Project Deliverable H

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Introduction

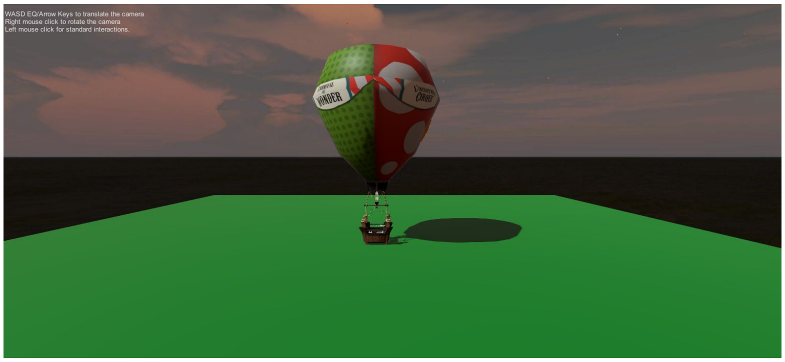
In this deliverable, we will be giving a final prototype status update. This will include all that we were able to get done in the time given and the inaccess VR equipment. Then we will be describing the functions of the prototype left uncompleted, either due to the lack of time or disruption from the virus. This will cover the detailed functions and the action plan that was in place to complete them. Lastly, the testing in person was entirely removed due to distance learning, but the process will be described below.

Final Prototype Status Update

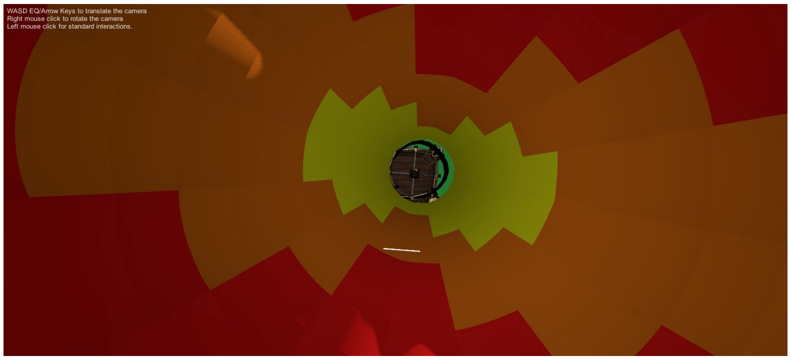
Final State

Hot Air Balloon

The macroscopic and microscopic scenes for the hot air balloon are complete. The buttons which allow the user to switch between these two scenes are fully functional as well. The buttons which allow the user to change the temperature of the air in the balloon, the pressure of the air in the balloon, and the amount of molecules in the balloon are in the game, but aren't functional. There is a non-functional map for this scene which was designed to transport the user from one place to another within this scene, as well as to see their progress, and have their knowledge tested. This map is simple in design and acts as a median for the user and their game.



WASD EQ/Arrow Keys to translate the camera
Right mouse click to rotate the camera
Left mouse click for standard interactions.



