

Project Post-mortem

Supporting Portfolio Document

EXPERIMENTAL GAMES PRODUCTION: GDEV50016

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Project Title: EraShift

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1. Project Concept

Introduction

Our game development project began with a simple yet intriguing challenge: to create a game without relying on traditional input methods like keyboards or controllers. Instead, we explored the use of Arduino hardware alongside Unreal Engine software, aiming to provide players with a fresh and unconventional gaming experience.

The objective is to develop a series of puzzles that could be solved using only Arduino-based interactions. This meant players would engage with physical hardware components to navigate through virtual challenges, offering a unique blend of tangible and digital gameplay.

We divided the work into two main parts for each other, I am mainly working on Arduino, while Jack is mainly working on the Unreal. We both thinking on the ideas on what we would want to do by getting insight from researching and the example from the lessons.

Game Description / Overview

In our experimental game, we blend the physical world with the virtual realm by utilizing Arduino to interact with various hardware components such as sensors, buttons, switches, dials/potentiometers, and LEDs. Unreal Engine acts as the conduit, facilitating communication between the Arduino board and the game environment through the serial port.

The core concept revolves around creating captivating puzzle experiences devoid of traditional input methods like keyboards, mice, or controllers. Instead, players are challenged to navigate through intriguing puzzles solely using hardware interactions.

Central to the game's design philosophy is the emphasis on delivering immersive experiences that seamlessly blend the real and virtual worlds. Through inventive gameplay mechanics and thoughtful design, players will find themselves engrossed in a captivating fusion of physical and digital realms.

A timer element adds an additional layer of challenge, encouraging players to test their skills and complete puzzles as swiftly as possible. Moreover, players will need to employ physical or digital Morse code decoding techniques, adding depth and complexity to the gameplay experience.

Key features,

1. Innovative Input Methods:

Our game introduces interesting input methods by utilizing Arduino hardware, offering players a fresh and immersive gameplay experience without relying on traditional input devices like keyboards or controllers. By interacting with physical components such as sensors, buttons, switches, and potentiometers, players are challenged to navigate through interesting puzzles using hardware interactions.

2. Multiplayer Interaction:

Enjoy the excitement of cooperative puzzle-solving or compete against friends in multiplayer modes. Whether collaborating to overcome challenges together or engaging

in competitive speed runs, our game offers diverse multiplayer interactions that enhance replay value and social engagement.

3. **Diverse Puzzle Challenges:**

Enjoy an exciting journey through a variety of puzzles that will test your mind and problem-solving skills. The puzzles range from medieval cog puzzles to futuristic parcel sorting systems, each with its own unique mechanics and objectives.

4. **Timer-Based Gameplay:**

Challenge yourself against the clock as you strive to complete puzzles within the allotted time. With a timer element adding intensity to the gameplay, players must hone their skills and strategize their moves to beat the clock. Competing for faster completion times adds an exhilarating aspect to the gameplay experience, pushing players to test their limits.

5. **Thematic Setting and Narrative:**

Immerse yourself in an engaging narrative set across various historical eras, from medieval times to futuristic worlds. Driven by an urgent message from Dr. Warp and a sense of duty, players embark on an exciting adventure filled with mystery. Explore thematic settings and unravel the secrets hidden within each puzzle as you progress through the game.

Game genre

Our game falls under the genre of 3D Puzzle, offering mainly single-player with slightly multiplayer experiences. It presents players with a series of puzzles to solve, utilizing hardware interactions facilitated by Arduino technology. The puzzles are designed to challenge players' problem-solving skills. While the primary focus is on puzzle-solving, the game also accommodates multiplayer interactions, allowing players to collaborate or compete with each other. The target audience includes puzzle enthusiasts and those interested in experimental gaming experiences.

Platform / Technologies

Our game is designed to be played on PC and we have utilized the Unreal Engine for game development along with Arduino hardware for unique input interactions. Although the game is currently optimized for PC, we plan to explore compatibility with other platforms that support Unreal Engine or offer serial port connectivity for Arduino integration in future iterations.

