Natural Interaction techniques using Kinect

Jaime Chapinal Cervantes
Universidad de Granada
Jaime.chapinal@gmail.com

Francisco Luis Gutiérrez Vela
Universidad de Granada
fgutierr@ugr.es

Patricia Paderewski RodrÍguez
Universidad de Granada
patricia@ugr.es

ABSTRACT

The work presented focuses on the study of interaction techniques in 3-dimensional (3D) and its implementation with the device Kinect. We analyze this device and its operation in order to know their characteristics and limitations. The main objective is to study how to adapt the classical 3D interaction techniques to Kinect. For this, we have made a study of several modes of interaction that are currently using this device and videogames that use this device. We conclude presenting a case study which use Kinect to implement a system of cognitive rehabilitation.

Categories and Subject Descriptors

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Human Factors, Experimentation, Measurement, Design

Keywords

Natural Interaction, Virtual Reality, Kinect, cognitive rehabilitation.

1. INTRODUCTION

This article presents an analysis of the current situation of natural interaction using the Kinect device. It focuses on the paradigm of classical interaction techniques in Virtual Reality (VR) and the proposal of how to deal with the design of Kinect applications. Other works like [1] [2] analyze the augmented reality and Virtual Reality. We will focus on the second one.

This study comes from the project that we are working: creating a cognitive rehabilitation system using natural interaction with Kinect. Specifically, our work focuses on the disease of Alzheimer, due to the difficulty for these people to work with other rehabilitation methods that use 'traditional' input devices to interact such as keyboard and mouse.

2. KINECT

Kinect is a control device developed for the video console Xbox 360 by Microsoft.

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The device has several modules: video, audio, control and processing. Also has a motor to orient the viewing angle of the camera. Even though not having a high resolution, the main strength of Kinect as 3D sensor that is able to work in real time at 30 frames per second for the detection of 3D images. The RGB camera is responsible for capturing images and color information, while the purpose of infrared cameras is to detect the depth of objects. For this, it projects a point cloud which can determine the distance to each of them. The operating system of 3D capture system works by triangulation as it provided better results than the system of flight time. In terms of distance, if it is located 2 meters, has a spatial resolution of 3 mm. and a depth resolution of 1 cm. Once you have captured on both sides the distance vector and image can be mapped to obtain 3D information. About audio, Kinect has recognition capabilities and location of the source of sounds thanks to its array of microphones.

The main limitations are that the device cannot obtain information about the orientation of the head or hands, and neither can get the exact position of the fingers [3] [4]. These limitations are in the official Microsoft Kinect SDK, which is the SDK that we have used.

3. 3D INTERACTION WITH KINECT

Besides projects about user's identification with Kinect, investigation groups are also working in the field of interaction. The classical interaction techniques [5 in any virtual reality 3D system are navigation, selection, manipulation and control of the system. This section will discuss how to adapt each of them (and their subcategories) to Kinect.

In summary, Table 2 shows all the techniques discussed.

Table 1. 3D Interaction with Kinect

Type	*Technique*	*Applied*
Navegation	• Gaze-Directed Steering • Pointing • Map-based Travel • Grabbing the air	○ Body movement ○ Brazos ○ Voice ○ Arms movement
Selection	• Virtual Hand • Ray-casting • Técnicas de oclusión • Arm-Extension	○ Hands ○ Click gesture ○ Not ○ Hands
Manipulation	• H.O.M.E.R • Scaled-World Grab • Wolrd-in-Miniature	○ Ray casting ○ Hands ○ Arms
Control of the system	• Menús • Órdenes de voz	○ Gestures ○ Voice

4. XBOX 360 GAMES INTERACTION

This section analyzes the interaction used in video games that have been developed for the Xbox 360 and the how they use the Kinect device. The objective of this analysis and our main interest in this study is to compile the operating modes that could be applied to gaming industry (so you have a guide about them) and any other application that requires natural interaction with Kinect. It discusses various aspects of the operating mechanism of the interaction between the user and the system using Kinect, such as selection menus, dynamic actions in the game or the integration of the user interface. We analyze how interaction techniques are being used and present a critical study of its functionality.

We analyze 65 games of several kinds: trivia, sports, fitness, dance, adventures and action.

5. COGNITIVE REHABILITATION APPLICATION

Some of the techniques of interaction analyzed are being used in a research project that involves the creation of software that support to perform the cognitive rehabilitation processes using Kinect. Specifically, our project aims to develop a video game in an enjoyable way to incorporate different types of exercises which are normally done with Alzheimer's disease and rehabilitation combining both fields: cognitive and physical (lifting an arm, moving legs, etc.). We are adapting traditional techniques used by therapists to the technology of natural interaction through Kinect. Adding further elements of video games, such as gamificación [6], which produces large benefits for rehabilitation such as increasing the motivation of patients.

The game also has configurable modules to suit any user, depending on their limitations and the degree of disease progression. Thus, exercises that make a patient will be different from those of another. The therapist can enter the necessary information to personalize the exercises and level. Similarly, another main feature is the ability to create their own stories and adapted with multimedia (videos, images, etc.) and the can combine it with the games.

6. CONCLUSIONS AND FUTURE WORK

Natural Interaction begins to establish as the new paradigm of human-computer interaction with the emergence in the market for 3D Kinect sensors at low cost that makes it more accessible to the vast majority of the people. From the Kinect characteristics, we have studied how adaptation to the usual techniques of interaction in the field of virtual reality. We have also analyzed the interaction techniques that are currently be used in commercial games with Kinect and its advantages and disadvantages; and we have proposed some improvements as a result of that analysis. Finally, we comment on the cognitive rehabilitation project in which we work.

Future work will continue in this line, studying next games for the Xbox 360 and analyzing if they tend to standardize some of these interaction techniques when the number of games in the catalog increases. Another line of future work is to evaluate the implementations of 3D interaction techniques in virtual environments discussed in section 4. We are interested in studies with a significant number of users with different profiles to offer a comparison of their behaviors. Finally, in our project of cognitive rehabilitation for Alzheimer's, we will continue working on its implementation and evaluation with other related associations in this field and evaluating it.

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