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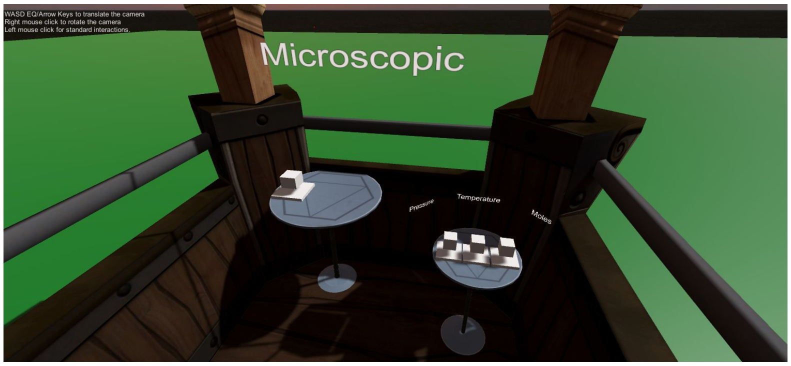
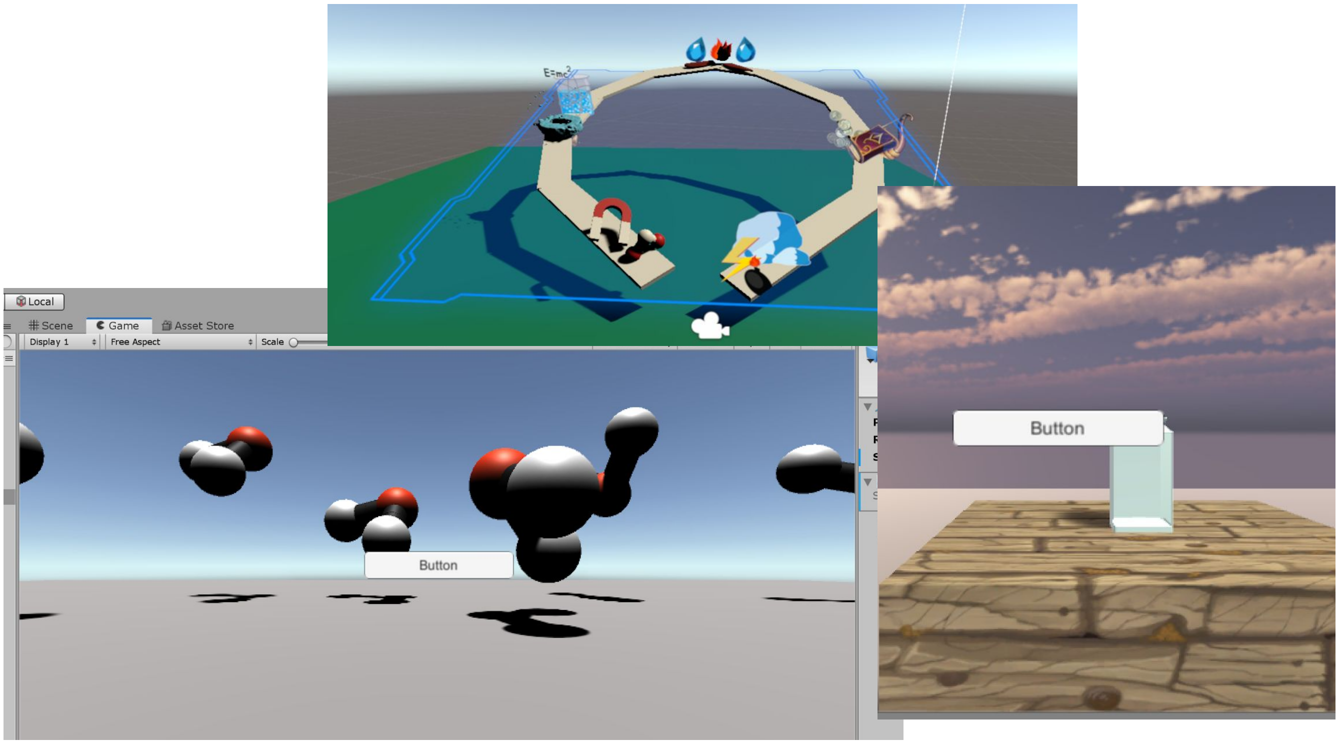


WASD EQ/Arrow Keys to translate the camera
Right mouse click to rotate the camera
Left mouse click for standard interactions.

State Change Scene

Basically, given the current situation, we weren't able to combine the scenes in the state change to the map using buttons. We did however create separate functioning scenes in the molecular and macroscopic portions of the state change but could not go in depth with proper molecular interaction and user interactivity as of now. The map represents visually the different stages planned for the user and provides a structure for them to follow. Currently, the user is able to move around the map freely, but is not able to access any specific scenes in the game through it. The paragraph below explains our plans for the state change scene and how we planned to carry it out.

