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HAPTIC TECHNOLOGY - A SENSE OF TOUCH

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ABSTRACT
Haptics is the science of applying touch (tactile) sensation and control to interact with computer applications. Haptic device offers folks a way of bit with laptop generated environments, in order that once virtual objects area unit touched, they seem real and tangible. Haptic technology refers to technology that interfaces the user with a virtual atmosphere via the sense of bit by applying forces, vibrations, and/or motions to the user. This mechanical stimulation could also be accustomed assist within the creation of virtual objects (objects existing solely during a laptopsimulation), for management of such virtual objects, and to enhance the remote control of machines and devices. This paper includes however perception technology works, concerning its devices, its technologies, its applications, future developments and disadvantages.

Keywords: *Human sense of touch, tactile feedback, Virtual object creation and control, Phantam, Haptic rendering.*

I.   INTRODUCTION

Haptical Technology or haptics is tacticle feedbacks that take advantage of user sense of touch by applying forces, vibration and motion to the user. Haptics refers to sensing and manipulation through touch. The word Haptic is derived from the Greek word "haptesthai".

Haptic Technology guarantees to possess wide reaching applications because it already has in some fields. For   example, perception technology   has created it doable to   research well however the   human   sense of bit works   by permitting the   creation   of fastidiously controlled perception virtual   objects. Hapticstechnology are often accustomed train folks for tasks requiring hand-eye coordination, such as surgery and space ship maneuvers. Although perception devices area unit capable of activity bulk or reactive forces that area unit applied by the user, it should not to be confused with touch or tactile sensors that measure the pressure or force exerted by the user to the interface. Through perception interface, human will act with the pc through body sensation and movement.

Several   applications like surgical coaching, vice etc   use perception technology   .Haptic   technology has created it doable to research well however the human sense of bit works by permitting   the   creation of fastidiously controlled perception virtual objects.

II.   LITERATURE REVIEW

Perception interfaces area unit divided into 2 main categories:
  ➢ Force feedback
  ➢ Tactile feedback

Force feedback interfaces area unit accustomed explore and modify remote/virtual objects in 3 physical dimensionsin applications as well as software, computer-assisted surgery, and computer-aided assembly. Tactile feedback interfaces deals with surface properties like roughness, smoothness and temperature.
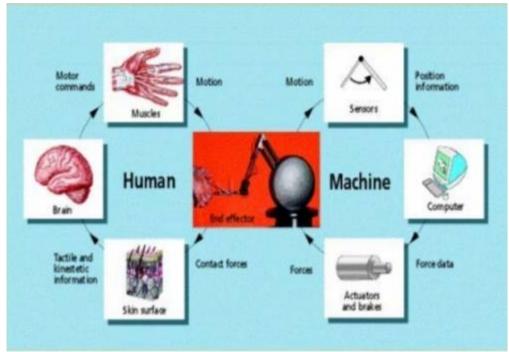
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Figure 1: Basic Configuration of haptics

Basically Haptic system consists of two parts
- ➢ Human part
- ➢ Machine part

From the above figure 1, human part (left) controlsthe position of the hand, while the machine part (right) exerts forces from the hand to simulate contact with a virtual object.Also each the systems are supplied with necessary sensors, processors and actuators.In the case of the human system, nerve receptors performs sensing, brain performs processing and muscles performs actuation of the motion performed by the hand while in case ofthe machine system, the above mentioned functions are performed by the encoders, computer and motors respectively.

Haptic Devices
Haptic devices(or perception interfaces) areaunit mechanicaldevices acts as treaterin act between the user and therefore the laptop.Haptic devices enable users to the touch, feel and manipulate three-dimensional objects in virtual environments and tele-operated systems.

Haptic devices area unit input-output devices that track a user's physical manipulations (input) and supply realistic bit sensations coordinated with on-screen events (output).
Examples of haptic devices include consumer peripheral devices equipped with special motors and sensors such as force feedback joysticks and steering wheels and more sophisticated devices designed for industrial, medical or scientific applications such as PHANTOM device.

Typically, a Haptics system includes;
- ➢ Sensor(s)
- ➢ Mechanism (motor) management electronic equipment

> One or a lot of actuators that either vibrate or exert force period algorithms (actuator management software system, that we have a tendency to decision a "player" and a haptic effect library.
> Application programming interface (API), and often a haptic effect authoring tool
> The Immersion API is used to program calls to the actuator into your product's operating system (OS).

