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Haptic Technology- Interaction with Virtuality

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Abstract: *Our daily routine activities revolves on our sense of "touch" or "feel". And a technology that helps in experiencing this sense through a device is called "haptic technology". Haptic tries to evaluate the sensation of touch through various mechanisms. Haptic devices make virtual objects seam real when they are touched. Haptic technology uses force, motions and vibrations to the user to initiate interaction between virtual environment and user. With this technology we can now touch the objects that is only in the mind of a computer system but does not exist in reality. Users can receive feedbacks in the form of felt sensations in the hand or other parts of the body from computer applications using various input and output devices. The idea of haptic technology evolved from virtual reality. Haptic is a technology that is evolving day-by-day. As the demand for virtual reality is being intensified the haptic technology will also intensify. In this paper we will study the idea and evolution of haptic technology, haptic devices and their applications. Finally we will conclude with the future of haptic in our daily life.*

Keywords -*feedback,haptic, interaction , touch, virtual*

I. INTRODUCTION

Computer Science has been the source for a variety of applications in different fields. The combination of computer science and human senses has led to great inventions. The interaction between humans and communication and information ideas has been drastically changed due to the use of haptic technology in the field of computer interface. The word haptic derived from the Greek word haptikos, means “tactile, designed to be perceived by touch”. The sense of touch may be passive and active, and the term "haptic" is often used with active touch to interact or recognize objects. Among the five senses that a human posses, touch is the most proficient one. The sense of touch involves simultaneous input and output through which there is flow of information between user and virtual environment. Such kind of touch is known as “active touch”.

In the past, haptic has been helpful at creating things that are noticeable, with vibration feature in your phone or the gaming controllers. But now there’s been a shift toward creating things that feel more natural, and can interpret similarly that of natural communication. Over the past decade, there is an increase in exteroception applications that are more robust, compact, and easily controllable actuators becoming readily available.

Immersion, interaction and imagination the three important features of “Virtual Reality” are enhanced by haptic feedback. This is achieved because users can obtain immediate feedback through directly manipulating virtual objects. Imagination can be enhanced when haptic helps user to construct an virtual world that is beyond temporal limitations. Haptic feedback can provide more realistic feedback that imitates physical interaction which in turn enhances the feature of immersion.

Involving touch in human-computer interactions would enhance the fields of robotics, therapeutic rehabilitation, education, navigation, communication and even online shopping.

II. WORKING OF HAPTICS

Different technological concepts are used for providing the sensations that mimic solid objects and resistance. Devices apply force, pressure or defaince by using electric actuators, pneumatics and hydraulics.

For example, gamepads use electric motors to convey feedback vibrations. What is more fascinating is that some data gloves each track our hand movements and use air bladders to harden and limit our grip, therefore you'll feel an object virtually.

A typical Haptic Technology System includes blocks namely:
• Touch screen device with capacitive buttons
• Processor
• Driver circuit
• Actuator

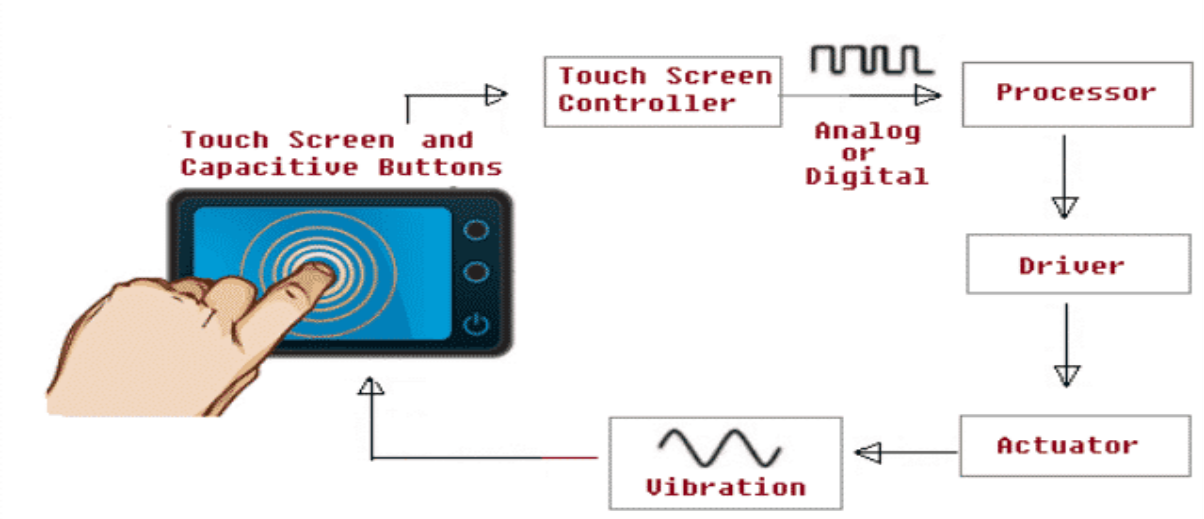

Fig.1 typical haptic technology system

The input to the Haptic Technology System could be touch, a touch to the buttons on the touch screen. This acts as an input that's sent to the touch screen controller. The sensors within the device senses the change of the quantity of force applied, the change in angle of the input and sends the result to the processor.

