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HAPTIC TECHNOLOGY: A TOUCH REVOLUTION

R.Waheetha,
Head, Department of Computer Science
Holy Cross Home Science College
Thoothukudi, TamilNadu, India.

S.Jeya Revathi,
Student, Department of Computer Science
Holy Cross Home Science College
Thoothukudi, TamilNadu, India

Abstract: Haptic is the "science of applying tactile sensation to human interaction with computers"**.** In our paper we have discussed the basic concepts behind haptic along with the haptic devices and how these devices are interacted to produce sense of touch and force feedback mechanisms. Also the implementation of this mechanism by means of haptic rendering and contact detection were discussed. We mainly focus on 'Application of Haptic Technology in Surgical Simulation and Medical Training'**.** Further we explained the storage and retrieval of haptic data while working with haptic devices. Also the necessity of haptic data compression is illustrated.

keywords: Haptic, tactile,CyberGrasp,PHANTOM, Surgical Simulation

I. INTRODUCTION

Haptic, is the term derived from the Greek word**,** haptesthai, which means 'to touch'. Haptic is defined as the "science of applying tactile sensation to human interaction with computers"**.** It enables a manual interaction with real, virtual and remote environment. Haptic permits users to sense ("feel") and manipulate three-dimensional virtual objects with respect to such features as shape, weight, surface textures, and temperature. A Haptic Device is one that involves physical contact between the computer and the user.By using Haptic devices, the user can not only feed information to the computer but can receive information from the computer in the form of a felt sensation on some part of the body. This is referred to as a Haptic interface**.**In our paper we explain the basic concepts of 'Haptic Technology and its Application in Surgical Simulation and Medical Training'.

II. HAPTIC DEVICES

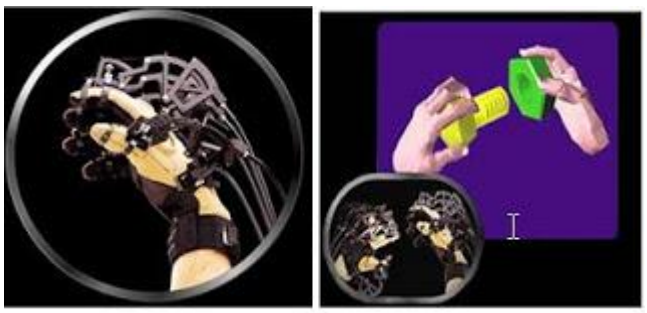
Force feedback is the area of haptics that deals with devices that interact with the muscles and tendons that give the human a sensation of a force being applied—hardware and software that stimulates humans' sense of touch and feel through tactile vibrations or force feedback.

These devices mainly consist of robotic manipulators that push back against a user with the forces that correspond to the environment that the virtual effectors are located. Tactile feedback makes use of devices that interact with the nerve endings in the skin to indicate heat, pressure, and texture. These devices typically have been used to indicate whether or not the user is in contact with a virtual object. Other tactile feedback devices have been used to stimulate the texture of a virtual object. PHANTOM and CyberGrasp are some of the examples of Haptic Devices.

a) PHANTOM: A small robot arm with three revolute joints each connected to a computer-controlled electric DC motor. The tip of the device is attached to a stylus that is held by the user. By sending appropriate voltages to the motors, it is possible to exert up to 1.5 pounds of force at the tip of the stylus, in any direction.

a)Phantom Device

b) CYBERGRASP: The CyberGlove is a lightweight glove with flexible sensors that accurately measure the position and movement of the fingers and wrist. The CyberGrasp, from Immersion Corporation, is an exoskeleton device that fits over a 22 DOF CyberGlove, providing force feedback. The CyberGrasp is used in conjunction with a position tracker to measure the position and orientation of the fore arm in three-dimensional space.



b) Cyber Grasp

III. HAPTIC RENDERING

It is a process of applying forces to the user through a force-feedback device. Using haptic rendering, we can enable a user to touch, feel and manipulate virtual objects. Enhance a user's experience in virtual environment. Haptic rendering is process of displaying synthetically generated 2D/3D haptic stimuli to the user. The haptic interface acts as a two-port system terminated on one side by the human operator and on the other side by the virtual environment.

Haptic Interface

IV. CONTACT DETECTION

A fundamental problem in haptics is to detect contact between the virtual objects and the haptic device (a PHANTOM, a glove, etc.). Once this contact is reliably detected, a force corresponding to the interaction physics is generated and rendered using the probe. This process usually runs in a tight servo loop within a haptic rendering system.

Another technique for contact detection is to generate the surface contact point (SCP), which is the closest point on the surface to the actual tip of the probe. The force generation can then happen as though the probe were physically at this location rather than within the object. Existing methods in the literature generate the SCP by using the notion of a god-object, which forces the SCP to lie on the surface of the virtual object.

V. APPLICATIONS OF HAPTIC TECHNOLOGY

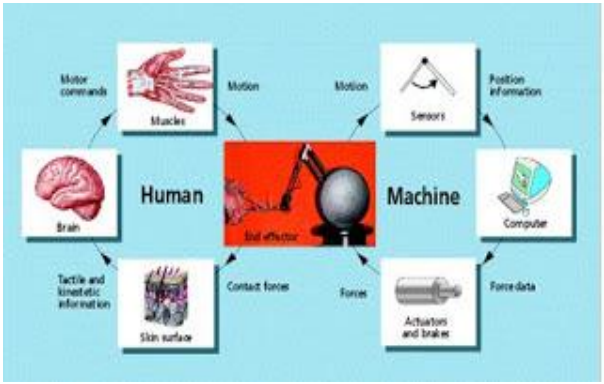
Haptic Technology as it finds it wide range of Applications some among them were mentioned below:

