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Human computer Interaction in Virtual Reality

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Abstract: Biometric as the science of recognizing an individual based on his or her physical or behavioral traits, it is beginning to gain acceptance as a legitimate method for determining an individual identity. Biometric have now been deployed in various commercial, civilian, and national security applications. Biometrics has been identified as a promising, even disruptive, technology for at least ten years. Around the globe, governments are pursuing policies that depend on information and communication technology ICT and government give the proposal for a national identity system, based on biometrics. This paper is try to focus on role of human computer interaction in virtual reality.

Keywords: HCI, ICT, Virtual reality

I. Introduction to HCI

Humans interact with objects of all types in the world on a daily bases. These objects can be as simple as an apple or as complex as a car or a computer. However, most interactions occur with other humans. These interactions can take the form of verbal behavior such as talking or non-verbal behavior such as gaze, gestures or body language. There are many factors that drive this behavior, such as, personality, emotion, mood and cognition, culture, gender, history and education. The task of describing all this behavior embodies a huge amount of work from neuroscience and psychology to Cognitive science and artificial intelligence.

Virtual humans are embodied interactive agents that represent real humans in a virtual environment. These avatar characters take on human representations in their appearance, interaction and decision making and are used in many applications that require human-like interfaces, such as guides, trainers or medical. These human like qualities add to the complexities and constraints on the way users interact with the virtual characters.

Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them [1].

Biometric authentication or, simply biometrics, refers to establishing identity based on the physical and behavioral characteristics of an individual. The physiological characteristics include Iris, Finger Print, Retinal, Palm Prints, Hand Geometry, Ear, Face and DNA, while the behavioral characteristics include Handwriting, Signature, Body Odor, Gait, Gesture and Thermal Emission of Human Body [4]. Biometric involve two categories: physiological biometrics and behavioral biometrics.[7]

Areas of HCI research emerge, all engaged with interactive computing systems for human use. In the following I briefly outline these and their individual key activities.

A. Design of interactive computing systems "is about developing interactive products that are easy, effective and enjoyable to use". Within this focus, the primary activity is the creation of new design solutions.

B. Implementation of interactive computing systems focuses on providing "knowledge about the capability of technology and ideas about how this potential can be harnessed". Within this focus, the primary activity is building applications.

C. Evaluation of interactive computing systems "is concerned with the process of system-atically collecting data that informs us about what it is like for a particular user or group to use a product for a particular task in a certain type of environment". The primary activity within this focus is usability data collection and analysis.

D. The study of surrounding phenomena addresses issues such as "how the introduction of computers will influence work practices" or "how to make sense of what is going on when people communicate with each other or with machines". The primary activity within this focus is the conduction of user studies.

II. Virtual Reality

Virtual reality can be defined as an upcoming technology that makes users feel in a Virtual Environment (VE) by using computer hardware and software. It was originally conceived as a digitally created space which humans could access by donning special computer equipments. It enables people to deal with information more easily. VR provides a different way to see and experience information, one that is dynamic and immediate. The goal of *virtual reality* (VR) systems is to immerse the participant within a computer-generated, *virtual environment* (VE). Interacting with the VE poses issues unique to VR. The ideal VE system would have the participant fully believe he was actually performing a task. Every component of the task would be fully replicated. The environment would be visually identical to the real task. Further, the participant would hear accurate sounds, smell identical odors, and when they reached out to touch an object, they would be able to feel it. For example, in a VR system to examine designs for product assembly, the ideal system would

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present an experience identical to actually performing the assembly task. Parts and tools would have mass, feel real, and handle appropriately. The participant would interact with every object as if he would if he were doing the task. The virtual objects would in turn respond to the user's action appropriately. Training and simulation would be optimal.

Following are the main components of a virtual environment:

1. The visual displays that immerse the user in the virtual world and block out contradictory sensory impressions from the real world.
2. The graphics rendering system that generates the ever changing images at 20 to 30 frames per second.
3. A tracking system that continuously informs the position and orientation of the user's movements.
4. The database construction and maintenance system to build and maintain a detailed and realistic model of the virtual world.
5. A sound system that can produce high quality 000directional sounds and simulated sound fields.
6. Devices like tracked gloves with pushbuttons to enable users to specify their interactions with the virtual objects.

Why have virtual reality?

This may seems like a lot of effort, and it is! What makes the development of virtual reality worthwhile? The potential entertainment value is clear. Immersive films and video games are good examples. The entertainment industry is after all a multi-billion dollar one and consumers are always keen on novelty. Virtual reality has many other, more serious, applications as well.

There are a wide variety of applications for virtual reality which include:

- Architecture
- Sport
- Medicine
- The Arts
- Entertainment

Virtual reality can lead to new and exciting discoveries in these areas which impact upon our day to day lives.

Wherever it is too dangerous, expensive or impractical to do something in reality, virtual reality is the answer. From trainee fighter pilots to medical applications trainee surgeons, virtual reality allows us to take virtual risks in order to gain real world experience. As the cost of virtual reality goes down and it becomes more mainstream you can expect more serious uses, such as education or productivity applications, to come to the fore. Virtual reality and its cousin augmented reality could substantively change the way we interface with our digital technologies. Continuing the trend of humanizing our technology.