Target audience

The game is designed for individuals who love puzzle games and enjoy exploring innovative gameplay experiences. It is suitable for both experienced puzzle enthusiasts who are looking for fresh challenges and gamers who are interested in unique gameplay mechanics. The game also offers a blend of real-world hardware interactions with virtual gameplay, making it particularly appealing to those who appreciate such fusion. With its combination of traditional puzzle-solving elements and unconventional input methods, our game provides an immersive experience for players of all backgrounds and interests.

Playthrough Video

<https://youtu.be/ZGkNfaN7TFo>

Forum Link

<https://digitalacademy.staffs.ac.uk/forum/index.php?/topic/63414-wong-paul-w020591m/>

2. Research Evaluation

Overall Approach to Research:

My research mainly relied on my existing knowledge and experience in relevant fields such as Arduino, electronics, C programming, and gaming. Rather than extensive new research, I reviewed what I already knew to identify relevant tools and techniques for the project.

Explorative Research:

The objective of my research was to investigate the use of basic electronic components, specifically those included in the Arduino Starting kit, to create a game within a timeframe of approximately less than 2 months. I normally relied on my existing knowledge of electronics and Arduino to explore existing game examples that had similar components such as sensors. I also considered the possibility of expanding the project scope by exploring wireless connections and integration with other platforms such as smartphones. However, due to time constraints and a desire to minimize costs, I ultimately decided to focus on utilizing the resources available within the Arduino Starting kit provided by the lecturer, meanwhile also allowing the project extending onwards with adding extra content and components to the game.

Dynamic Research:

Throughout the development process, I kept researching the solutions to specific challenges encountered during the project. This included investigating methods for implementing a timer function within Unreal Engine to enforce time-based gameplay mechanics. Additionally, I researched Morse code implementation techniques to integrate the Morse Code Puzzle mechanic into the game. Another area of research was the movement of parcels in Puzzle 3, which required exploring the Unreal Engine. Furthermore, I sought out resources and documentation to optimise the efficiency and effectiveness of both the Arduino code and Unreal Engine blueprints utilized in the project.

Technical Research

For the technical learning aspect of the project, I primarily relied on my existing knowledge and experience in electronics, Arduino programming, and game design. Since I had previous exposure to these areas through coursework and professional experience, I found that most technical challenges could be addressed using familiar techniques and problem-solving methods. I did not extensively engage with external resources such as forums or documentation, as I felt confident in my ability to troubleshoot and implement solutions independently. However, I did consult with my teammate, Jack, to get more ideas, solutions and decision-making when faced with particularly complex issues, which provided valuable insights and alternative approaches.

Throughout the project, we explored several initial ideas, but as time went on, we realized some were more ambitious than practical. One such idea involved connecting the Arduino hardware to smartphones via Bluetooth, allowing players to use their smartphones for augmented reality (AR) or mixed reality (MR) interactions. However, considering the need to develop a smartphone app alongside the game, we thought of concerns about managing time effectively within our project's timeframe.

Similarly, we entertained thoughts of incorporating additional components like gyroscopes or infrared sensors. Yet, given our limited schedule and resources, we recognized that pursuing these components and adding to our project would only complicate matters further. Consequently, we opted to prioritize the development of a playable version of the game using the components and technologies readily available to us.

In addition to these initial ideas, we encountered challenges in implementing multiplayer functionality within our project's timeframe. While multiplayer features would have undoubtedly enriched the gaming experience, we realized that synchronizing gameplay between multiple players presented formidable obstacles. Therefore, we decided to focus our efforts on delivering a single-player experience, while the game allows multi-player play at the same time as a cooperative puzzle game.

Contextual Research

Sources of Inspiration:

Games Visuals:

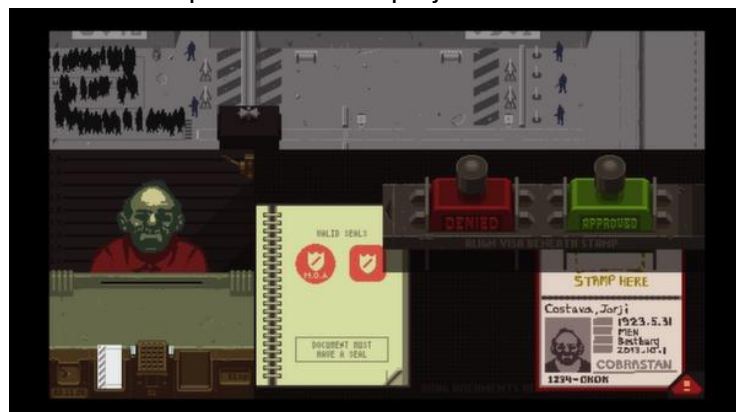
My main source of inspiration came from game visuals, particularly from experiences such as the Lockpicking Museum game. This game provided a visual reference for puzzle-solving mechanics and influenced the overall aesthetic direction of our project. Also during the Game Cinematic module this semester, I learned more about researching 3D meshes and mesh materials, which also inspires me.

