CURIOSITY-DRIVEN EXPLORATION

Human curiosity through Level Design

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Level Design specialization project

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THEORETICAL APPROACH

WHAT IS CURIOSITY?

Why are humans curios?

Curiosity is a **primary need** as hungry, thirst, sleep etc...
To satisfy that, the people seek more information to resolve uncertainty in a small period. The uncertainty creates a sense of frustration that undermine cognitive and mobility skill: the more uncertain you are, the less awareness you have.

For this reason, the curiosity's scope is to improve the people awareness to **reduce the uncertain and have more control** of the environment.

In this presentation sees how Curiosity Driven Exploration work, based from theoretical studies and making some examples from the game *Gone Home* (Fullbright, 2013).

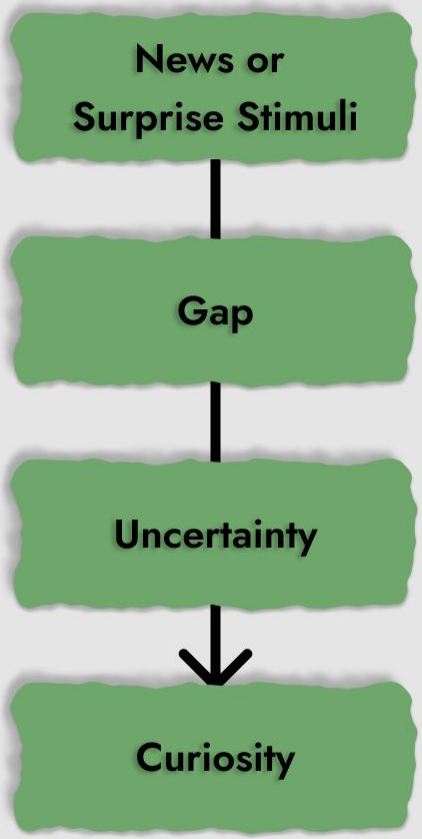
The real life **uncertainty** is a negative factor, but in video-game is different: it is a close system without consequence and the designers can used it to **improve the player's agency**.

The uncertain produces **gaps**: is the divergence between what the player knows and what they want know. The gaps made some **questions** that feed the curiosity of the player **to seek more information**.

The information seeking phase help the player to find new or surprising elements.

New or surprising elements

These stimulus work according how many times the player sees it or if it's a familiar elements. For this reason, the player expected to receive other stimulus after it.



SENSE MAKING

The Sense Making is a **positive reinforcement** in witch the player connects the information they have collected. It stimulates curiosity and mental effort, satisfying the desire for knowledge because it functions as a computational process.

Our brain compresses and organizes information to resolve cognitive gaps through four initial steps:

Representation **Manipulation** **Encoding** **Recall**

Gone Home Example

Representation
In the Sam's room, there is a locked box that requires a four-digit pin to open.

Manipulation
During the information-seeking process, the player discovers a map with two hidden locations in the house.

Encoding
In these spots, there are two similar notes with a four-digit pin and a reference to Sam's room that connect to the locked box.

Recall
The player returns to the locked box and tries to use the pin.

MAIN FRAMEWORK

This process leads the player to seek new information to develop **two fundamental states**: curiosity and interest.

- **Curiosity** is the drive to satisfy a momentary stimulus by establishing a fact
- **Interest** is the desire to return to a topic over the long term because the player feels engaged

To keep interest alive, the player needs to seek information on **specific topics**.
For this reason, a more detailed framework is provided.

Question
The player develops questions based on cognitive gaps present in the game world and is driven to resolve them.

Information Seeking
The player is indirectly motivated to seek as much information as possible in order to fill those gaps.

Sense Making
Once the necessary information is obtained, the player begins to develop a sense that helps them resolve their uncertainty.

Interest
The player is no longer just curious, but will want to return to that topic multiple times in an effort to resolve it.

REWARD LEARNING FRAMEWORK

The *Reward Learning Framework* is the conceptual model underlying *Curiosity-Driven Exploration*. This framework is a **tentacle-like structure organized around multiple topics**, designed to keep the player's interest alive.

