GNG 1103F

Deliverable K: User Manual

Team Members:
Bleston Mercado
Ayush Talekar
Mashood Abbasi
Nick Smith, 300076165
Numan Tariq, 300148867

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University of Ottawa

Abstract

This document outlines the group project that our team had in the class of GNG1103 that discusses the aspects of the learning game project in terms of the design process and how the game is used. The learning game enables students who are studying organic chemistry to have a visual reality experience and an effective, fun and engaging learning system which could be helpful and easy for them to understand the principles of organic chemistry. The students will also be able to go to different elevations and to different environments to make the learning experience even more interactive, fun and interesting. A quiz is added at the end of the game that tests the students' on what they have learned throughout the experience. At the end of the game experience, students shall be knowledgeable about the principles and the basics of organic chemistry.

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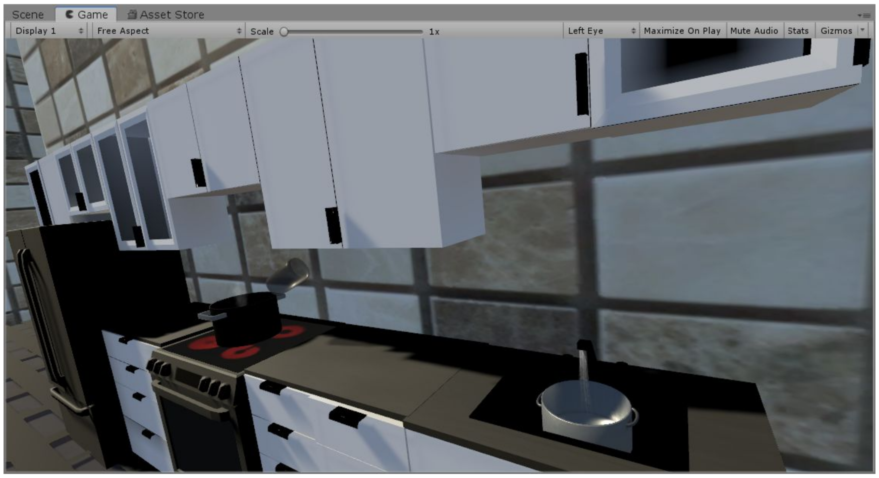
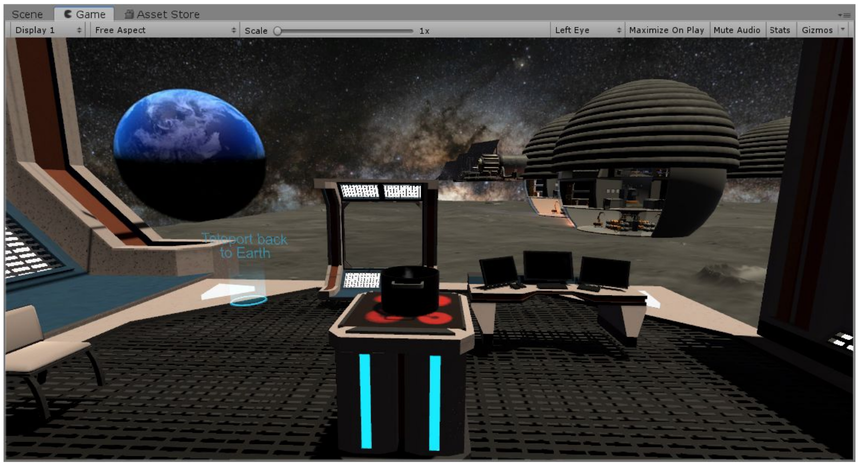
List of Acronyms

Acronym	Definition
VR	Visual reality technology where users have the ability to interact with 3D objects and have a realistic experience in a simulated environment.

1 Introduction

This document is based on an organic chemistry game where the user is able to interact with such experiments and objects and view the reaction in both micro and macroscopic worlds as well as going to different elevations. The user will be able to view how molecules react in the microscopic world based on an experiment of salt and water. The user also has the freedom of changing the water temperature. The main goal of this game is to enable students to learn organic chemistry in an effective, interactive and fun way and to as well dispel common misconceptions in chemistry.





Customer Needs and problem statement

The First step of the design process is the empathize stage where team members begin to have a beginner's mindset when listening to the customer’s needs. We often use this method to understand the customer’s “do things” and why and to as well understand their physical and emotional needs. As well as knowing who the user is. After collecting the raw data from the customer, we interpret the data by using positive phrasing that expresses what the product has to do. The client, however, gave us the opportunity to choose one of the following 4 scenarios. As each scenario has different requirements.

