PAIN TERMINATOR

Design Document

ABSTRACT

Pain Terminator is a game in Virtual Reality that explains the mechanism of action of painkillers (specifically nonsteroidal anti-inflammatory drugs (NSAIDs)) inside the human body. The game is set up as a museum installation for children. The interaction starts with a physical display which explains the concept of the game followed by a VR experience which has the rules and the gameplay. The player acts as the painkiller. The objective of the game is to go through the bloodstream and block the enzyme openings to relieve pain. The purpose of making the game was to educate children and initiate discussion around the human body from an early age so that they are more thoughtful about their medicine intake in the future. This design document details the entire process behind making the game and playtesting it with children and other audience.

KEYWORDS

Virtual reality; game; medicine; human body; disease; painkiller; NSAIDs; museum installation; pharmaceuticals; children; education; learning

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Parsons School of Design

PAIN TERMINATOR

Fall 2018 Final Project

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THE PROJECT

DESIGN STATEMENT

Inspired by my research in the field of VR and medicine and my background in the pharmaceutical sector, I want to create a game using virtual reality to explain the mechanism of action of painkillers. A VR game would make the experience immersive and would allow the players to understand the concept of painkiller action by being inside the body and acting as the medicine. I plan to create the game for children and set it up in a museum so that the technology is accessible to everyone. I believe that initiating discussion around the human body from an early age would enable children to be more inquisitive about their medicine intake in the future.

OBJECTIVE

Through this project, I want to spread awareness on the mechanism of action of painkillers. My research[1] on the use of VR, medicine, and education made me realize that not much has been done to educate the consumers of medicine about its mechanism of action. Most of the work in Virtual Reality and education has been done for the physicians to teach them how to conduct surgeries[2].

This project is a starting point of that awareness because I want consumers to know about the medicine they are consuming.

[1] Primary Research:
Akl, Elie A., Sameer Gunukula, Reem Mustafa, Mark C. Wilson, Andrew Symons, Amir Moheet, and Holger J. Schünemann. 2010. "Support for and Aspects of use of Educational Games in Family Medicine and Internal Medicine Residency Programs in the US: A Survey." BMC Medical Education 10: 26. doi://dx.doi.org.libproxy.newschool.edu/10.1186/1472-6920-10-26. https://login.libproxy.newschool.edu/login?url=https://search-proquest-com.libproxy.newschool.edu/docview/1585895390?accountid=12261.
BALAN, Oana1, oana.balan@cs.pub.ro, Rares-Mihai1 TAEREL raresmihai.taerel@gmail.com, Mircea1 NEDELCU mirceavalentin.nedelcu@gmail.com, Alin1 MOLDOVEANU alin.moldoveanu@cs.pub.ro, Victor1 ASAVEI victor.asavei@cs.pub.ro, Anca1 MORAR anca.morar@cs.pub.ro, and Maria-Iuliana1 DASCALU maria.dascalu@upb.ro. 2018. "Design and Development of a Serious Game for Treating Acrophobia." eLearning & Software for Education 2: 182-186. doi:10.12753/2066-026X-18-095. https://login.libproxy.newschool.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=129458658&site=ehost-live&scope=site.
Pitt, Michael B. 1., Emily Borman-Shoap, and Walter J. 2. Eppich 3. 2015. "Twelve Tips for Maximizing the Effectiveness of Game-Based Learning." Medical Teacher 37 (11): 1013-1017. doi:10.3109/0142159X.2015.1020289. https://login.libproxy.newschool.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=110861161&site=ehost-live&scope=site.
Suleman, Fatima1. 2016. "Conceptualisation and Development of Medicines Research and Development Game for Pharmacy Students." Proceedings of the European Conference on Games Based Learning 1: 651-657. https://login.libproxy.newschool.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=118263402&site=ehost-live&scope=site.

[2] Primary Research:
Izard, Santiago González, Juan A. Juanes, Francisco García Peñalvo J., Estella, Jesús M. ª Gonçalvez, Mª J. Ledesma, and Pablo Ruisoto. 2018. "Virtual Reality as an Educational and Training Tool for Medicine." Journal of Medical Systems 42 (3): 50. doi:10.1007/s10916-018-0900-2. https://login.libproxy.newschool.edu/login?url=https://search-ebscohost-com.libproxy.newschool.edu/login.aspx?direct=true&db=mnh&AN=29392522&site=ehost-live&scope=site.

CONCEPT

Pain Terminator is a game in Virtual Reality which explains the mechanism of action of painkillers inside the body. Particularly, the game explains how Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)[3] work inside the body. During the gameplay, the player acts as medicine and flows inside the blood to treat pain. The objective of the game is to block the enzyme openings to prevent the pain signals from reaching the brain.

Scientifically, our body feels pain because our brain receives pain signals through a network of neurons. These pain signals are natural chemicals called prostaglandins, which are generated when our body is hit. So, whenever there is an impact, our skin cell layer (epidermis) releases fatty acids, which go inside the enzyme openings to generate chemicals called prostaglandins.

When we consume painkillers like ibuprofen, they go inside the blood and block the enzyme openings so that fatty acids cannot go inside them to generate prostaglandins. This prevents the pain signals from reaching the brain and hence reduces the pain sensation.

Pain Terminator replicates this concept by making the medicine go inside the enzyme openings. These enzyme openings are represented using rings through which the medicine must pass through. The idea is that as the medicine goes through the ring, it is effectively going inside the enzyme to block its opening. The more number of rings the medicine passes through, the more pain areas it cures.

REASON

From my research[4], I found that painkillers (NSAIDs) primarily work on blocking the enzyme openings on the skin epidermal layer to prevent

[3] My project would give an experience on the working of NSAIDs (Non-Steroidal Anti-Inflammatory Drugs). Any other type of pain killers is out of the scope of this project.

[4] Tertiary Research:

Ramsey, Lydia. "Here's how common pain relievers actually work in your body and brain." Business Insider. October 4, 2016. https://www.businessinsider.com/how-pain-relievers-tylenol-ibuprofen-work-2016-10.

Soniak, Matt. "How Do Painkillers Find & Kill Pain?" Mental Floss. May 10, 2008. http://mentalfloss.com/article/18615/how-do-painkillers-find-kill-pain.

Gavin, Mary L. "How Do Pain Relievers Work?" KidsHealth. June 2014. https://kidshealth.org/en/kids/ibupro.html.

Lambert, Katie. "How CIPA Works." HowStuffWorks.com. September 21, 2007. https://science.howstuffworks.com/life/inside-the-mind/human-brain/cipa.htm.

"How Does Medicine Know Where You Hurt?" Wonderpolis. Accessed August 2018. https://www.wonderopolis.org/wonder/how-does-medicine-know-where-you-hurt.

"How do painkillers work?" Science Museum. Accessed August 2018. http://whoami.sciencemuseum.org.uk/whoami/findoutmore/yourbrain/howdodrugsaffectyourbrain/howdopainkillerswork.

Day, Ric, and Graham Garry, "Curious Kids: How does pain medicine work in the body?" The Conversation US, Inc. February 13, 2018. https://theconversation.com/curious-kids-how-does-pain-medicine-work-in-the-body-82495.

TED-Ed. "How does your body process medicine? - Céline Valéry". Filmed [May 15, 2017]. YouTube video, 4:12. Posted [May 15, 2017]. https://youtu.be/uOcpsXMJcJk.

TED-Ed. "How Do Pain Relievers Work? - George Zaidan". Filmed [June 26, 2012]. YouTube video, 4:13. Posted [June 26, 2012]. https://youtu.be/9mcuIc5O-DE.

Bayer Global. "How Aspirin Works". Filmed [November 26, 2015]. YouTube video, 2:29. Posted [November 26, 2015]. https://youtu.be/ZwDZEOtAB-Q.

prostaglandins from forming. Hence, our brain does not receive the pain signals from the target region, and our pain sensations are reduced. So, in a way, painkillers relieve pain by blocking the feeling of pain (not actually killing pain)[5].

This was an exciting realization for me, and I wanted to share it with children to educate them from the early years of their lives.

INTERACTION

The game's interaction is divided into two parts: physical and digital.

The physical part is the first level of interaction with the game. It is a display which introduces the purpose of the game and what the player is supposed to do. The display includes a cutout of a lady in pain, a picture of the VR headset and the cutouts of the skin layer and enzyme openings which the player must go through to treat pain.

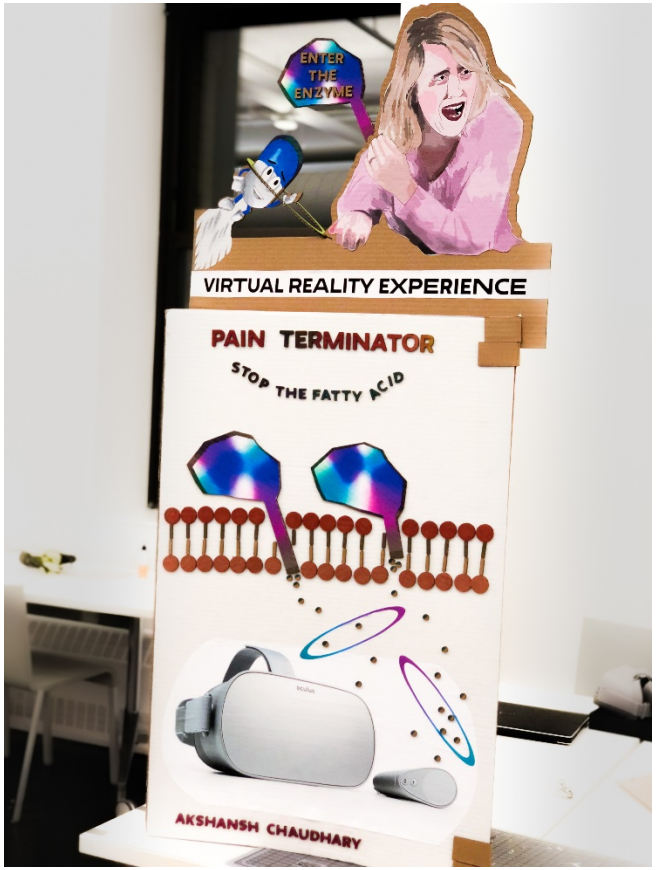

Figure 1: Physical interface of the game

TEDx Talks. "TEDxAdelaide - Lorimer Moseley - Why Things Hurt". Filmed [November 21, 2011]. YouTube video, 14:32. Posted [November 21, 2011]. https://youtu.be/gwd-wLdIHjs.