The framework leverages **Self-Boosting**: the player's ability to autonomously seek out the information they consider most useful. This generates a **feedback loop** that reinforces interest based on the information collected and consolidates it in the player's mind, simplifying the learning process.

Self-Boosting is fueled by the questions the player asks themselves.
These questions can be divided into:

- **Fundamental questions** - they fuel interest in a specific topic
- **Secondary questions** - they serve to keep the player's curiosity alive in the short term

Gone Home Example

The questions to develop *Self-Boosting* are:

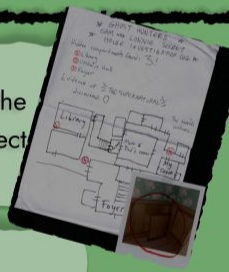
- **Fundamental Question**
  - *Who is Lonnie?*
  - *Why don't his parents like her?*
- **Secondary Question**
  - *Where are the Kaitlin's Family?*
  - *Is the house truly possessed?*

CURIOSITY-DRIVEN EXPLORATION

CDE is a desire or **thirst for knowledge**.
The **reward** isn't a item or skill (*extrinsic reward*), but **information** of the world (*intrinsic reward*).

To satisfy this thirst, the player must **interact with the game word**. This is called the **Choice Space**, where they can acquire the necessary information through three mechanisms:

- *Based on Actions*
- *Based on Goals*
- *Based on Social Partners*

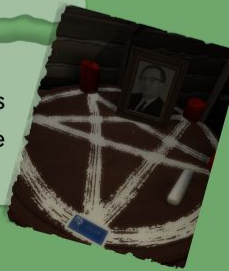


Based on Actions

In Gone Home, the player finds a floor plan with secret passages. This triggers an mechanism based on Actions: reaching the marked spots and interacting to progress (e.g., opening a hidden hatch). This is called Direct Dynamics. In contrast, Indirect Dynamics occur when the player knows the next state but must figure out which action to perform.

Based on Goals

This type of mechanism is based on the Self-Boosting questions of the player. In Gone Home, the player immediately learns that Sam has run away from home, which drives them to explore and uncover the reasons behind it.



Based on Social Partners

In certain contexts, NPCs can display agency that drives them to specific behaviors. Stimulated by these, the player is encouraged to retrace their steps out of pure curiosity. In Gone Home, this element appears in the uncle's side quest, where the player revisits Sam's experiences and the seance.

DINAMICS

Un-directed Exploration

An environment dense with information leads the player to move randomly out of fear of missing something. This can be useful for stimulus seeking, but beyond that it is not very effective, because the player needs to master and reiterate the information.

Knowledge-Based Exploration

This type of exploration allows the player to keep track of both the effects of their actions and their mistakes, learning to better understand the consequences of their behavior.

Competence-Based Exploration

This strategy relies on the agent's skills and can be easily integrated into existing models. It is useful for agents with self-imposed goals, as it allows them to assess which challenges to tackle while avoiding those already completed or too difficult.

