

The Ghost Anatomy Project

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Problem Statement

Effective visualization of the human body contributes to success in learning the curriculum in the field of medicine. However, physical means of human body visualization costs thousands of dollars and thus limited in availability to students. Desktop applications that virtualizes the body fails to offer the benefits of hands-on learning experiences which enhance “learning and confidence in the subject matter”. These applications are limited to flat, two-dimensional displays which only renders a subset of the visual cues human requires for a truly rich perceptual experiences. These cues, which contribute to visual richness, include “perspective, occlusion or interposition, light and shadows, relative size, motion parallax, and stereopsis to interpret depth and dimension”. Without a truly rich perceptual experience, students are deprived of more effective ways to study the human body. Three-dimensional displays are capable of presenting information to students with a visual richness, which can display the human body more realistically than two-dimensional displays. Research results from a study involving extensive interviews with anatomy experts has suggested that 3D volumetric displays would be “great for education, diagnosis, and in particular, surgical planning,” with a “huge range of prospects” and “almost no end of encouraging future applications”.

Project Scope

Inside the Project Scope

Our project scope focus on user research, designing user interface, and provide a minimum viable product. The first half of our project will mainly focus on user study and design. We will spend the first two weeks on writing interview script, conducting users interview and contextual inquiry. And for the next four weeks, we will draw design sketches, make low-fidelity prototypes, and high-fidelity prototypes. Each low-fidelity and high-fidelity prototypes will be followed with user tests in order to show users' interaction with the application prototypes. Therefore, we will be able to adjust or redesign the application according to the user test results.

The validity of our results will be addressed through our initial literature reviews, which will give us an idea of how we can measure the effectiveness of our hologram interface in the realm of human anatomy learning. We will be able to generalize our findings by collecting specific data through our contextual inquiries. Interviews with anatomy learners can help us understand what difficulties they usually encounter when learning on a 2D interface. Therefore, we will be able to create an application that will provide a high degree of usefulness among its users. This will also let us control the quality of our application because we will be able to set standards based on the feedback that we receive from our interviews, giving our developers an idea of what they will need to accomplish over the course of our project.

The second half of the project will focus on creating the application. We are utilizing some existing codes and documentations, which allows to speed up the process. Version control systems will be set up in place for our developers to check in code and review changes that each group member will make.

We will have our human anatomy 3D volumetric display made out of plexiglass created in the end of our project. Zoom-in-zoom-out, rotation, stripping layers, and quizzing users will be the three main gestures and functionalities implemented based on our user study and time restriction. The details of these three functionalities will be explained in the later spec. We have acquired some human anatomy models through multiple different ways. They will be used as our sample models. By the end of the second quarter, our MVP will be displayed volumetrically and interactively with these functions on plexiglass.

