GNG1103 - Client Feedback and Second Prototype for a VR Climate Change Simulation

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Abstract

This document describes the objectives and results from testing the second prototype for a VR climate change simulation and sets out the changes and plans made for the third prototype. Client feedback on this first prototype and other teams' prototypes presented during the pitch session are documented and used to guide further development. The companion and dialogue systems were successfully implemented and tested to positive results, though more work is needed to bring the other non-player characters to function. The third prototype will focus on building the final scene and designing it to show the future ramifications of climate change.

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1 Introduction

The first prototype was focused on creating the core features of the simulation and familiarizing each team member with the Unity engine and their specific role in content development. This prototype was presented to the client and other teams working on similar projects during a pitch session, where the story, environmental design, starting menu, and scanning tool were shown off. The primary critique from this was the lack of long-term focus in the current iteration's story, with the elements included in the presentation only showcasing the immediate effects of climate change. The target specifications and further testing plans are thus being repositioned to concentrate on completing the dialogue system to show the long-term consequences of climate change and building a complete first scene to show by example what specific consequences this simulation is equipped to explore.

2 Client Feedback on First Prototype

The main point of concern raised for this first prototype and many others during the client pitch session was how the story will demonstrate the long-term consequences of climate change. In its current iteration, the simulation is designed to show the immediacy of climate consequences with a canonical time span on the order of hours or days. Earlier feedback on the design concept emphasized the importance of being educational on the subject, which motivated the pivot towards the fire inspector concept with interwoven scanning and dialogue systems. The client seemed satisfied with the potential of these systems to communicate and explore information in the prototype, though the particulars of what data would be collected, how that would relate to climate change, and how it would show the escalating frequency and severity of wildfires in the coming decades as a consequence thereof were evidently not sufficiently explored nor explained. Further efforts must be made to communicate these further-out effects through the primary interactive systems.

3 Objectives and Results of the Second Prototype

With the scanning tool sufficiently developed in the previous prototype, the dialogue system was the target mode of interaction to build for this iteration. It uses a player-facing textbox tracked to the companion character with an accompanying button to progress the companion's dialogue or select what the user's character will say in response. Scanning items in the world will both display relevant data and statistics on the scanner and trigger contextual dialogue, where the companion comments or asks about the particular scanned element and leads the conversation into asking about how it ties to climate change. At the start of the simulation, the companion gives some brief exposition on the situation and goals for the user, triggered by just looking at the companion rather than needing to scan anything. An inexperienced user cannot be assumed to infer that they should tag the companion to get their first dialogue, but it is reasonable to guess that they would turn to look at the person they want to talk to, who can then prompt them to try using the scanner.

The dialogue text is written using a typewriter effect to make it feel more like the companion is actually speaking, though it intentionally prints somewhat faster than a person could speak so as to not frustrate users who read quickly. Numerous iterations and extensive debugging were required to fix the self-scaling dialogue box and figure out how to keep the system from replaying, skipping, or overwriting the lines, though it has finally reached a version that consistently operates as intended.

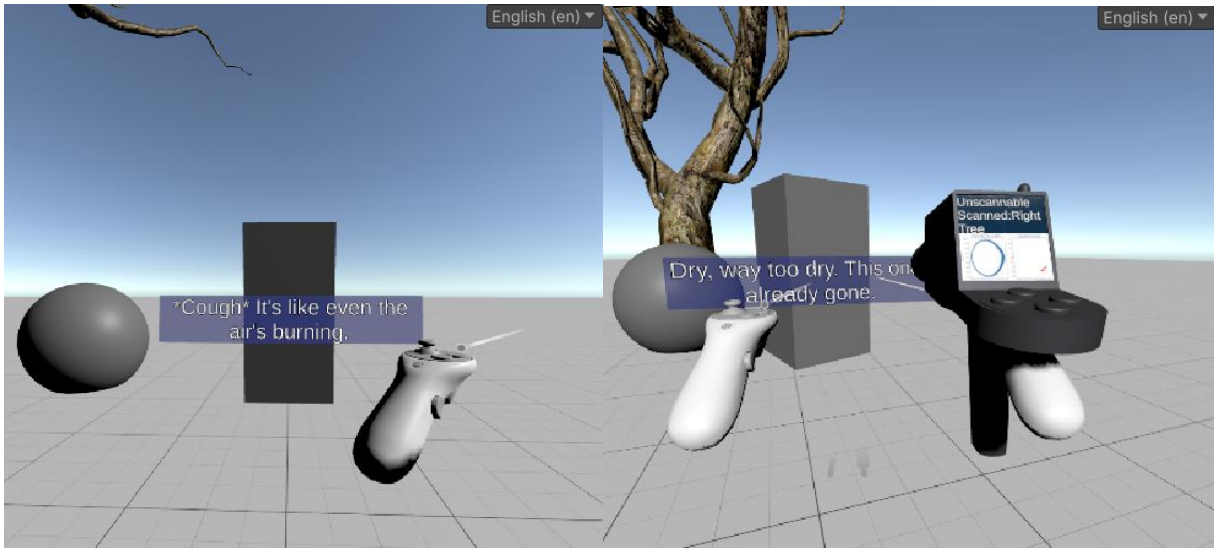


Figure 1. Prototype of the scan-triggered progressible dialogue system. Introduction (left) and scan-activated context dialogue (right)