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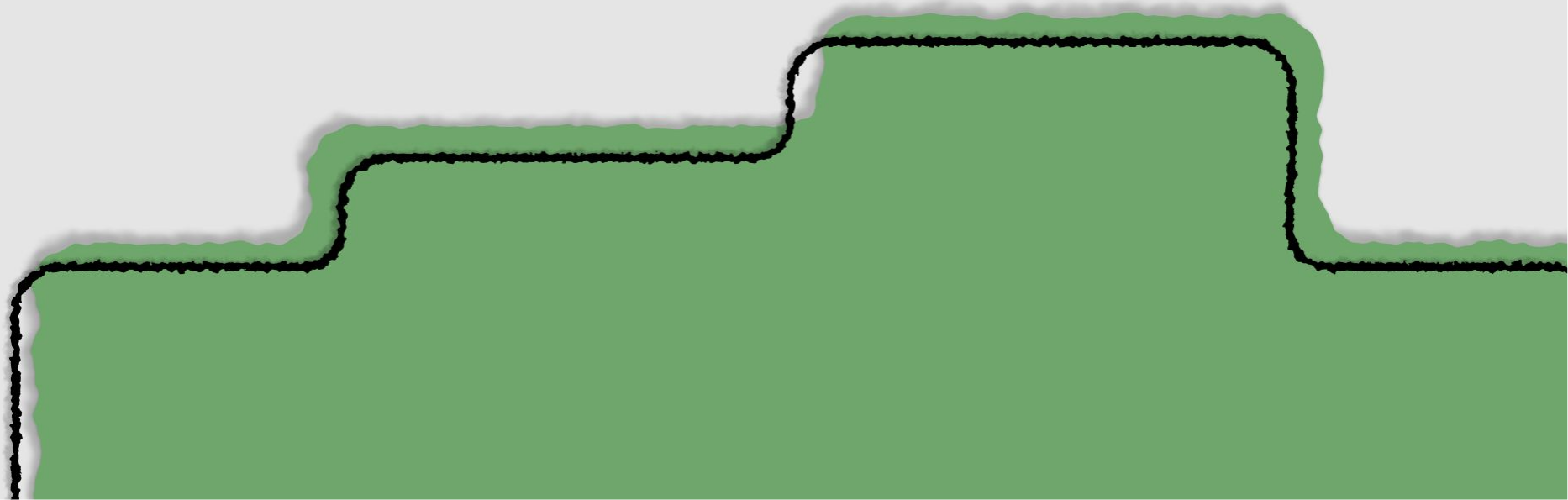
- Donnellan, Sakari and Kou Murayama; *From Curiosity to Interest*; Irene Cogliati Dezza, Eric Schulz and Charley M .Wu; *The Drive of Knowledge - The Science of Human Information Seeking*
- Ten, Oudeyer and Moulin-Frier, *Curiosity-Driven Exploration*; Irene Cogliati Dezza, Eric Schulz and Charley M .Wu; *The Drive of Knowledge - The Science of Human Information Seeking*
- K. Beachum, Sparking Curiosity-Driven Exploration Through Narrative in "Outer Wilds": GDC YouTube Channel, Jul 19, 2022
- A.Beachum, *Outer Wilds-A game of Curiosity-Driven Exploration*, 2013
- A. Beachum, *Alex Beachum Designing for Curiosity in Outer Wilds*, Full Indie YouTube Channel, May 27, 2023

DESIGN



S.W.O.T.

Strengths

- Good knowledge of the foundational theoretical material
- Solid basic knowledge of Unreal, including *Landscape Mode* and *Modeling Mode*
- Willingness to search for online resources to structure an efficient workflow

Weaknesses

- Limited programming skills
- No artistic abilities
- Limited time to develop a plot that can effectively support the level design

Opportunity

- Opportunity to create the project entirely centered around the blockout
- Opportunity to develop a story that serves my specific objectives
- Simple, derivative system to test theoretical studies

Threats

- Getting stuck in programming
- Failing to stimulate the player's curiosity
- Creating an experience that is too frustrating or confusing for the player

CONCEPT

Feature

Feature 1
Play an unnamed character who is reliving some of their memories to solve an unsolved case, which will lead their to uncover something much bigger.

Feature 2
Freely explore the city of Old Town, interacting and gathering information to solve the case.

Feature 3
Develop an interest that drives you to seek out the various pieces of information scattered throughout the game world and understand how the surrounding environment works.

Reference

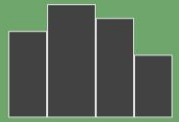
Twin Peaks,
David Lynch (1990),

Narrative & Aesthetic

Outer Wilds,
Mobius Studios (2019),

Curiosity-Driven Exploration

PLANNING



Town

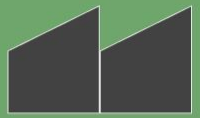
Small mining town stretching along the coast.

Sense Making
Bar's basement

Forest

Forest with an ancient town church.

Sense Making
Hidden House



Sawmill

Main industry that exploits local timber.