Scenario	**Customer Statement**	**Interpreted needs**
1.Size & Time Scale	The client requires us to rank the relative size of objects in the VR environment	The VR can rank the relative size of objects
	The client requires us to rank the relative time of events in the VR environment	The VR can to rank the relative time of events
	The client requires us to relate time and size in the VR environment	The VR can relate time and size
	Likes	**Dislikes**
	One could alter the size and time scales in order to find objects and events.	It won’t function properly if the size and time do not relate.
	Creative visual aids can be added.	Very important to identify human size and time constraints.
2. Molecules	The client requires us to describe internal movements in the VR environment	The VR can describe internal movements
	The client requires us to select a proper representation in the VR environment	A proper presentation will be selected

	The client requires us to identify all the requirements for a collision to occur in the VR environment.	All the requirements for a collision to occur will be identified
	Likes	**Dislikes**
	We can manipulate two molecules to find out how they would collide.	The molecules are in constant motion, they are not static.
	At least 2 good representations of the model would do.	The movement of molecules Is completely random.
		There is less purpose for the molecules to collide.
3. Proportions	The client requires us to estimate the amount and probability of a collision to occur	The VR is capable of estimating the amount and probability of a collision to occur
	The client requires us to Identify requirements for a successful collision in the VR environment	The VR is capable of Identifying requirements for a successful collision
	Likes	Dislikes
	The player can view the molecules in real time movements.	Students may misjudge the proportions of the molecules.
	Unsuccessful collisions can be predicted.	They also might not know how the molecules are actually moving.
4. Connection between molecular and macroscopic	The client requires us to explain the effect of molecular events to macroscopic observation in the VR environment	The effect of molecular events to macroscopic observation will be explained

	The client requires us to explain the effect of macroscopic events to molecular observations in the VR environment	The effect of macroscopic events to molecular observations will be explained
	The client requires us to connect and relate both molecular and microscopic in the VR environment	The VR can connect and relate both molecular and microscopic
	Likes	**Dislikes**
	The main plus point is that the event can be seen at molecular as well as macroscopic levels.	It is very necessary to relate molecular to macroscopic. Without this concept, the VR would not function properly.
		VR environment must be able to alter and connect the macroscopic level as well as the molecular level.
		This is quite important for the functioning of the VR environment.

After a long team discussion we decided to choose scenario 4 which is the connection between the molecular and microscopic. From the customer statement and the interpreted needs we came up with the problem statement.

Problem Statement: “A need to design a VR environment to help students learn chemistry in an easy, fun, and effective way along with dispelling common misconceptions”.

Taking into account who is the user:

User: Students learning organic chemistry who may or may not have previous experience with VR.

Benchmarking

We have chosen 3 game program companies and did a comparison between all 3 companies in terms of program specifications.

Game Program Specification	HoloLab Champions (VR)	The Chemist (not VR)	Google Tilt Brush
Company	Common Sense Media	tensixfour Creative	Google
Interactivity	Interactive	Very interactive, can walk around rooms	Very interactive, many things to do in 3D space
Usability	Highly Intuitive	Less Intuitive	Intuitive
Instructions	Lots of dialogue and instructions	Lots of dialogue to read	No instructions, learn by trying
Theme	Sci-fi and chemistry	Dark, sci-fi theme	Open background, can change as you like
Learning system	Score system, variety of questions	Instructions to complete missions to progress	No learning system
Robustness	Can fix mistakes	Can retry and fix mistakes	Very robust, can undo easily
Multimedia	Lots of pictures and music	Lots of music	Lots of music
Objects	Many moveable objects	Many moveable objects	Create and move your created objects
Aesthetics	Very pleasing to look at	Not very pleasing	Simple, aesthetic GUI
Plot	Different situations for questions	Has a story	No story

After making a comparison of all 3 companies in terms of program specifications, we then evaluate each spec of each company from a 1-3 scale based on the importance of each spec. Then we compare the final result of the 3 companies with our product.

Importance 1-5 High-3 Medium-2 Low-1

Game	Importance	HoloLab	The	Google Tilt	Our VR

Program Specification		Champions (VR)	Chemist (not VR)	Brush	Environment
Company		Common Sense Media	tensixfour Creative	Google	Group F-9
Interactivity	**5**	1	2	3	2
Usability	**4**	3	1	2	3
Instructions	**3**	3	2	1	3
Theme	**3**	3	3	2	3
Learning system	**4**	3	2	1	3
Robustness	**3**	2	2	3	2
Multimedia	**2**	3	2	2	3
Objects	**5**	2	2	3	3
Aesthetics	**4**	3	1	2	3
Plot	**2**	2	3	1	2
Total Score		**85**	**67**	**74**	**93**

From the previous table, it illustrates that by comparing all 3 companies together (excluding our VR environment), it results that Holo Champions has the highest score and the better VRenvironment. However, comparing Holo Champions with our VR environment, it results that our VR environment has better specs as well as the highest overall score compared to the 3 other companies.