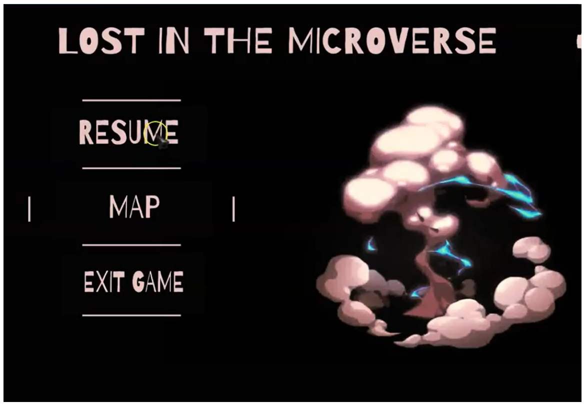
For this scene, we have created a map which was supposed to take the user between different scenes as they explore the different stages of a melting block of ice using both macroscopic and microscopic perspectives. When in the State change scene, once the map is available, the user has a clear vision of all portions of the map which has different stages with descriptive icons related to the main functions planned for each scene. It consists of 5 different scenarios, starting off with the initial macroscopic state where the user encounters a solid ice cube. That scene consists of a button which the user can press to then be pulled into the macroscopic world inside that ice cube. In the microscopic world, the user is able to interact with a solid state ice molecule by pressing a button, which acts as a source of extra energy being added onto the ice molecule, consequently the ice structure was supposed to break into the free floating nature of water molecules in liquid water. Once past that stage, the user can press another button which was supposed to make the map available to them once again, however this portion is not functional. The user is then able to move onto the latter stage which was supposed to transport them to a scene where the user is tested, which we were unable to develop due to unforeseen circumstances. Following the test portion, the map is available to the user to then be transported to a macroscopic scene, clearly indicating the results of their actions when the extra energy was added as now they face a puddle of liquid water where there initially was an ice cube. These buttons were unable to be made functional as we were unable to combine the map and the state change scenes come together. The map is once again available to the user through a button in that scene so the user is able to proceed to the next stage using a button on the map. This step will take them back into the microscopic world where they are faced with the water molecules. These water molecules are accurately represented with the correct chemistry colours but fail to possess dynamic attributes similar to how molecules act in real life. The water molecules flow freely as they represent liquid water, the molecules are in motion constantly as they rotate, flow, but we aren’t able to make them collide as they do in real life. Note, there are very few molecules on purpose as we believe this would not overwhelm the user and allow them to focus mostly on a collective of molecules which would demonstrate molecular interaction. We did have plans to explain to the students using text that there are a vast number of molecules in each object and what we show is only a small fraction, to avoid any misleading. We had plans to go more in depth with their motion and explore molecular interaction and the required conditions associated with bonding as this scene was meant to allow the user to cool the particles by lowering their energy levels so the water would form lattice structures and revert back to ice. This function was not included in the final game status. Inside the microscopic scene, the user was planned to be able to access the map through a button and then travel to the final stage in the map which was planned to be another final test, this time on the probability of bonds forming, the conditions required and the polar nature of water molecules. This scene as well was not completed but was mentioned here to explain what each stage of the map contains.

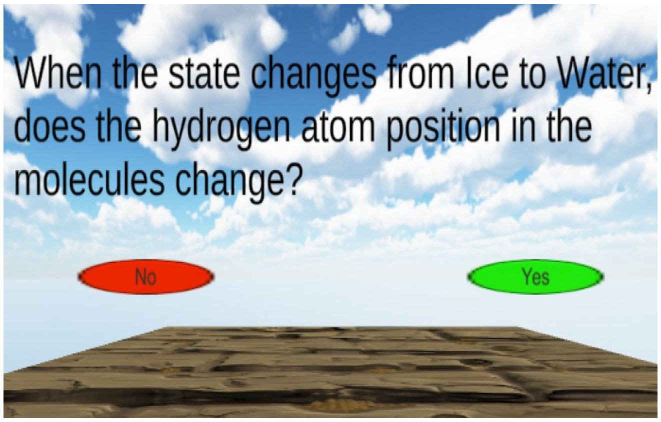


Menu

The menu was completed in a manner that would allow control of the audio, allow a user to take a break from the game, and to access the scenario's map. Each button was customized to fit seamlessly into the menu background, and the menu is made of a custom image to allow for the buttons to appear integrated, as well as adding pleasing visual elements for user satisfaction.

