Prasad V. Suryawanshi Int. Journal of Engineering Research and Applications www.ijera.com
ISSN : 2248-9622, Vol. 5, Issue 7, (Part - 1) July 2015, pp.63-66

RESEARCH ARTICLE OPEN ACCESS

A Simulation Method of Soft Tissue Cutting In Virtual Environment with Haptics

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ABSTRACT
Currently, virtual simulation has an increasing role in the medical field. Now virtual surgery simulation has been largely explored in medical field. Virtual surgery is a good complement to traditional Surgical Training. Modeling effects of soft tissue during cutting is quite complex, hence the concept of virtuality is used to develop realistic surgical instruments for providing exact force feedback to the surgeon during surgical operation and simulation of soft tissue processes. Scalpel is a basic instrument required for soft tissue simulation. Hence we will design a virtual organ to cut by using Scalpel in Haptic Environment.
***Keywords* -** Haptic Environment, Surgery Simulation, Virtual Environment, Virtual Surgery.

I. INTRODUCTION

Surgery simulators are generally used to train medical students and surgeons in specific types of procedures without the use of animals or cadavers before working with live patients. They are best suited for two types of skills needed for surgery, eye-hand co-ordination and the ability to perform three dimensional actions using a two-dimensional screen as a guide. Haptic technology or haptics is tactile feedback technology which creates the sense of touch by applying motions, vibrations or forces to the user. We are using haptics in virtual surgery simulation for obtaining force-feedback.

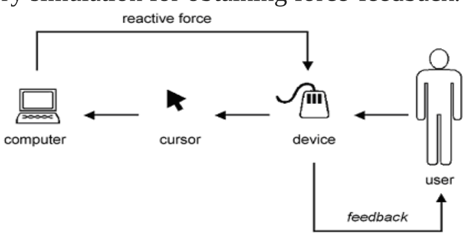

Fig. 1 Haptic Operation

This kind of virtual reality is most often used in the training of surgeons in laparoscopic procedures, as in reality it is not possible to see the operation being performed. The simulator uses a computer screen displaying a three-dimensional graphic of the organs being operated on. Various surgical tools are connected to motion sensors and haptic or tactile feedback mechanisms where the user can physically feel the difference in simulated tissue and organs.
Virtual surgery as a means to simulate procedures and train surgeons grew out of the videogame industry. Videogames for entertainment has been one of the largest industries in the world for some time. In this paper virtual reality is explained in more detail which is used in .surgical training.

II. PROBLEM DEFINATION

Surgical Dissection requires proper handling and understanding of instruments like Scalpel, Scissors etc for operation purpose. Hence the User must be expertise in dissection operation for proper surgical activity. Currently students are educated in soft tissue cutting techniques in the operating room or in lecture. This work will help to illustrate their knowledge in Virtual World in more Simple Way.

III. OBJECTIVE

Our main objective is to create a 3D organ (Ear) in Virtual World and also to create 3D Scalpel associated with it. After that we will perform the Operation of Soft Tissue Cutting in Virtual Environment. During the cutting of soft tissue user will also experienced the force feedback from the haptic device. In this way the user can interact to the virtual world with the help of haptics.

IV. THE DESIGN OF THE SYSTEM

a. Platform and Communication Process

For cutting simulation research, we established a complete hardware platform which includes computer display and haptic device. We are using a Phantom Omni as haptic force feedback device to connect with the virtual world.

b. Software Programming of the System

Virtual Surgery System consists of various interconnected parts. First part is a haptic device which is used to provide haptic force-feedback. This device provides simple interface to user. After that 3D model (Ear) is constructed so that user can cut it into Virtual Environment.

We are using 3DsMax software for developing 3D modeling, VC# for programming and Unity software for performing Cutting operation,.

V. VIRTUAL MODEL

A. Physical Model

For soft tissue cutting there must be a physical model to achieve the physical simulation like deformation and force feedback. As shown in Fig. 2, we establish the physical model for ear.

