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How to Possible Virtual Education by Haptic Technology

Uttama Suryavanshi

Lecturer, *Information Technology*,
CSVTU University Bhilai (Chhattisgarh) India

Abstract **- In this paper we study and introduce some ideas of applying Haptics technology in the field of Education. We argue that Haptics technology of virtually touching and feeling objects and forces, enhances the existing methods and procedures of teaching and learning and it is a valuable tool for pupils and students to apprehend certain aspects of knowledge. The effectiveness of Educational applications concerning school age children can be enhanced by the immersion that Haptics technology provides. The objects that appear visually on the screen also exist physically in a virtual way in order to provide the impression that they can be touched and manipulated as if they were real objects. This work presents on the one hand, the specifications and design of an educational haptic device and an educational platform and on the other hand, the educational trial of the applications that specially constructed in order to use this advanced virtual reality system. New haptic device designed especially for educational purposes and a prototype were implemented, interactive educational software . 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. Haptic technology focuses on making the technology secondary to the interaction between the user and the desired object. ."Haptic technology is like exploring the virtual world with a stick. The computer communicates sensations through a haptic interface –a stick, scalpel, racket or pen that is connected to a force-exerting motor.**

Keywords **– Interactive Kiosk Demonstrator , Teleoperated , Falcon, Haptic 3D Interface,**

I. INTRODUCTION

In the recent years, education has been influenced by technology evolution in several ways. Informatics has offered various tools and methodologies that led in applications with visual or acoustical interaction. Picture and motion aided in the apprehension of the Physical World and helped students acquire a better image of Science . . Haptic technology comes from the Greek word "haptesthai", meaning to touch . Haptic refers to technology that uses touch to control and interact with computers. A user may apply a sense of touch through vibrations, motion or force. Haptic technology is used mainly in creating virtual objects, controlling virtual objects or in the improvement of the remote control of machines and devices. The word haptic is derived from the Greek "haptikos," which means a sense of touch. Or to grasp or perceive. Haptic sensations are created in consumer devices by actuators, or motors, which create a vibration. Those vibrations are managed and controlled by embedded software, and integrated into device user interfaces and applications via the embedded control software APIs. Haptics refers to sensing and manipulation through touch. The term haptics has been used by psychologists for studies on the active touch of real objects by humans. Haptics is the science of applying tactile sensation to human interaction with computers. A haptic device is one that involves physical contact between the computer and the user, usually through an input/output device, such as a joystick or data gloves, that senses the body's movements. 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. Haptics includes all aspects of information acquisition and object manipulation through touch by humans, machines, or a combination of the two; and the environments can be real, virtual or teleoperated. This is the sense in which substantial research and development in haptics is being pursued around the world today .

II . HISTORICAL BACKGROUND

Haptics technology started in the late 50's early 60s, with scientists such as Ralph Mosher (1962-64) who used the technology as a component in his robotic systems and exoskeletons (GE Pedipulator). Traditionally human interactions with computers have been predominantly visual, using text, data or imagery on screen. The keyboard or mouse is used to input and manipulate this data but there is no physical response relayed back to the user as a result of those actions. Haptics can provide both touch (tactile) and motion feedback and can simulate physical properties, such as the weight of an object, the user can feel friction, texture or resistance and the haptic hardware can communicate those properties and lets the users sense what is happening on the screen. Haptic interfaces come in many forms, such as touch mice, gloves, styluses and joysticks. a common arrangement uses an articulated stylus to link a person's fingers to a computer interface. Haptic technology is intuitive. Haptics is hoping to increase the human-computer interaction by enhancing the quality of communication between humans and their physical environment through touch. This takes advantage of the sense of touch by applying forces, vibrations, or emotions to the user. When tactile feedback, address things like devices such that they provide users with the sensations of heat, pressure, and texture, overall motion that support the already existing visual and audio aspects.