University of South Australia. "Pain. Is it all just in your mind? Professor Lorimer Moseley - University of South Australia". Filmed [May 9, 2011]. YouTube video, 48:52. Posted [May 9, 2011]. https://youtu.be/-3NmTE-fJSo.

PKB Productions. "How painkillers work. The clearest explanation ever!". Filmed [July 26, 2017]. YouTube video, 2:06. Posted [July 26, 2017]. https://youtu.be/QjsralCEyUc.

National Geographic. "This Is What Happens to Your Brain on Opioids | Short Film Showcase". Filmed [November 23, 2017]. YouTube video, 4:37. Posted [November 23, 2017]. https://youtu.be/NDVV_M__CSI.

[5] Although pain killers do not directly act on pain, they work on other aspects of pain reduction like inflammation.

The digital interaction begins as the player puts on the VR headset. Inside VR, the player is presented with a startup screen telling them that they are the medicine and they must go through the enzyme openings to reduce pain. Below the startup screen, there is a bloodstream with red blood cells (RBCs) flowing towards the player. The skin layer with enzymes is present on either side of the bloodstream.

The interaction in the game takes place through the player's head movement and through inputs from the VR controller. The VR controller starts and restarts the game, and the head movement navigates the medicine in the direction of head movement.

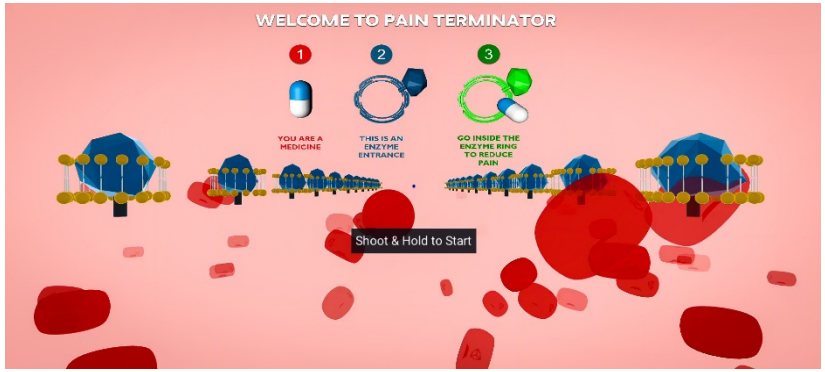

Figure 2: Pain Terminator Startup UI

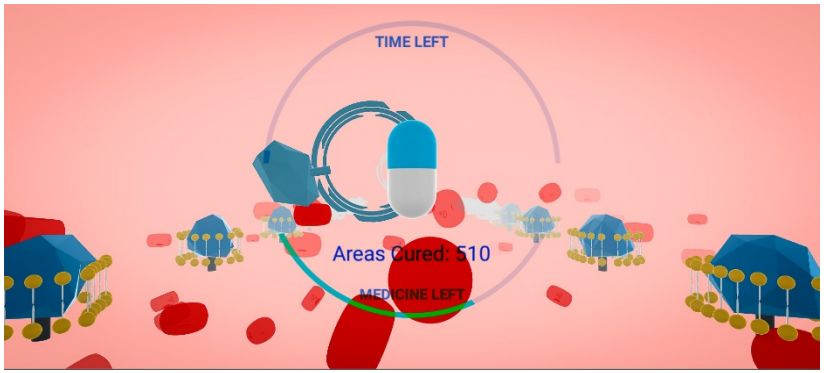

Figure 3: Pain Terminator Gameplay

SETUP

Figure 4: Setup for museum installation

Presently, due to the high setup cost for VR headsets, it is not accessible to everyone. So, to make the players access this technology, I have set up the game to be played in a museum. The setup would include 3 parts: the physical display, the VR headset, and a monitor connected to the VR headset[6] to show the gameplay in real time.

AUDIENCE

The target audience for my project is children because they are early adopters of technology. Moreover, they are curious to know more about the things around them. I believe that directing their curiosity toward medicine and education would enable them to question their choice of medicine intake as they grow up and consume medicines.

Also, during my playtesting, I found that parents are interested in using media like games and platforms like VR to impart education to their kids.

MEDIUM

I have selected game as a medium to communicate my message because, for children, games offer an increased engagement in comparison to media like blogs, articles, and research papers[7]. And, the interactivity that is provided by a game has better retention and recall.

To enhance engagement, I have selected virtual reality as my platform because VR gives an immersive experience, more than the traditional forms of game formats like web and mobile[8].

TOOLS

Physical

I have used laser cutting on the cardboard to make physical cutouts of the poster.

Digital

I have used Unity 3D environment for the development of the game[9].

[6] "Oculus Go Unity Developer Guide." Facebook Technologies LLC. Accessed October 2018. https://developer.oculus.com/documentation/unity/latest/concepts/book-unity-dg/.

[7] Rice, Nathan C., Ashu Guru, Caprianna N. Keeler, Deepak R. Keshwani, and Jennifer Keshwani. 2018. "Comparison of Game-Based Learning and Traditional Lecture Approaches to Improve Student Engagement and Knowledge Transfer in STEM Education." Proceedings of the ASEE Annual Conference & Exposition: 1-14. https://login.libproxy.newschool.edu/login?url=https://search-ebscohost-com.libproxy.newschool.edu/login.aspx?direct=true&db=a9h&AN=131758322&site=ehost-live&scope=site.

[8] Chen, Yuping, HsinChen D. Fanchiang, and Ayanna Howard. 2018. "Effectiveness of Virtual Reality in Children with Cerebral Palsy: A Systematic Review and Meta-Analysis of Randomized Controlled Trials." Physical Therapy 98 (1): 63-77. doi:10.1093/ptj/pzx107. https://login.libproxy.newschool.edu/login?url=https://search-ebscohost-com.libproxy.newschool.edu/login.aspx?direct=true&db=a9h&AN=126959807&site=ehost-live&scope=site.

[9] VR Sample Asset from the Asset Store by Unity Technologies was my primary reference for the digital interaction. "VR Samples Unity Asset Store." Unity Technologies. Accessed November 17, 2018. https://assetstore.unity.com/packages/essentials/tutorial-projects/vr-samples-51519.

I have used Cinema4D[10] to prepare the 3D models and Adobe After[11] Effects to create animations for the documentation. I also used Adobe Photoshop and Illustrator during that process.

FINAL VERSION

Following are video and photo mosaic of the final version of the game, including the process, prototyping, and playtesting.

Figure 5: Pain Terminator Movie

Online link: http://bit.ly/Pain_Terminator_Movie

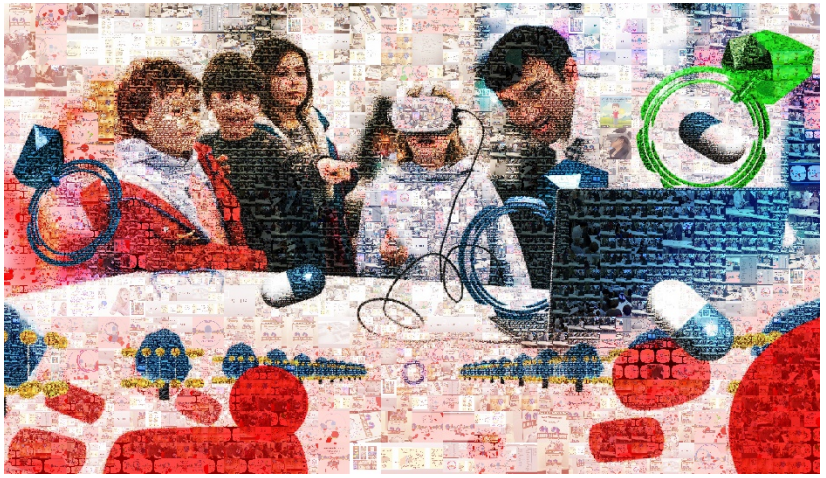

Figure 6: Photo mosaic of the entire process

[10] "Cinema 4D." MAXON Computer. Accessed October 2018. https://www.maxon.net/en/products/cinema-4d/overview/.

[11] "Adobe Creative Cloud." Adobe. Accessed July 2018. https://www.adobe.com/creativecloud.html?promoid=NGWGRLB2&mv=other.

PROCESS

The process was divided into two parts. First, I did research to understand the mechanism of action of painkillers and created a digital prototype to understand the concept of the mechanism of action. Then, I did brainstorming to plan the best form of interaction for this project and finalized with a two-part interaction: physical and digital.

PART 1: RESEARCHING THE MECHANISM OF ACTION

STORYBOARD

For the first part of my project, I prepared a two-dimensional digital interaction using Processing[12] to show the mechanism of action of painkillers. The process started with narrowing down the scope of the study – from essential interaction with medicine to the functioning of painkillers, and finally to the mechanism of action of Nonsteroidal anti-inflammatory drugs (NSAIDs).

Figure 7: Storyboard for the first prototype

FIRST PROTOTYPE

After researching the entire process, I created its digital version to create a visual understanding[13].

[12] Fry, Ben and Casey Reas. "Processing.", Processing Foundation. Accessed July 2018. https://processing.org/.

[13] The first prototype was a part of my Bootcamp Final Project at MFADT, Parsons School of Design.