The companion character should be able to move to keep within a reasonable distance of the player and track around obstacles so it is not inconvenient to seek them out for dialogue sections. Following a simple guide with the AI navigation tool and setting fixed environmental objects to be static, the companion was represented with a box and used a pathfinding script to follow the player around basic terrain. The test was successful with the companion not getting stuck behind the blocks or trees and then stopping at the desired distance from the user. The current iteration of the script will thus continue to be used, though it will have to be re-tested when applied to more complex environments.

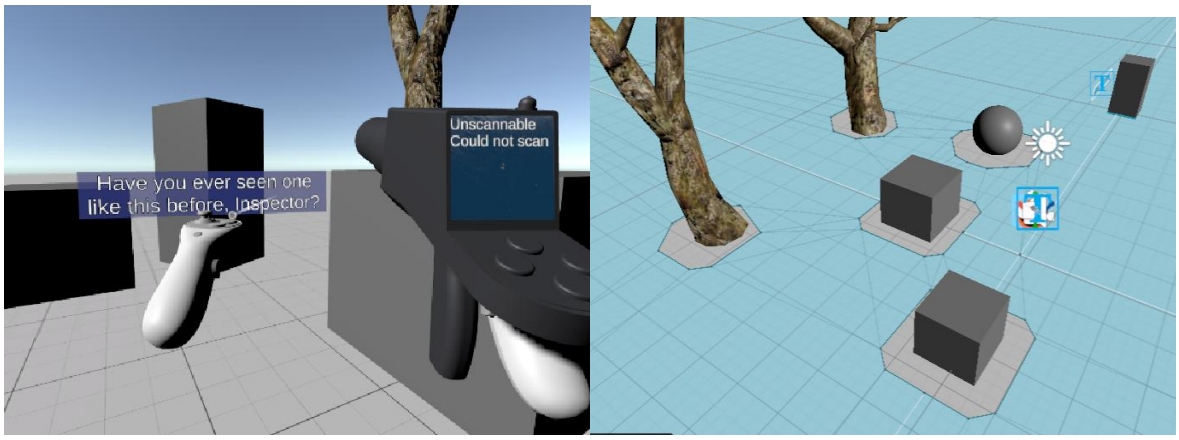


Figure 2. Companion character navigating simple static obstacles (left) and the terrain navigation mesh showing how its AI "sees" them

With the fire particle pack having been found visually suitable, the next test was to activate it on contextual actions to make the simulation react to the user. This was accomplished by using scripts that allow the creation of a spawn point and trigger. This works by having an invisible object, such as a large box, with a spawn point attached to it. Once the user walks through that object, with no collision enabled, the desired particle will be spawned at the object's origin. This script can be used multiple times on the same object to spawn multiple different effects, but more "spawnpoint" objects would be needed. After testing multiple times with different approaches to the problem, this was the simplest and most reliable solution.

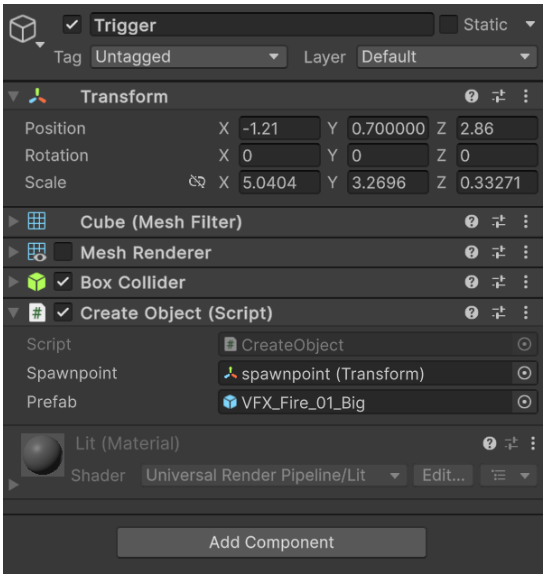


Figure 3. Box collider trigger set up to spawn a fire when the user enters an area

Good quality audio is necessary to immerse the user in the experience, and with that comes good audio layering. This test focused on adding different sound effects over different scenarios to judge whether or not they'd be suitable for the final simulation. As of now with testing, the

only sound pack that is being used is Casual Game SFX Pack. More tests on other situations will be conducted in the future to judge how well they sound. Going forward, more sound effects from other asset packs will most likely be needed as those included in CG SFX Pack do not adequately cover all applications for this simulation.