Sound:

During the testing phase, particularly when experimenting with the buzzer alongside buttons, the interaction was similar a Morse code system, sparking ideas for incorporating sound-based puzzles into our game mechanics.

References to Other Games:

"Papers, Please": It serves as a pivotal reference point for our project. This game's straightforward yet captivating gameplay, revolving around document inspection and decision-making, provides valuable inspiration for our design process. Specifically, we draw upon the simplicity and effectiveness of its mechanics, envisioning ways to leverage buttons and LEDs to create a similar immersive experience in our project.



The Museum of Mechanics: Lockpicking: Another significant reference was "The Museum of Mechanics: Lockpicking" by Dim Bulb Games. This indie title provided valuable insights into creating immersive puzzles using electronic components. The game's intricate lockpicking challenges inspired us to create puzzles using components like potentiometers to simulate dial or cog mechanisms and replicate the tactile sensation of manipulating locks.

Nintendo Switch Party Games:

Games like "WarioWare: Move It" and "1-2-Switch" served as references for creating entertaining and interactive mini-games. These party games, designed specifically for the Nintendo Switch console, showcased creative uses of motion controls and multiplayer interactions. Through studying the various mini-games included in these titles, we acquired valuable insights into creating gameplay experiences that utilize electronic components.



Assessment of Sources and Research Depth:

The sources of inspiration that I chose were mainly based on my personal experience and familiarity with the games mentioned. Since I have played these games before, I was able to evaluate their quality and relevance firsthand, which gave me deeper insights into their mechanics and gameplay elements. As someone who already has knowledge in electronics and Arduino, my focus was on connecting this expertise with game development ideas. While I recognize that there is potential for further research in terms of depth and breadth, the current level of exploration was considered adequate for the scope of our experimental game project.

Research Conclusion

During my research, I learned a lot about creating experimental games based on my own experience and what I already knew. Looking at different game examples and electronic components helped me to come up with ideas, but I know I can do better. So, for future research, I plan to spend more time exploring and analysing things more deeply, which should help me understand things better and come up with even cooler ideas. Also, I think talking to more people and getting different perspectives could really help me out. Working together on projects like this can lead to even better outcomes.

3. Development Evaluation

About the development process, it would be helpful to have a timeline that shows the progress from week 1 to week 8, as below:

Week 1:

- Initial discussions with team member Jack about the game genre and type, including considerations for single or multiplayer, and whether to incorporate a story.
- Research into existing games for inspiration, with a focus on "Papers, Please" for its use of buttons and LEDs in a similar context to our project.

Week 2:

- Continued research into potential game ideas, including exploration of Nintendo Switch games like "WarioWare: Move It" and "1-2-Switch" for inspiration on mini-games.

Week 3:

- Further exploration of game ideas, with additional inspiration drawn from playing "The Museum of Mechanics: Lockpicking" for puzzle design concepts.
- Collaboration with Jack to finalize the game concept and develop a pitch presentation.

Week 4:

- Preparation and refinement of the pitch presentation materials, including slides and talking points.
- Delivery of the pitch presentation to the class, sharing initial ideas and seeking feedback.
- Review of feedback received during the presentation to inform further development decisions.

Week 5:

- Exploration of potential puzzle mechanics, including consideration of a buzzer puzzle initially, but later pivoting to a Morse code puzzle due to technical constraints.

Week 6:

- Focus on prototyping and developing the three main puzzles identified in the pitch presentation: potentiometer puzzle, door puzzle using switches, and additional puzzles using buttons, buzzer, sensors, and LEDs.
- Initial testing and iteration on puzzle mechanics and gameplay elements.

Week 7:

- Continued development and iteration on puzzle mechanics, focusing on refining the gameplay experience and addressing any technical challenges encountered.