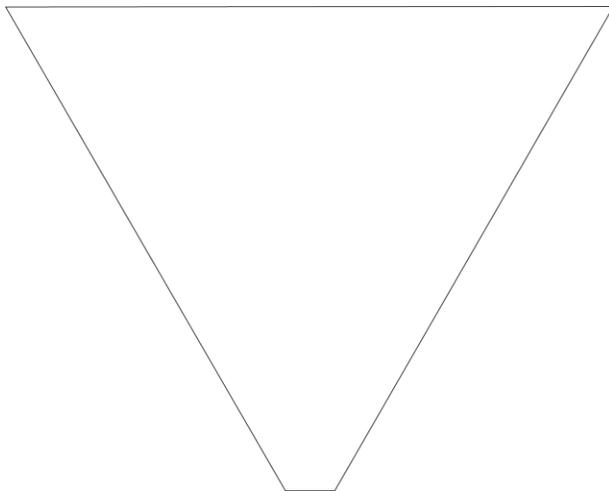
Outside the Project Scope

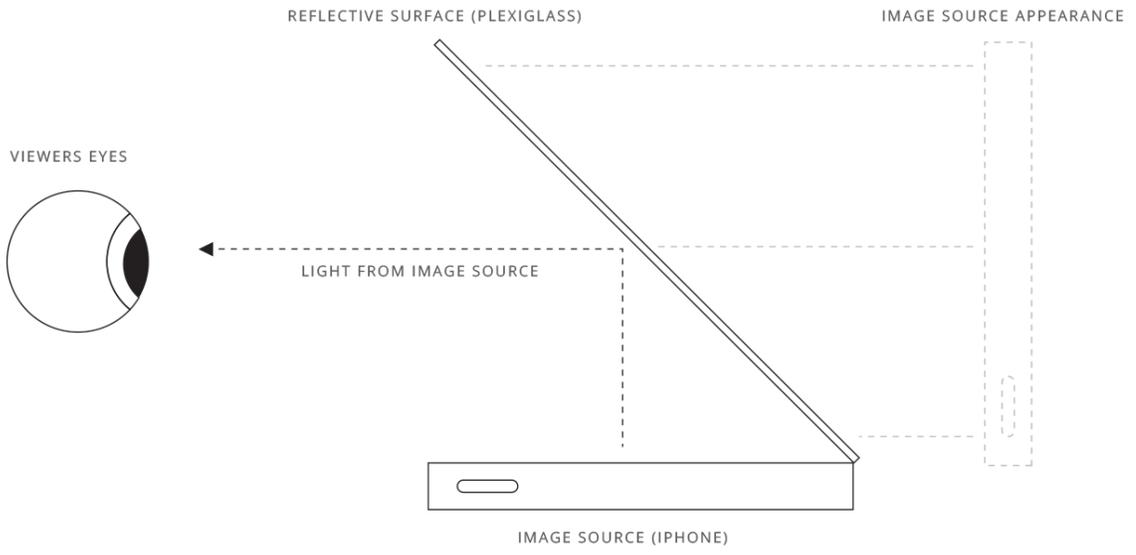
Due to limited to time and budget, some of our design will not be implemented. Isolating a body part, showing names of organs, searching a body part, dissecting, and animation of body fluid are also desired functionalities according to our user research. While we only have 10 weeks in total to develop the application, these functions are outside of our project scope.

Hardware

The display will be made of a acrylic plexiglass material shaped into a pyramid. The plexiglass will be laser-cut into four panels of equilateral triangles. One corner will be cut off one each panel, and will be aligned along the same side when attached to the other panels. This side will act as a base for the prism. The will be assembled in such a way that it is angled 45 degrees from the baseline. The prism will be place in the middle of a regular monitor or TV, which will be the display source for the image. The height of any one side of the prism will be the length of a sub-square from one corner to the diagonal corner.

The TV will have a square that will encompass the maximum height of the screen size. This square will then be divided evenly into four other sub-squares. Each sub-square can act as a different camera angle for the model we are displaying, or provide the same camera angle for all sub-squares.





Software

With advent of WebGL, we can now have browsers take full advantage of the hardware of modern computers. This allows us to fully render 3D images in a web context without having to write our own shader code or rely on systems level technologies like C++. In addition it allows our application to be deployed to any web browser environment, which has a much lower barrier for entry than a C++ application that will likely require the installation of many redistributables.

Three.js and Trond's Framework

The primary framework we are going to be using for rendering the models will be Three.js. An additional graphics engine is written by Trond which will adapt the 4 way view split for the hologram and base framework for the application which includes, but is not limited to, model rendering, heads up display, label views, and API calls for actions like zooming and rotating.

Leap.js (Leap Motion for JavaScript)

The Leap.js framework will be used for all gesture input and recognition. In addition to relying on some of the built in gestures, developers will implement custom detection algorithms to recognize the gestures that we plan on using with the application. These gestures will provide data which can be passed to Trond's existing framework and used to manipulate the models on screen.

Since the separation of concerns is inherent in the application, adding new gestures or modifying existing ones will be a viable option at any point during development. This also allows for future upgrades to the system as the design may change.