The information is further processed generating a waveform which could be either analog or digital which acts as an input to the drive circuit and specific instructions are given to actuator to create a pattern that creates a vibration. This feedback from actuator that is given back to the touchscreen device acts as a force feedback. The user thus feels this force feedback virtually.

III. HAPTIC DEVICES

Force feedback is that part of haptics that deals with devices that interact with various parts of physical human body that give human a sensation of a force being applied—hardware and software that trigger human's sense of touch and feel through tactile vibrations or force feedback.

These devices mainly contains robotic manipulators that keep off against a user with the forces that correspond to the environment that the virtual effector's is in. Tactile feedback makes use of devices that interact with our nervous system within the skin to point heat, pressure, and texture. These devices typically indicate whether or not the user is in touch with a virtual object. Other tactile feedback devices are used to stimulate the texture of a virtual object.

Haptic devices are often grouped into three main types: graspable, wearable and touchable. For graspable, think joysticks. One clear application is the operation of robots, in order that an operator can feel the amount of resistance the robot is pushing against.

Take surgical robots, which enable doctors to carry out operations from the other side of the earth, or to regulate tools too small or in spaces too tight for his or her hands. Numerous studies have shown that adding haptic feedback to the control of those robots increases accuracy and reduces tissue damage and operation time. Ones

with haptic feedback also allow doctors to check on patients that exist only virtually while getting the sensation of actually cutting and suturing.

Phantom and CyberGrasp are some of the examples of Haptic Devices.

3.1 Phantom

It is used for providing 3D touch to virtual objects.it provides a programmable sense of touch that allows user to feel the texture and shape of virtual objects.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's held by the user. By sending appropriate voltages to the motors, it's possible to exert up to 1.5 pounds of force at the tip of the stylus, in any direction. It was developed by Sensible Technology.

Fig. 2 phantom device

3.2 CyberGrasp

The CyberGrasp , a light-weight 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 matches over a 22 DOF CyberGrasp, providing force feedback. It is used in conjunction with a foothold tracker to measure the position and orientation of the fore arm in three-dimensional space. There are five actuators one for each finger.

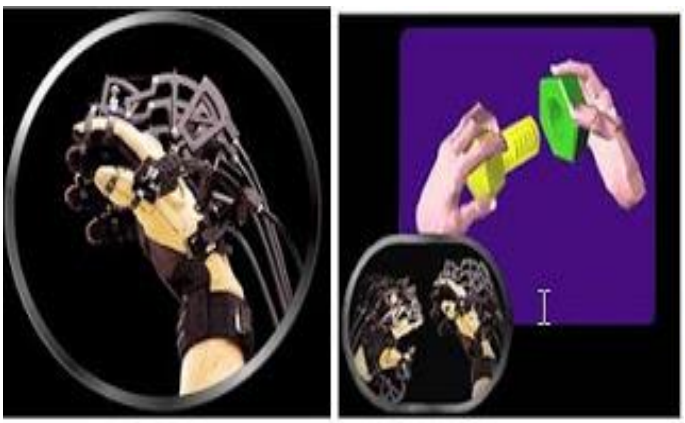

Fig. 3 cybergrasp

IV. APPLICATIONS OF HAPTIC TECHNOLOGY

Haptic Technology has a wide range of applications some among them were mentioned below:

4.1 Tactile electronic displays

A tactile electronic display may be a display device that delivers text and graphical information using the sense of touch. Devices of this sort are developed to assist blind or deaf users by providing assistance for visual or sound.

4.2 Surgical simulation and medical training

A primary application area for haptics is in surgical simulation and medical training. Haptic rendering algorithms finds collisions between surgical instruments and virtual organs and generate organ-force responses to users through haptic interface devices. For haptic rendering, conceptually divided minimally invasive surgical tools are conceptually divided into two generic groups based on their functions.

4.2.1 Long, thin, straight probes for palpating or puncturing the tissue and for injection (puncture and injection needles and touching probes).