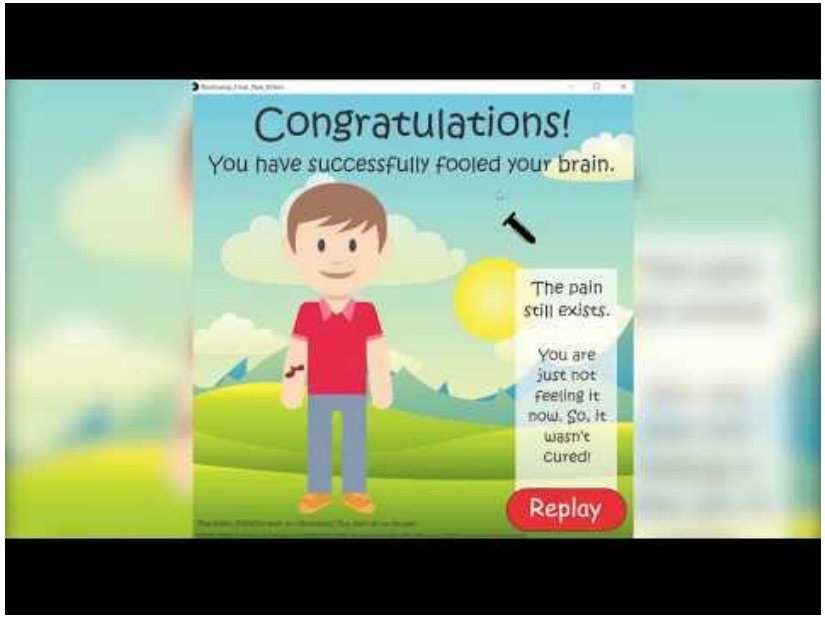

Figure 8: First prototype: Digital interaction

As represented through the digital interaction[14], when the body is physically hit, the skin layer called epidermis releases fatty acids. For simplicity, I have represented them through green squares.

Figure 9: First prototype: Start screen

[14] The images used in the prototype were taken from freepik.com which were then customized to match the project requirement.

"Freepik.com." Harryarts. Accessed August 2018. https://www.freepik.com/.

Figure 10: First prototype: Start screen on hover

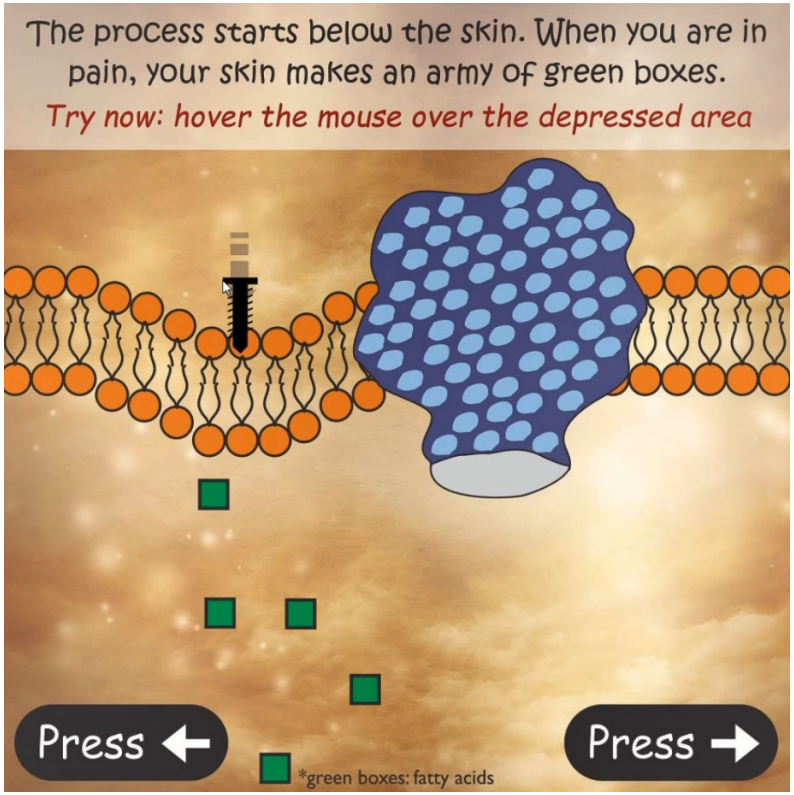

Figure 11: First prototype: Fatty acid release when the body is hit

Next, these fatty acids go inside the enzyme opening to release chemicals called Prostaglandins. I have represented Prostaglandins with yellow triangles.

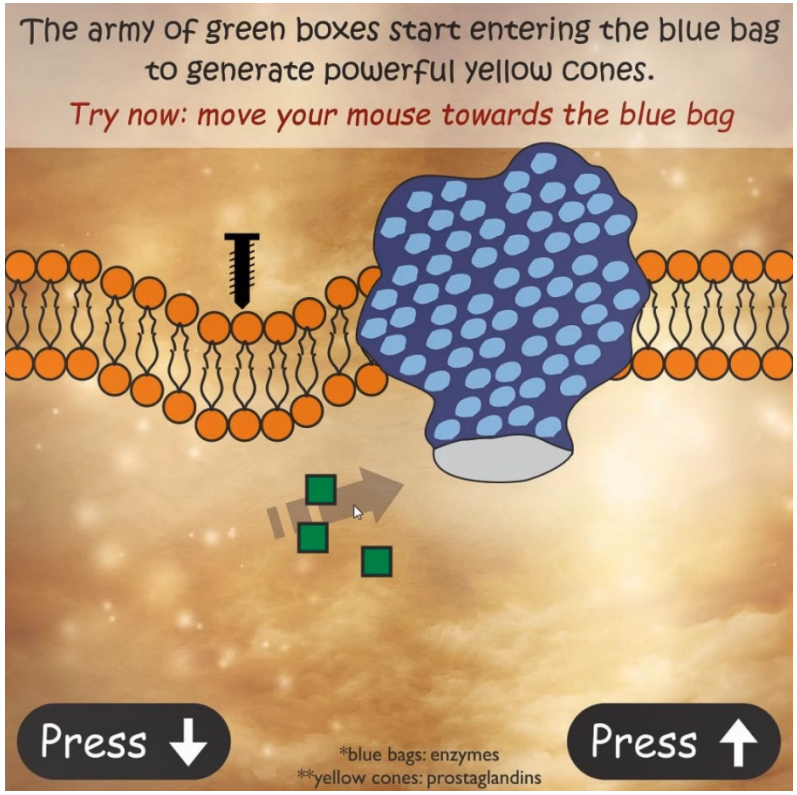

Figure 12: First prototype: Fatty acids going inside enzymes

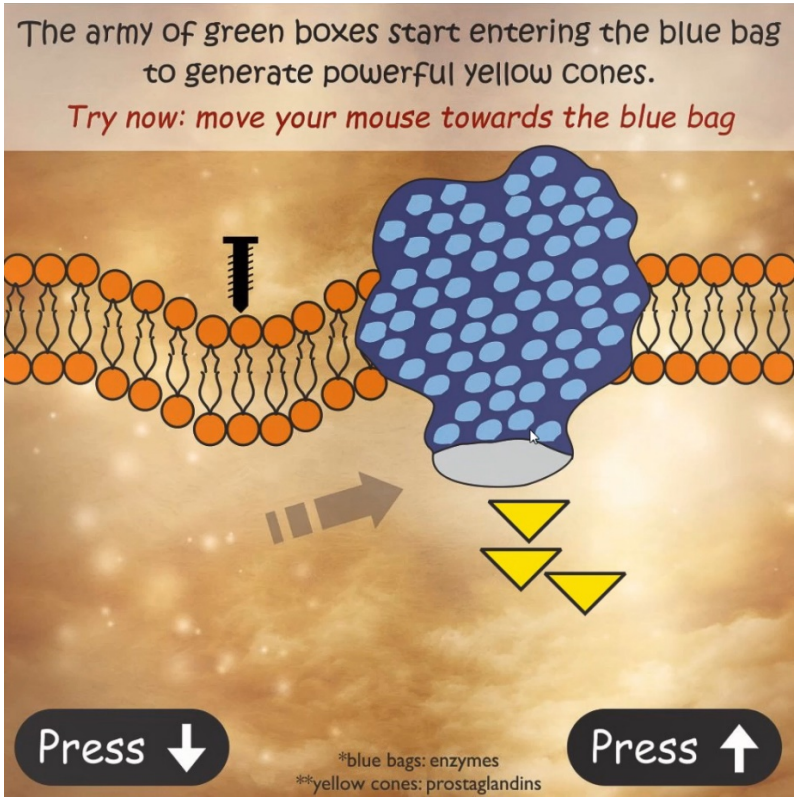

Figure 13: First prototype: Prostaglandin released from enzymes

These prostaglandins are then detected by the neurons to reach the brain. Once the pain message reaches the brain, the person starts feeling pain. This entire process takes place in a fraction of a second. So, it's almost instantaneous.