Users

Target Audience

We have two primary target audience members who will be utilizing our application and two secondary audience members who have interested in utilizing our holographic anatomy program. After thoroughly analyzing our user research, we've prioritized our audience members in the following order based on needs and current resources that are available to them:

1. Students (Undergraduates)

We want to primarily target undergraduates because we found that undergraduates don't have as many resources available to them compared to other groups, and also have more content to learn and to get familiarized with. Through our interviews, we found that both the basic interface and the quiz function was important for this group because they mentioned how exposure to the human body was a crucial part of their learning experience. They also mentioned how cadaveres were a vital part of their learning experience, but it was also hard to work with them due to availability. Hence, we want to make sure that our application will be able to bridge the gap between studying with cadaveres and technology.

2. Students (Applying to Graduate School)

Students who have graduated will be our second primary target . Many students who are applying to graduate school already have a thorough understanding of how the human anatomy functions, and would primarily use our application as a way to review content to aid their graduate school application process. Through our interviews, we found that a selective quiz functionality was very important for this group, because it would help them understand what they know and what they need to brush up on.

3. Instructors

Instructors are a secondary target audience for us, and we want to be able to market are application to instructors so that they can introduce it to their students or help them demonstrate certain aspects that may be hard to interpret without the use of 3D holographic technologies during lecture.

4. Students (Graduate Program)

Graduate students studying anatomy have cadaveres readily available, and are our last priority because they've stated that the best way to study anatomy is through the use of cadaveres. Graduate students typically have access to cadaveres during typical business hours, and would most likely not use our application unless they need to use it during the after hours.

Assumptions

We are assuming our primary target users, undergrad students and people who are applying for grad school, are technology savvy. They can understand the basic icons and operate modern technology device easily. And we are also assuming our secondary target users, professors and instructors, are not as technology savvy as our primary target users. They might have problem using any technology devices and they are not familiar with icons.

Personas



Sally Wang
Undergraduate, Applying to Biochemistry
20 Years Old

Description

Sally is a bright sophomore who is in the midst of applying to the biochemistry program at the University of Washington. She's been trying to take as many classes in the field as possible, and started taking her first anatomy class this quarter.

Use Cases

1. Go to our application → Look at the human body → Realizes that she is unfamiliar with certain systems → Go to "Quiz" → Study
2. She has an exam → Goes to "Quiz" → Study



Mike Hawk
Graduate with a B.S. in Chemistry, Applying to Grad School
24 Years Old