When the user interacts with your product's buttons, touch screen, lever, joystick/wheel, or other control, this control-position information is sent to the OS, which then sends the play command through the control circuitry to the actuator.

Phantom Device

Figure 2: Phantom Device

The above figure 2 shows Phantom device.P HANTOM tactual interface is one in all the wide used tactual devices. This device measures a user's finger tip position and exerts a precisely controlled force vector on the finger tip. The device has enabled users to act with and feel a large kind of virtual objects and can be used for management of remote manipulators.

2.3 Human Senses
It's believed that vision associate degreed audition conveys the foremost info regarding an atmosphere whereas the opposite senses square measure additional delicate. Because of this, their characteristics are wide investigated over the previous couple of decades by scientists and engineers, which have led to the development of reliable multimedia systems and environments.

2.3.1 Vision
The vision is predicated on the extent of absorption of sunshine energy by the attention and therefore the conversion of this energy into neural messages. The acceptable wavelength vary for human eyes is between zero.3 and 0.7_m (1_mD10_6m).The temporal resolution sensitivity of the human sensory system is biologically restricted and not spare to discover the presentation of consecutive video frames past a particular speed. This is the reason why we do not perceive a digital movie as a series of still images, but rather as moving pictures.

Audition
The human sensory system transmits sound waves through the outer, middle, and inner ears.

This acoustic wave is reworked into neural energy within the internal ear.It is then transmitted to the cortical area for process. The sonic frequency of humans ranges from 16 to 20,000Hz and is most effective between 1,000 and 4,000Hz.

2.3.3 Touch

The sense of bit is especially related to active tactile senses like our hands. Such senses may be categorized in many ways that, and they have a link to the kinesthetic senses.

According to Heller and Schiff, touch is twenty times faster than vision, so humans are able to differentiate between two stimuli just 5ms apart and it found that bit is extremely sensitive to vibration up to 1KHz, with the height sensitivity around 250 Hz; and skin receptors on the human palm will sense displacements as low as 0.2_m in length.

Tactual feedback

Haptic/Tactile feedback (or haptics) is that the use of advanced vibration patterns and waveforms to convey info to a user or operator. Haptic feedback has two major benefits for manufacturers. Firstly, it can improve user experience. Even everyday merchandise square measure currently being engineered with bit displays and interfaces.They're cheaper to construct than control panels with buttons or switches, and designers can make context specific user interfaces simply by changing the graphical layout on the screen.

III.   HAPTIC CONCEPTS

Tactile cues embody textures, vibrations, and bumps kinesthetic cues- include weight, impact.In the following section, we present some crucial concepts and terminology related to haptics:

Haptic: Haptic is the science of applying tactile, kinesthetic, or both sensations to human-computer interactions.It refers to the flexibility of sensing and/or manipulating objects during a natural or artificial atmosphere employing a tactual interface.

Cutaneous: Relates to or involving the skin.It includes sensations of pressure, temperature, and pain

Tactile: Pertaining to the cutaneous sense, but more specifically the sensation of pressure rather than temperature or pain.

Kinesthetic: Relates to the feeling of motion.It is associated with sensations originating in muscles, tendons, and joints.

Force Feedback: Relates to the mechanical production of knowledge that may be detected by the human kinaesthetic system.

Haptics or tactual Technology: Associate degree rising knowledge domain field that deals with the understanding of human bit (human haptics), motor characteristics (machine haptics), and with the development of computer-controlled systems(computer haptics) that permit physical interactions with real or virtual environments through bit.

Haptic Communication: this suggests by that humans and machines communicate via bit.
It mostly concerns networking issues.

Haptic Device: it's a manipulator with sensors, actuators, or both.A variety of tactual devices are developed for his or her own functions.The most popular are tactile-based, pen-based, and 3 degree-of-freedom (DOF) force feedback devices.

Haptic Interface: This consists of a tactual device and software-based laptop/PC management mechanisms. It enables human-machine communication through the sense of touch. By employing atactual interface, somebody can'tsolely feed data to the pchowever may also receive information or feedback from the pc within the sort ofa physical sensation on some components of the body.

Haptic Perception: This is often the method of perceiving the characteristics of objects through bit.

