Chapter 9
Approaches and Applications of Virtual Reality and Gesture Recognition:
A Review

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ABSTRACT

Interaction with a computer has been the center of innovation ever since the advent of input devices. From simple punch cards to keyboards, there are number of novel ways of interaction with computers which influence the user experience. Communicating using gestures is perhaps one of the most natural ways of interaction. Gesture recognition as a tool for interpreting signs constitutes a pivotal area in gesture recognition research where accuracy of the algorithm and the ease of usability determine the effectiveness of the algorithm or system. Introducing gesture based interaction in Virtual reality applications has not only helped solve problems which were commonly reported in traditional Virtual Reality systems, but also gives user a more natural and enriching experience. This paper concentrates on comparison of different systems and identifying their similarities, differences, advantages and demerits which can play a key role in designing a system using such technologies.

INTRODUCTION

The evolution in user experience has been humongous. One major wave of change was brought by the introduction of Graphical User Interface (GUI) which was preceded by complex commands entered through terminal to operate a computer machine (Dirk Börner, Marco Kalz, Marcus Specht, 2013). The gap between the user and the virtual environment in the computer has been narrowing at a rate faster than ever (Aggarwal, S., & Bhatnagar, V., 2013). With the introduction of the concept of technologies like Virtual Reality, the blurring of boundaries between reality and virtual world has been made plausible.

The most common approaches in gesture-recognition that have traditionally been used in the literature are: image based and sensor-based systems (Li-Minn Ang, Kah Phooi Seng & Tee Zhi Heng, 2016). While using the sensor-based systems, the user has to wear electronic gloves while performing the signs. There are many sensors within the glove to detect different hand and finger articulations. Image-based systems use camera(s) to acquire a sequence of images of the hand. In this paper, several existing methodologies that were used to implement these systems were analyzed and their merits and demerits are expounded.

The concept of Virtual Reality (VR) was first presented in 1965 by Ivan Sutherland (Mazuryk & Gervautz, 1996) who is regarded as father of computer graphics. He proposed the concept of "The Ultimate Display" that led to the creation of The Sword of Damocles, the first virtual reality game designed with specialized Head Mounted Display (HMD) and head tracking. Since then, virtual reality has come a long way. From Aspen Movie Map, CAVE to Oculus Rift and Google Cardboard, the technology has advanced over the years in terms of quality, cost and even size. VR gradually gave rise to a concept called Augmented Reality (AR) which blurred the boundaries between virtual and real world. The Virtual Trial Room Simulation (Biswas, Dutta, Dey et al., 2014) is a fine example of AR applications which aims to simulate virtual trial rooms in real-time without the need for tags, markers or expensive depth and motion cameras. Lately, attempts have been made to not only allow the user to view virtual worlds but also interact and feel the virtual world through various interaction devices and haptic sensation using props.

The paper is organized in the following order. The first following section describes the various theoretical concepts of Virtual Reality and Telepresence. The next section focuses on the myriad applications of Virtual Reality used for various fields. The third section classifies and analyses the history of gesture and sign language detection and its interpretation techniques. It explores techniques that use image processing and neural networks, sensor embedded glove based systems and the applications that use skeletal tracking devices like the Kinect and Leap Motion Controller. The final section explains how Virtual Reality can be coupled with Gesture Recognition Techniques for a more intuitive and natural user experience. It addresses the common design challenges and usability constraints posed by Virtual Reality systems.

CONCEPTS IN VIRTUAL REALITY

Since the inception of virtual reality and its conception by Ivan Sutherland, different perceptions of virtual reality have been developed and presented. While each of them differs from one another in their method of implementation, the level of immersion and sensory revelation, they all share some qualities that are unique to the concept of virtual reality. A well-known method proposed by Zelzter (Zeltzer, 1992) is the Zelzter's AIP cube which defines the components in a virtual reality environment's complexity and quality using three parameters namely – Autonomy, Interaction and Presence as shown in Figure

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