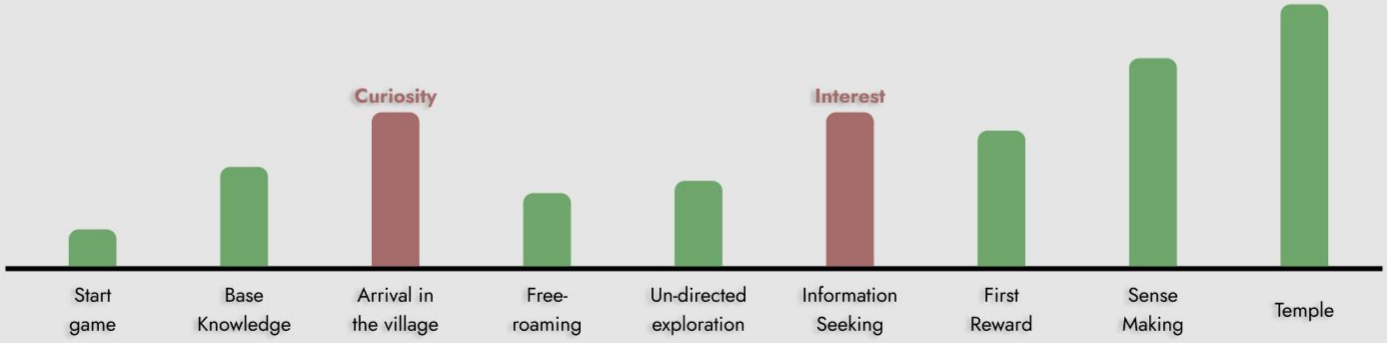
Sense Making
Office

Temple

The suspicious behavior of the townspeople is the element that sparks the player's interest, leading them to the discovery of the temple (the **topic** where all the related information converges).
This is a place that is **difficult to reach unless the right information** emerges during the *Information-Seeking* process.