Week 8:

- Finalization and polishing of the three main puzzles, prioritizing gameplay balance and user experience.
- Discussion with Jack about potential additional puzzle ideas, ultimately deciding to focus on polishing existing puzzles due to time constraints.
- Preparation of the postmortem document and reflection on the development process.

Jack and I are working on a project together. Since I have more experience with hardware, I am focusing on the Arduino part while Jack is working on the Unreal Engine. We don't have a detailed or fixed plan, but our goal is to come up with ideas and work on them before the end of week 8. While the results may not be exactly what we expected, I think we are making good progress.

Contribution within a group

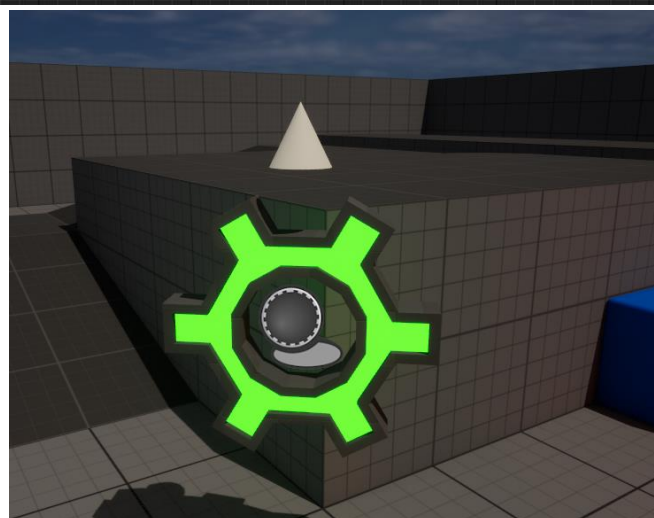
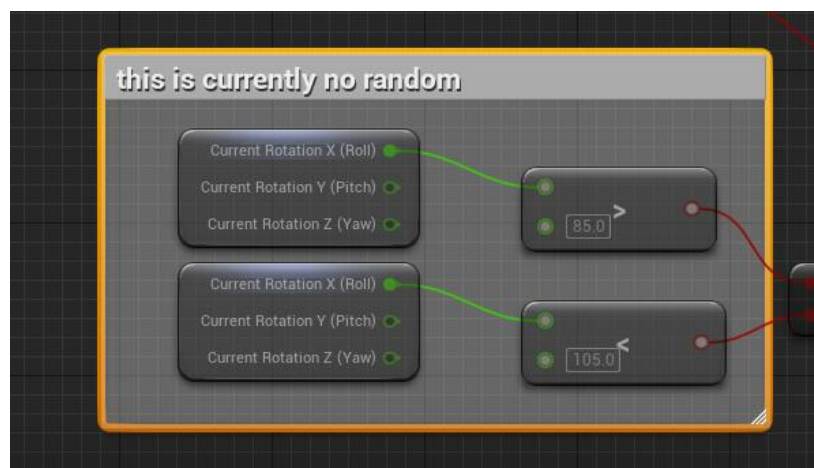
During the development process, we primarily communicate through Discord to share ideas and hold discussions. When we both return to the lesson, we focus on creating puzzle games using both Unreal Engine and Arduino. We then migrate and test the game while discussing additional ideas to enhance it.