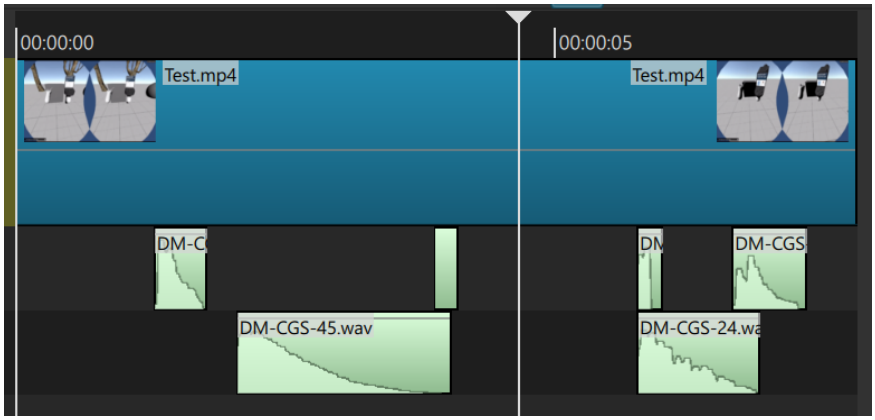


Figure 4. Scanner tool with audio layered over for testing audio quality

Figure 5. Further development of the town scene

For prototype 2, priority was given to making the pre-fire environment for scene 2. Green trees were added, a road with a roundabout was made, a fire hydrant was added, and many houses were placed using the asset store to make it look like a small-town scenery. Colliders were added to the trees and houses so that the user does not clip through.

Figure 6. Early model for the forest scene

For prototype 2, one of the focuses was on implementing character movement for the fire inspector, which was done successfully. The fire inspector has full freedom of movement in the 3rd-person-perspective movement controller. The development for the next stage of the fire inspector is to merge with the first person perspective movement and equip them with the scanner tool. The second major development was with the companion character, as shown in Figure 7. The character comes dressed in safety equipment, and the asset also includes a helmet and a mask.

Figure 7. Companion fire inspector design

Figure 8. Fire Inspector model

Following selection of the user and companion models, the next test was to implement the civilian evacuation. The objective is for the townspeople to run away on the available road as the fire inspector arrives in the town. The character's animation should be similar to the fire inspector and companion character, but they must move along a preset track. The first implementation of this faced issues with the character speed being too slow and their animations not activating. The second test added a "speed" parameter and set it to 1, but this failed to alter the previous behaviour. For the third test, the controller was changed from freehand to starter controllers, though this still did not fix the issue. Further testing will be required to debug this.

Figure 9. Townspeople models

4 User Feedback on the Prototype

User feedback was limited, though it echoed some of the critiques raised by the client regarding the simulation's potential to show the effects of climate change. The implementation of the dialogue system was generally well regarded, but the companion's movement patterns were seen as somewhat jittery. Sentiment improved regarding the scenery modelling, though further work will be needed to bring it up to expectations.

5 Updated Target Specifications and Bill of Materials

With new understandings of the limitations and abilities of the Unity engine, as well the constructive feedback provided by the client, some of the original design specifications are revised to better reflect what can and should be done:

- Each survey question should focus on querying a different "area" of empathy for climate change. This involves asking about the user's concern for and/or understanding of events such as those that are geographically distant from them; events whose consequences build over decades rather than showing in the scale of months or less, and the effects on people they don't know as compared to those they are close to.
- The long-term consequences are built into the story with slight revisions to the narrative. The first two scenes at the forest outskirts and in the town take place within the same setting and are chronologically sequential as before, drawing data from events such as the 1989 Manitoba wildfires [1] or the 1950 Chinchaga wildfires in Northern B.C. and Alberta [2]. A third scene is now planned which takes place closer to the present in a similar town but with worse conditions, using data from more recent events such as the 2016 Fort McMurray fires [3], 2021 Lytton fires [4], or 2023 Alberta wildfires [5].

The other design specifications from deliverables C and D are largely qualitative and have been chosen to remain as they are. The bill of materials has been updated as follows:

Table 1. Updated bill of materials

Part #	Count	Cost	Item Name	Link
1	4	$0	Unity 6 Game Engine	https://unity.com/download
2	1	$452	Meta Quest 3S VR Headset	https://www.meta.com/ca/quest/quest-3s/
3	2	$50	Meta Quest 2 Remote Controller	https://www.meta.com/ca/quest/accessories/quest-2-controllers-refurbished/
4	4	$0	Music - Sad Hope	https://assetstore.unity.com/packages/audio/music/music-sad-hope-157746
5	4	$0	Dry Tree Asset	https://assetstore.unity.com/packages/3d/vegetation/trees/dry-trees-86967
6	4	$0	FREE Casual Game SFX Pack	https://assetstore.unity.com/packages/audio/sound-fx/free-casual-game-sfx-pack-54116
7	4	$0	Free Fire VFX - URP	https://assetstore.unity.com/packages/vfx/particles/fire-explosions/free-fire-vfx-urp-266226
8	4	$0	Animated Sun Skybox	https://assetstore.unity.com/packages/2d/textures-materials/sky/animated-sun-skybox-98447
9	4	$0	Haptic Feedback	https://assetstore.unity.com/packages/tools/integration/haptic-feedback-308330
10	4	$0	UK Terraced Houses Pack FREE	https://assetstore.unity.com/packages/3d/environments/urban/uk-terraced-houses-pack-free-63481
11	4	$0	Town Houses Pack	https://assetstore.unity.com/packages/3d/environments/urban/town-houses-pack-42717
12	4	$0	Dry Trees	https://assetstore.unity.com/packages/3d/vegetation/trees/dry-trees-86967
13	4	$0	Localization Plugin 1.5.4	(Built in to Unity, requires install from package manager in the engine) About Localization | Localization | 1.5.4
14	4	$0	MockHMD XR Plugin 1.4.0	(Built in to Unity, requires install from package manager in the engine) About the Mock HMD XR Plugin | MockHMD XR Plugin | 1.4.0-preview.2