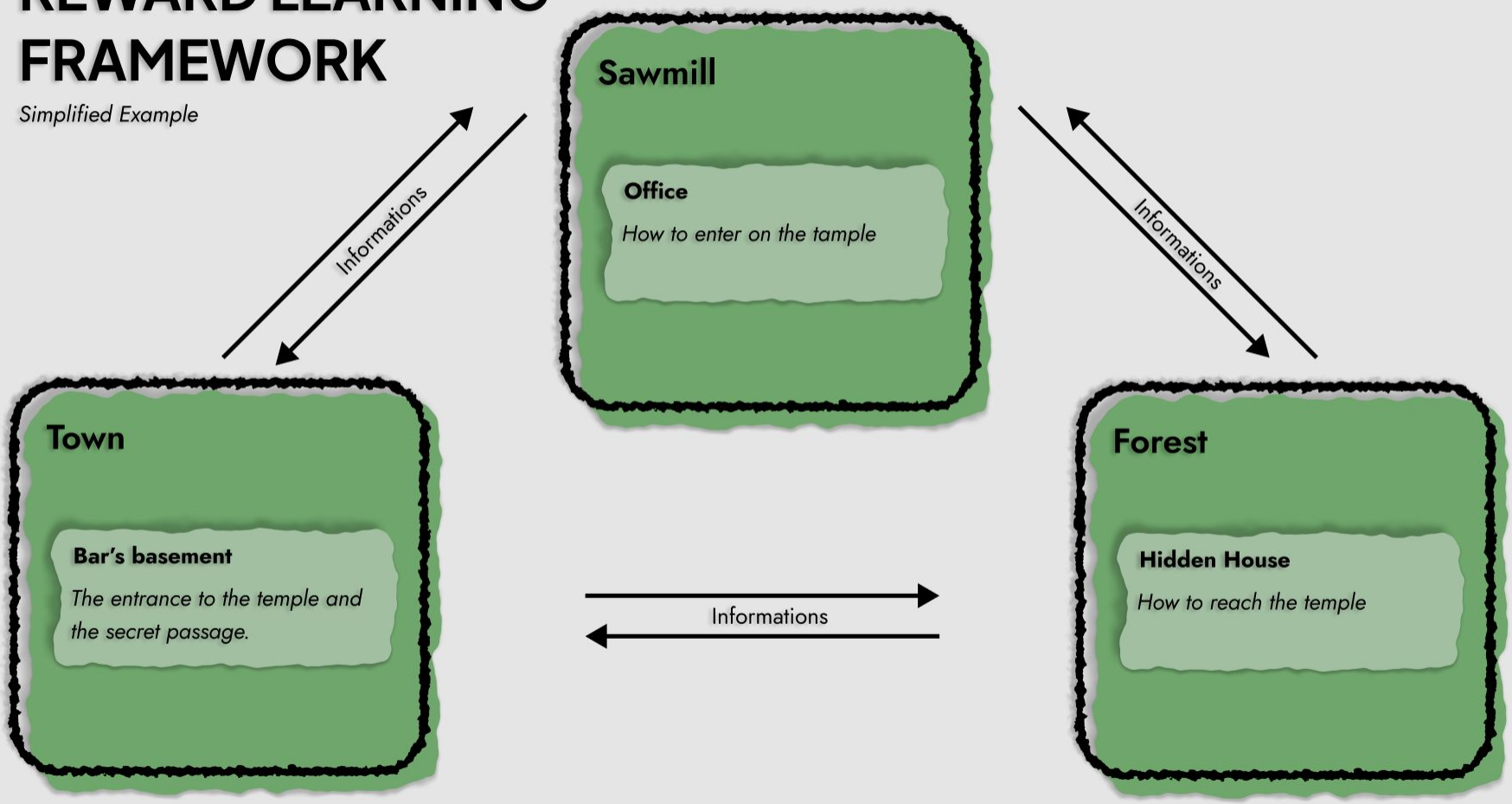
PACING

In a system like this, it's difficult to determine the level's intensity because there is **no direct control over the player's experience**. For this reason, intensity is managed based on the player's curiosity.
At first, the intensity is minimal due to the player's limited knowledge of the world. When it reaches the **first peak** (the player becomes **curious**), there **will immediately be a drop**: as the *Choice-Space* will be so wide that **the player will need to search information with un-directed exploration** (randomly). After this initial phase, the intensity will continue to grow due to the increasing amount of information gathered, which encourages the player to seek out information independently.