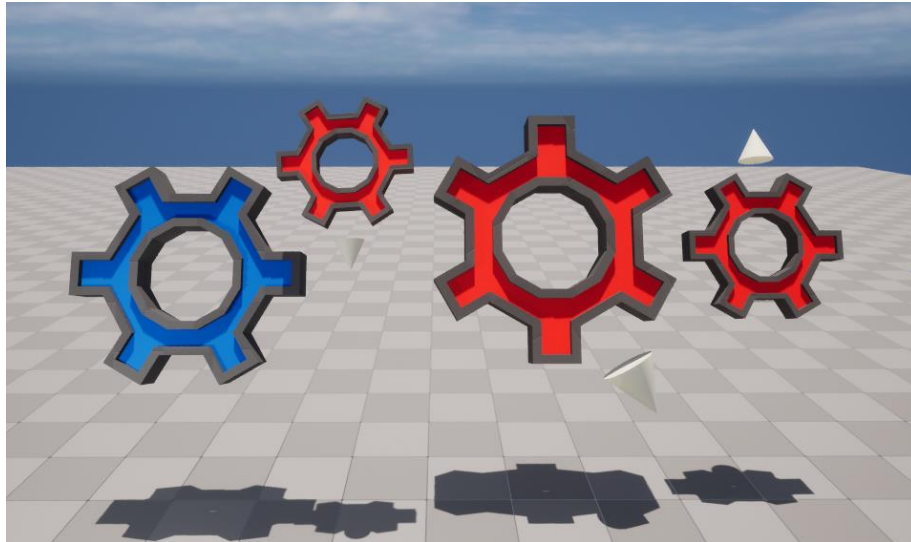
Iterative Design Practice

There were quite a few changes made throughout the development process, so to better organise, I would like to group the changes by discussing each puzzle idea separately.

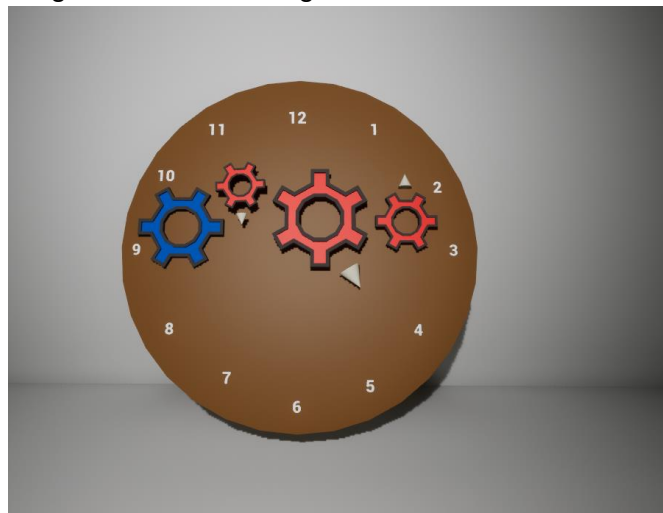
Puzzle 1: Cog Puzzle

The cog puzzle is the easiest puzzle we have designed. It is based on the lesson example of how to use the potentiometer in the Unreal Engine game. We first added a checking function to ensure that the cog turns in the desired rotation.





We first incorporate the random function to alter the meshes in the Unreal blueprint. Next, we test adding two more cogs with different target rotations.



Although there haven't been many changes to this puzzle, the appearance has undergone a significant transformation to better align with the background story of Era. In the end, Jack modifies it to resemble a clock.