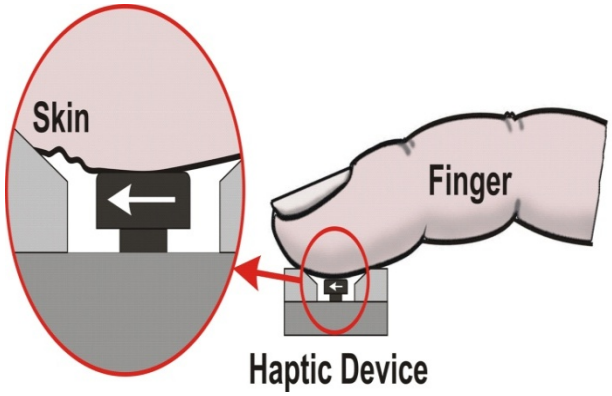

Fig 1 Concept of haptic technology

III. POSSIBILITIES AREAS OF HAPTIC TECHNOLOGY

There are so many potential opportunities for haptic technology:

- Entertainment**:** Like we saw in the Disney Research example above, the possibilities are extremely exciting in the field of games and entertainment with haptic technology. The challenge will be bringing this technology down to a reasonable price point, along with an understandable, dynamic user interface.
- Hardwired**:** Some proponents of this technology believe that one day haptic technology will be able to directly stimulate the central nervous system in order to replicate a touch experience. This could mean brain implants, nerve stimulation, and mechanical interfaces that work in tandem with our bodies.
- Robots**:** Haptic technology could greatly assist those with motor control issues or elderly people who have lost or degraded functions.
- Wearable haptics**:** With Google Glass and Kinect tweaks, it looks like we're entering a whole era of wearable body sensors and computer networks. Devices like these could be tweaked to create a completely new paradigm of human and computer interaction, providing guidance for blind people, information and help for those with special needs, or even extra interaction while doing other tasks – cooking, driving, in a meeting, etc.
- New signals**:** We're all familiar with what a vibrating phone means, but what about making that vibration more meaningful than just "you've got a new call"? Active research is underway that could make a "haptic language" for our mobile devices, interpreted in much the same way we are able to process a traffic signal or the light on a coffee maker.
- Touchscreens**:** Our touchscreens right now offer vibrations and sound, but what about going beyond that to a touchscreen experience that allows us to reach out and "feel" images on a screen, or a touchscreen keyboard that makes it feel like we're typing on actual, raised keys?

IV. HOW HAPTIC TECHNOLOGY WORK

Haptics applications use specialized hardware to provide sensory feedback that simulates physical properties and forces. Haptic interfaces can take many forms; a common configuration uses separate mechanical linkages to connect a person's fingers to a computer interface. When the user moves his fingers, sensors translate those motions into actions on a screen, and motors transmit feedback through the linkages to the user's fingers. The screen might show a ball, for example, and by manipulating a virtual hand through the device, the user can "feel" the ball, discerning how much it weighs or the texture of its surface. Because the ball and its environment are purely virtual, the properties can be changed—adding more air to an underinflated ball to make it less squishy, or altering the amount of gravity to let users feel how much the ball would weigh on the moon.

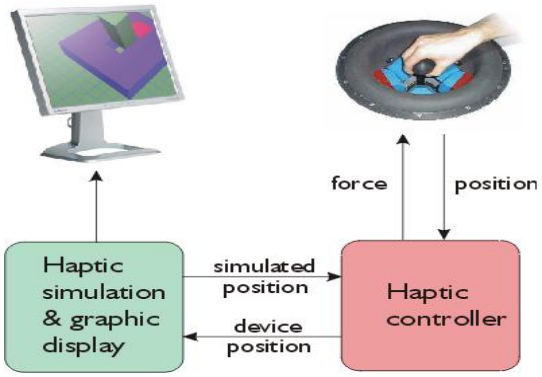

Fig2 Working principle of haptic technology

V. APPLY HAPTIC TECHNOLOGY IN EDUCATION

In the Education field the sense of touch and force-feedback can offer great improvements to the existing teaching methods, thus enhancing the quality of education procedures. Haptics Educational Applications are an under development research field and some non-commercial applications have been developed for the above haptic interfaces. In our research and study, the applications and the device are oriented to each other and both to educational purposes.