Description

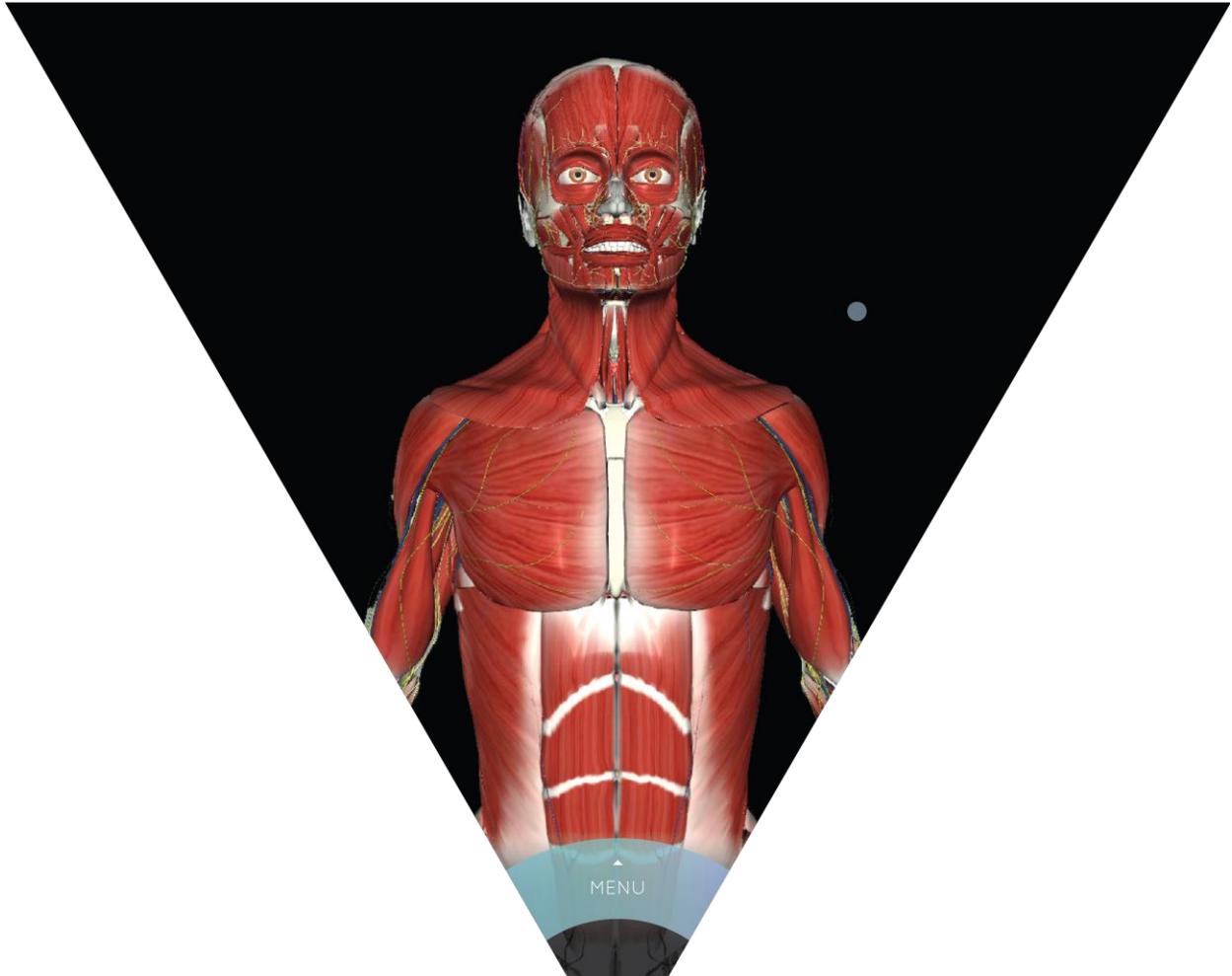
Mike Hawk studies LONG and HARD every single day, and has lately been in a constant state of stress studying for his GRE and PCAT exams. He typically wakes up at 7:30 A.M. every day and takes Metro Bus Route 43, from Capitol Hill all the way to Ballard in order to volunteer at Swedish Medical Center. After finishing work at around 5:00 PM, he heads home and stops by the local Top Pot Donuts to get a solid 3 hours of studying in to prepare for his exams. At the end of the week, Mike enjoys going out to the bars with his friends to drink away his pains. He always complains about the amount of effort he needs to put into remembering trivial concepts such as how the human respiratory system functions.

Use Cases

1. Go to our application → Think about what processes he needs to study about → Clicks on “Quiz” → Selects the process he needs to study → Studies
2. Go to our application → Sleeps