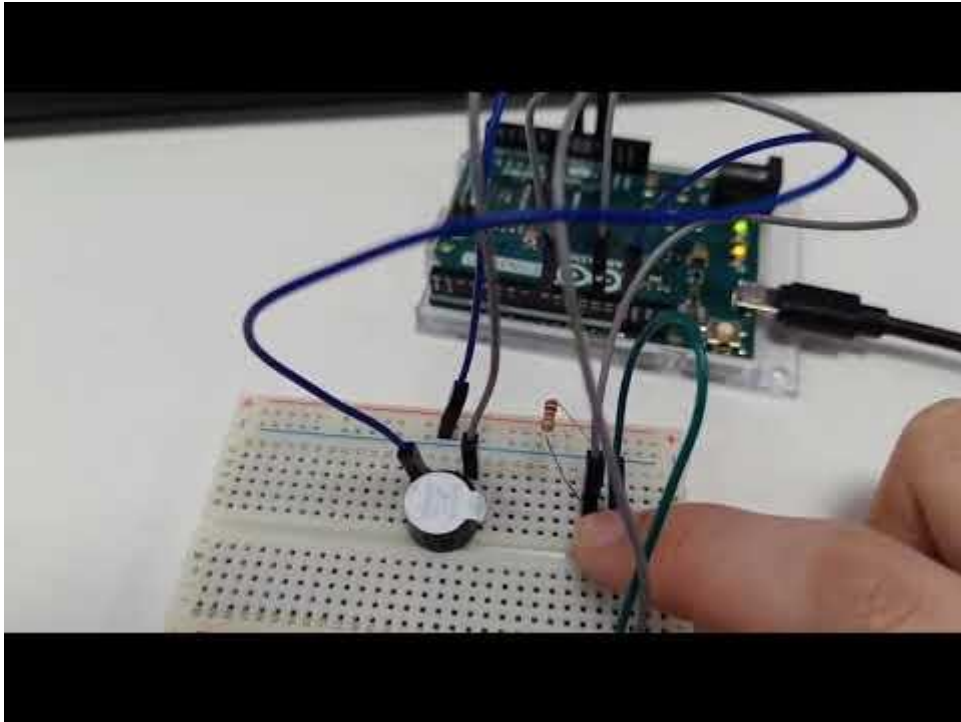
Puzzle 2 : Morse Code Puzzle

This puzzle is quite different from Puzzle 1 and has undergone many changes from our initial ideas. Originally, the puzzle was about remembering the sequence of tones and pressing the buttons in the correct order. This idea was also part of our game pitch.



However, when I tested the code on the Arduino, I found that although the code worked fine, the buzzer sounded strange. After some research, I discovered that the buzzer was an active buzzer, which is typically used only for beep sounds, rather than a passive buzzer that can produce tones and melodies. While testing, the sound of the buzzer gave me the inspiration for the alternative idea - the Morse code puzzle.

The beginning of developing the morse code puzzle is just testing by testing press or release of the button.

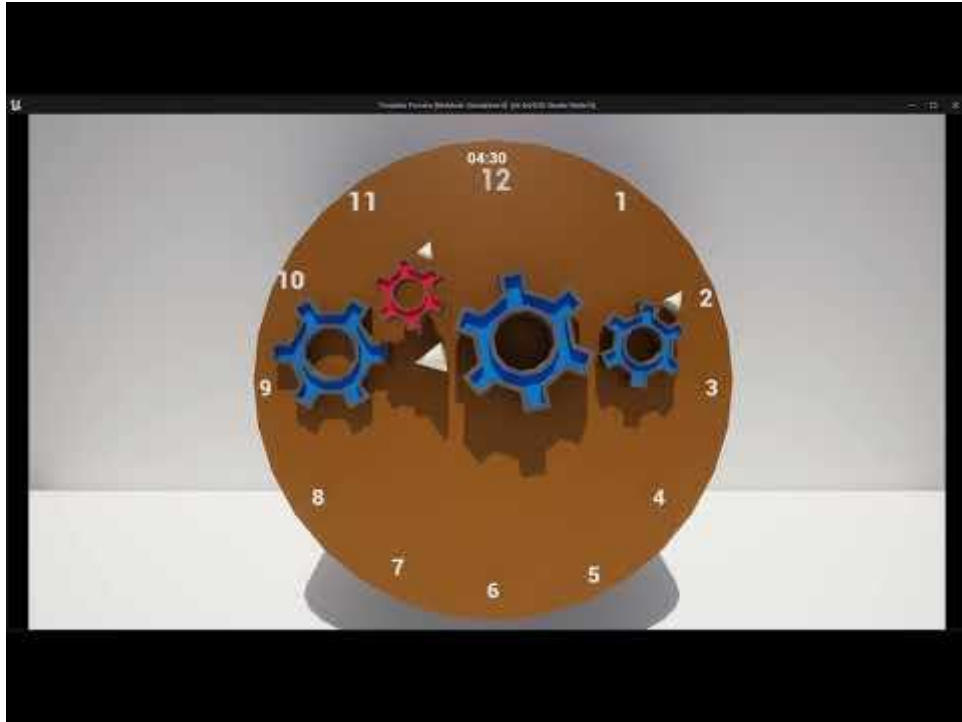


Later, we discussed how to implement a Morse code system, specifically how to decode the Morse code message from the Arduino in the Unreal Blueprint. We both agreed that it is best to only decode the 26 alphabetic letters, using the Morse code convention of "dit" and "dah" for short and long pitches respectively.

