**HAPTIC TECHNOLOGY**

**BY**

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**ABSTRACT**

*A technology that adds the sense of touch to virtual environment. Haptic interfaces allow the user to feel as well as to see virtual objects on a computer, and so we can give an illusion of touching surfaces, shaping virtual clay or moving objects around. The sensation of touch is the brain’s most effective learning mechanism more effective than seeing or hearing—which is why the new technology holds so much promise as a teaching tool. With this technology we can now sit down at a computer terminal and touch objects that exist only in the "mind" of the computer. By using special input/output devices (joysticks, data gloves, or other devices), users can receive feedback from computer applications in the form of felt sensations in the hand or other parts of the body. In combination with a visual display, haptics technology can be used to train people for tasks requiring hand-eye coordination, such as surgery and space ship maneuvers.*

Keywords: Haptic Technology

**INTRODUCTION**

According to Johnson (2007) Haptic refers to sensing and manipulation through touch. The word comes from the Greek ‘haptesthai’, meaning ‘to touch. The history of the haptic interface dates back to the 1950s, when a master-slave system was proposed by Goertz (1952). Haptic interfaces were established out of the field of tele- operation, which was then employed in the remote manipulation of radioactive materials. The ultimate goal of the tele-operation system was "transparency". That is, an user interacting with the master device in a master-slave pair should not be able to distinguish between using the master controller and manipulating the actual tool itself. Early haptic interface systems were therefore developed purely for telerobotic applications

**WORKING OF HAPTIC DEVICES**

**Figure 1:Architecture for haptic feedback:**

RENDERING:

Process by which desired sensory stimulate are imposed on the user to convey information about a virtual haptic object.

The human operator typically holds or wears the haptic interface device and perceives audiovisual feedback from audio (computer speakers, headphones, and so on) and visual displays (a computer screen or head-mounted display, for example). Audio and visual channels feature unidirectional information and energy flow (from the simulation engine towards the user) whereas, the haptic modality exchanges information and energy in two directions, from and toward the user. This bi directionality is often referred to as the single most important feature of the haptic interaction modality.

**SYSTEM ARCHITECTURE FOR HAPTIC RENDERING**:

According to Peter (2009) An avatar is the virtual representation of the haptic interface through which the user physically interacts with the virtual environment.

Haptic-rendering algorithms compute the correct interaction forces between the haptic interface representation inside the virtual environment and the virtual objects populating the environment.



Figure 2.2 Haptic rendering divided into three main blocks.

1.)Collision-detection algorithms detect collisions between objects and avatars in the virtual environment and yield information about where, when, and ideally to what extent collisions (penetrations, indentations, contact area, and so on) have occurred.

2.) Force-response algorithms compute the interaction force between avatars and virtual objects when a collision is detected. This force approximates as closely as possible the

3.) Control algorithms command the haptic device in such a way that minimizes the error between ideal and applicable forces. The discrete-time nature of the haptic- rendering algorithms often makes this difficult.

The force response algorithms’ return values are the actual force and torque vectors that will be commanded to the haptic device.

Existing haptic rendering techniques are currently based upon two main principles: "point-interaction" or "ray-based".

In point interactions, a single point, usually the distal point of a probe, thimble or stylus employed for direct interaction with the user, is employed in the simulation of collisions. The point penetrates the virtual objects, and the depth of indentation is calculated between the current point and a point on the surface of the object. Forces are then generated according to physical models, such as spring stiffness or a spring-damper model.

In ray-based rendering, the user interface mechanism, for example, a probe, is modeled in the virtual environment as a finite ray. Orientation is thus taken into account, and collisions are determined between the simulated probe and virtual objects. Collision detection algorithms return the intersection point between the ray and the surface of the simulated object.

**Haptic Devices**

**Types of Haptic devices**:

There are two main types of haptic devices:

• Devices that allow users touch and manipulate virtual object.

• Devices that allow users to "feel" textures of 2-dimensional objects.

Another distinction between haptic interface devices is their intrinsic mechanical behavior. Impedance haptic devices simulate mechanical impedance—they read position and send force. Simpler to design and much cheaper to produce, impedance-type architectures are most common. Admittance haptic devices simulate mechanical admittance—they read force and send position. Admittance-based devices are generally used for applications requiring high forces in a large workspace.