The menu utilizes a two-part system. One part is the menu access button, and the other part is the menu itself. The code is written so that while the menu access button is visible and interactive, the menu itself is not and vice-versa. The menu contains four buttons: Resume, Map, Exit Game, and a volume icon. Clicking on the Resume button hides the menu again and reveals the menu access button. The Map button would link to the physical position of the map in the scenario. The volume icon can toggle sound on and off, and the Exit Game button ends the program.




When the state changes from Ice to Water, does the hydrogen atom position in the molecules change?

Function

The main function of our final prototype is to allow the users to travel smoothly between the microscopic and macroscopic world in both the hot air balloon scene, as well as the State change scene. Since the main topic of focus in our game was the connection between the macroscopic phase and the microscopic one, we believe by being able to physically transport them between these phases where they are able to clearly see the effects of any change made in the macroscopic on the microscopic and vice versa, we will give the users a clear understanding of how these 2 worlds are connected. This function includes being able to interact with and observe molecules as they move in real life with constant motion and rotation. Although the interactivity was limited due to distractions, this prototype is still able to communicate the interconnectivity of how any change in the microscopics of an object can have a significant impact on the visual properties of that substance. Since there is a common misconception within classrooms on the motion of molecules, we made sure our prototype is effective in showcasing that these molecules are not still and do not experience motion in any routine way. Finally, the maps are able to provide the user with structure and help them navigate through the game in an optimal fashion that leads to successful learning outcomes. For example, in the state change scene, the map was designed in terms of different levels where the user would be able to complete tasks in order with quizzes in between.

Client Interaction

In an ideal situation, the client would interact with the final prototype by using a VR headset, and the accompanied controllers to navigate the virtual world by teleporting, and pushing buttons which transport the player to another part of the virtual world. Our game primarily uses exploratory learning techniques to demonstrate to the user the expected learning outcomes. In our final deliverable, the client would be able to interact with many of the mechanisms intended to demonstrate this, such as teleportation between scenes in the macroscopic and the microscopic, buttons arranged to move the user forward during the game and a map that is able to transport the user onto different scenes.

In Action

https://www.youtube.com/watch?v=adsIemRgHxE
https://youtu.be/1YvUYCdfKDA

Planned Execution under Normal Conditions

Uncompleted Aspects

Due to the issues arising from COVID-19, our project has all the underlying concepts developed, but they have not been integrated into a polished final project.

Our two scenarios both suffered from a lack of access to the design space at CEED. While our hot air balloon scenario has the sprites required to demonstrate the changes incurred by changing variables, the buttons required to tie the concepts to specific acts were not able to be properly introduced, as there is not the ability to try to interact with them as the player would.

The state change scenario has 4 scenes, and was to have two explicit quizzes within the level. The testing portion was missing for both quiz 1, with questions inquiring about the user's initial understanding of how the water molecules would act in specified conditions such as increased energy, and quiz 2, which focused more on the polarity in water molecules, probability associated with reaction frequency and the required conditions in molecules bonding.

The microscopic portion in scene 4 is missing due to time constraints. This scene would have focused on user interactivity by allowing the user to cool and slow down the water molecules by pressing a button. This would have led to an animation where the user would be shown the molecules slowing down and slowly forming bonds which would create a lattice structure as seen in solids such as ice.

We were initially planning to have fun interactive portions for our user especially after they are pulled into the microscopic portion in scene one. Instead of just using a button, we were planning to allow the user to initiate the addition of energy by throwing things such as bombs onto the scene to symbolize the addition of energy like we experienced in class while trying out the VR headsets in class, but since time did not allow that, we proceeded with a button.