MorseCode	Letters
dit,dah,	a
dah,dit,dit,dit,	b
dah,dit,dah,dit,	c
dah,dit,dit,	d
dit,	e
dit,dit,dah,dit,	f
dah,dah,dit,	g
dit,dit,dit,dit,	h
dit,dit,	i
dit,dah,dah,dah,	j
dah,dit,dah,	k
dit,dah,dit,dit,	l
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dit,dah,dit,	r
dit,dit,dit,	s
dah,	t
dit,dit,dah,	u
dit,dit,dit,dah,	v
dit,dah,dah,	w
dah,dit,dit,dah,	x
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dah,dah,dit,dit,	z
dah,dah,dah,dah,dah,dah,	ClearArray

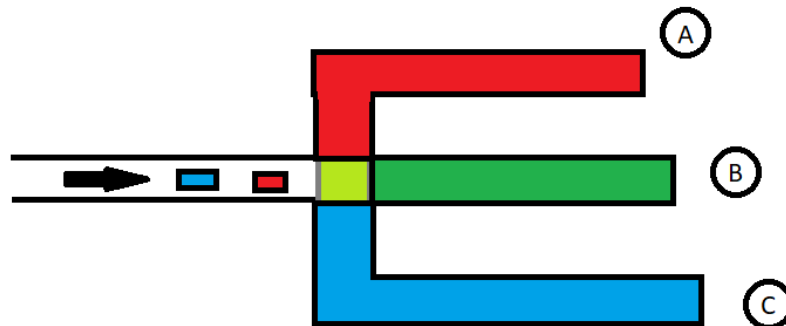
After conducting several tests, I have added a command to clear the stored message in the puzzle. This command involves a 6 long pitch and works like a reset button. After this, is continue the development on using it to create a riddle puzzle.

As the game development comes to an end and after complete testing, it's better to give players a hint to lower the difficulty, especially when they spend too much time pressing the Morse code due to mis-pressing the wrong pitches. To avoid frustration, when the remaining time reaches 2 minutes, the riddle hint will be shown below the riddle message. Here is the video on testing the hint function, I adjust it to when the timer reaches 4 minutes instead.

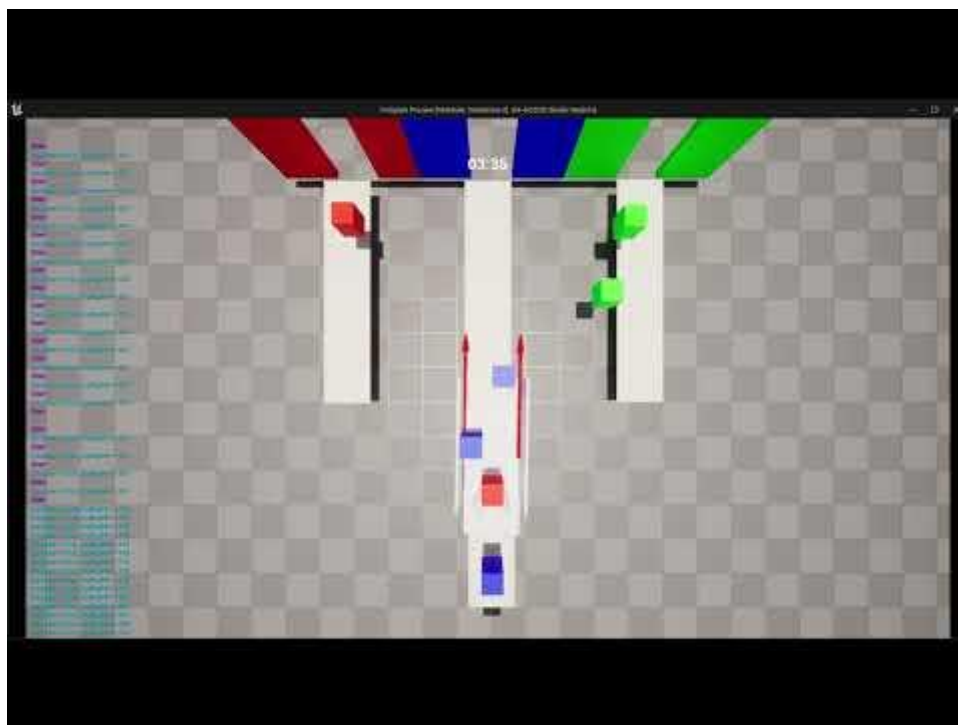


Puzzle 3 – Factory system Puzzle

I had this idea while listening to a pitch presentation from one of my other classmates teams, but I can't remember which team it was. I discussed the idea with Jack and drew a diagram, which I still have.



The idea is to simulate a part of the dispatch system in a factory warehouse or mail service. The player must control the light green part to direct parcels to the correct portal. We quickly started working on this idea around week 7, after finishing the Morse code puzzle.



