Optimization of a Tablet-based Health Care Education Application

Sam Yoders – Sponsor: Dr. Laurie Dringus

Introduction

The topic of interest is the development of a tablet-based educational application. For now, the Apple iPad2 is the designated platform for the new app, with future migration to other tablet device operating systems (OS) possible, allowing for greater flexibility. The app will assist novice students in their learning process in a medical ultrasound education program. Specific design goals include enhancing user spatial cognition during visualization of complex 3-dimensional structures, user navigation through representative applications and their intended real-world corollary, and user interaction with simulated or enhanced environments.

Research Goal and Problem Statement

The goal is to identify and incorporate in development, the latest interface design techniques for touch-screen and gesture-based computing, while avoiding user interface design flaws seen in early-adopter tablet applications. The effective and efficient development of the new learning app is to be undertaken, by leveraging the discovered knowledge of developers who have forged a path in tablet-based applications; by discovering and using their best practices while avoiding their early mistakes; and by incorporating theories of visuospatial cognition into the user interface design.

Research Questions

1) What are the underlying considerations supportive of visuospatial cognition, fundamental learning theories, and any other constraints unique to touch-based and motion recognition interfaces?
2) What missteps in user interface design were made by developers of early touch-screen applications resulting in sub-optimal performance?
3) What are the best practices and leading edge techniques for the design of touch-screen and motion recognition interfaces?

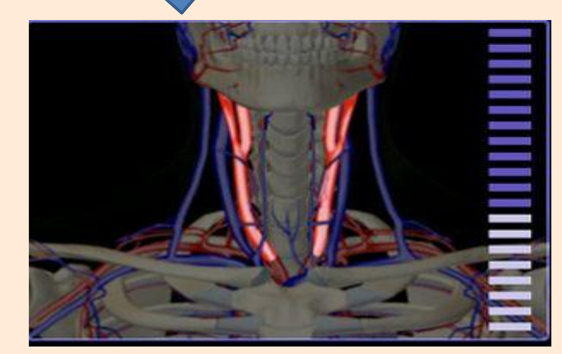
A Few Findings

Katuk and Ryu (2010) state that the design of intelligent tutoring systems (ITS) should be based upon "solid pedagogical theories", and developed an evaluative framework for educational applications. Mayer (2005) theorized that multimedia learning enjoys increased effectiveness due to effects in three cognitive areas; the Dual Channel Assumption, the Limited Capacity Assumption, and the Active Processing Assumption. Smith, Ritzhaupt, and Tjoe (2010) identified a visuospatial working memory (WM) concept, that learners who utilize a "key features" image identification and visual learning strategy were significantly more accurate in shape recognition tests. Nguyen, Nelson, and Wilson (2012) describe the use of computer-based visualization schemes for learning anatomy, reporting that dynamic, interactive visualization tools were successful in overcoming individual differences in visualization learning ability (VZ) of learners.

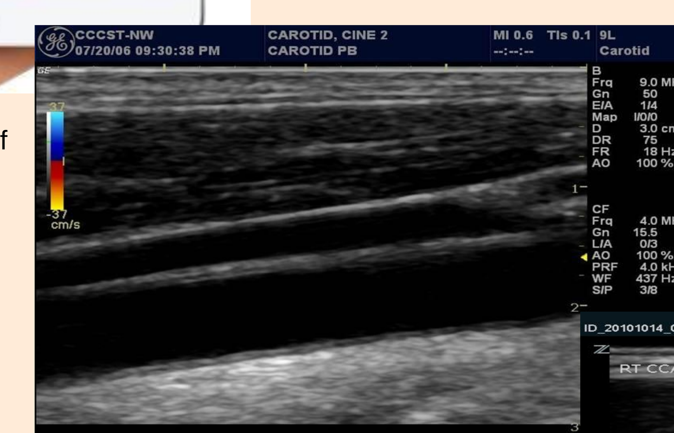
iDi = "interactive Diagnostic images"

Male head image Courtesy of 3DScience.com.