15	4	$0	OpenXR Plugin 1.14.0	(Built in to Unity, requires install from package manager in the engine) OpenXR Plugin | OpenXR Plugin | 1.14.1
16	4	$0	AI Navigation Plugin 2.0.6	(Built in to Unity, requires install from package manager in the engine) AI Navigation | AI Navigation | 2.0.6
17	4	$0	Starter Assets: Character controllers|URP	https://assetstore.unity.com/packages/essentials/starter-assets-character-controllers-urp-267961
18	1	$5	Floating Dust & Falling Ash	https://assetstore.unity.com/packages/vfx/particles/environment/floating-dust-falling-ash-175524
19	1	$10	Dead forest environment	https://assetstore.unity.com/packages/3d/environments/dead-forest-190976
20	1	$15	FireFighter	https://assetstore.unity.com/packages/3d/characters/humanoids/humans/firefighter-171169
21	1	$25	Worker 3	https://assetstore.unity.com/packages/3d/characters/humanoids/humans/worker-3-304338#asset_quality
22	4	$0	Woman with cap and jacket	https://assetstore.unity.com/packages/3d/characters/humanoids/humans/woman-with-cap-and-jacket-221114
23	4	$0	Sporty Girl	https://assetstore.unity.com/packages/3d/characters/humanoids/humans/sporty-girl-29666
24	4	$0	Fantasy Forest Environment	https://assetstore.unity.com/packages/3d/environments/fantasy/fantasy-forest-environment-free-demo-35361
25	4	$0	Yughues Free Bushes	https://assetstore.unity.com/packages/3d/vegetation/plants/yughues-free-bushes-13168
26	4	$0	Low Poly StreetPack	https://assetstore.unity.com/packages/3d/environments/urban/low-poly-street-pack-67475
Total Cost - All Items		$557	-	-
Total Cost - Planned Items		$25	-	-

As stated in the first prototype document, the Planned Items cost only covers the costs of parts 19 and 20, with other paid items either not requiring purchase or being purchased out of pocket.

6 Third Prototype Test Plan

The details of the third prototyping test plan are given in full in the appendix, section 10. Tests for elements not implemented in prototype 1 or 2 have been carried over, as well as the stress tests which must be repeated as the project is built further to catch new bugs. The roles of each member in development of the simulation are tabulated as follows, which have not changed since the previous deliverable:

Table 2. Content specialization of each group member

Name	Content Roles
Mohammad	Character models and animation
Malcolm	Lighting, sound, and particle effects
Krithivaas	Environmental and setting design
James	UI, dialogue, and interactable elements

7 Conclusions and Recommendations

Client feedback on the initial prototype showed concern for the ability of the simulation to demonstrate the long-term effects of climate change. Development of the second prototype focused on completing the movement and dialogue systems of the companion character and building out the first scene with all of the textures, set pieces, and audiovisual effects required to make it immersive. Alongside these features, plans are being laid to steer the story and feature implementations to better address the client's critique. Slight additions have been made to the target specifications to reflect this. The third and final prototype plans are described in the appended table and are centered on finishing, stress-testing, and refining the end product.

8 Future Work

The third and final prototype is intended to complete all scenes, fully incorporate desired data into the interactive and setting elements, and ensure the elements developed by each member seamlessly integrate with one another. Further iterations of the simulation would aim to add scenes and potentially new features to demonstrate how wildfires interact with other climate phenomena to propagate climate change. Further analysis of climate data would also be beneficial to more concretely project how the climate will change in the long term, though the availability of data and the skills required to analyze it may be prohibitive for the team in its current state.

