FlexAR: Anatomy Education through Kinetic Tangible Augmented Reality

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Figure 1: (a) Desktop display for interaction (b) Smart glasses display. (c) Tablet display.

Abstract

We present FlexAR, a kinetic tangible augmented reality [Billinghurst,2008] application for anatomy education. Anatomy has been taught traditionally in two dimensions, particularly for those in non-medical fields such as artists. Medical students gain hands-on experience through cadaver dissection [[Winkelmann, 2007]. However, with dissection becoming less practical, researchers have begun evaluating techniques for teaching anatomy through technology.

Prior Work

Prior research of AR for anatomy education can be found in the work of Juanes'[Juanes,2014] and Seo[Seo,2014}. Juanes' introduces a tool for augmenting 2D images from a book with static 3D models on mobile devices. This allows the user to view the structure of particular body parts in 3D space without the need for physical models. Seo's work focuses more on creating a tangible interface by using a tangible to control the display of information on a mobile device. Though this application does include dynamic text, there is little interaction between the user and the tangibles themselves; the tangible controls only the location of the text on screen. Thus, this application is useful primarily as a tool for memorizing written information found in textbooks but with a more hands on approach.

Design Approach

When designing Flex AR we wanted to explore ways of teaching the more kinetic nature of anatomy. For our research we focus on demonstrating the flexion and extension of various muscle groups as the result of moving a physical skeletal model. In addition we wanted to explore the different AR interface styles to see how they support different learning styles. The styles we explored were wearable, tablet, and computer.

Interaction

Users of our prototype manipulate a physical skeletal model affixed with augmented reality (AR) targets. An AR-enabled device records this interaction and projects a digital 3D model consisting of the bones and major muscles of the arm over the physical model. Users are then able to examine both gross anatomy as well as muscle flexion and extension. The user can also interact through a graphical user interface to highlight and display additional information on individual muscles.

Implementation

Flex-AR was built using the Unity game engine with Qualcomm's Vuforia plugin, a mobile AR library, to handle the capturing and tracking of our augmented reality targets. For FlexAR, we use 4 targets: 1 to determine the basic position of the arm and the others to control the rotation of the shoulder, elbow, and wrist joints of the 3D model. The assets for the 3D overlay were developed in Maya using our physical arm model and Gray's Anatomy [Gray,1974] as reference. To enhance immersion, the physical and digital models had to align as closely as possible in appearance and be anatomically correct.

Future Work

We are currently furthering our research and expanding our prototype to include not only the arm but also other key regions such as the torso. A larger tangible would likely enhance the user's sense of immersion

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