User interacts with i3D model to select desired anatomy

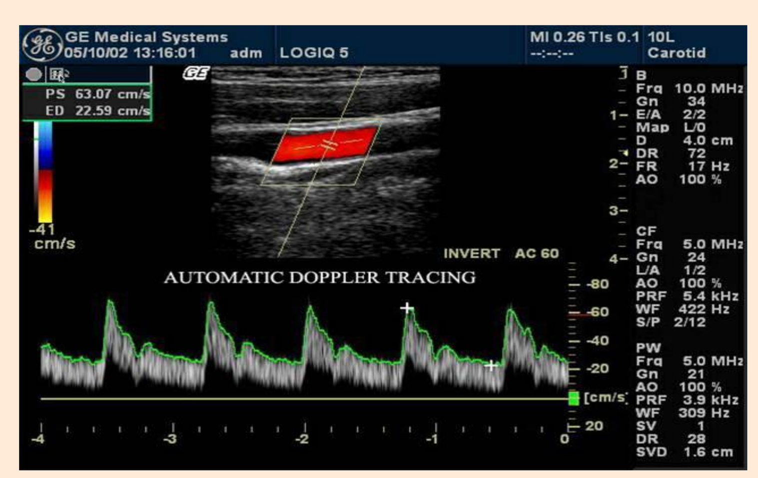


Swipe to rotate and zoom to area of interest

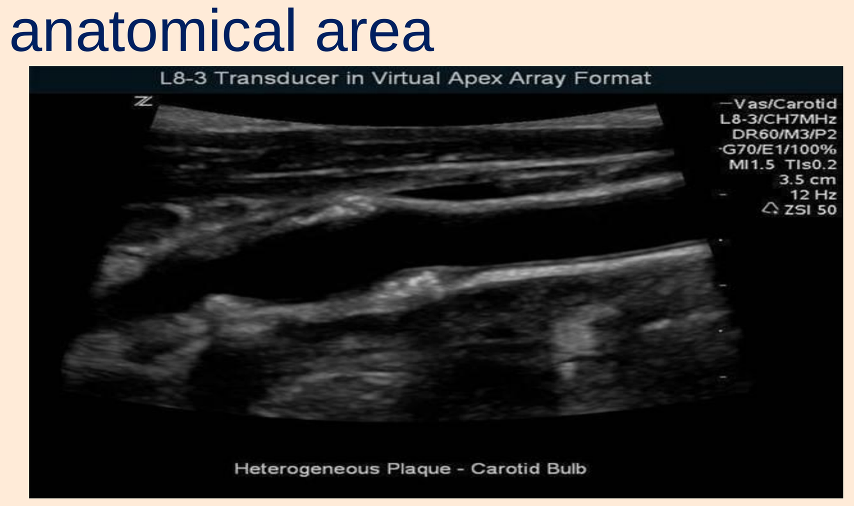


Touch-select features to activate ultrasound image catalog for area; swipe to change image orientation

Touch hotspots and select to activate advanced features. . .



. . . and a library of typical pathology seen in that anatomical area



Budui and Nielsen (2011) describe their findings of flaws in user interface design in both initial and second-generation iPad applications, and their suggestions for improvements. Yu, et al. (2011) outline the use of a tangible user interface (TUI) on a capacitive display device, without hardware modification, the additional layer of user interface allowing application engagement without selection of menus or screen icons, and "tangible object sensing and tracking" (p. 3003). This capability may be incorporated into a learning app to create interactive, object- based quizzes or exercises that would provide instant feedback to the user. Song, et al. (2011) describe the ability to interact with a 3D volume rendering by using a handheld device (such as the iPad2) that is capable of multi-touch interface and movement sensing. The learner can virtually "slice" through the 3D image by moving the device accordingly. This feature may be incorporated into a version release of the iDi educational application as a value-added feature.

Conclusions

A number of promising cutting-edge techniques identified by this initial exploratory research, as well as recommended design features to improve the usability and overall functionality of iPad-based applications. Basic design flaws to avoid have been identified as well, allowing the initial app to benefit from the missteps of early app developers.

Future Research

Inquiry pathways identified in this exploratory research point the way to the use of Augmented Reality (AR) in the next version of the application, and the possible incorporation of additional interfaces to support detailed gesture and movement recognition, beyond what is capable within the iPad2 alone. The findings of Wu, et al. (2010) point the way to the incorporation of Augmented Reality (AR) into our learning application, to take advantage of *in-situ* learning abilities and lessen the cognitive load due to extrinsic factors. Baheti, Swaminathan, Chari, Diaz and Grzechnik (2011) report findings regarding the development of an effective AR image database, using the high-resolution cameras available on mobile devices. Their conclusion that the resulting AR functionality is sufficient for use, lends credence to the pursuit of incorporating AR into the next version of our educational app.

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