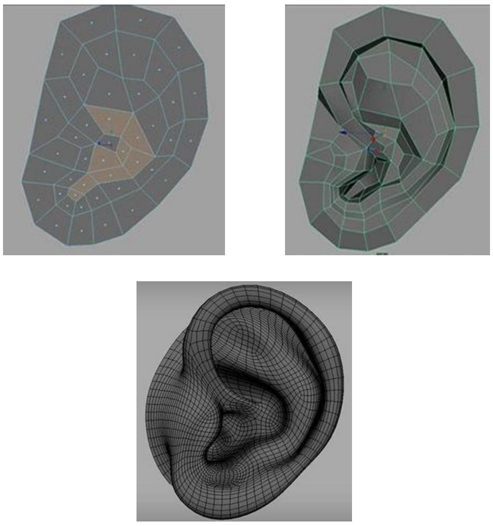

Fig. 2 – 3D Modeling of Ear

We use surgical instrument like scalpel to validate the correctness of the physical model. On the surface of ear, a scalpel results in a long and narrow deformation. The experimental results prove that the physical model can reflect the basic feature of the ear deformation. In the virtual surgery, lack of force feedback will not only make the virtual simulation system anamorphic, but can also cause an incorrect operation. So we can say that force feedback is essential for surgery simulation. Today, Virtual surgical simulation is getting more and more interest from all over the world. It is a good complement to old surgical training, it provides a safe, economical way in medical training in which the surgeons can control the haptic devices to interact with the virtual 3D organs, acquire the tissues pathological information from some phenomena like surface rendering.

B. Scalpel

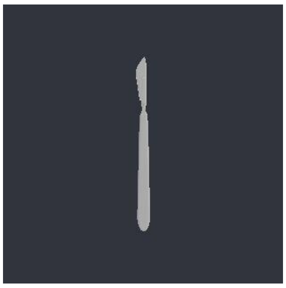

Fig. 3 – Model of a Scalpel

For cutting operation to be performed there must be a requirement of any surgical instrument. We designed the 3D Scalpel in 3DsMax.Cutting surgery simulation is done with the help of this scalpel. User can experience the force feedback when this scalpel cuts the physical model.

VI. EXPERIMENT AND RESULTS

Here, we are performing experiment in unity software itself. We design 3D model of human ear and associated 3D scalpel (in 3dsMax software as mentioned earlier) in order to cut it. As we moves the pen of the haptic device or pointer of the mouse, the scalpel moves in the virtual environment. We can cut the ear in multiple ways like in horizontal, in vertical or in an inclined direction. After cutting ear with the scalpel, the parts of the ear are fell down while the scalpel remained in virtual medium.

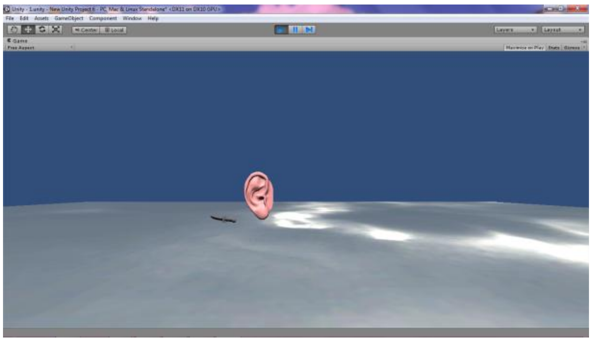

Fig. 4 – Ear and scalpel in Virtual environment before cutting

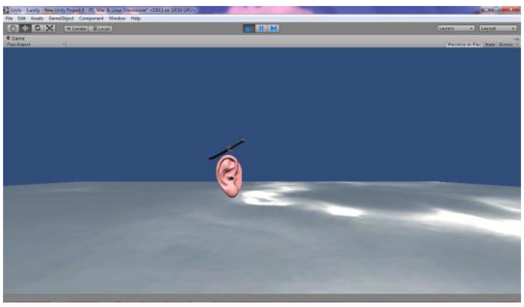

Fig. 5 – Scalel above the ear before cutting

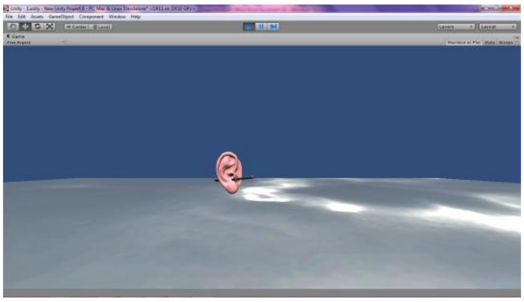

Fig. 6 – Scalpel cutting the ear

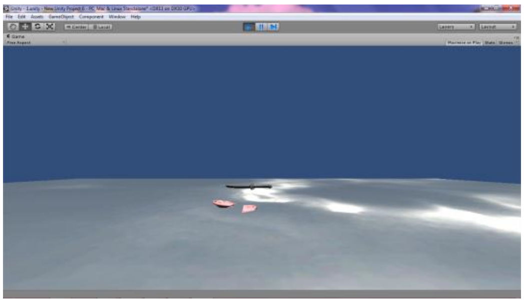

Fig.7 – After cutting ear fell down.

VII. CONCLUSION

Based on the haptic device, a surgery simulation system is put forward. A cutting model is proposed in the paper and is tested based on the simulation system. A model is used as the internal physical model of the surgery object; deformation and force feedback in the virtual surgery are realized by the physical model. And a surface model associated with the physical model is constructed. Hence it concluded that the proposed method in the paper is feasible.

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