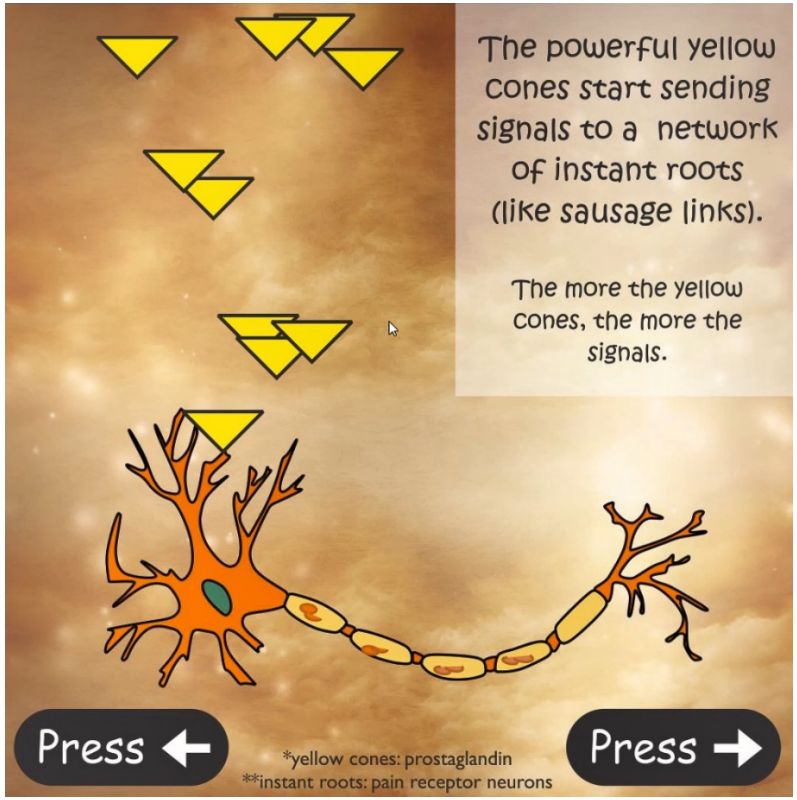

Figure 14: First prototype: Prostaglandins travel through neurons

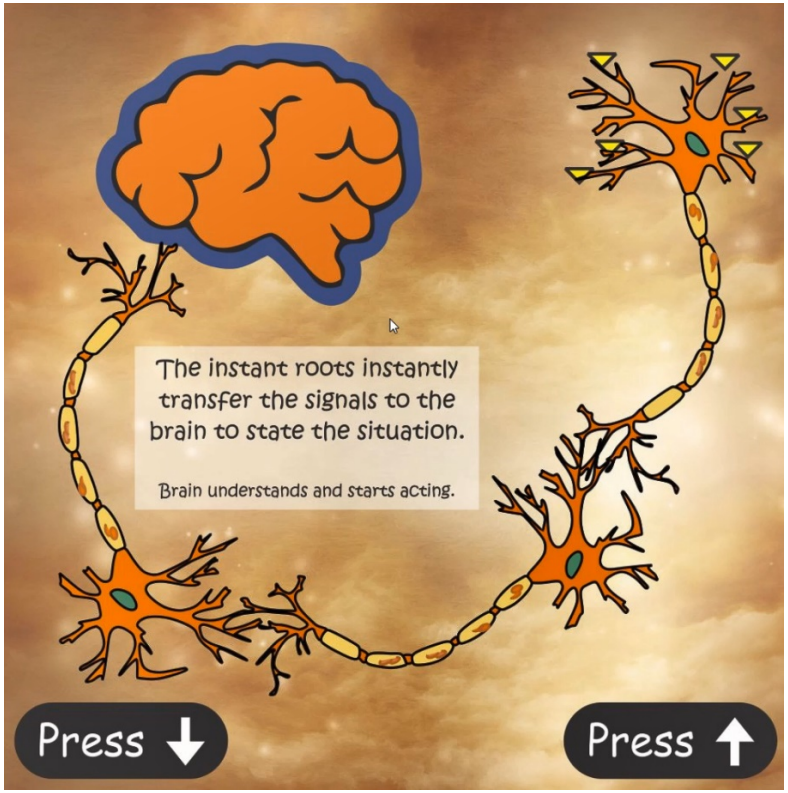

Figure 15: First prototype: Brain receiving pain messages

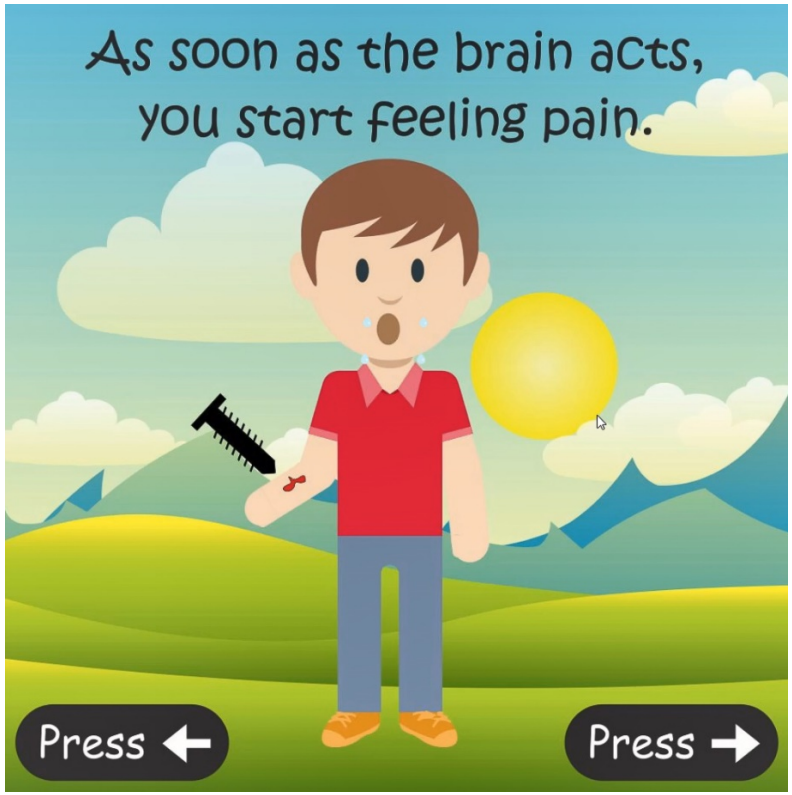

Figure 16: First prototype: Body feeling pain

Figure 17: First prototype: Consuming painkiller orally

Now, when we take medicine[15], it circulates through the body to find the target regions of pain[16]. When it reaches the target site, it blocks the enzyme opening. This prevents the fatty acids from going inside the enzyme to release the prostaglandin chemicals.

[15] I have shown oral intake of the medicine. Usually ibuprofen is consumed orally. But, intake through injections is also possible.

[16] Since the medicine circulates through blood, the pain killing action takes place in any area that has pain. For instance, if we took the pain killer for shoulder pain, we may also have reduced pain in our head if we had a headache.