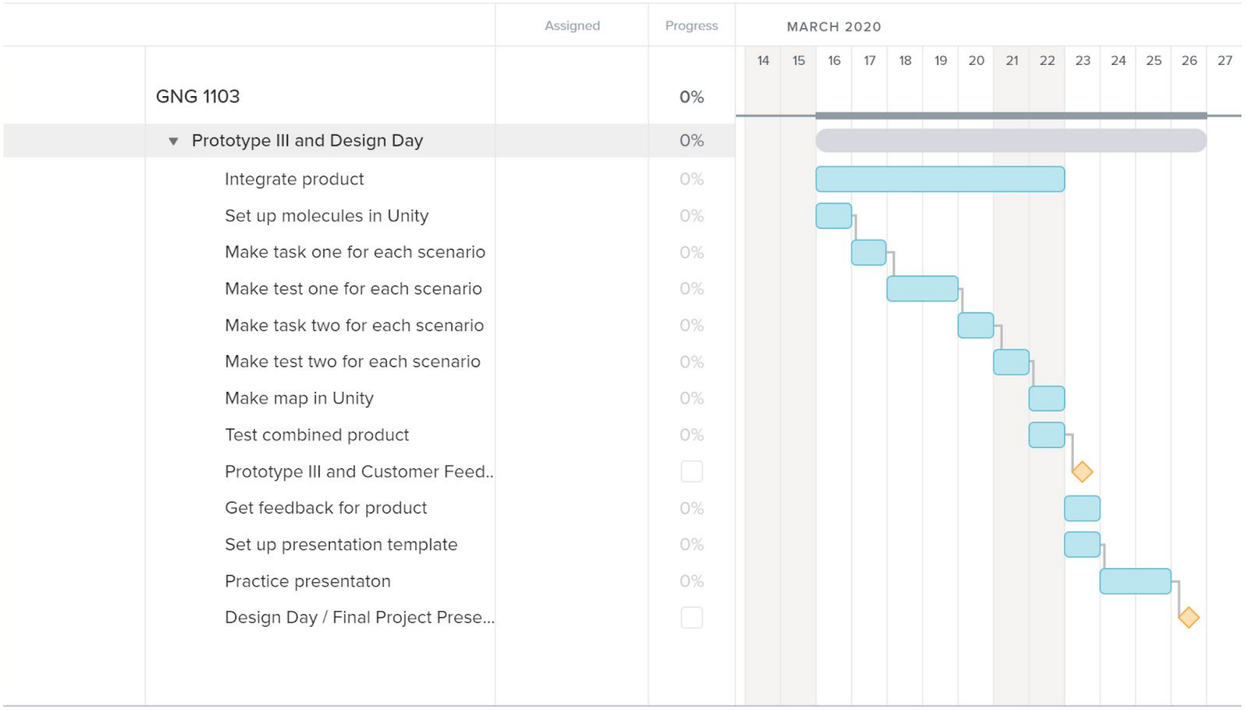
The expected experience with the current state of the game is not the most satisfying as we were unable to ensure smooth navigation without testing via the VR headsets. Details we had planned to add were to amplify ease of use and user satisfaction. These plans included a voice-over explaining instructions and what is being taught in each scene, so the user is engaged and understands the objectives of our game. None of us in the group own any VR equipment, so our ability to debug and detect issues that the client would experience is severely limited. The programs can be run in an emulator on a laptop, but it is not representative of how it looks when viewed through a VR product. It has removed our ability to guarantee or even verify what the end-product would have looked like.

The current menu, while functional, would have served the user better as a radial system menu. Ideally, the user would be able to access the menu throughout the game using a button on the VR set. This menu would include both the maps to allow navigation between 2 different scenes and also contain essentials such as audio control, game settings, and keep track of the user's progress and score. If we had access to the correct resources such as steam VR, general navigation along the map and the different scenarios would have been permissible, allowing for an enhanced experience.

Integration was our largest issue. Due to the busy schedules of all of us in the group, the different parts of the project were completed largely independently. Integration was to begin the week that campus shut down, so the project has some dead ends in each part of the code to accomodate for other parts when they were to be added together. For example, one of the buttons on the general menu was supposed to link to the map for that scenario, so it has no code running behind it currently. The maps were entirely dependent on the integration of the maps and the scenarios themselves, so they were most negatively affected by the school shutdown. The scenes are missing to connect the map to them and therefore not all buttons work on the map are functional. We also were not able to check for bugs and truly fine tune the program between the scenes that we have.