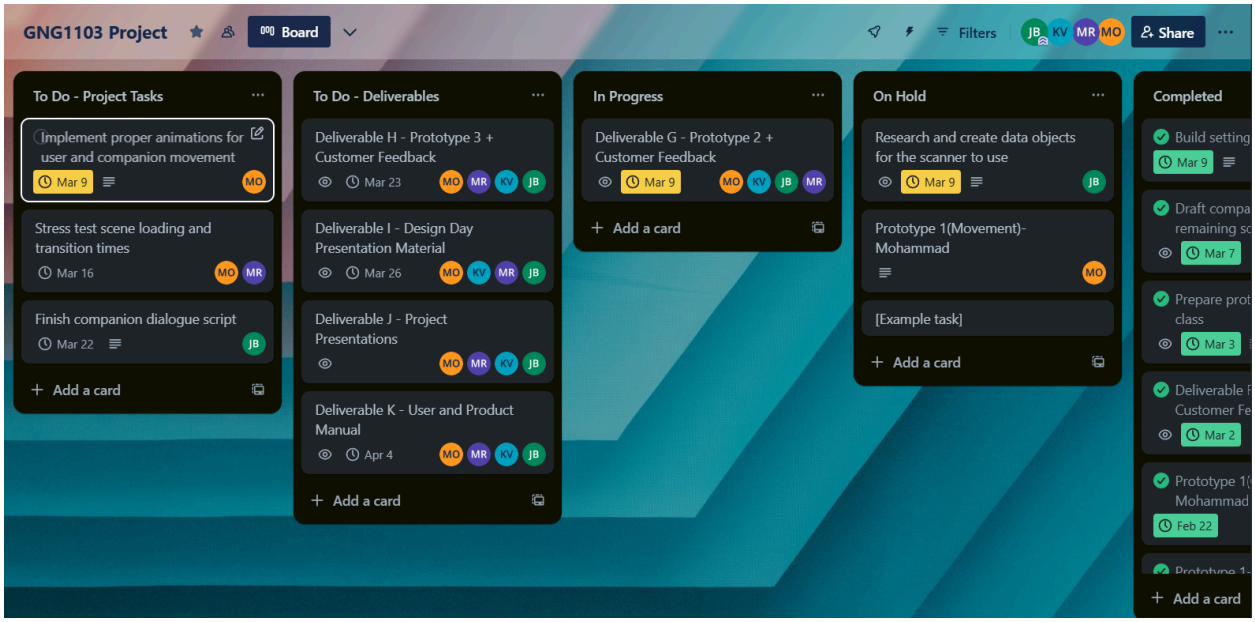
9 References

1. Hirsch, Kelvin (1991). A chronological overview of the 1989 fire season in Manitoba. The Forestry Chronicle **67**(4).
2. Struzik, Ed (11 May, 2011). 1950 monster fire burned its way into history | Edmonton Journal. Edmonton Journal.
3. Parsons, Paige (3 May 2016). "Thousands flee from Fort McMurray wildfire in the largest fire evacuation in Alberta's history". Edmonton Journal.
4. *Record breaking heat in Canada.* (1 July, 2021). RMetS. https://www.rmets.org/metmatters/record-breaking-heat-canada
5. "Wildfires Rage in Western Canada". National Environmental Satellite, Data, and Information Service. May 11, 2023.