Education has evolved and new teaching methods have been acquired in order to improve the learning procedures. In learning procedure is to obtain knowledge without interacting with the media that offers it. One such way is by reading books, where the student accepts the knowledge but has limited ways to test if he has fully perceived it. But now a days with the help of Haptics technology Learning Procedure's Is making practical based .

The Falcon was actually created as a video game controller but works exceptionally well as a classroom tool. It's a futuristic-looking device made of metal and plastic, consisting of a base and three arms connected to a spherical-shaped grip. These arms are positioned around the base at the 12 o'clock, 8 o'clock, and 4 o'clock positions. Thus, when move the grip, the three arms move simultaneously. Each arm is paired with a motor that updates the arm's position every thousandth of a second,

which leads to a high level of accuracy and creates realistic-feeling objects in a virtual environment. It weighs six pounds and is nine by nine by nine inches. It's compatible with Windows 95 or higher, connects to the computer via USB, and has a power supply to plug it into an outlet.

To feel virtual objects, you hold the spherical grip with your dominant hand by positioning all five fingers around its circumference, and then you can move the grip up/down, left/right, and in/out to sense all three dimensions of objects. It's like a Cartesian graph found in mathematics where you deal with the x, y, and z planes. Feeling virtual objects with the Falcon differs from how use sense of touch in reality. With real-life touch, the entire surface area of hand(s) placed on the object to discern texture, size, and shape. Yet, on the Falcon, feel a small patch (less than a square inch in size) through the grip at once, so have to move the grip around to piece these patches together to discern the whole object. One analogy is to picture extending two fingertips to explore the surface area of an apple, finding the top portion, moving to the bottom, and then going around the circumference. The Falcon can depict virtual objects that are sizes of four by four by four inches or smaller. For reference, a virtual bowling ball is about four inches in circumference, and a virtual pea is about one-eighth inch in circumference. Two pounds is the maximum virtual weight of an object, so this amount is used when showing the weight of the heaviest items. Then, lighter ones are scaled to this number.

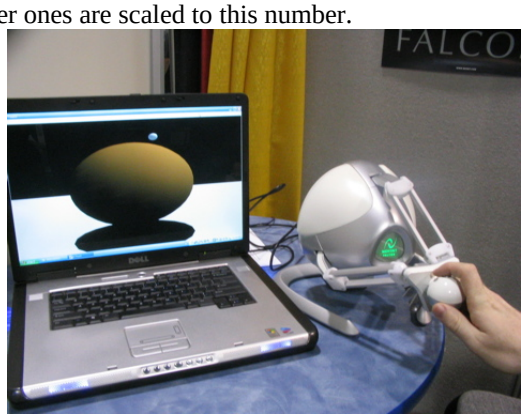

Fig 3 Haptic technology falcon

The goal of this application is to have students understand the difference between weight and mass due to the amount of gravity present. The first screen's speech output gives definitions for these terms and shows a bowling ball of a set mass. Successive screens show this same bowling ball, but it is located in different celestial bodies' atmospheres, including Earth, Earth's moon, Jupiter, Mars, and Venus. The awesome thing is that can pick up the bowling ball to compare differences in weights! This virtual sensation is caused by change in tension of the Falcon's arms. When touching the ball surface, there is no resistance coming through the arms to the grip, but when press and hold down a button on the grip, instantly feel tension increase in the arms. Can even change its location on the screen by picking it up and moving hand on the Falcon's grip to go from the foreground to background.

In this technology the users grab two different spaceships. The users do not control the trajectory of the spaceships. Instead, the spaceships move on a predefined trajectory while H3DI responds (through force feedback) to the planets' gravity fields. Thus, the users are able to concentrate on the forces they feel on their fingers and realize the different gravity fields of the planets. 3D sound effects will help users perceive the volume and the direction of the forces, and filling in the planet, the special areas are distinguished with hot spot marks. They feel the geometry of the planet surface and distinguish between rock, ice and water surface types. A close-up, constant view of the planet is presented to them, so that they can gather specific information about it. The planet is converted into such a size that the user can use hand to rotate it and explore its surface. The Metaphor is a huge-hand resembling the users' hand on the H3DI device. They will be able to feel the geometry of the planet surface and distinguish between rock, ice and water surface types. Moreover, textual and pictorial information of the space object is presented on the side of the screen.