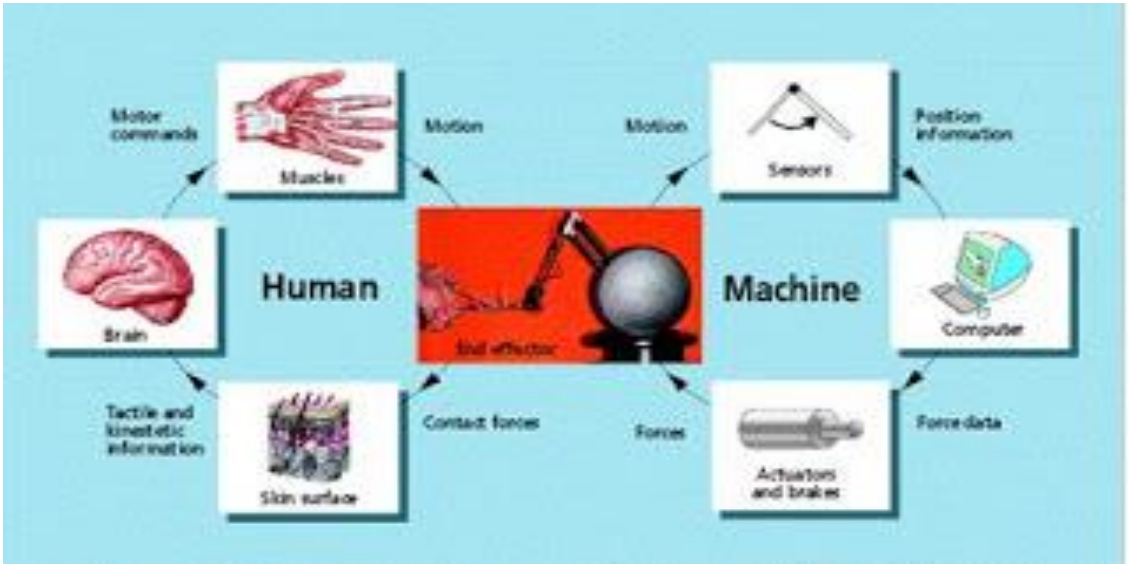

Fig.4 haptic science operational structure

4.2.2 Articulated tools for pulling, clamping, gripping, and cutting soft tissues (such as biopsy and punch forceps, hook scissors, and grasping forceps).

4.3 Virtual reality

Haptics are receiving vast support as a vital part of virtual reality frameworks, adding the feeling of touch to formerly visual-just arrangements. an large portion of these arrangements use stylus-based tactile rendering, when the user interacts with the virtual world by means of a tool or stylus, giving an illustration of association that is computationally sensible on today's hardware. Frameworks are endlessly being generated to involve perception interfaces in 3d demonstration and plans that provide specialists a virtual expertise of real intelligent displaying.

4.4 Arts and design

Touching is not restricted to feeling but permits intelligence endlessly with virtual objects. By this manner, haptics are utilised as an area of virtual arts for instance, sound combination or visual computerization and animation. The tactile device permits the artists to have immediate contact with a virtual instrument that systematically produces sound or photos. Case in point, the reproduction of a fiddle string creates continuous vibrations of this string below the load and quality of the bow (haptic gadget) command by the craftsman. This may well be attainable with physical demonstrating mix.

4.5 Cell phones

Material haptic feedback is going to be basic in cell gadgets. Mobile phone manufacturers deploy distinctive types of tactile innovations in their gadgets, this takes the manifestation of vibration reaction to the touch. High physical science deploys a haptic feedback technology named plus touch on a considerable heap of their touch-screen automotive vehicle route and stereo units. The Nexus One gimmicks tactile feedback, as indicated by their determinations.

4.6 Wearable haptics

With Google Glass and Kinect changes, it would appear that we're coming into an entire new world of wearable body sensors and pc systems. Gadgets like these may well be modified to make a very new ideal model of human and computer cooperation, giving help to visually impaired people, knowledge and facilitate for those with distinctive needs, or even extra affiliation whereas doing completely different assignments change of state, driving throughout a gathering and far more.

V. CONCLUSION

5.1 Future of Haptics

5.1.1. Wearable devices that aim to enhance well-being wearable devices, like step trackers, are already serving to individuals improve their health. Now, wearable devices are using haptic technology to boost overall well-being. Apollo, which can be a brand new wearable device, aims to help once the body gets over stressed. throughout stressful time, the body activates its “fight or flight” response. repeated nerve-wracking events will cause fatigue and anxiety over time.

5.1.2. An even bigger shift toward digital buttons and controls Ever since mobile phones created their debut, every new invention has become more user friendly. Take a look at your current smartphone compared to the mobile you used 10 years past. thanks to touchscreens, the phone you’re using these days has only a couple of buttons. Haptic technology is consistently serving to boost product style, with a shift toward digital buttons and alternative screen controls rather than physical buttons.

5.1.3. VR-assisted surgical training When it involves game, tactile technology isn’t new. However, this technology combination is currently moving on the far side of gaming by serving to medical professionals learn new surgical techniques. Fundamental Surgery, which can be a completely licensed VR education platform, uses a VR headset and perceivable haptic devices to simulate the tactile experiences of surgery. With these systems already in use by medical establishments, we are able to expect haptic technology to begin taking part in an even bigger role in medical field.

Haptics is still in its intial phase. It has a number of applications as discussed above. However it has various limitations like high cost, large weight and size of the haptic devices and few more. With the increase of development to achieve future aspects this limitations can be removed.

We finally conclude that haptic Technology is the only alternative that gives high kind of interaction that cannot be provided by BMI or video game. No matter the technology we are going to use, sense of touch is extremely vital. But, tactile technology has changed this trend. As the use of tactile devices can increase it'll cause the drop of their value. Haptic in future can change in the manner online interaction takes place. We tend to thus have positive expectations that this technology will build the long run world as a sensible one.

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