10 Appendix

Design Concept: "Fire Inspector" Simulation			User takes the role of a fire inspector with a companion to explore how wildifres can be caused by and propagate climate change								
Test Number	**Probable Critical Issue**	**Test Objective**	**Test Description**	**Analysis Method**	**Determine Measurables**	**Metrics**	**Level and Fidelity of Prototype**	**Kind of Prototype**	**Results**	**Interpretation and Feedback**	**Notes**
	What assumption are you testing?	*Communication, Performance Measurement, Risk Management, or Learning and Understanding*	*What specifically will you test? What is your hypothesis?*	*Specifics of how the test will be run, what it uses, pass/fail criteria, and how data is collected*	*What are you testing with the concept (focus on measurable attributes)*	*What metrics will you test and what are the associated units?*	*High or low fidelity? Focused or comprehensive?*	*Visual, Physical, or Analytical*	*Observe and record results*	*Pass or fail, why, and other feedback collected*	
1	Scanner correctly updates the display when targeting objects of interest	Performance Measurement (of scanner)	Collision test: Update text UI when a line intersects with different simple geometries	Make a crude scanner model and scene with two copies of each simple geometry mesh: one interacts with the scanner, one doesn't. For each object, tag it with the scanner while it is on the default text and try again when it has the reading from a different item. Estimated 30 min. to build scene, 10 min. to test all items.	Collision interaction with all simple geometries	Reading text on UI, Yes/No for correctness	LoFi Focused	Physical	Correctly gets and displays data attached to scanned objects, does not raise errors on tagging non-scannable objects.	Pass as each object scanned as expected. Continue use of scanner script	Consider using a player-facing PNG and for the light and glow texture overlay on the surface to simulate the indicator bulb instead of actual dynamic lighting.
2	Scanner plays correct sound effect when scanning and navigating UI	Performance Measurement (of scanner)	Sound test: Scan objects from Test 1 and listen for sound effects. Listen for correct sound effect on each of 4 menu navigation buttons	Update test 1 to include sound in the interaction functions. Repeat Test 1, marking which interactions do and don't play sound and any new fail conditions. Estimated 10 min. to test all items.	Presence and volume of sound effects from scanner	Yes/No for presence, test group feedback on volume	LoFi Focused	Physical	Plays the correct sound when the object is scannable, but plays no sound when not scannable. Requires debugging to figure out why.	Failed as the sound does not play consistently. Debug existing sound script.	
3	Simulation environment is realisitcally proportioned	Communication (of setting)	Visual test: Establish a frame of reference for further setpieces relative to avatar height and camera position	Place cars, houses, and tree assets in a scene along with user avatar that carries the camera. Scale objects to look appropriate to the avatar. Run the simulation and view objects from three different angles and distances. Estimated 10 min to build scene, 5 min. to test.	User approval of setpiece sizing	Yes/No for approval, collect and interpret other specific feedback	LoFi Focused	Visual			
4	Lighting and shadow effects from the fire appear believable	Communication (of setting)	Aesthetic test: Lighting from fire effects and the shadows cast around objects look realistic	Place a few fire assets in the scene from Test 3. Run the scene and observe the effects, checking whether for issues such as shadows not being cast away from the light source, or surfaces facing the source not being illuminated. Distribute to test users to gather feedback. Estimated 5 min. to build, 10 min. to test per user.	User approval of lighting effects	Yes/No for approval, collect and interpret other specific feedback	LoFi Focused	Visual			
5	Simulation runs smoothly with particle and lighting effects from the fire	Performance Measurement (of framerate)	Performance test: Check framerate does not fall to the point of looking choppy	Build a scene with several of each simple geometry, placed randomly in a loose cluster. Place instances of the chosen fire asset within this cluster 10 at a time. Run the simulation and move the avatar around the cluster for several seconds, then record the lowest stable framerate. Repeat until this falls below 30 fps. Estimated 30 min to build and render scene, 10 min. to test.	Average framerate and instances of severe frame loss	Observe and record framerate, units of frames per second (FPS)	LoFi Focused	Physical			
6	Character features suitably fit the image portrayed in the storyboard description	Communication (of characters)	Visual Test: The character is well designed with appropriate features and clothing	Build a simple character based off a real human figure, the figure will be adjusted to approproiate specifications in order for character to appear porportional comapred to the surrounding area. The character must have appropriate clothing that fits their role. Test will be visual and will be shared to the group to verify opinions and prespectives on potential improvements.	User approval of character asthetics	Yes/No for approval, collect and interpret other specific feedback	LoFi Focused	Visual			
7	Character movement is seamless, the character can move in all directions	Performance Measurement (of movement	Performance test: Check that the character has the freedom of movement in a space	Character movement setting will be set to move in all directions in the avaialble space. Run the simulation and attempt to have the character move around, record all movement pros and cons for future develpoment.	User approval of character movement	Observe and record movement precision and fludity	LoFi Focused	Physical			
8	Environment sound effects and music fit into the world	Communication (of setting)	Sound test: Interact with different objects to gauge how well they sound	Build a small scene with many little interactible objects, bushes, trees, doors, etc., and give them all the respective sound effects needed. From there, just try and play the simulation like normal and see how well they sound in fit into the game world. Add different music tracks in the background and see if they're too distracting or if they fit well. Estimated 30 min. to build, 20 min. to test.	User approval of audio quality	Yes/No for approval, get group feedback for what fits best	LoFi Focused	Visual			
9	Language selection appropriately changes in-game text	Performance Measurement (of text objects and UI)	UI test: Text in each section of the simulation matches the language chosen by the user	Build two scenes, each with a text object containing a line in either English or French. Make a HUD button that changes the language. Run the first scene and choose English, check the displayed language matches the button. Check that text on the scanner language matches or all menus. Change to next scene while running and repeat. Run all again starting in French. Estimated 2 hours to program, 10 min. to test.	Right or wrong language on different elements consistent, i.e. not reset, between scenes	Mark which elements do and do not change language during test. Mark whether language changes itself on scene change.	LoFi Focused	Analytical	All text and buttons configured to be bilingual correctly updated text as chosen, which persisted between scenes	Pass as all bilingual text updtaed appropriately. Contiue use of localization plugin	Completed using localization package, requires special configuration for all text objects