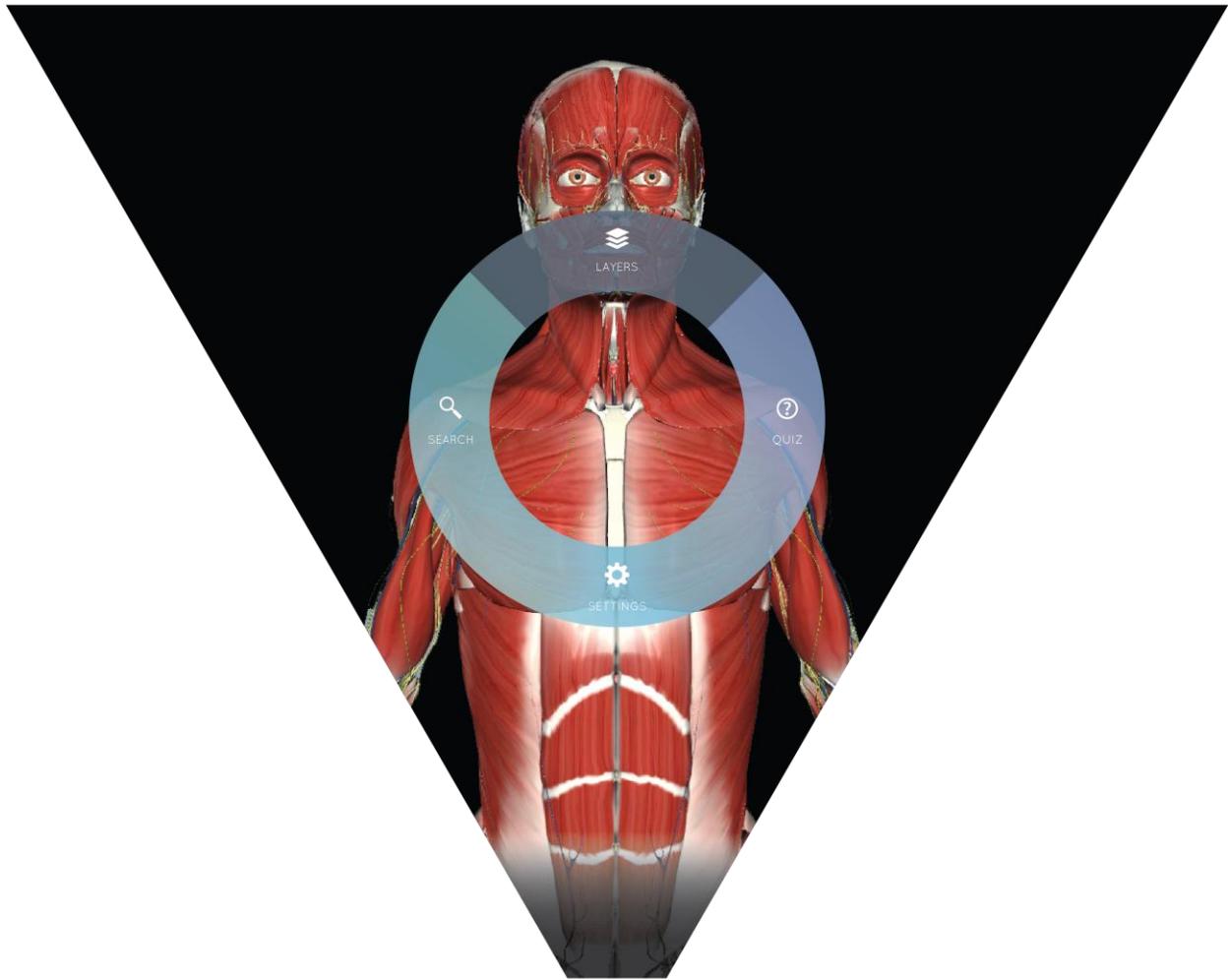
Application Details

Homescreen

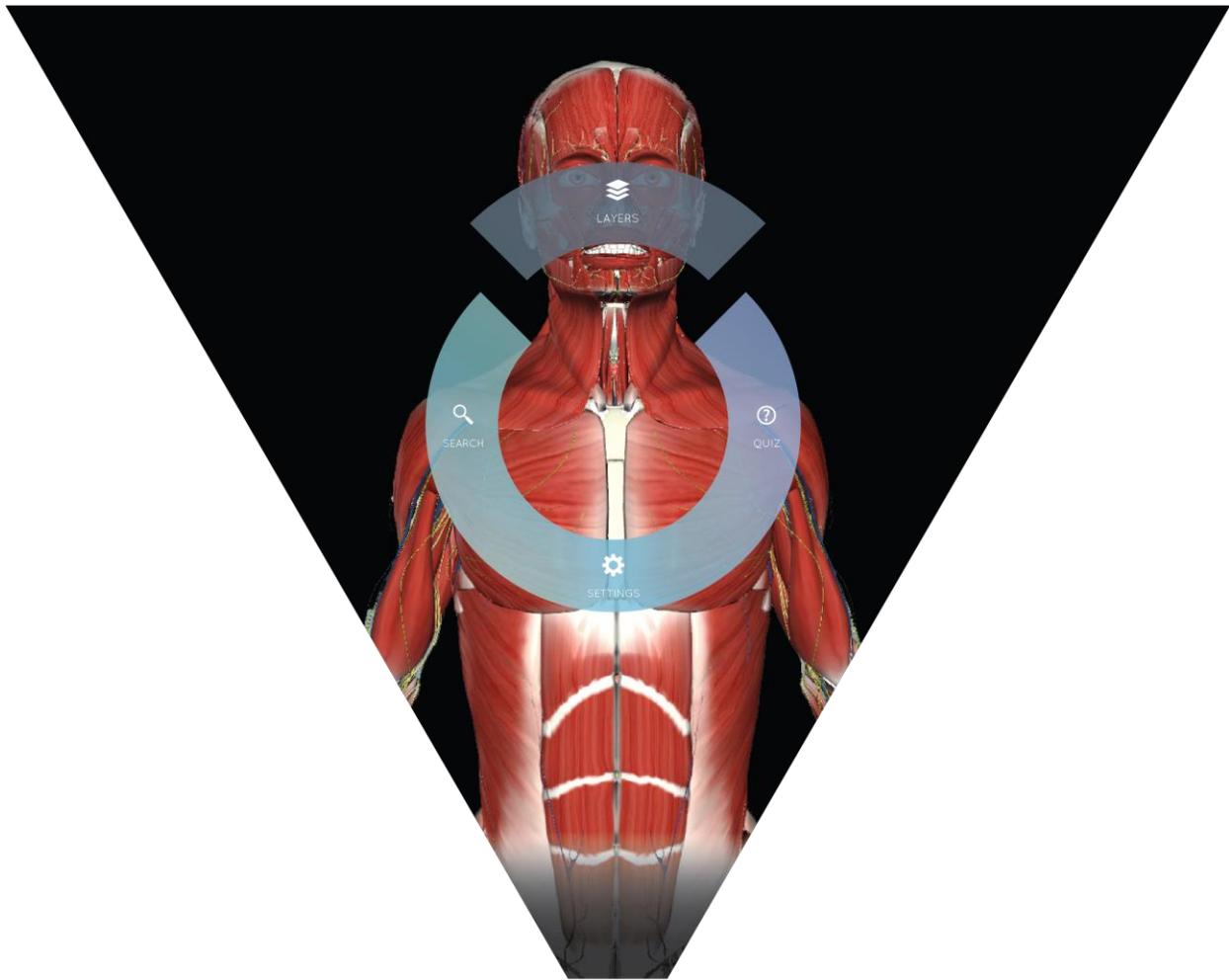


The homescreen is where users will access the main application. From this screen, users can perform basic manipulations on the human body. They can gesture to rotate, zoom in and out of the body, and peel off organ systems. A circular cursor shows where the user's finger is located in the context of the screen.

