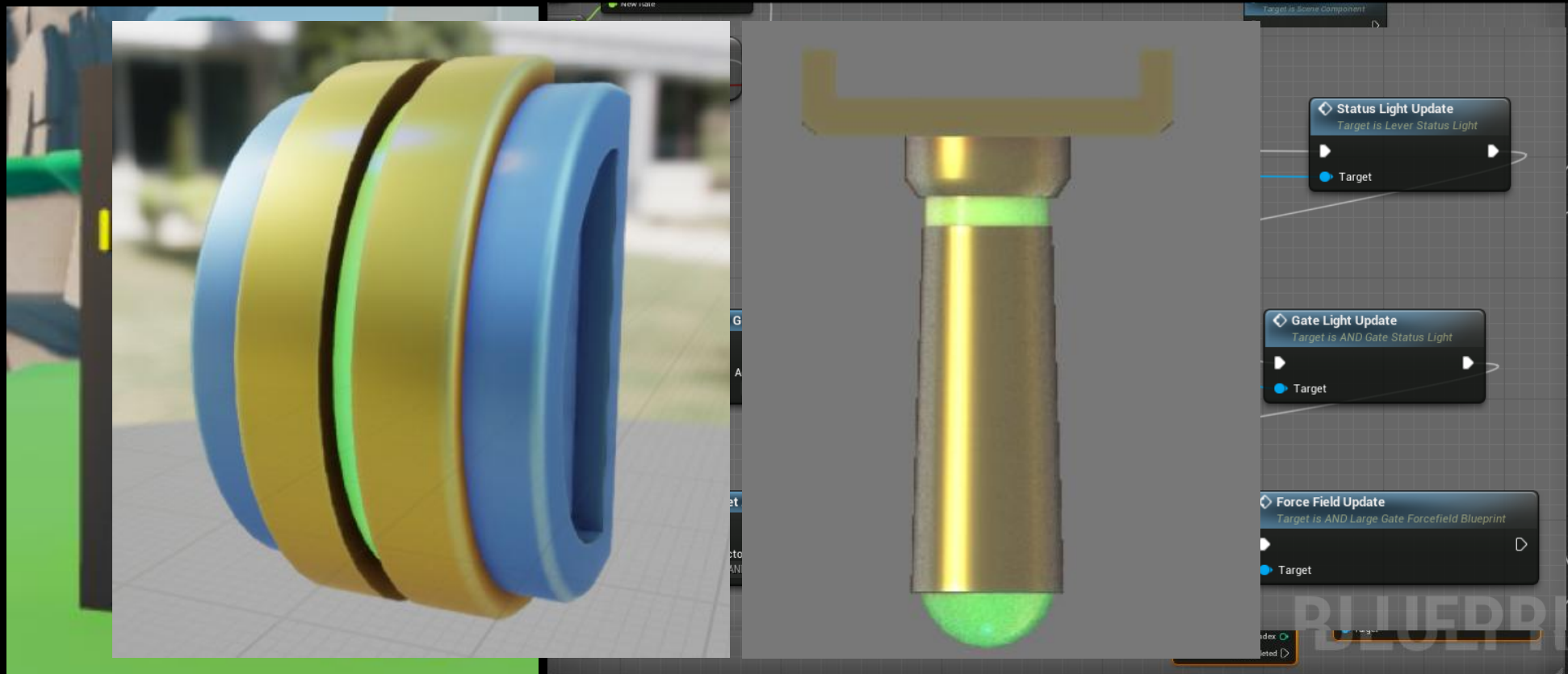
Temple Architecture – Roof
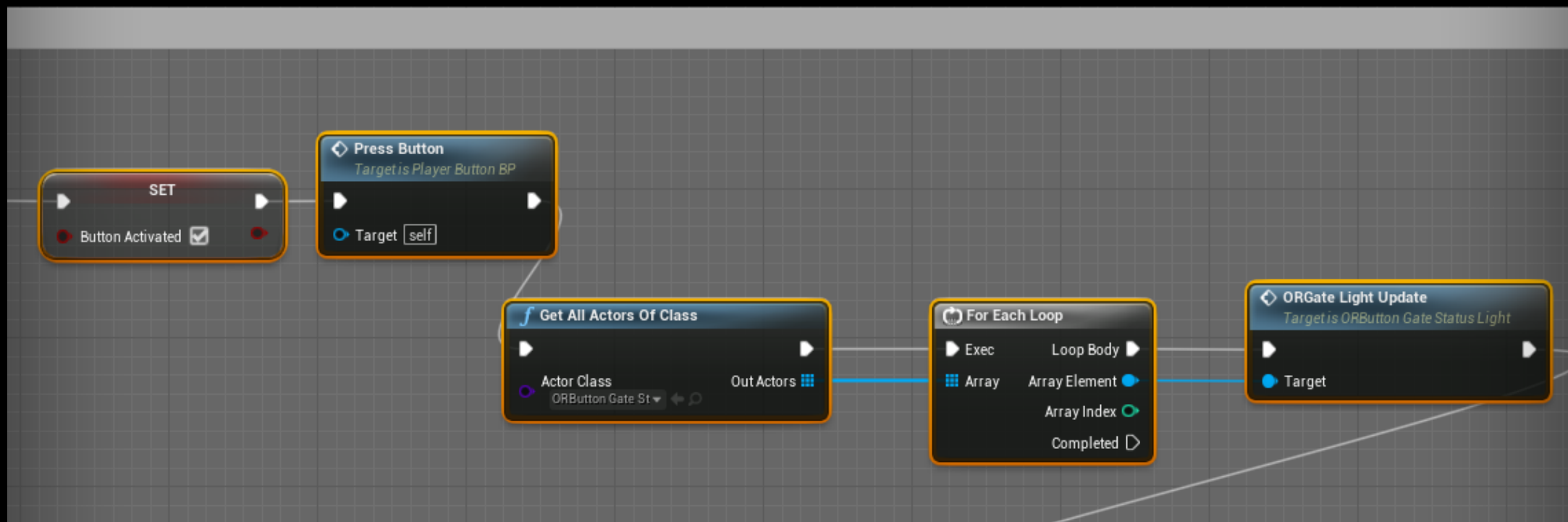
Forcefield