10	Scenes load in quickly and smoothly	Performance Measurement (of scene change functions)	Performance test: All scene elements load in within 3 seconds, tested by timing how long it takes to do this on starting the simulation and changing scenes	Using scenes built for the latest prototype, run the simulation in whole. Time how long it takes to change from one scene to the next. The scene is considered "loaded" once all objects are loaded in and the framerate stabilizes. Pass if the scene takes less than three seconds to load. Estimated 10 min. total to test 5 trials.	Load time between scenes	Load time (seconds)	LoFi Comprehensive for early prototypes, moves to HiFi for later versions	Physical	Quickly loaded between test scenes, requires further stress testing as scenes are built more	Pass since scenes loaded in less than one second. Redo for later prototypes	
11	User is appropriately confined to the story area	Learning and Understanding (of level boundaries)	Constraint test: The user can not take themselves out of the intended areas, nor do they clip through collision objects	Using scenes built for the latest prototype, run the simulation in whole. Move the avatar all along the bounding wall and into all collision objects. Observe which, if any, the character moves through. Make note of any other unexpected physics interactions with the avatar, e.g. slingshotting, falling through the ground. Estimated 20 min. total to test 3 trials.	Presence of non-functioning collisions	Yes/No for faulty collisions of each object	LoFi Comprehensive for early prototypes, moves to HiFi for later versions	Physical			
12	Scanner is stable for all variety of user inputs	Performance Measurement (of scanner stability)	Input test: The scanner UI follows its intended controls even when subjected to unintended user input patterns	Test "bad" input patterns of using unassigned keys, spamming the same key, spamming different keys, holding keys, using an assigned key while holding down another, and simultaneous inputs, each for 10-15 seconds. Between each trial, check that all scanner menus can be navigated to. Estimated 15 min. to test all patterns in each scene.	Presence of bugs or non-functional UI navigation on the scanner	Yes/No for marking a bug after each trial	HiFi Focused	Physical	Text did not fail to update during any of the stress test patterns.	Pass as the test did not encounter bugs. Continue using current scanner script.	
13	Companion keeps appropriate distance to and from the user during free navigation	Performance Measurement (of companion movement)	Tracking test: Companion follows the user while giving them space to act	Write a tracking script to test, which makes the companion move to keep a distance of between 1 and 5 units to the player, turning appropriately when changing direction. Simulate companion with a stretched box. Test by running around the companion, walking in and out of the following range, and teleporting out of range. Record distance companion moves to after each. Estimated 2 hours to build, 10 min. to test.	Distance at which companion stops moving	Unity position transform units	LoFi Focused	Physical	Companion stayed put when moving near it and navigated aroudn obstacles when walking or teleporting far away.	Pass as movement meets distance and reliability criteria. Continue use of companion follower script.	
14	Dialogue queues and plays lines when triggered	Performance Measurement (of dialogue system)	Dialogue test: Dialogue queue accepts and returns lines in the correct order when triggered	Write a dialogue script that can queue and write different sets of lines. Attach this to three different taggable objects, each with its own set of at least three dialogue lines, and scan each varying orders. For each tag, mark which dialogue lines do and don't play, tracking whether lines from certain objects are skipped or repeated in relation to the scanning order. Estimated 4 hours to build, 15 min. to test.	Consistency of the dialogue system	Yes/No for each line played no or less than once and in order	HiFi Focused	Physical			
15											