**LOGITECH WINGMAN FORCE FEEDBACK MOUSE**

It is attached to a base that replaces the mouse mat and contains the motors used to provide forces back to the user.

Figure 3.1 Logitech Mouse

**Interface use is to aid computer users who are blind or visually disabled; or who are tactile/Kinesthetic learners** by providing a slight resistance at the edges of windows and buttons so that the user can "feel" the Graphical User Interface (GUI). This technology can also provide resistance to textures in computer images,, which enables computer users to "feel" pictures such as maps and drawings.

PHANTOM:

According to Gotha (2008) The PHANTOM provides single point, 3D force- feedback to the user via a stylus (or thimble) attached to a moveable arm. The position of the stylus point/fingertip is tracked, and resistive force is applied to it when the device comes into 'contact' with the virtual model, providing accurate, ground referenced force feedback. The physical working space is determined by the extent of the arm, and a number of models are available to suit different user requirements. The phantom system is controlled by three direct current (DC) motors that have sensors and encoders attached to them. The number of motors corresponds to the number of degrees of freedom a particular phantom system has, although most systems produced have 3 motors. The encoders track the user’s motion or position along the x, y and z coordinates the motors track the forces exerted on the user along the x, y and z-axis. From the motors there is a cable that connects to an aluminum linkage, which connects to a passive gimbals which attaches to the thimble or stylus. A gimbal is a device that permits a body freedom of motion in any direction or suspends it so that it will remain level at all times.

Used in surgical simulations and remote operation of robotics in hazardous environments

**Intelligent machines:**

According to Daniel (2000) The Centre for Intelligent Machines is an inter-departmental inter-faculty research group which was formed to facilitate and promote research on intelligent systems.



Figure 3.3: Intelligent System

Intelligent systems and machines are capable of adapting their behavior by sensing and interpreting their environment, making decisions and plans, and then carrying out those plans using physical actions. The mission of CIM is to excel in the field of intelligent machines, stressing basic research, technology development, and education. CIM seeks to advance the state of knowledge in such domains as robotics, automation, artificial intelligence, computer vision, systems and control theory, and speech recognition.

This is being achieved by collaborative efforts involving researchers with very different interests - CIM faculty and students come from the School of Computer Science, Department of Electrical and Computer Engineering, and the Department of Mechanical Engineering. It is this diversity of interests along with the spirit of collaboration which forms the driving force behind this dynamic research community.

**Mobile Phones**: Samsung has made a phone, which vibrates, differently for different callers. Motorola too has made haptic phones.

**Cars:** For the past two model years, the BMW 7 series has contained the iDrive (based on Immersion Corp's technology), which uses a small wheel on the console to give haptic feedback so the driver can control the peripherals like stereo, heating, navigation system etc. through menus on a video screen.

The firm introduced haptic technology for the X-by-Wire system and was showcased at the Alps Show 2005 in Tokyo. The system consisted of a "cockpit" with steering, a gearshift lever and pedals that embed haptic technology, and a remote-control car. Visitors could control a remote control car by operating the steering, gearshift lever and pedals in the cockpit seeing the screen in front of the cockpit, which is projected via a camera equipped on the remote control car.

**Robot Control**: For navigation in dynamic environments or at high speeds, it is often desirable to provide a sensor-based collision avoidance scheme on-board the robot to guarantee safe navigation. Without such a collision avoidance scheme, it would be difficult for the (remote) operator to prevent the robot from colliding with obstacles. This is primarily due to (1) limited information from the robots' sensors, such as images within a restricted viewing angle without depth information, which is insufficient for the user's full perception of the environment in which the robot moves, and (2) significant delay in the communication channel between the operator and the robot.

Experiments on robot control using haptic devices have shown the effectiveness of haptic feedback in a mobile robot tele-operation system for safe navigation in a shared autonomy scenario.

**Haptic torch for the blind**: The device, housed in a torch, detects the distance to objects, while a turning dial on which the user puts his thumb indicates the changing distance to an object. The pictured device was tested and found to be a useful tool.



Figure 5.1 Haptic Touch

**CONCLUSION**

Haptic is the future for online computing and e-commerce, it will enhance the shopper experience and help online shopper to feel the merchandise without leave their home. Because of the increasing applications of haptics, the cost of the haptic devices will drop in future. This will be one of the major reasons for commercializing haptics. 1With many new haptic devices being sold to industrial companies, haptics will soon be a part of a person’s normal computer interaction.

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