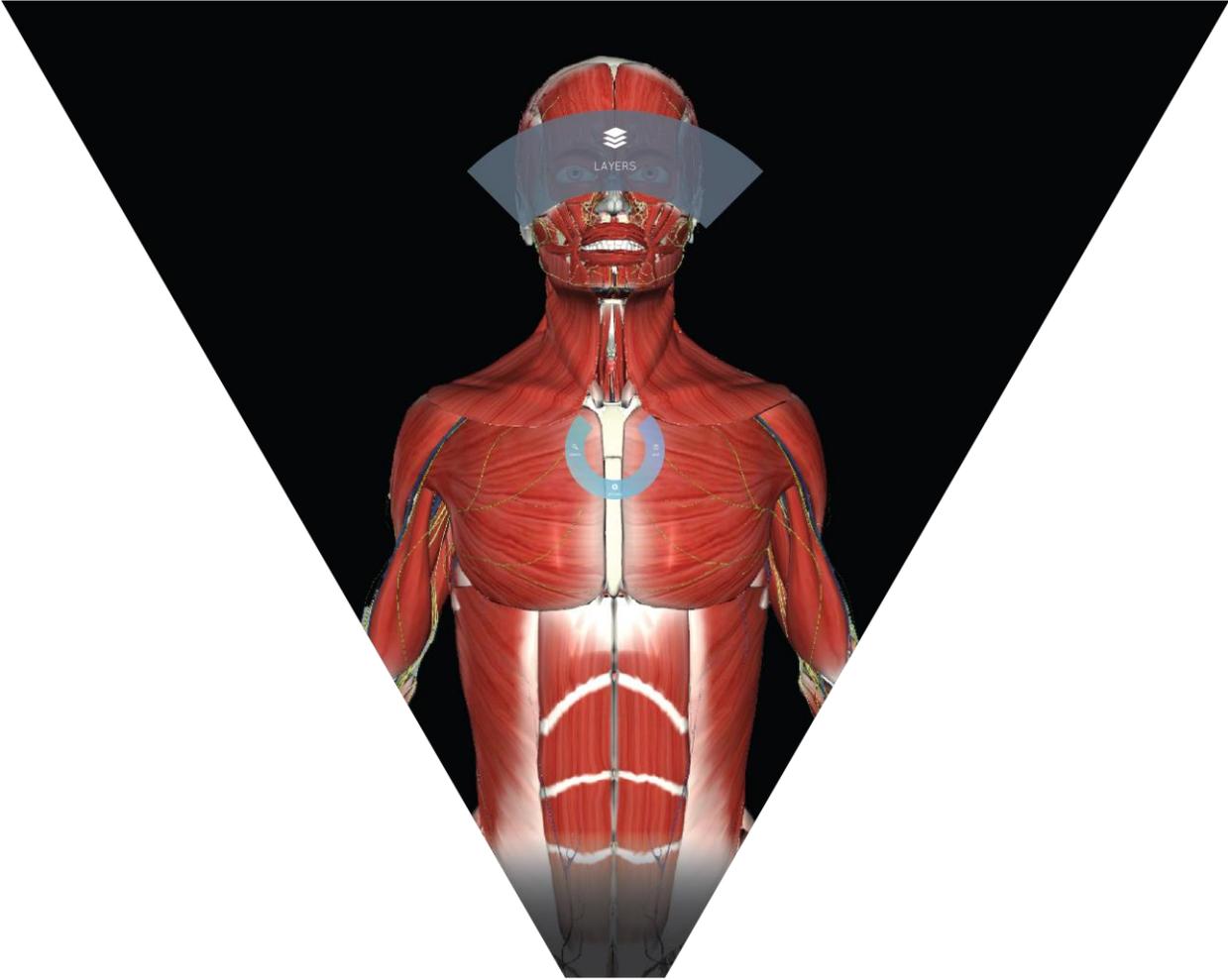
Menu



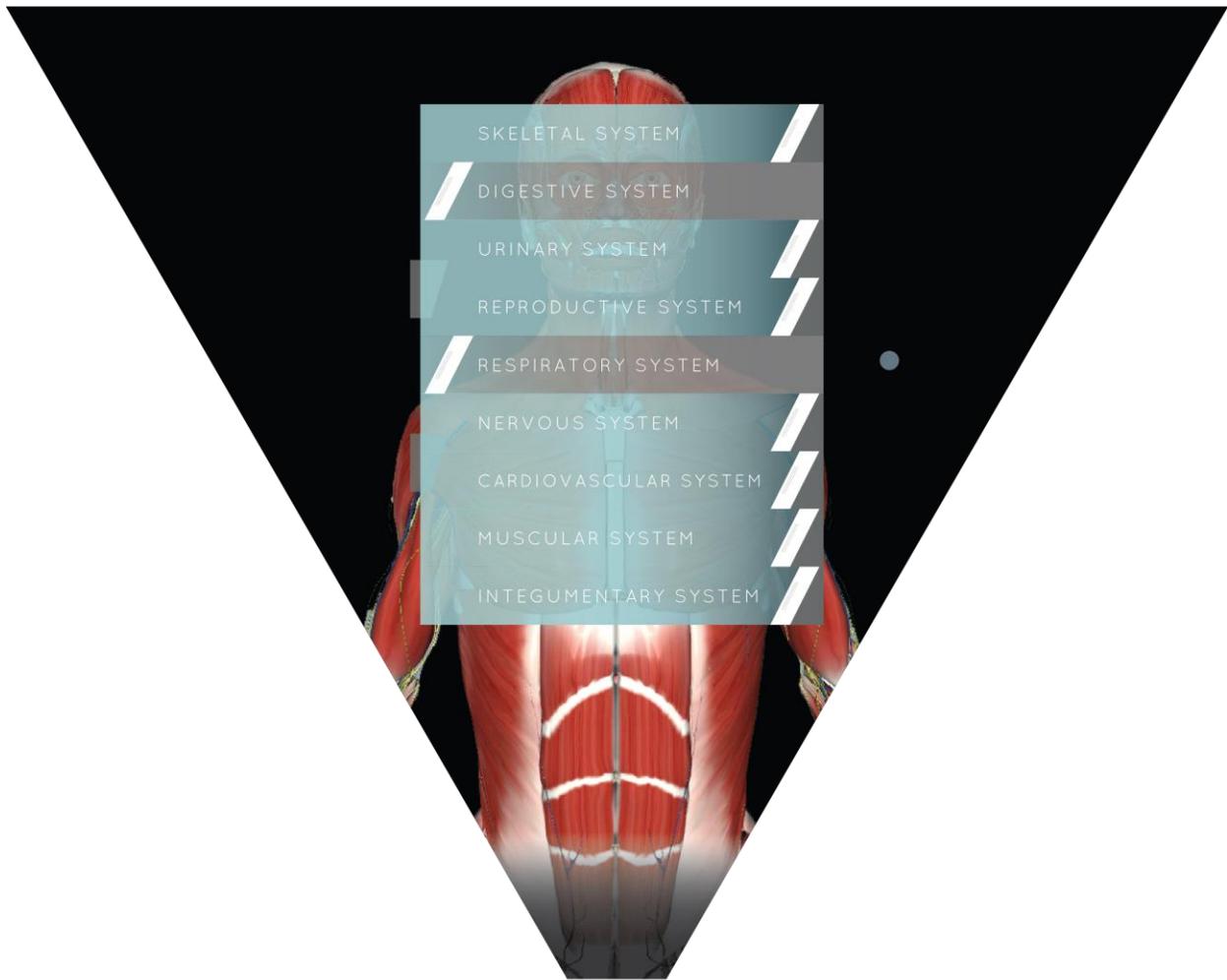
When the user moves their cursor towards the bottom of the screen near the “MENU” semicircle, a full menu dynamically explodes into the user’s view. From this menu, users can perform four main actions. Each action will be highlighted in a darker color to dynamically show the user which selection they are closest to. As the user moves their finger in any one direction upwards, downwards, left or right, the menu items are lifted from the circle of menu options, as seen on the next page.



As the user lifts their finger towards a menu option direction, the circle of other menu options minimizes in a dynamic gesture. As the selected menu option grows larger, the other menu options shrink into the middle. If the user makes a large swiping gesture towards a selected menu option, the option slides into space and the menu opens that option while circle of other menu options shrinks out of existence, as seen on the next page.



Layers Menu Option



When the “Layers” option is selected in the menu, the users can turn certain organ systems on and off in the view. With their cursor, the user can hover over a specific organ system. A swipe left or right will turn the visibility of the system on or off for the user. Organ systems with a light blue background are considered “Turned On” while the gray organ systems are considered “Turned Off.”