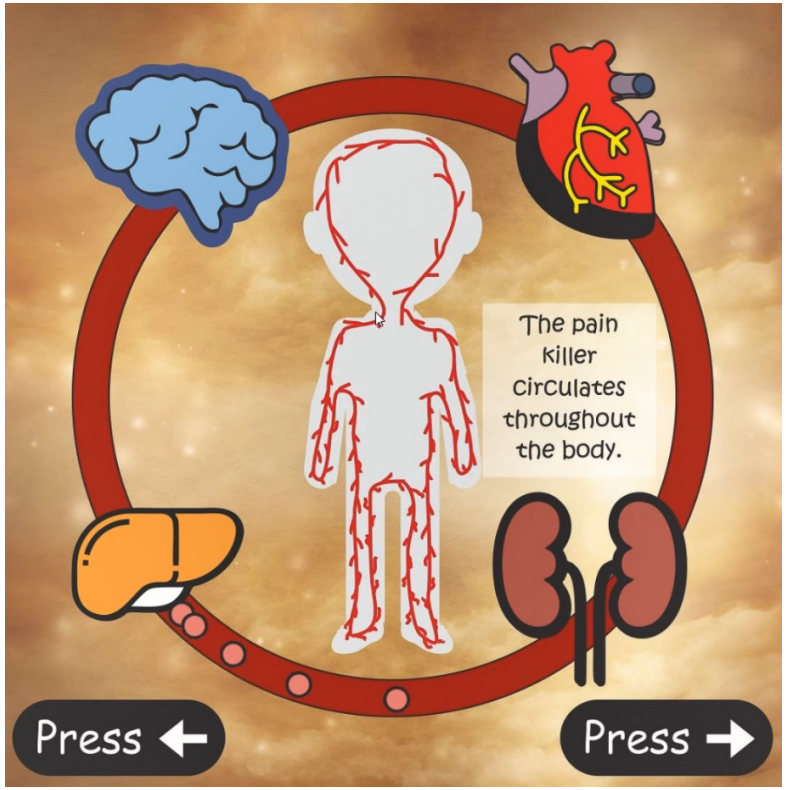

Figure 18: First prototype: Painkiller circulating through blood

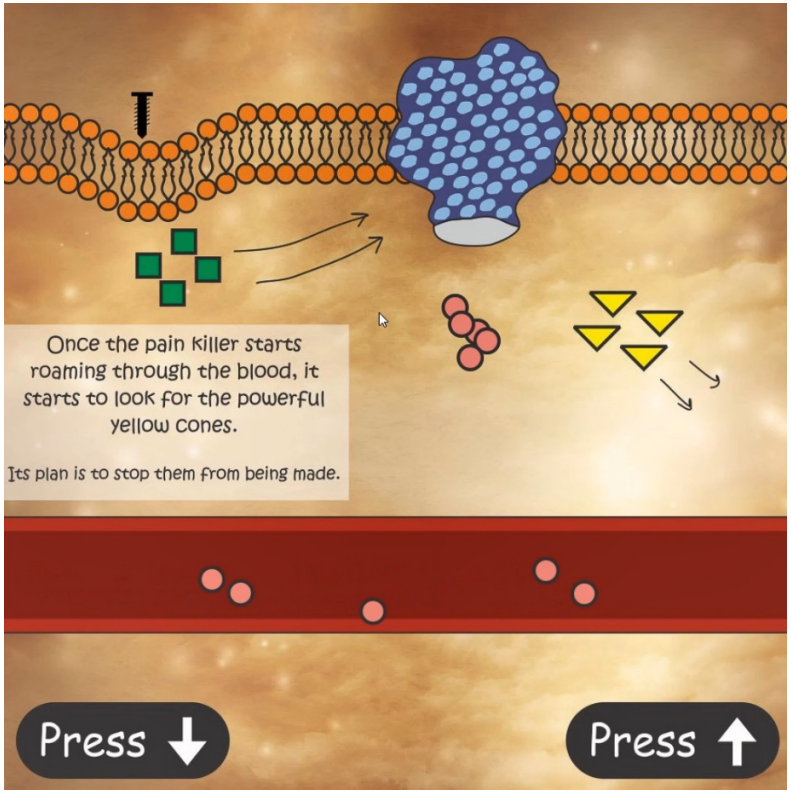

Figure 19: First prototype: Painkiller reaching the active site

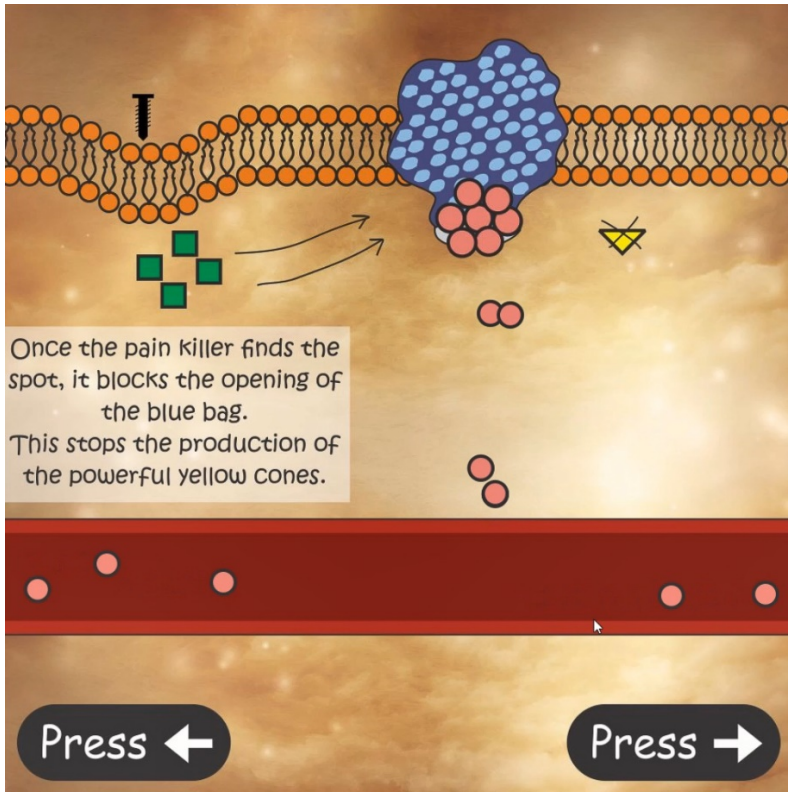

Figure 20: First prototype: Painkiller blocking the enzyme

As the enzyme openings start getting blocked, fewer prostaglandins get released. Hence, fewer prostaglandins are detected by the neurons. So, the intensity of pain messages received by the brain reduces. Once that happens, the body starts feeling better.

Note that the pain might still be there, but the sensation of pain has been reduced. So, in a way, the painkillers are not killing the pain. They are removing the feeling of it[17].

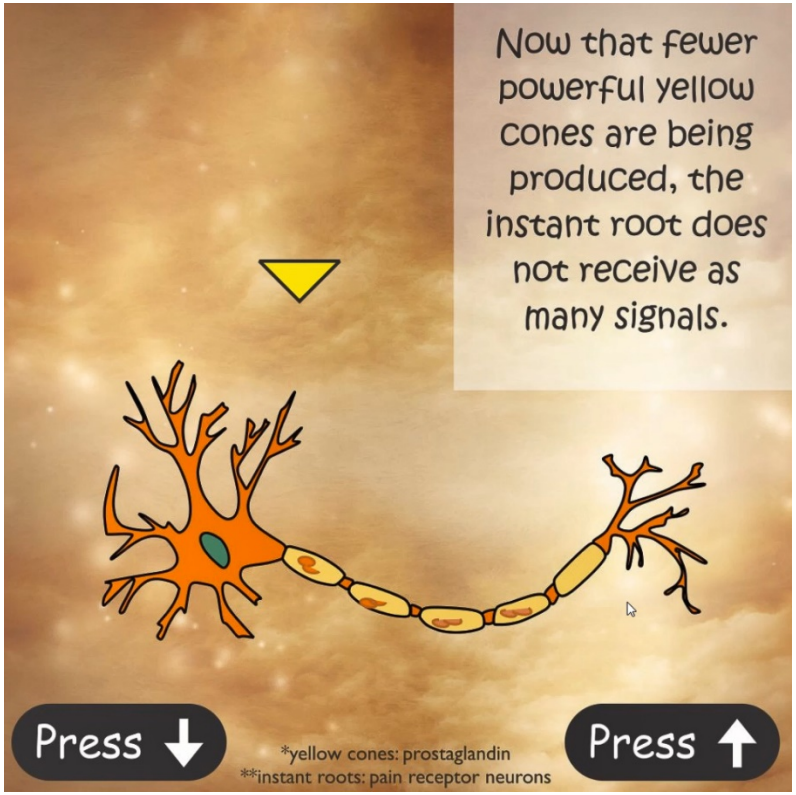

Figure 21: First prototype: Fewer prostaglandins traveling

[17] Pain killers work on other aspects of pain like inflammation. So, to state that they don't work entirely would be incorrect.

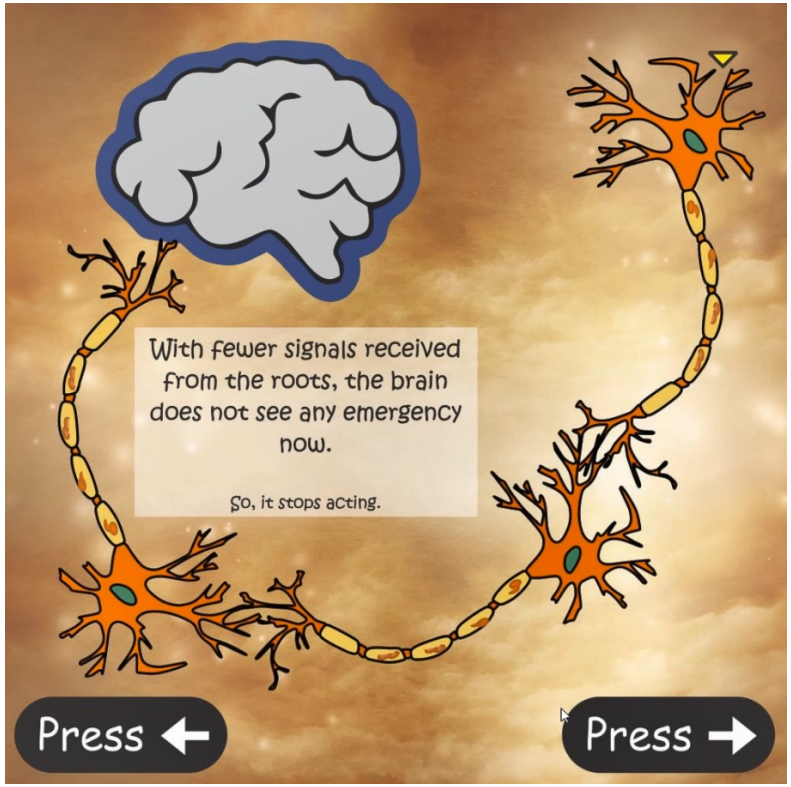

Figure 22: First prototype: Brain receiving fewer pain signals

Figure 23: First prototype: End screen

PART 2: RESEARCHING THE INTERACTION

STORYBOARD

Since VR is an expensive technology, I decided to set up the interaction for a museum to avoid the issue of accessibility. Setting it up for a museum meant that I had to think about the physical look and feel in addition to the digital interaction. So, I created a storyboard of how the entire game experience would take place.

In my storyboard, I planned that the player would begin the interaction by looking at the physical model to understand the basics of the game and then put on the VR headset to initiate the digital interaction. Inside VR, the player would be inside the bloodstream and would look for the regions of pain. Once they do, they would shoot medicines on the target spot to block the enzyme area and hence cure the pain.

The gameplay would begin in the physical environment in which the player would be shown a visual of a person who is hit by a needle and is in pain.

Figure 24: Second prototype storyboard: Physical display

To help this person in pain, the player would wear a VR headset to go inside the person's body and act as a medicine.

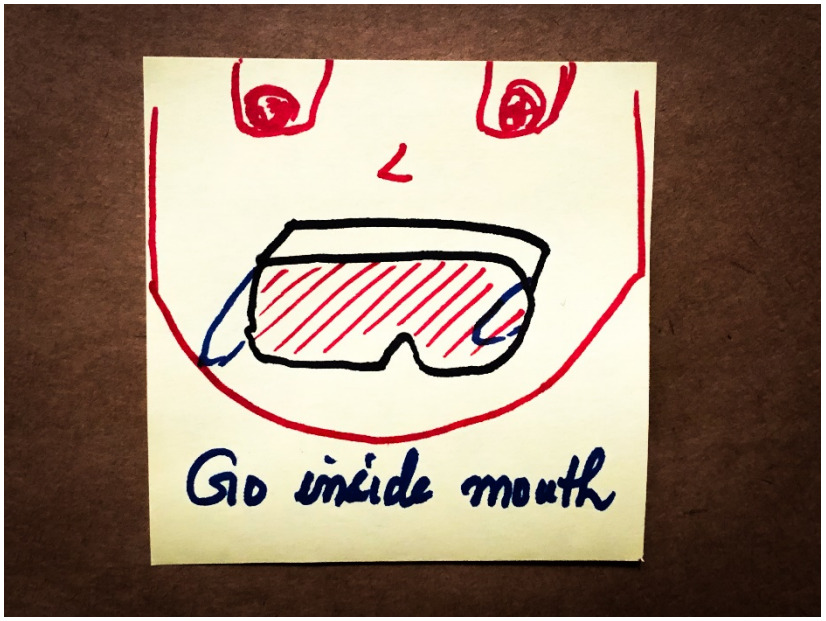

Figure 25: Second prototype storyboard: VR headset

Once inside the VR space, the digital environment would begin. The player would be greeted with a heads-up display telling them that they are a medicine (pill) and flowing with the bloodstream. They would have two controls: Ammunition and Pain Level. Ammunition would be the amount of medicine they have, and the pain level would be the pain of the person they are trying to cure.