Haptic Rendering: This is often the method of hard the sense of bit, particularly force. It involves sampling the position sensors at the haptic device to obtain the user's position within the virtual environment. The position info received is employed to see whether or not there area unit any collisions between the user and any objects within the virtual surroundings. In case a collision is detected, the tactual rendering module can calculate the suitable feedback forces that may finally be applied onto the user through the actuators. Haptic rendering is, therefore, a system that consists of 3components, a collision detection algorithmic rule, a collision response algorithm, and a control algorithm.

Sensors and Actuators: A sensing element is answerable for sensing the tactual info exerted by the user on a precise object and causing these force readings to the tactual rendering module.
The mechanismcans can the tactual knowledge sent by the tactual rendering module and remodel this info into a type perceivable by men.

Tele-Haptics: This is often the science of transmission actual sensations from a foreign explored object/environment, using a network such as the Internet, to a human operator. In different words, it's associate degree extension of human touching sensation/capability on the far side physical distance limits.

Tele-Presence: This is the situation of sensing sufficient information about the remote task environment and communicating this to the human operator in a way that is sufficient for the operator to feel physically gift at the remote web site. The user's voice, movements, actions, etc. may be perceived, transmitted, and duplicated in the remote location. Information is also traveling in each directions between the user and therefore the remote location.

Virtual Reality (VR): This willbe delineate because the framework of a true or virtual world wherever users can move with it in real time and alter its state to increase realism. Such interactions area unitgenerally allotted with the assistance of tactual interfaces, allowing participants to exchange tactile and kinesthetic information with the virtual environment.

Virtual surroundings (VE): This is often associate degree immersive computer game that's simulated by a laptop and primarily involves audiovisual experiences. Despite the very fact that the language is evolving, a virtual environment is mainly concerned with defining interactive and virtual image displays.

Collaborative Virtual Environments (CVE): This is often one in every of the foremost difficult fields in VR as a result of the simulation is distributed among geographically distributed computers. Potential CVE applications vary wide from medical applications to recreation.

Simulation Engine: This is often answerable for computing the virtual surroundings behavior over time.

Collaborative Haptic Audio Visual Environment (CHAVE): In addition to traditional media, such as image, audio, and video, haptics as a new media plays a prominent role in making virtual or real-world objects physically palpable in a CVE. A C-HAVE permits multiple users, every with his/her own tactual interface, to collaboratively and/or remotely manipulate shared objects in a very virtual or real surroundings.
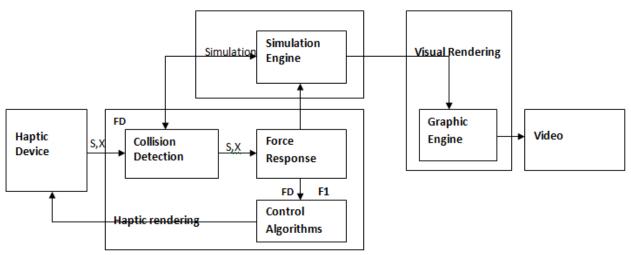
Figure 3: Haptic system block diagram

Figure 03 consists of three blocks, Haptic Rendering, Visual modeling and Simulation.
Haptic rendering is divided into three blocks.

Control Detection Algorithm: Detects collision between objects and avatar within the virtual surroundings and yield information.

Force Response Algorithm: Computes interaction between the virtual objects and avatar when the collision is detected. Control Algorithms: Command the haptic devise in order to minimize the error between ideal and application forces.

IV.   APPLICATIONS AND DISADVANTAGES

The above technology is wide employed in several applications like in recreation, surgical simulation and medical training, military training in virtual environment, Robotics, Virtual arts and design, mobile devices, research and entertainment. Implementation of haptic technology is expensive. Haptics applications may bevery complicated, requiring highly specialized hardware and considerable processing power.

V.   CONCLUSION

We tend to finally conclude that the Haptic technology is that the answer for interacting with the virtual surroundings associate degreed used wide in several applications tactual device acts as an input and output device chase user physical manipulations as associate degree input associate degreed providing realistic bit sensations as an output coordinated with onscreen events. As technology evolves and laptop power grows, haptic devices and effects evolve and get more realistic. This technology has tried that virtual objects may also be touched, felt and controlled. This technology should be created offered for the reasonable price and therefore the tactual devices should be created less complicated and easier to use.