Due to time constraints, we haven't made many changes to the idea. Instead, we have focused on making it work well and provide a better player experience. We have made adjustments to the puzzle, such as collision detection, parcel movement speed, spawn interval, camera view, etc.

Time Management

As mentioned in previous sections, some ideas were rejected at the beginning of the development process. Our goal was to create a game with 3 to 4 mini puzzles. Since we didn't have a fixed schedule for development, we didn't focus much on project planning. However, we set an internal deadline of week 8 instead of week 9 for project documentation. The pitch presentation in week 4 was a checkpoint for us to assess our idea research and implementation progress. Honestly, I don't think I effectively used my 200 hours of study time, but I did enjoy working with Jack and creating something.

Contributions towards the project with estimate of the time taken:

- Ideas generating: from week 1 to week 4 (total time taken around 20 to 25 hours)
- Implementation on Arduino: from week 3 to week 8 (total time taken around 35 to 40 hours)
- Documentation: mainly from week 8 to week 9, irregularly make post to forum from week 1 (total time taken around 35 to 40 hours)
- Helping Jack on merging the system to Unreal: from week 4 to week 8 (total time taken around 15 to 25 hours)

Development Conclusion

I am satisfied with the outcome of our project. However, I believe that we could have done even better by creating a more interesting puzzle game. We haven't added our story to the game yet, which could make it more engaging. If we have the time and budget in the future, I would like to work on some of the other ideas that I mentioned earlier to add extra content to the game. I wish I had known about the resources that were provided to us earlier, as it would have helped with planning.

4. Evaluation of Work Produced

I am very pleased with the outcome of the work we produced. However, as mentioned in the last section, I believe we could have managed our time better when creating the puzzle game. I feel a bit regretful about my personal limitations in knowledge related to game creation in the Unreal Engine. Although I have a lot of experience playing video games, it was not enough to fully prepare me for this project. Additionally, both Jack and I were a bit hesitant to express our ideas to each other, which could have been improved with more game development project experience.

Relevance to the brief

It actually quite close to what we plan to do in the beginning, which is a 3D puzzle game with 3 to 4 mini puzzles inside. Also mentioned in the previous section, we do change some of the ideas. For example, in the pitch, we have designed a “Door” puzzle that uses switches for controlling the “on” and “off” status for an object, and the player needs to make all of them are in “on” status. At last, this puzzle has not been implemented in the game mainly due to time, and also need more design ideas for polishing this to become more interesting and engaging.

Creativity & Scope

Using the Morse Code Puzzle as the first example. The technical part is the Morse code system, without the riddle part of the puzzle, it even is not a game, just only a simulation of a Morse code system. To make it playful, the idea of how to use the message is the key. I also thought about using the message as for selecting options like in a novel game, or it also could be for a word puzzle using the decoded Morse code letters. For this, after discussing, we decided to have a simple riddle instead.

Another example is the Factory System Puzzle. The things that the player could control are the spawner and the control bridge by using the switch and potentiometer. It actually just replacing using the keyboard as input. While the uncontrolled moving parcels are the game content of this puzzle.

Contextualising your work within a wider theoretical practice

In crafting the game, I kept a keen eye on factors impacting difficulty and player engagement. We honed in on puzzle level design, strategically limiting distractions to immerse players fully in the challenge at hand. Through iterative testing and feedback integration, we fine-tuned the experience to strike that perfect balance between challenge and enjoyment. For instance, we toyed with the idea of adding hints for players grappling with the Morse Code Puzzle.

Moving forward, I'm considering player-centric additions for future projects. Offering customizable difficulty settings and perhaps introducing a scoring system are on the horizon. These tweaks could inject a fresh layer of fun and replayability into our games.

Further Work

Honestly, I do not know if would there be opportunities to take this work further or apply knowledge learnt from this project to my future job. Similarly, I am unsure if I could utilize my knowledge and experience of electronic components, programming, and Arduino from my studies five years ago in a project on experimental game design. However, I always think it is never a waste of time to study things even if they are seemingly irrelevant to the previous studies. I also had a similar experience before when I was working as an IoT Engineer. Because of this, I was always excited when I could use or share my knowledge and experience. Hope to have a day when I can use this project as a foundation for the things I work on.