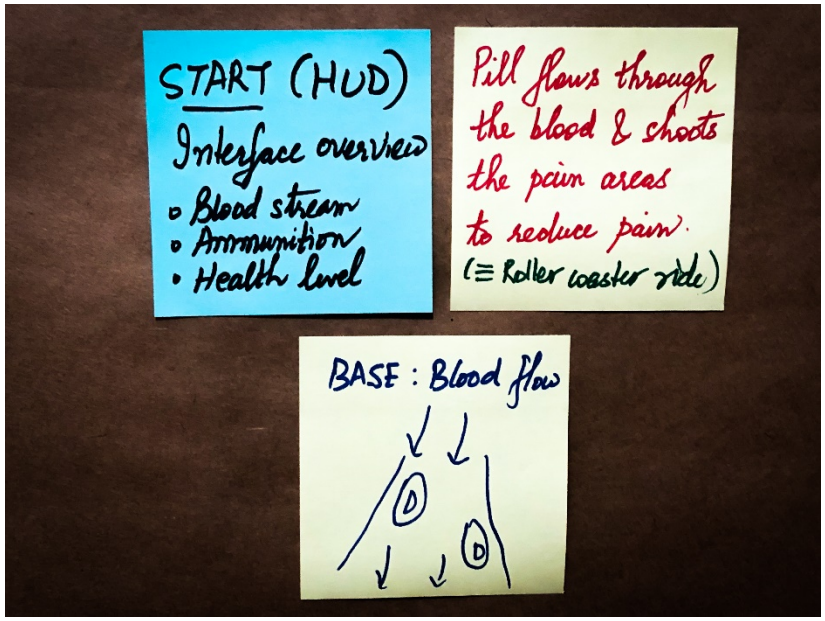

Figure 26: Second prototype storyboard: Start interface

On either side, they would see the skin epidermal layer. The sites (locations on the skin) that were hit by a needle would be shown to emit fatty acids (squares) which would continuously go inside the enzyme (blob) to generate prostaglandins (cones).

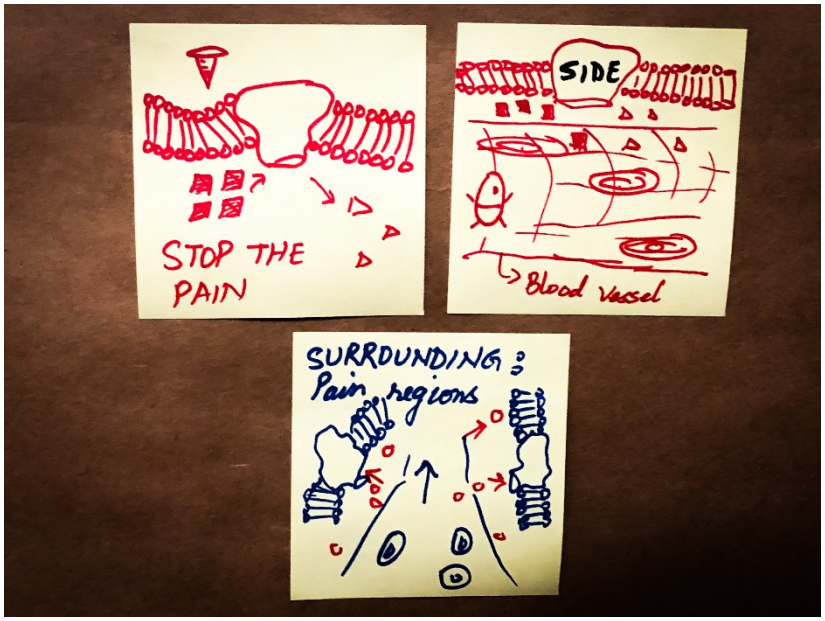

Figure 27: Second prototype storyboard: Gameplay

Now, the game would begin. The player would be allowed to shoot the medicine (circles) in any direction. As they shoot, their ammo in the meter would go down. The objective of the game would be to aim at the enzyme (blob) area and block it completely so that the prostaglandins (cones) are not released. Not all enzymes (blob) regions would be active. So, the players would have to be careful while shooting to avoid exhausting their ammo (medicine).

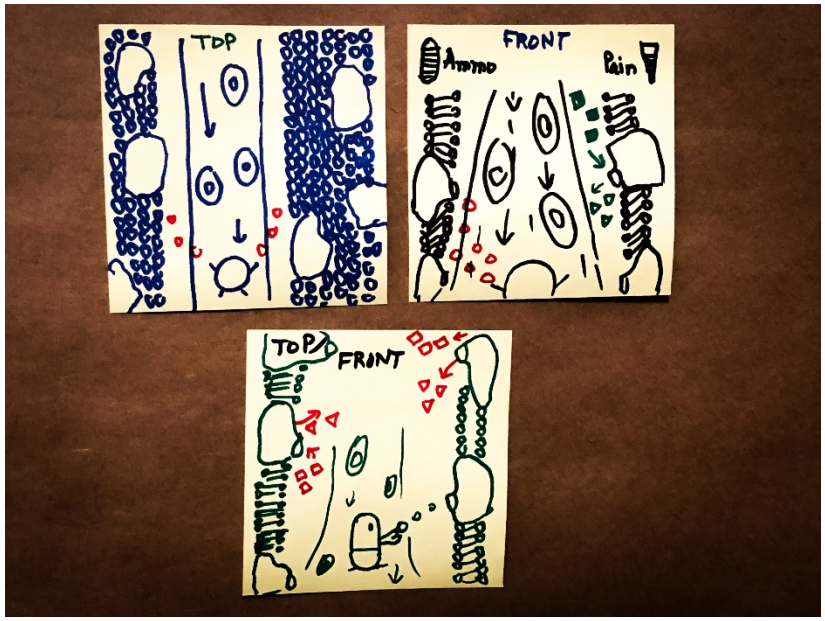

Figure 28: Second prototype storyboard: Gameplay actions

The key part of the game would be to identify the target site for the pain and block all the enzymes (blobs). Once the player blocks those regions, the prostaglandins (cones) which were going to the brain would no longer be able to deliver pain message, and the pain level would gradually go down. This would cure the person.

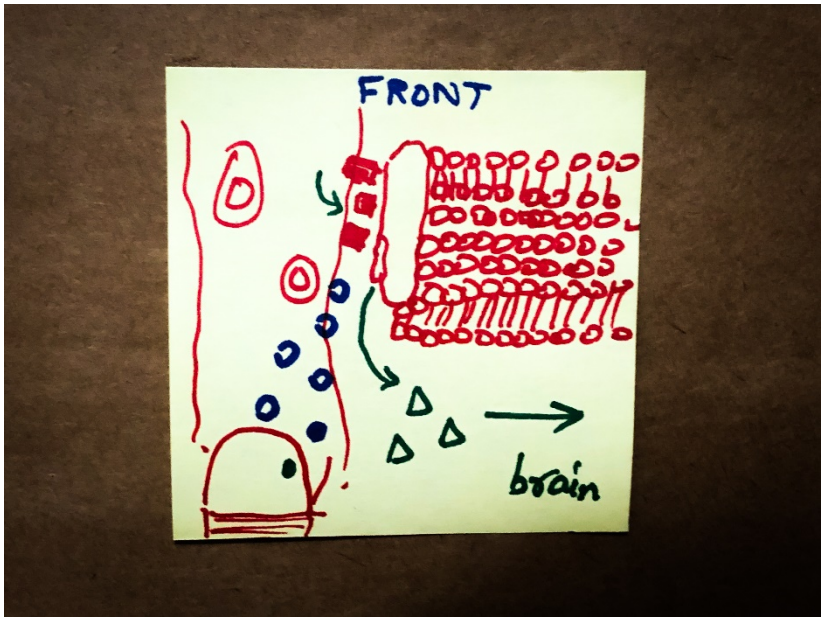

Figure 29: Second prototype storyboard: Detailing

The game would end in one of the two scenarios:

1. Win: The player brings the pain level on the pain meter to zero by blocking all the enzymes (blobs)
2. Lose: The player runs out of ammunition (medicine)

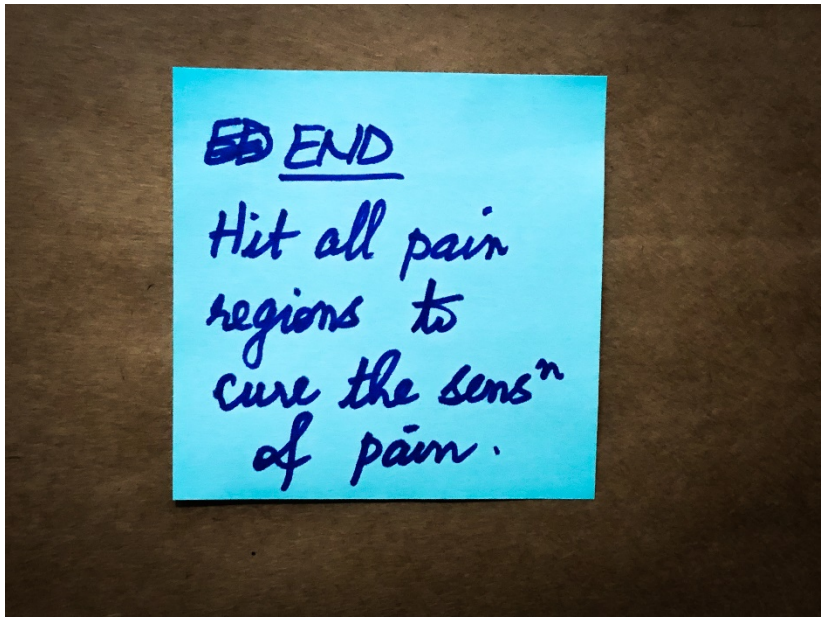

Figure 30: Second prototype storyboard: Ending

The player could then restart the game to try again or quit the game to end the experience.

