Virtual Stomach Visualization and a Stomach Tumor Detection System

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Abstract—**Anatomy, the study of the structure of the human body is a fundamental of medical education. The main techniques and tools which are used in studying human anatomy are the traditional dissection of the human body and 2-dimensional diagrams in text books. However, a natural abhorrence towards dissection, emotional concerns, incapability of repeating the dissection, limitations in the number of cadavers and difficulty of capturing the real view of human anatomy presented in a text book plague traditional learning.**

This paper investigates the possibility of building an interactive Augmented Reality system which enables users such as medical students to practice dissecting a stomach with a great deal of freedom whilst enjoying a nearly real enhanced learning experience. The prototype which is developed using Goblin XNA, can be used as a learning tool which helps in traditional dissection and provides capability for identification of abnormalities in endoscopic images in which users can upload an endoscopic image and the system will automatically segment the abnormal area. Three image segmentation algorithms such as Watershed, Normalized Cuts and Topological derivatives are implemented using Matlab in order to find the best approach.

Keywords-component; Augmented Reality, Medical Image Processing, Watershed, Normalized Cuts, Topological Derivative.

I. INTRODUCTION

Augmented Reality (AR) enhances a user's perception of and interaction with the real world. The virtual objects display information that the user cannot directly detect with own senses. The information conveyed by the virtual objects helps a user perform real-world tasks. Augmented Reality is a specific example of what Brooks and Frederick [1] call "Intelligence Amplification (IA): using the computer as a tool to make a task easier for a human to perform" [1].

The most important aspect of AR is, it can be used in many areas like medical visualization, AR learning systems, maintenance and repair, annotation, robot path planning, entertainment and military aircraft navigation and targeting.

Among these areas, AR in medicine plays a major role. Further AR applications for learning human anatomy have become an essential aspect as anatomy is a cornerstone of medical education. The main techniques and tools which help in learning human anatomy is the dissection of the human body. It gives an opportunity to learn a wide range of variability presented in a real human body that is difficult to capture in a textbook and specimen. However, there are some obvious problems with traditional dissection such as cadavers storing, issues of morality, and public perception.

The aim of this project is to design, build and evaluate an interactive AR system which enables users such as medical students, teachers as well as school children to dissect the human stomach with a great a deal of freedom whilst enjoying a nearly real enhanced learning experience and also use endoscopic images to detect the presence of stomach tumors which will help to reduce the probability of missing some abnormalities if the abnormalities cannot be detected by naked eye.

II. RELATED WORK

Augmented Reality Technology and computed tomography together with newly emerging technology in 3D visualization have brought anatomical education into a new era. As a result of that, lots of interactive AR systems for learning human anatomy have been implemented.

At UNC Chapel Hill, a research group has conducted trial runs of scanning the womb of a pregnant woman with an ultrasound sensor [12].They have generated a 3-D representation of the foetus inside the womb and display that in a see-through Head Mounted Device (HMD). Another similar project is carried out by the same research group for a needle biopsy of a breast tumor [13]. It is predicted that trial runs of scanning the womb would be a 3D stethoscope one day and both applications can be used as visualization and training aid for surgery and learning anatomy.

A system called "Anatomic VisualizeR" is presented for learning modules in anatomic education [11]. In this system, they have provided a virtual dissection room in which students and faculty can directly interact with three dimensional models of human anatomy and also concurrently provision access for supportive curriculum material as well. This system has overcome previously mentioned issues in traditional

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