MAIN BODY

Leveraging existing technology and my knowledge, I aimed to design my project for users to interact with virtual content via finger gestures on a mobile screen. Consequently, I chose to incorporate the following finger gestures as the primary mode of interaction.

* Pinch scale – using the Thumb and Index finger to scale the virtual content on the screen
* Rotate – sliding the Index finger on the screen, either left to right to rotate the content in either direction
* Translate – move the content through three-dimensional space by placing the index finger on the virtual content and dragging it across the screen
* Display 1 – hide/unhide portions of the content or display hidden contents by double-tapping on the screen
* Display 2 – Show annotations and additional information through a touch-hold of the screen

Applying a user-centric design principle, as detailed in (Ref #17), I aimed to reduce the inherent learning curve associated with navigating ARe. This goal was achieved by incorporating intuitive gesture interactions commonly found in modern touchscreen mobile devices. Subsequently, my intention was for ARe to be a complementary learning tool, not a substitute for traditional resources such as textbooks.

ARe: Planning, and Design

Planning

In the planning and design phase, I created a storyboard to visually depict the prototype's precise functionality, facilitating necessary adjustments. Tailored for self-learning, the project is illustrated with a single learner in their own space. To efficiently manage development, I established a timeline with weekly goals, evaluating the prototype's functionality through test builds at the end of each week. Employing an agile design method, I integrated the testing of new visuals or features after each weekly sprint, aligning with a software development approach (Ref #7). Additionally, I required a testing model that could provide feedback for new iterations and continued testing during production. This goal was achieved via Test-driven development (Ref #webpage here).

Design

Centering my design around user engagement and interest, I opted to explore visually appealing elements for my digital content. Considering the mobile development context, I sought a method to present my models with optimal visual quality while preserving device performance. To reduce the polycount, I opted for low-poly models and employed gradient texturing for the final renders. Downloaded assets with high resolution were optimized using decimation to maintain functional polycounts.

For the learning experience, I chose trigonometry as my focus because of its challenging nature in mathematics and the visual aids commonly used in trigonometric problems. After receiving feedback from informal peer reviews, I decided to proceed with the circulation of blood in the heart for the second topic. The purpose of choosing these subjects was to demonstrate abstract concepts visually while testing user engagement and exploration.

An ARe marker was developed to replace the traditional 2D images on paddles, as demonstrated in (Ref #4). The marker takes the form of a textbook page that incorporates educational material along with distinctive patterned images to activate the digital content. Here, users enhance their learning with ARe alongside physical resources, incorporating digital content and instructional text.

ARe: Development, Challenges and Solutions.

I researched tools for Augmented Reality (AR) development, prioritizing control over features. Unity was chosen as my preferred platform, followed by an exploration of AR Foundation and Vuforia AR SDK. Evaluating both, I found AR Foundation setup initially smoother but faced challenges with image tracking. Attempts to combine Vuforia and AR Foundation resulted in errors and lag. To address this, I discovered Lean Touch, a free Unity plugin, and refined the system using Vuforia for its straightforward image tracking.

While developing, I realized the "Lean touch Rotate Axis" component required a two-finger interaction. I aimed to create a user-friendly prototype that used the index finger for interaction, except for scaling. I combined custom-written C# scripts with the Leantouch Scale component, enabling me to rotate and scale. However, implementing the lean touch translate component caused a script conflict, with the 3D model moving and rotating simultaneously. To address this, I made the object's movement activate only when the user touched and moved it, while also blocking any rotation during translation using a constraint in the translation C# script.

Adhering to my timeline, I initiated work with cubes and test markers, focusing on developing interactions and on-screen features. This strategy aimed to establish fundamental interactions and address challenges concurrently with advancing the 3D production pipeline, allowing for the creation of 3D models for both mathematics and biology. In the final stages, after completing the models, I replaced the cubes with finalized 3D assets.

In choosing visualizations, I pursued an art style balancing playfulness and relevance, using vibrant colours for user engagement. Employing a gradient texture approach facilitated smooth transitions between colour gradients without inflating file size.

To augment the learning component, an information board was incorporated, housing trigonometry details, clues, and formulas accessible through hand placement. Additionally, a triangular image could be unveiled through a double-tap gesture. In Biology, animated arrows illustrated blood flow between ventricles, providing a realistic depiction compared to conventional 2D images.

For my presentation, I utilized custom markers generated from (website) and integrated them with subject-specific images—a modified human heart for biology and a 2D representation of a trigonometry problem for mathematics. This, combined with the final textbook design, resulted in a distinctive and purposeful presentation using the Vuforia image tracking system.