SECOND PROTOTYPE

To start building my prototype, I researched how museum interactions should take place. To do that, I went to The New York Hall of Science Museum in Queens, New York[18]. It was an excellent reference for inspiration because children were a primary audience in that museum, and most of them were accompanied by their parents. I imagined a similar setup for my interaction.

[18] Secondary Research: "New York Hall of Science, Queens, New York." New York Hall of Science. Accessed November 25, 2018. https://nysci.org/.

Figure 31: The New York Hall of Science Museum, Queens, NY

Next, I sketched the main image for the physical interaction showing a lady in pain and medicine going inside her body to cure the pain.

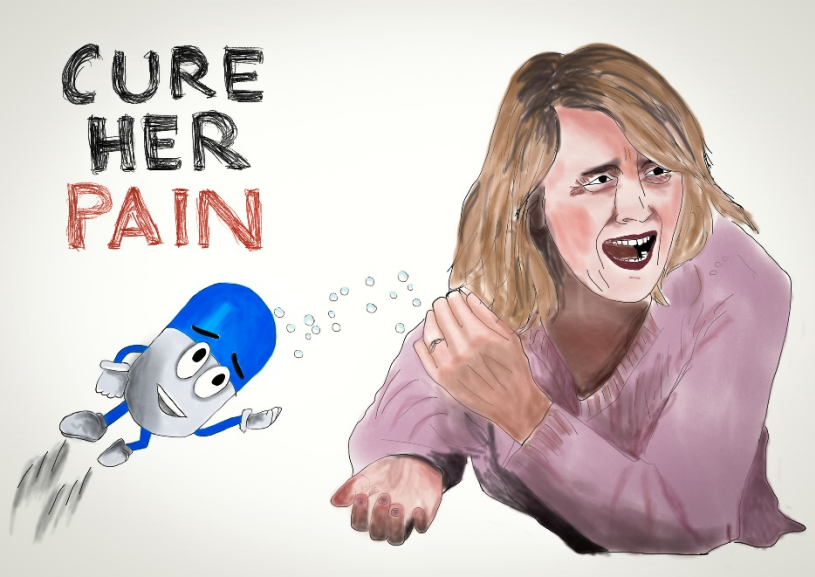

Figure 32: Illustration for the physical display

Then, I created the first prototype in VR for the interaction[19]. The view displayed a medicine flowing through the blood such that the red blood cells (RBCs) are coming towards the player. On either side of the interface were enzymes and skin cells. The player could shoot medicines on the screen. The functionality to block the enzyme regions was not yet ready.

Additionally, I connected the VR headset to the screen[20] to watch the gameplay outside VR in real time.

I tested this prototype with my friends in class[21] and received feedback that the interaction was not apparent, and the game interface looked more educational than fun.

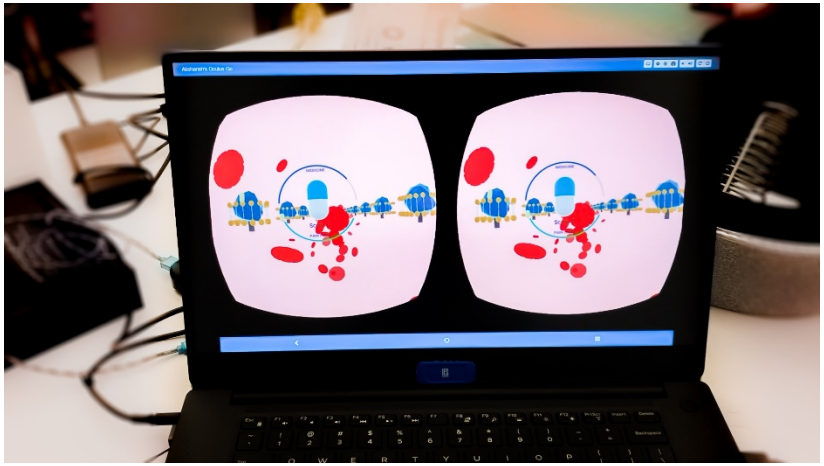

Figure 33: Second prototype: Digital interface

[19] This was the second prototype after the 2D digital interaction. I used Unity 3D to create the prototype and Cinema4D to prepare the 3D models for the prototype.

[20] I used Vysor Pro to connect VR headset to the screen.

"Vysor." ClockworkMod. Accessed October 2018. https://www.vysor.io/.

[21] I made this project during my first year at MFA Design + Technology, at Parsons School of Design. My classmates were first year MFADT students.

Figure 34: Second prototype: Playtesting

Figure 35: Third prototype: Physical display laser cutting

THIRD PROTOTYPE

After testing the second prototype, I updated the physical and digital interactions. For the physical part, I laser cut the poster cutout and pasted the images to prepare a physical model.

Figure 36: Third prototype: Physical display laser cutting

To add more engagement, I changed the digital interaction from shooting on the enzyme openings to going inside the enzyme openings. I displayed that through rings flowing through the blood. So now, instead of shooting medicine on the side, the player was supposed to flow through the blood and go inside the rings. The rings represented the enzyme openings. So, with the player being the medicine going inside the circles, the pain level reduced in the game.

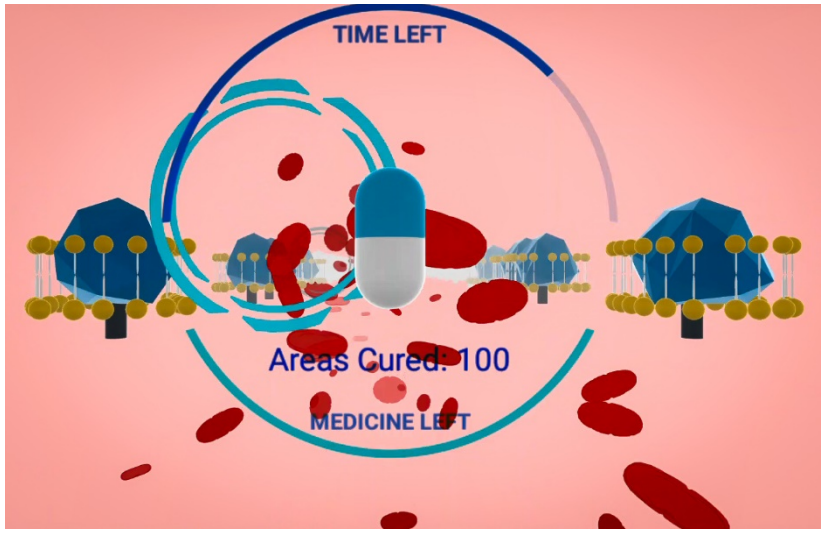

Figure 37: Third prototype: Digital interface

Figure 38: Third prototype: Playtesting at Playtech

Figure 39: Third prototype: Playtesting at Playtech

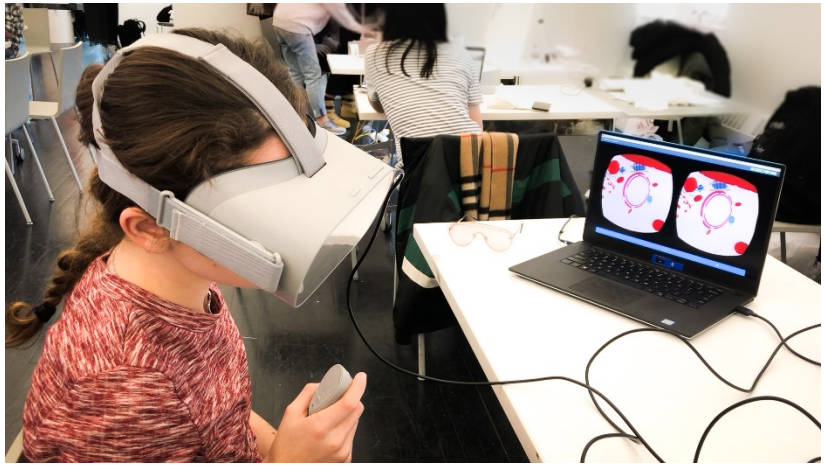

Figure 40: Third prototype: Playtesting at Playtech

Figure 41: Third prototype: Playtesting at Playtech

Figure 42: Third prototype: Playtesting at Playtech

Figure 43: Third prototype: Playtesting at Playtech

I tested this prototype during Playtech at Parsons School of Design. In this event, children and parents of the faculty and others were invited to test the prototypes and games of the students.

I received an overwhelming response from the children, who were excited to play the game multiple times and share their feedback. Parents also appreciated the concept of integrating medicine and games to create an educational experience for the kids.