General Experimental Setup

There a number of systems but they have some common features that include:-

1. A set of goggles that controls what your left and right eyes see. By providing slightly different views into each eye, your brain is fooled into thinking that the scene is 3D. Virtual chairs look solid and so on.
2. Other wearable input devices are used such as gloves that detect your finger movements. As you wiggle or tap your fingers on a virtual control then the computer carries out the command, such as turning on a virtual television.
3. Headphones to control what you hear.

The other part is a powerful computer that can create the graphics and sound in 'real time'. These images may be projected onto the walls and floor of the room. So you can walk around freely.

A. *VR Interaction with Technology*

Tracking and signaling actions are the primary means of input into VEs.

INPUTS

Tracking is the determination of a object's position and orientation. Common objects to track include the participant's head, participant's limbs, and interaction devices (such as gloves, mice or joysticks). Most tracking systems have sensors or markers attached to the objects. Then, other devices track and report the position and orientation of the sensors.

Commercial tracking systems employ one or a combination of mechanical, magnetic, optical, acoustic, inertial, and *global position satellites* (GPS) approaches. Each method has different advantages with respect to cost, speed, accuracy, robustness, working volume, scalability, wifelessness, and size. No one tracking technology handles all tracking situations.

Object tracking, usually accomplished by attaching a sensor, allows a virtual model of an object to be registered with a physical real object. For example, attaching a tracker to a dinner plate allows an associated virtual plate to be naturally manipulated. Since each sensor reports the pose information of a single point, most systems use one sensor per object and assume the real object is rigid in shape and appearance.

The most common interaction devices are tracked mice (sometimes called bats) and joysticks. They are identical to a regular mouse and joystick, but with an integrated 3 or 6 *degrees-of-freedom* (DOF) tracking sensor that reports the device's position and/or orientation. Tracked mice and joysticks have numerous buttons for the participant to provide input, and they are cheap, easily adaptable for different tasks, and familiar to many users. However, they might not provide the required naturalness, feel and functionality for a given task.

OUTPUTS

Given the system inputs, the resulting VE (visuals, audio, tactile information) is outputted to the participant. For

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example, as the participant changes their head position and orientation, the tracking system passes that information to the VR system's rendering engine. 3D views of the VE are generated from the updated pose information.

VR systems use either stereo headphones or multiple speakers to output audio. Given the participant's position, sounds sources, and VE geometry, stereo or specialized audio is presented to the user. VR haptic (tactile) information is presented to the participant through active feedback devices. Examples of force feedback devices include a vibrating joystick (e.g. vibrating when the user collides with a virtual object) and the Sensible Phantom, which resembles a six DOF pen. Active feedback devices can provide a high level of HCI fidelity.

III. VR INTERACTION

Training and simulation VR systems, which make up a substantial number of deployed systems, aim to recreate real world experiences. The accuracy in which the virtual experience recreates the actual experience can be extremely important, such as in medical and military simulations.

The fundamental problem is that most things are not real in a VE. The other end of the spectrum having all real objects removes any advantages of using a VE such as quick prototyping, or training and simulation for expensive or dangerous tasks. Having everything virtual removes many of the important cues that we use to perform tasks, such as motion constraints, tactile response, and force feedback. Typically these cues are either approximated or not provided at all. Depending on the task, this could reduce the effectiveness of a VE.

Fig. 1. Virtual Keyboard

The participant interacts with objects in the VE, simulations, and system objects. The methods to interact will vary on the task, participants, and equipment (hardware and software) configuration. For example, the interactions to locate 3D objects in orientation and mobility training for the vision impaired are different than those in a surgery planning simulation. Variables to consider include accuracy, lag, intuitiveness, fidelity to the actual task, and feedback.

A. *VR Simulation Interaction*

VR systems use simulations for a variety of tasks, from calculating physics (i.e. collision detection and response) to lighting to approximate real world phenomena. Most VR systems require participant interaction to control simulation objects and the simulation itself. For example, in a military solider simulation, the participant affects a soldier's view and battlefield location and provides input such as pressing buttons for firing his weapon.

Many simulations focus on recreating realistic experiences for the participant. Having a natural means of interaction improves realism. However, this adds to the difficulty in high-quality VR interaction. We can engineer specific objects, for example a prop machine gun with the trigger sensor connected to the computer, but that increases cost and reduced generality (the prop has limited uses in other applications). On the other end of the spectrum, using a generic interaction device, such as a tracked joystick, might prove too different than the actual task to provide any benefit.

Fig. 2. VR Simulation

Our relationship with computers has altered dramatically. Where the interface or point of contact with computers now resides and the extent to which it is visible to us is now no longer as clear as when we interacted at the desktop or the terminal. One trajectory is inward, moving the boundary closer to us and making our interaction with digital systems more intimate in nature. For example, we now carry in our pockets and our handbags multiple points of contact to a computational infrastructure, such as a mobile phone, iPod or BlackBerry. With the shift to medical monitoring and embedded bio-sensing devices this is likely to get closer still. Indeed, it may be difficult to define the boundary at all when devices are embedded within us.

IV. CONCLUSION:

In this paper we suggest that HCI needs to extend its methods and approaches as to focus more clearly on human values. This will require a more sensitive view about the role, function and consequences of design, just as it will force HCI to be more inventive. The advantages of using a VE such as quick prototyping, or training and simulation for expensive or dangerous tasks.

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