REWARD LEARNING FRAMEWORK

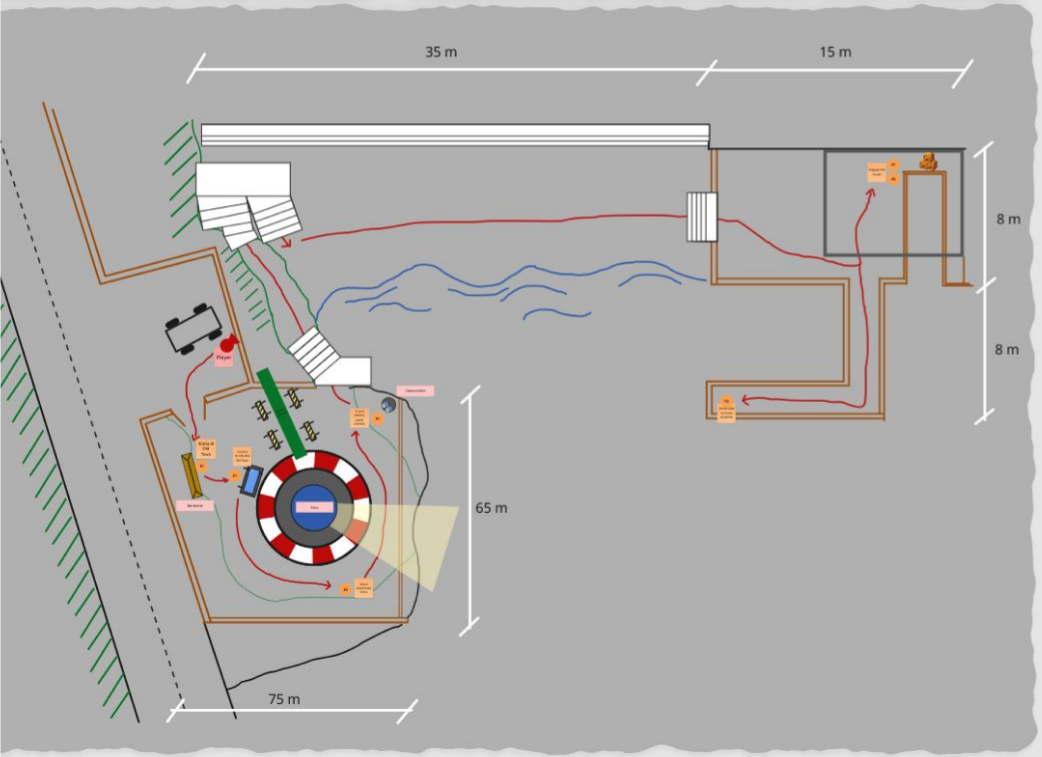
Simplified Example



OLD TOWN

Microscale - Lighthouse

Tutorial



The player begins inside the lighthouse area and will be required to explore this initial zone in order to receive the first pieces of information. They will also have the opportunity to gain a complete view of the map, helping them to orient themselves later on, while noticing the presence of several focal points such as the church and the factory. Furthermore, by the end of this area, the player's curiosity will be drawn to Anna's disappearance, prompting them to seek out more information about it.

Legend

- Player
- Terrein
- Wall
- Vegetable
- Information
- Stairs
- Critical Path

OLD TOWN

Microscale - Village

The village is the first area where the player can freely explore. For this reason, a series of pieces of information are provided, such as the accident at the factory, the presence of a citizen considered insane, and the disappearance of another girl.

The first location they will visit is the bar, a central element that stands out in the environment and suggests to the player that something useful can be found there.

Afterward, depending on their curiosity, the player can decide whether to go right (towards the Forest) or left (towards the Sawmill).

Legend

- Player
- Terrein
- Wall
- Vegetable
- Information
- Stairs
- Critical Path
- House

FOREST

Microscale - Church

The forest area consists of three key sections:

- Church
- Lake
- Hidden House

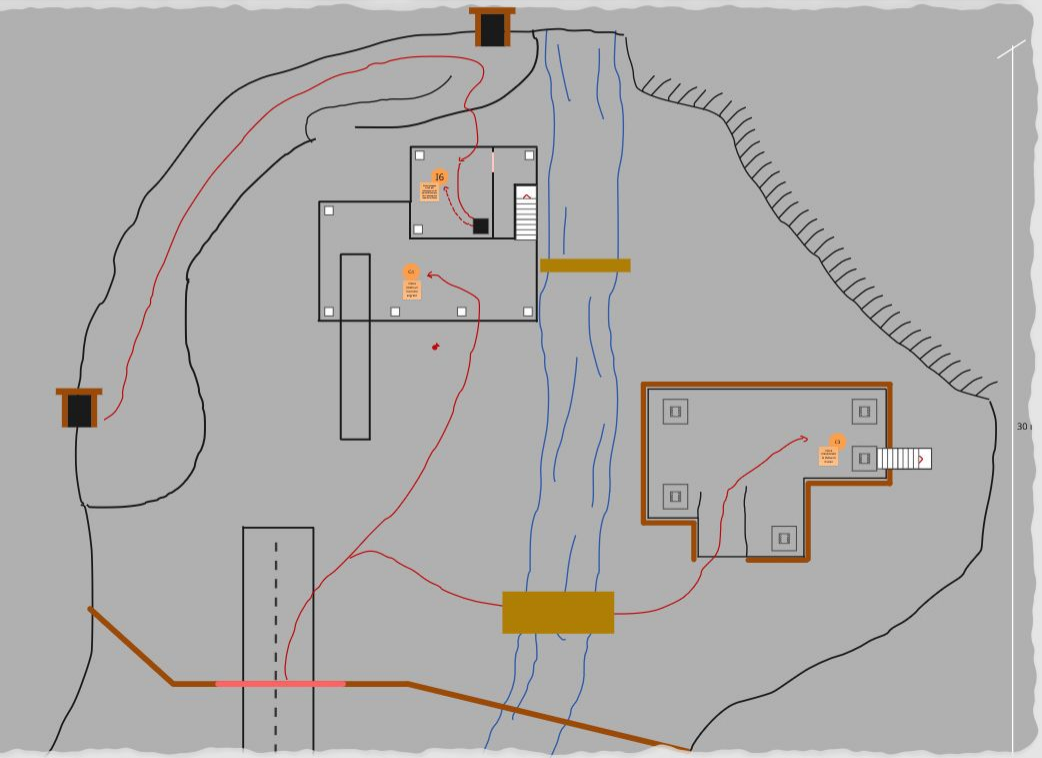
The player will primarily see the lake and the church, and can decide which one to visit first. Behind the church there is a secret passage, accessible only if the player possesses the required information. This passage leads to the Hidden House, where the player can uncover one information that sense-making the exploration.