Figure 44: Third prototype: Playtesting player response

Figure 45: Third prototype: Playtesting player response

Figure 46: Third prototype: Playtesting player response

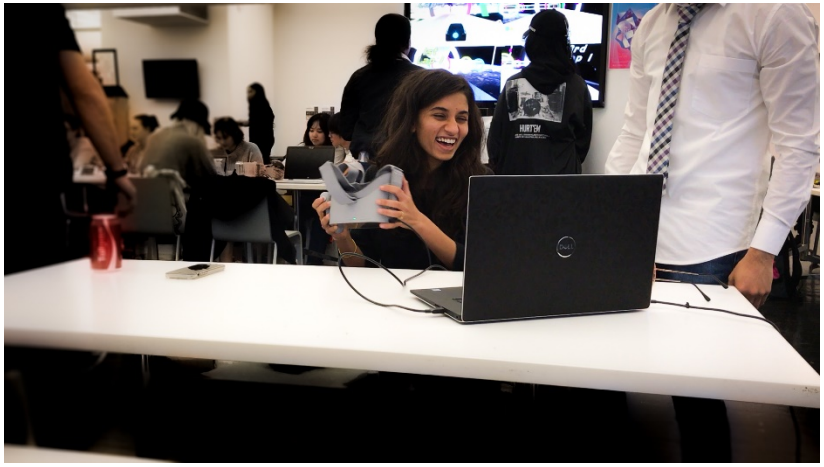

Figure 47: Third prototype: Playtesting player response

Figure 48: Third prototype: Playtesting player response

Figure 49: Third prototype: Playtesting player response

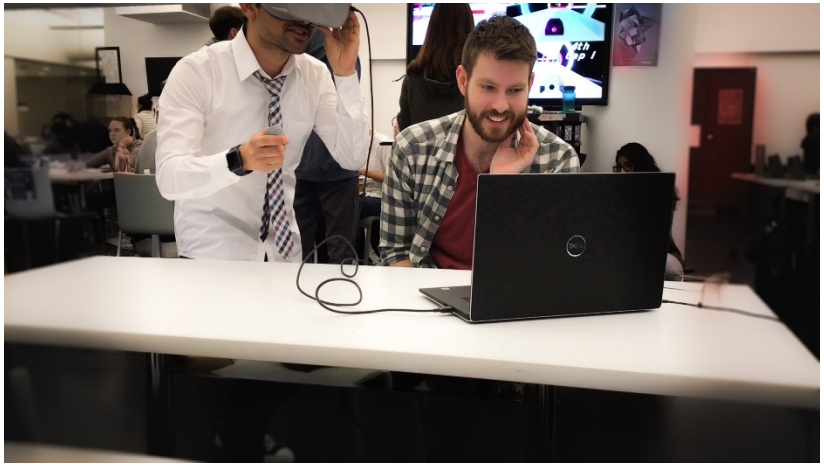

Figure 50: Third prototype: Playtesting player response

The primary feedback I received from Playtech was that the interaction was engaging but unclear. I had to be physically present to explain that the interaction was about a medicine killing pain inside the body. Only after I told did the players appreciated the concept.

Figure 51: Third prototype: Playtesting player feedback

Figure 52: Third prototype: Playtesting player feedback

Figure 53: Third prototype: Playtesting player feedback

FOURTH PROTOTYPE

After gathering suggestions from the past prototypes, I updated the physical and digital interactions.

I added more colors to the physical model to highlight the interaction and match the colors of the physical elements (like the epidermal layer) with those inside VR.

Next, to give a better direction to the player, I added a startup user interface in the game, clearly stating that they are the medicine and they must move their heads to go through the rings to reduce pain. I also incorporated the physical models of the enzyme along with the rings so that it is simpler for the players to relate the action of going inside the rings with the reduction in pain level. Finally, I changed the ring colors to give better feedback: green when the player successfully blocks the enzyme, blue when they are approaching an enzyme, and grey when they are away from the enzyme.

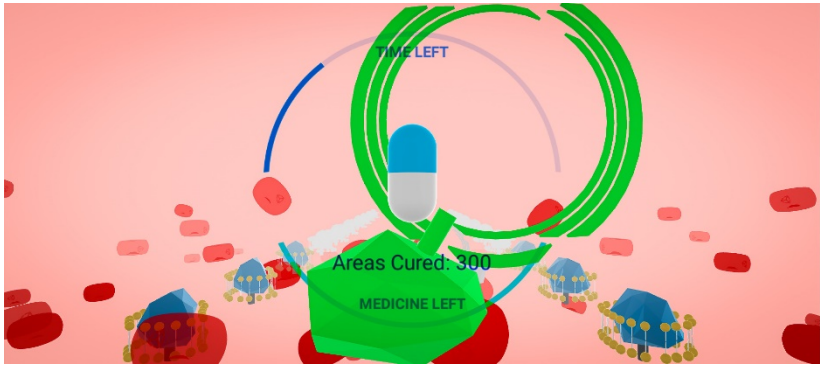

Figure 54: Fourth prototype: Digital Interface

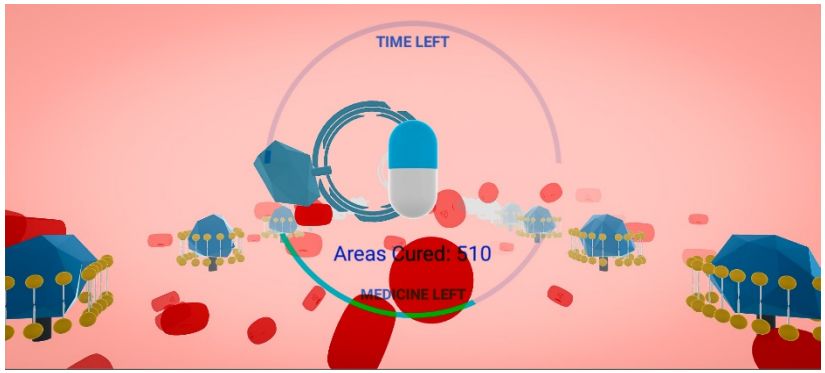

Figure 55: Fourth prototype: Digital Interface

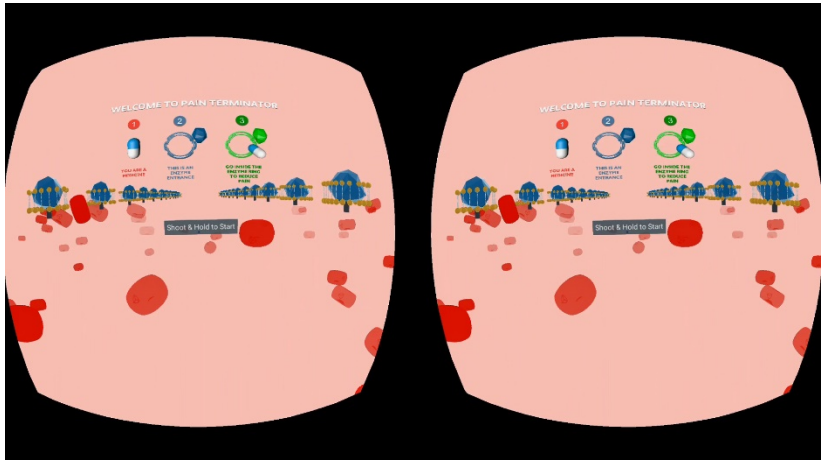

Figure 56: Fourth prototype: VR interface

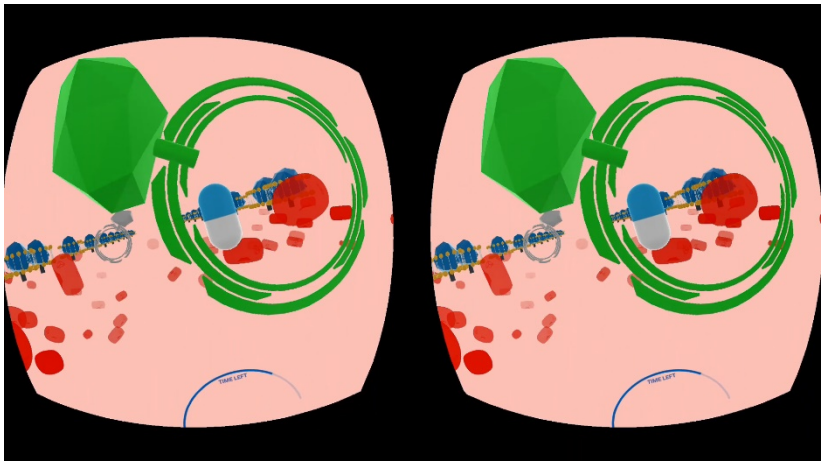

Figure 57: Fourth prototype: VR interface

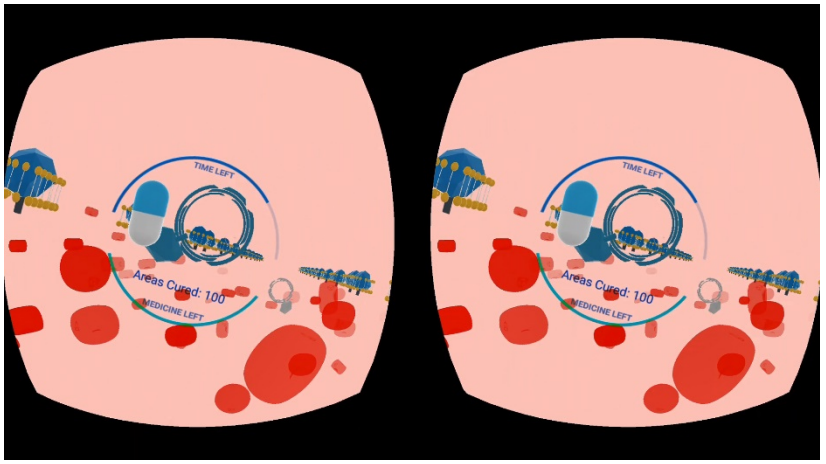

Figure 58: Fourth prototype: VR interface

During playtesting this prototype, the players said that they understood the logic of the game and their role better because of the updated instructions on startup.

Figure 59: Fourth prototype: Playtesting

Figure 60: Fourth prototype: Playtesting

Figure 61: Fourth prototype: Playtesting

Figure 62: Fourth prototype: Playtesting

FUTURE

I did the playtesting of my final prototype with my classmates and not my target audience (children). So, for the future, I would want to test that version with the kids to observe how well they understand the concept with the added cues to explain what the game is doing. So, I would plan to make the experience such that it does not require a facilitator to explain the concept behind it.

Once that version is ready, I will share my documentation and the project file on open-source platforms like GitHub to increase the access of this information to developers, who can create more versions of the game with other diseases and different parts of the body.

Regarding its setup, I plan to reach out to museums and schools to install the game so that children can play and learn from it.

I also see this as an opportunity for pharmaceutical companies to market the mechanism of action of their medicines inside the body. Pharma exhibitions like CPhI[22] can be another platform for sharing this experience with the masses.

[22] "CPhI | Mix with the world of Pharma products, people and solutions." UBM. Accessed December 14, 2018. https://www.cphi.com/.

Akshansh Chaudhary

Digitally signed by Akshansh Chaudhary
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