1. **VIDEO GAMES** : Frank haptic gadgets are regular as diversion controllers, joysticks, and directing wheels. In 2007, Novint discharged the Falcon, the first shopper 3d touch gadget with high determination three-dimensional energy feedback; this permitted the haptic reenactment of objects, surfaces, backlash, force, and the physical vicinity of objects in games.
2. **VIRTUAL REALITY :** Haptics are picking up tremendous support as an important section of virtual reality frameworks, adding the feeling of touch to formerly visual-just arrangements.
3. **ARTS AND DESIGN :** Touching is not constrained to feeling however permits intelligence continuously with virtual objects. In this way, haptics are utilized as a part of virtual arts for example, sound combination or visual computerization and animation. The haptic gadget permits the craftsman to have immediate contact with a virtual instrument that creates continuous sound or pictures.
4. **HELPING THE BLIND FEEL A CITY :** Using a haptic interface device, a blind person can feel these forces and along with audio cues, get a much better feel of a city's or building's layout.

VI. WORKING OF HAPTIC DEVICES

Haptic is usually classified as:-

- **Human haptics** : Human touch perception and manipulation.
- **Machine haptics** : Concerned with robot arms and hands.
- **Computer haptics** : Concerned with computer mediated.



Working of haptic devices

VII. CAPTURE, STORAGE, AND RETRIEVAL OF HAPTIC DATA

The newest area in haptic is the search for optimal methods for the description, storage, and retrieval of moving sensor data of the type generated by haptic devices. This techniques captures the hand or finger movement of an expert performing a skilled movement and "play it back," so that a novice can retrace the expert's path, with realistic touch sensation; The INSITE system is capable of providing instantaneous comparison of two users with respect to duration, speed, acceleration, and thumb and finger forces. Techniques for recording and playing back raw haptic data have been developed for the PHANTOM and CyberGrasp. Captured data include movement in three dimensions, orientation, and force (contact between the probe and objects in the virtual environment).

VIII. HAPTIC DATA COMPRESSION

Haptic data compression and evaluation of the perceptual impact of lossy compression of haptic data are further examples of uncharted waters in haptics research. Data about the user's interaction with objects in the virtual environment must be continually refreshed if they are manipulated or deformed by user input. If data are too bulky relative to available bandwidth and computational resources, there will be improper registration between what the user sees on screen and what he "feels.On analyzing data obtained experimentally from the PHANTOM and the CyberGrasp, exploring compression techniques, starting with simple approaches (similar to those used in speech coding) and continuing with methods that are more specific to the haptic data. One of two lossy methods to compress the data may be employed: One approach is to use a lower sampling rate; the other is to note small changes during movement. For example, for certain grasp motions not all of the fingers are involved.Further, during the approaching and departing phase tracker data may be more useful than the CyberGrasp data. Vector coding may prove to be more appropriate to encode the time evolution of a multi-featured set of data such as that provided by the CyberGrasp. For cases where the user employs the haptic device to manipulate a static object, compression techniques that rely on knowledge of the object may be more useful than the coding of an arbitrary trajectory in three-dimensional space.

IX. ADVANTAGES OF HAPTIC INTERFACES

Haptic interfaces provide ease of use products for people who "techsavvy" with technology

- Can be used in small and compact form
- Enhance user experience in vedio games by engaging the user, making it more personalized
- Saves time and minimize coats in training new workers in the way of hptic interface products
- Reduces the need for office supplies by using digital interfaces
- Business gain a competitive advantage by implementing unique and efficient methods of operation
- Directly measure the performance gains associated with haptic feedback
- Provide immediate information for users and allows them to modify behavior to more effectively implement the task

X. DISADVANTAGES OF HAPTIC INTERFACES

- Due to the high cost companies cannot afford such equipment within their organization and consequently will not implement it.
- It has not become very common; therefore, it is still relatively expensive and may not be affordable to the average income homeowner and small business.

XI. FUTURE APPLICATIONS OF HAPTICS

Future applications of haptic technology cover a wide spectrum of human interactions with technology. Some other applications are Virtual Reality interfaces used for an internet shopping mall (remotely touching materials like clothes via the internet, CAD or other tangible spaces). Research focuses on the mastery of tactile interactions with distant objects, which if successful, may result in applications and advancements in gaming, movies, manufacturing, medical, and other industries. The medical industry stands to gain from virtual and telepresence surgeries, which provide new options for medical care One currently developing medical innovation is a central workstation which is used by surgeons for performing operations remotely. Local nursing staff set up the machine and prepare the patient, and rather than travelling to an operating room, the surgeon becomes only a telepresence . This allows expert surgeons to operate from across the country, thus increasing availability of expert medical care. It is a useful tool for simulating surgery for training purposes. Haptic technology aids in the simulation by creating a realistic environment of touch. Yet, current trends in medical technology and training methods involve less haptic feedback to clinicians and trainees.Performances of experts and novices can be modelled by using artificial intelligence techniques, in order to provide immediate constructive feedback to trainees during clinical skill practice.

XII. CONCLUSION

We finally conclude that Haptic Technology is the only solution which provides high range of interaction that cannot be provided by BMI or virtual reality. Whatever the technology we can employ, touch access is important till now. But, haptic technology has totally changed this trend. We are sure that this technology will make the future world as a sensible one.

We finally conclude that the haptic technology is the solution for interacting with the virtual environment and used widely in many applications Haptic device acts as an input and output device tracking user physical manipulations as an input and providing realistic touch sensations as an output coordinated with onscreen events. As technology evolves and computer power grows, haptic devices and effects evolve and get more realistic. This technology has proved that virtual objects can also be touched, felt and controlled. This technology must be made available for the affordable cost and the haptic devices must be made simpler and easier to use.

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