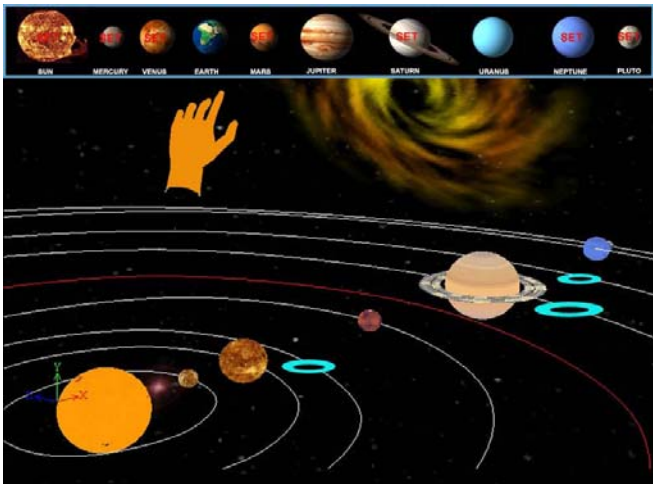

Fig 4 To touch planet surface using haptic technology

Multi User Virtual Interactive Interface (MUVII) project that aims at developing an Immersive Theater Demonstrator (ITD) and an Interactive Kiosk Demonstrator (IKD). The IKD requires the development of a prototype Haptic device (H3DI – Haptic 3D Interface) and certain applications for educational purposes. This project offers the opportunity to study the Haptic technology and its appliances in new ways of learning and teaching

IKD- H3DI – Haptic 3D Interface:- The IKD requires the development of a prototype Haptic device (H3DI – Haptic 3D Interface) and certain applications for educational purposes. An H3DI – Prototype has been developed by CEA . It is composed by two 3-DOF robots attached to the hand allowing finger movements without restriction (except closing movements are limited to ~20mm aperture due to tactile motors). The Force feedback on each finger is 5N in all directions and the device's size is adjustable to hands of various sizes. Attached on the index and thumb fingers are two tactile motors, whose function is to allow the user feel the surface contours and textures. Developed by Computouch , each one of them

weighs 15gr, has a 20mm diameter and is15mm high. The integration on the H3DI allows a good force feedback on finger while keeping fingertip free for tactile feedback.

Fig 5 : Haptic device IKD-H3DI

VI. EDUCATION BENEFITS

- Haptic involves active and intentional action
- Combination of kinesthetics and sensory perception creates
- Particularly strong neural pathways in the brain
- Students are able to feel nano-sized materials such as viruses that are imaged under an atomic force microscope

VII. FUTURE USE OF HAPTIC TECHNOLOGY

- Future use of haptic technology covers a wide array of human technology and interaction. For the retail industry, some people speculate the coming of feel and texture of clothing in online shopping.
- The idea of telepresence is really phenomenal, as it allows doctors and surgeons from all over the world to be able to operate on any patient that is under the device and able to feel every movement he makes as he was there in reality
- Military use of haptic technology is also very common. Soldiers can prepare for battle in a variety of ways, from learning how to defuse a bomb to operating a helicopter, tank or fighter jet in virtual combat scenarios.

VIII. CONCLUSIONS

The concept has been applied to students in a case study experiment to validate the learning methodology. In the end their knowledge was tested and their perception on the relevance and interest of the system was evaluated. Results show that physics understanding was greatly enhanced and that students motivation for learning, even theoretical aspects and concepts, was increased . In relation to the practical way of learning using haptic technology it is clear that it raised the interest and motivation of the students . The haptic technology is the solution for interacting with the virtual environment and used widely in many applications. This technology must be made available for the affordable cost and the haptic devices must be made simpler and easier to use. Improved accuracy and richness in object modeling and haptic rendering will require advances in our understanding to carry out real-time computations. Our efforts to communicate information by rendering how objects feel through haptic technology, and the excitement in our pursuit, might reflect a deeper desire to speak with an inner, physically based language that has yet to be given a true voice.

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