Legend

- Player
- Terrein
- Wall
- Vegetable
- Information
- Stairs
- Critical Path
- Locked Door

SAWMILL

Microscale - Industry



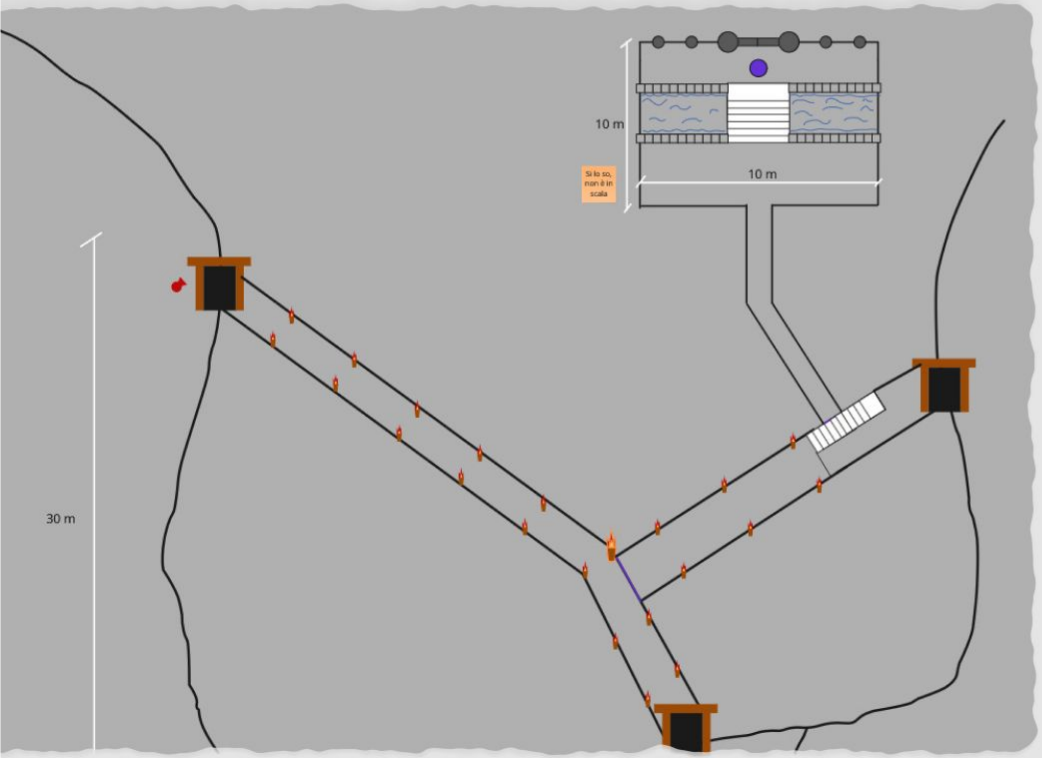
The sawmill is an area divided in two by a river that carries the logs. Here stands a structure that the player can explore, although they cannot access its interior at first.
Upon noticing a hole in the wall (caused by the factory accident), the player will begin to wonder how to get inside. By spotting a tunnel that emerges from the mines, they will realize that they need to enter it in order to reach the roof. Once inside the structure, the player will be rewarded with another piece of information for the main topic.

Legend

- Player
- Terrein
- Wall
- Bridge
- Information
- Stairs
- Critical Path
- Locked Door

MINERS

Microscale - Temple



The first time, the player can access the mines only through the entrance by the lake. It is only after traversing them and exiting that they will discover the existence of a second entrance, hidden by vegetation behind the bar.