Action Plan

The week and a half that was greatly disrupted by COVID-19 was very packed. It started with making sure the molecules in Unity were fully functional. As a lot of the project was dependent on that function. After, each day was dedicated to a task for each scenario. The day after would be for building the test factor for each scenario and testing everything on the VR headset equipment. After the tasks and tests were all made by the weekend (21-22), then the maps would be worked on and combined. The customer test would occur, and deliverable H would be completed. Then, in the next couple days the presentation for design day would be set up and practiced, until March 26.



	Assigned	Progress
GNG 1103		0%
▾ Prototype III and Design Day		0%
Integrate product		0%
Set up molecules in Unity		0%
Make task one for each scenario		0%
Make test one for each scenario		0%
Make task two for each scenario		0%
Make test two for each scenario		0%
Make map in Unity		0%
Test combined product		0%
Prototype III and Customer Feed..		☐
Get feedback for product		0%
Set up presentation template		0%
Practice presentaton		0%
Design Day / Final Project Prese...		☐

Testing Plan

Final prototype testing is not possible in our case. According to the specifications we developed in Project Deliverable B, our prototype would have had to meet the following specifications and needs:

#	Need
1	The product connects the molecular and macroscopic.
2	The product is interactive.
3	The product is scientifically accurate.
4	The product follows chemistry colour schemes.
5	The product shows feedback on what the user has learned.
6	The product represents molecules as dynamic.

7	The product evaluates the user’s understanding.
8	The product is simple to use.
9	The product can move between 2D and 3D representations.
10	The product conveys the probability in collisions.
11	The product emphasizes the relationship between size and time.
12	The product contains elements of gamification.

The needs that we identified as testable were going to be integrated into a questionnaire. We would have had the game played by other students, preferably those in non-science majors. They would play each scenario, and then answer the following questions:

- What atom does the (red/white/etc) sphere represent?
- What did you learn about in this level?
- Did any of the questions not make sense? If so, what made them confusing?
- Did there seem to be a lot of collisions?
- On a scale of 1-10, 1 being a lesson and 10 being a game, what would you rate this level?
- On a scale of 1-10, how easy was this game to play?
- Do you think the game could be more interactive? If so, how would you change the part(s) you found static/uninteresting?
- A multiple choice question testing their understanding of the level

At the end, there would be an opportunity for the participants to clarify anything they had trouble expressing, for us to ask them questions on any responses we found interesting or particularly astute, and for the participants to ask us questions on anything that was not discussed in the questionnaire.

After the testing was over, we would distill the information into any actionable tasks to improve the project before the final prototype submission, and if anything could be accomplished before the finished product submission. The specifications of the final prototype would have been recorded according to the same metrics and design criteria originally used for benchmarking and target specifications.

- Number of scenarios
- User friendliness (according to questionnaires)
- Amount of collisions
- Number of interacting objects
- Number of viewpoints
- Number of questions/level
- Time between opportunities for feedback

Conclusion

In conclusion, and with regards to the underlying circumstances, our final prototype is now complete. This prototype was broken into different parts/ scenes, with some group members working on our state change scene, and others working on the hot air balloon scene. There were also group members working on maps for each scene. Both scenes are fully developed; however, they do lack functionality. Our map for the hot air balloon scene is built but not functional. The biggest issue we found with the given circumstances was the lack of resources to help us connect all the parts of our prototype. In an ideal scenario, all the pieces of this prototype would be functional for the user with the VR headset, and we could then begin the rapid iterative testing as outlined above. Due to the sudden closure of the school and lack of resources available, this prototype would not suffice as a proper learning tool for the client; however, we are confident in its capability, and what it would've been able to offer barring a pandemic. Overall our final product met most of our original functional needs including: to be scientifically accurate, show proper colour schemes, have an element of gamification, and others.