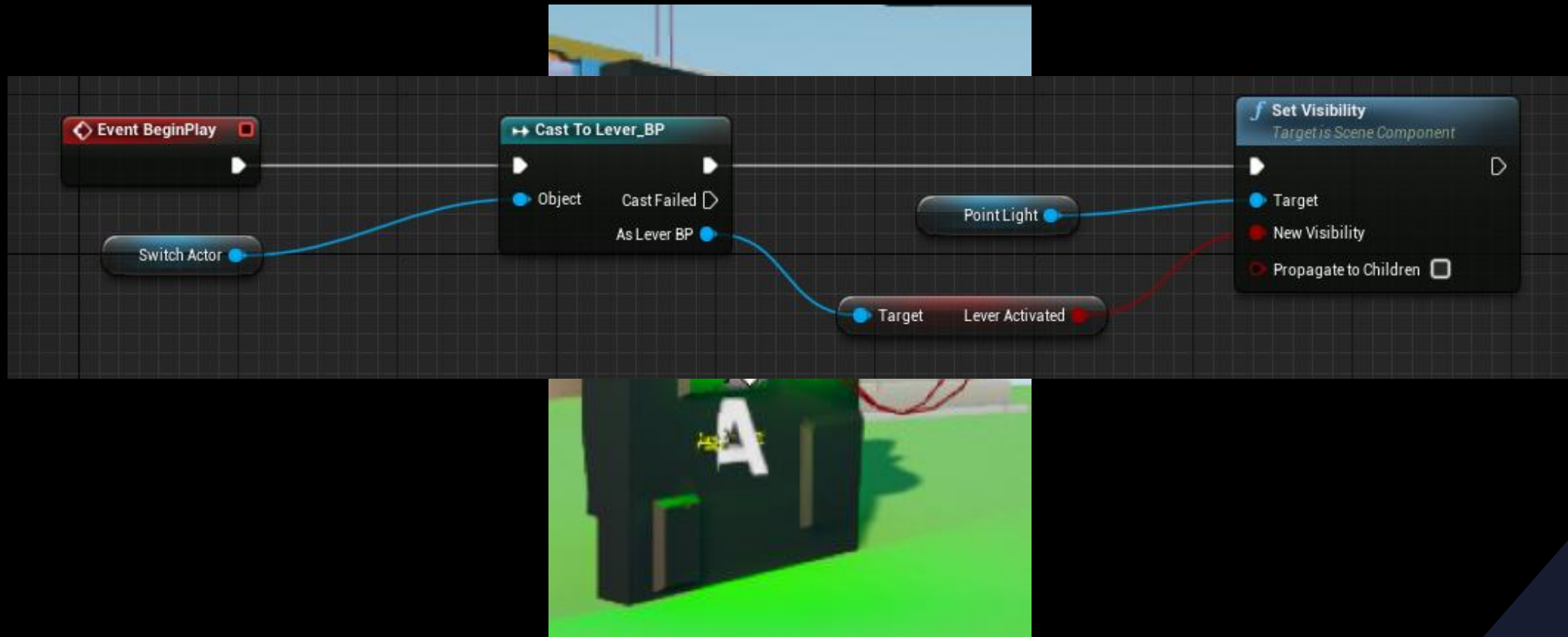# Forcefield - Blueprint

Aesthetic Elements

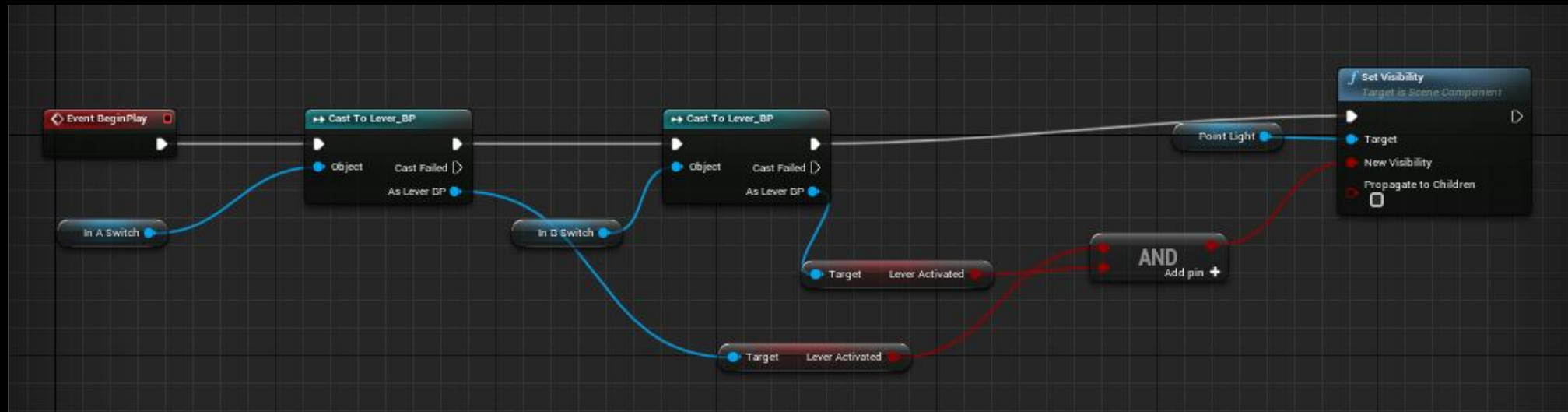# Interactive Elements - Levers
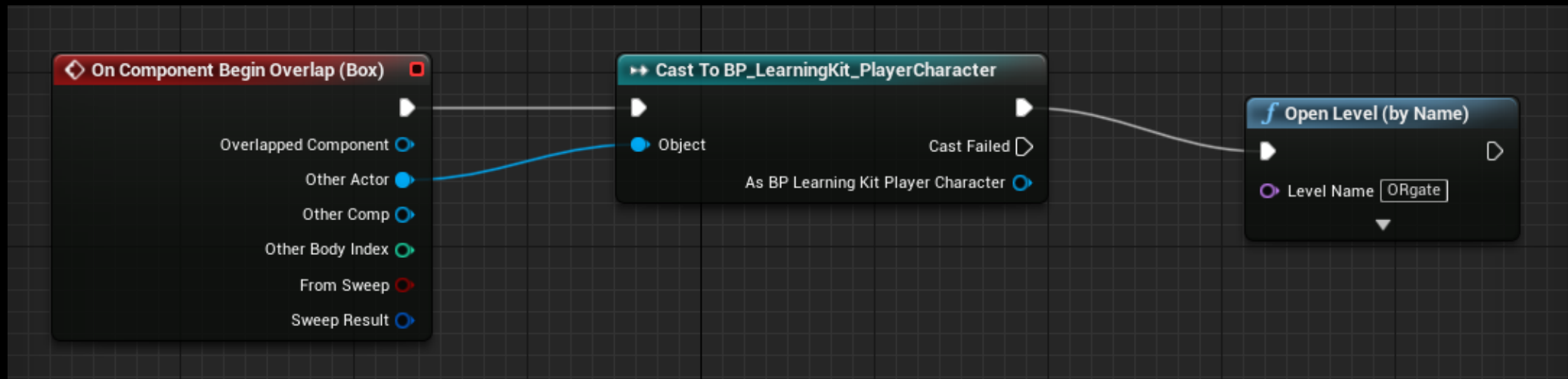
Interactive Elements - Switches

Computing Functions – Lever Status Light

Computing Functions – Gate Status Lights

Computing Functions - Teleporter

Computing Functions

Character

Testing & Conclusions

Demonstration