Assumptions and special concentrations

A VR game that could be used as a study guide for university students studying organic chemistry and that can also be essential for dispelling common misconceptions. Clients are the instructors of the chemistry department who are willing to use our products for their students.

2 How the prototype is made

The prototype is made solely using the free commercially available unity 3D. Before starting our work on this challenging project we first had many group discussions on what scenario to select as well as how to proceed and how to distribute labour among ourselves in an efficient and powerful way. We made the program by buying and obtaining most of our models from the unity free store which was sufficient enough for most of our models and needs and did the job in an efficient and powerful way. As for the code used to execute the program we got our code from github as instructed from our instructor to do so along with doing some minor programming on our own to accomplish our goals.

Category

It's a focused prototype which tests very specific key elements of the VR environment needed for the user to learn chemistry in a fun, exciting and innovative way.

We decided to go with a focused prototype as we had our resources stretched thin due to covid 19 and could not afford to add everything that was planned but instead opted for a focused prototype so we could fulfill our requirements and teach the new generation in an appealing way

BOM

Bill of Materials				
#Item	**Item description**	**Quantity**	**Unit Price**	**Amount**
1	Fully Functional Modular Kitchen	1	$4.99	$4.99
2	Kitchen cooking FX	1	$25.00	$25.00
3	Moon base 20340	**1**	$4.99	$4.99
TOTAL				**$34.98 CAD**

Equipment used

Equipment used in our project just involves our laptops, the free version of unity available to all and the university provided VR head-set

Instructions

It is quite simple to use the prototype provided following instructions are followed:

1) Game is booted using a powerful Windows computer having at least 8GB of ram, a core i-7 processor and a gtx 1060 and all the while having 2GB of space to store the game itself. Of Course a VR headset is also required with a sufficient enough space in the room.

2) Game is booted by clicking its icon.
3) Once in game player is introduced to a menu screen
4) Player will be asked to select his scenario using the VR joysticks all the while being able to experience the scenario in all its might
5) Player will interact with the scenario somehow by pressing a button or just simply interacting with it and adding something
6) Player will observe an accurate approximation of the reaction
7) Quiz shall be taken and grades will be given
8) Option to redo scenario or move back to menu screen will be given

Quiz

To quiz the players of the game we employ a variety of different methods to first teach the player the content we are trying to teach this includes pointing out information also highlighting certain phenomenon which are likely to be asked

later in the finished prototype if we had the resources we would have a virtual tutor point out any necessary information while would have been asked later
As for the quiz itself it consists of multiple choice question which are relevant to the scenario experienced and feature a grade at the end with also an option to rety

3 How to use the prototype

Upon entering the VR program the user would be in an open environment where they can choose which learning environment they would like to teleport to. The user can select the kitchen environment or the outer space environment. Upon selecting either environment, the user will get teleported to that environment. Once in the kitchen, the user can choose to heat up water by putting it on the stove or cool it down by putting it in the fridge. In the kitchen the user can also add salt to water. In both scenarios, the user will make the change in the macro then zoom in to see what's going on in the micro. We initially tried to immerse the user in the liquid but it proved to be too difficult to do so the user now sees a large cube with the liquid in it and can observe the micro by looking in this cube. After interacting with the kitchen environment, the user can exit back to the home page then select the outer space environment. In this environment the user will have the same functionality as the kitchen but this time the user will see how elevation affects molecules.

4 How to maintain the prototype

To maintain the prototype the best course of action would be to regularly update as the unity software updates to make sure it runs on the latest version of unity without any problems.
Also as VR is constantly evolving we must update our game to make sure our VR game is also compatible with the latest VR hardware and gadgets as to make sure our game is always playable and able to teach the next generation

5 Conclusions and recommendations for future work

To conclude our prototype has been a success in which we have managed to create a VR environment capable of accurately displaying and teaching phenomenon in chemistry with the help of simulations also slight nudges from us the developers. We wished to further develop the project but due to covid-19 we were not able to develop the project as far as our ambitions.
As for future work we would like to add many more scenarios to the game itself and like to polish it a bit further to look more appealing to the eye along with creating a more robust form of taking quizzes.

6 Bibliography

1. M. Carle, "Designing a VR environment to teach chemistry, GNG1103-F01, Ottawa, 2020.