Furthermore, if they have noticed the other exit located in the sawmill area, they will start wondering how to reach that spot.

At this point, the player will rely on emerging information that will help them unlock the various hidden passages, ultimately leading them to the entrance of the temple.

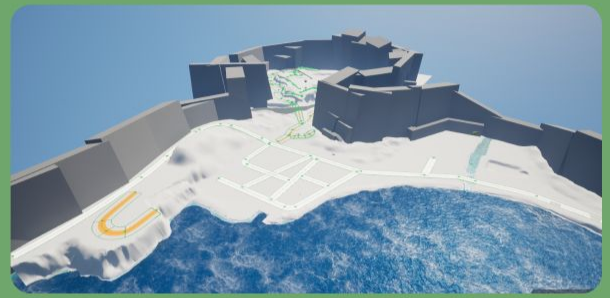
Legend

- Player
- Miners
- Temple Door
- Light Spot
- Tuorch
- Stairs
- Critical Path
- Locked Door

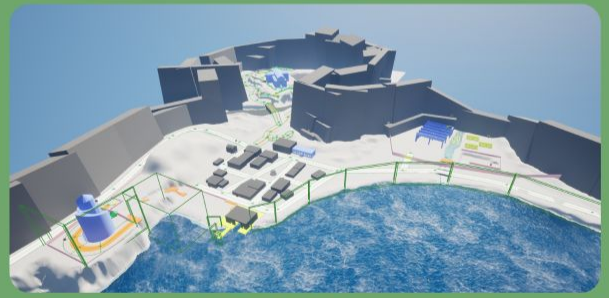
PROTOTYPE

WORKFLOW

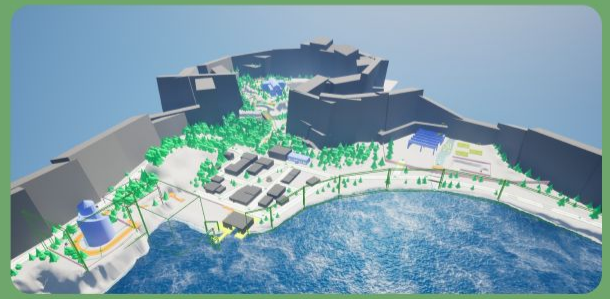
First Phase
Position of the blocks



Second Phase
Landscape Mode



Third Phase
Props position & programming



Fourth Phase
Procedural Content Generetion

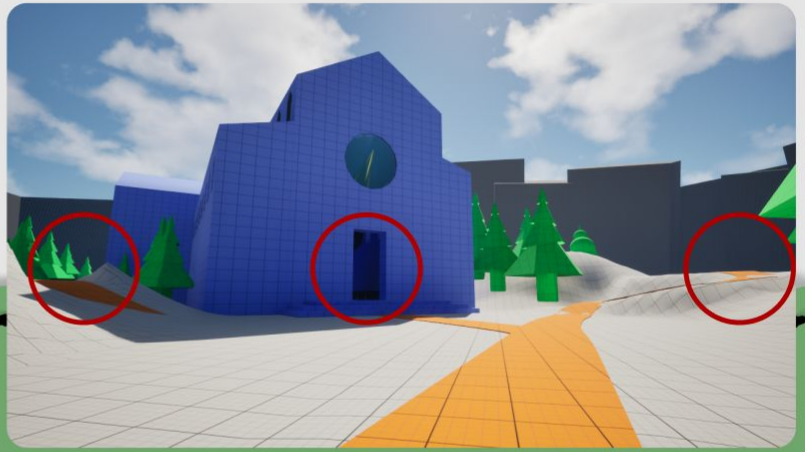
OVERVIEW

By climbing the lighthouse, you can see the three main focal points in each area of the game.

The lighthouse is visible in many parts of the game to orient the player

OVERVIEW

In the sawmill, the player can see a miner's exit to suggest them how to jump on the roof



In the church zone, the player can take 3 path: one is the main path, one is a shortcut and the last one is a overview of the lake

CONCLUSION

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Play the game

Read the documentation