GNG1103 Project
Board
Filters
Share
To Do - Project Tasks
Implement proper animations for user and companion movement
Mar 9
Stress test scene loading and transition times
Mar 16
Finish companion dialogue script
Mar 22
Add a card
To Do - Deliverables
Deliverable H - Prototype 3 + Customer Feedback
Mar 23
Deliverable I - Design Day Presentation Material
Mar 26
Deliverable J - Project Presentations
Deliverable K - User and Product Manual
Apr 4
Add a card
In Progress
Deliverable G - Prototype 2 + Customer Feedback
Mar 9
Add a card
On Hold
Research and create data objects for the scanner to use
Mar 9
Prototype 1(Movement)- Mohammad
[Example task]
Add a card
Completed
Build setting
Mar 9
Draft compa
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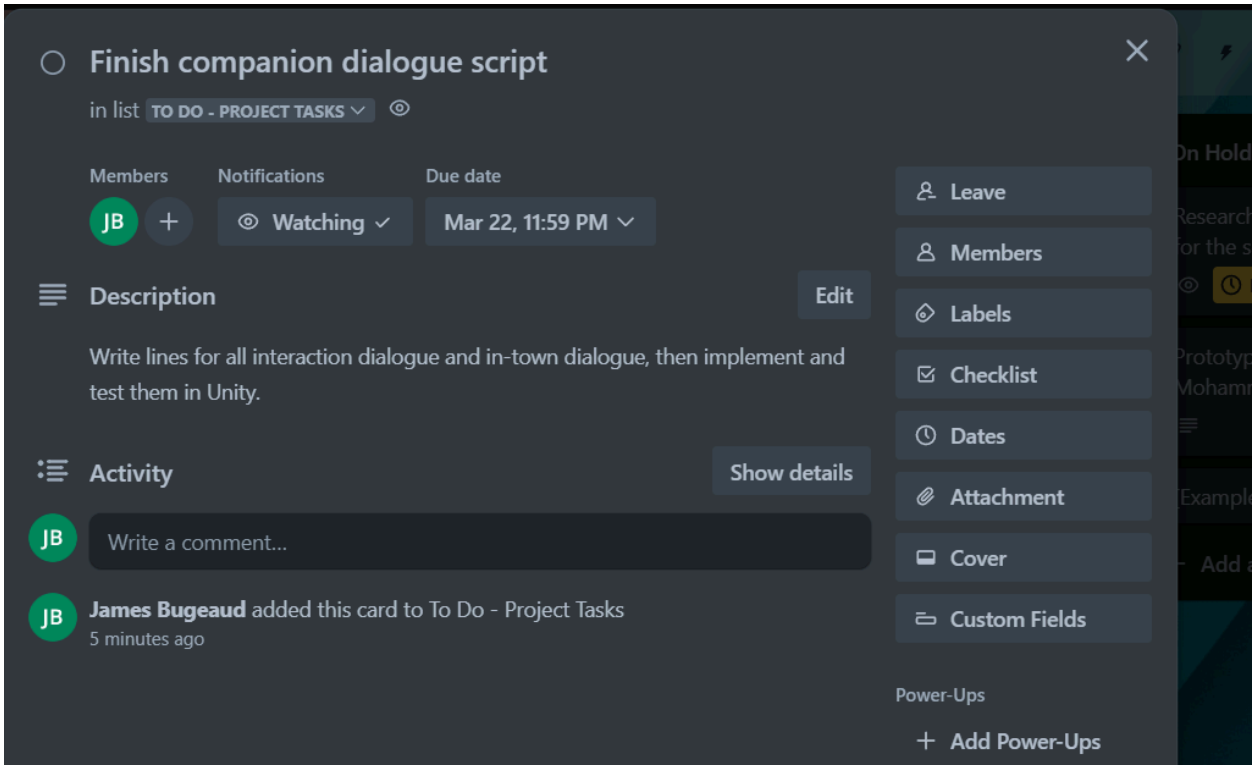
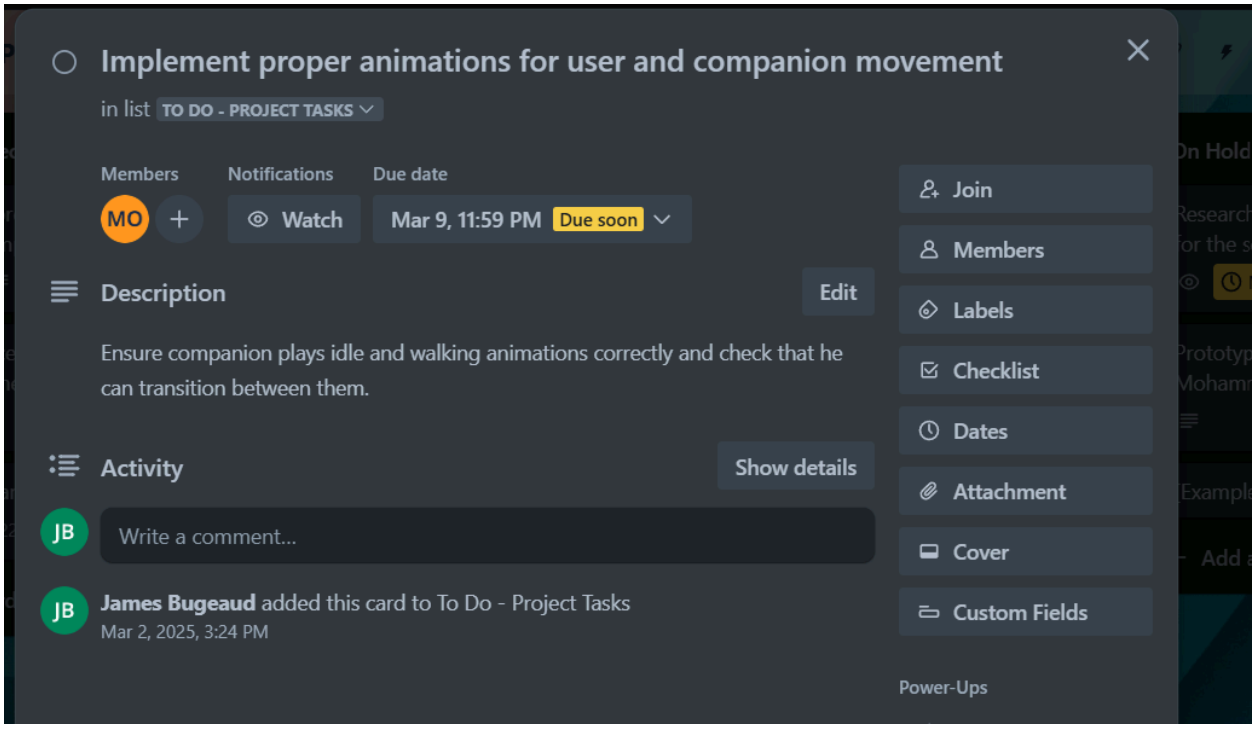
Add a card


Finish companion dialogue script
in list TO DO - PROJECT TASKS
Members
Notifications
Due date
Watching
Mar 22, 11:59 PM
Description
Edit
Write lines for all interaction dialogue and in-town dialogue, then implement and test them in Unity.
Activity
Show details
Write a comment...
James Bugeaud added this card to To Do - Project Tasks
5 minutes ago
Leave
Members
Labels
Checklist
Dates
Attachment
Cover
Custom Fields
Power-Ups
Add Power-Ups


Implement proper animations for user and companion movement
in list TO DO - PROJECT TASKS
Members
Notifications
Due date
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Mar 9, 11:59 PM
Due soon
Description
Edit
Ensure companion plays idle and walking animations correctly and check that he can transition between them.
Activity
Show details
JB
Write a comment...
JB
James Bugeaud added this card to To Do - Project Tasks
Mar 2, 2025, 3:24 PM
Join
Members
Labels
Checklist
Dates
Attachment
Cover
Custom Fields
Power-Ups