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**Natural Interaction and Tangible Interfaces for Games and Entertainment in Augmented Reality**

**A Survey and Exploration of the Use of *Kinect*™**

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Abstract

Augmented Reality (AR) is spreading to different application fields. In entertainment, and more specifically, in the game industry, AR is already being used within a couple of applications, most of them academic and experimental. Interaction design issues are probably currently a major bottleneck for the further dissemination of AR within the entertainment sector; once the interaction modalities are better developed and understood, new entertainment and edutainment concepts can arise that are specifically adapted to different AR settings.

In this thesis I will explore the potential of Tangible User Interfaces (TUI) within the game world, i.e. of using objects that are part of a scene of an AR-game as interaction devices as a means of providing input to the system. I will also look at the technologies and the potential of detection and interpretation of Natural Gestures for the control of various parameters and actions. To accomplish this, I will survey the existing concepts and technologies for interacting with an AR-system and, based on this survey, I will propose solutions to the interaction tasks that employ specifically the *Kinect™*. A functional system that employs the *Kinect™* with TUIs and Natural Gestures will demonstrate the results.

Theme

Natural Interaction and Tangible Interfaces for Games and Entertainment in Augmented Reality.

Background Information

Augmented Reality is a type of Virtual Reality that aims to replicate the real world’s environment in a virtual world. This is an area that is spreading more and more to different application fields, e.g. industry, engineering, military, advertisement, entertainment, and others. The objective is to create a composite view that combines the real scene with virtual elements, enhancing the user’s sensory perception.

In entertainment, and more specifically, in the game industry, AR is already being used within a couple of applications, most of them academic and experimental. Interaction design issues are probably currently a major bottleneck for the further dissemination of AR within the entertainment sector: once the interaction modalities are better developed and understood, new entertainment and edutainment concepts can arise that are specifically adapted to different AR settings.

Some approaches, in order to increase user’s immersion into the AR-System, use devices as Head Mounted Devices or Virtual Retinal Displays. These methods are based on augmenting the reality though sight and they do effectively, however, not everyone have the same acceptance to these devices because they are intrusive. Another way to improve user’s engagement and that’s not intrusive is through Tangible User Interfaces. This approach relies on real objects that are used to both represent and interact with the computer-generated world and, using objects that are part of a scene of an AR-System as interaction devices is a mean of providing input to the system.

Context

The subject of this thesis is related to R&D that is being carried on with the support of the Centro de Computação Gráfica (CCG). The CCG already has an AR-system build in OGRE that demonstrates how a loom machine works, combining a real model of a loom and a virtual character that explains the functioning. This demonstrator targets edutainment at public spaces and museums. The thesis will build upon this demonstrator and its concepts, and will study the further potential of specific interaction modes for AR for entertaining applications. Possible usage scenarios are public spaces or specific, typically educational, “serious” games.

Objectives

This thesis aims at analyzing existing tangible and natural interface concepts for AR, and exploring, applying and extending these concepts for a use in a context of games and of the *Kinect™*. In particular, the use of physical (i) game objects – cars, chairs, action figures–, of (ii) objects for scene and/or terrain modeling – e.g. for defining the location of water in a terrain–, and of (iii) natural gestures for interacting with virtual objects will be explored. The focus is likely to be on games with a strong narrative component, e.g. adventure games.

Evaluation criteria for interface concepts will be developed, and the analyzed interface concepts will be evaluated according to these criteria. The most promising concepts will be implemented as part of a demonstrator. User tests will be made with the demonstrator, in order to validate them.

Among the subjects to be studied are:

* Recognition and analysis of natural gestures, in particular hand movements, using the *Kinect™*;
* Analysis of natural gestures and interaction with tangible interfaces within different game types;
* Recognition of physical game objects and definition of a virtual scene with dedicated physical objects, using the *Kinect™* forrecognition of the type of object, its position, and possibly of textures;
* Integration of the virtual elements into a previously generated scene and animation within the scene (level of the game);
* Modification and actualization of the virtual system, in real-time, according to the physical object manipulation;

Work/Investigation Methods

This work aims at showing that the *Kinect™* can be used for certain innovative interface concepts for games in AR. The result will be a demonstrator that “proves the concept” and that will be evaluated. Accordingly, these steps are required:

* Bibliographic research and SoA-report on interface concepts;
* Analysis and definition of evaluation criteria and categories for tangible and natural interfaces;
* Analysis of the capabilities of the *Kinect™* for implementing existing and novel interaction concepts;
* Analysis of the interaction concepts with respect to game types, and conceptual integration of the most promising concepts into different game types;
* Definition of a demonstrator that implements the most promising concepts (“Proof-of-concept demonstrator”);
* Implementation;
* User Tests to validate the usability of the interface concepts in the context of a game idea;

Calendar

The work plan of the presented thesis will be constituted by the following phases:

Phase 1 – Problem Definition, SoA (2 months)

Phase 2 – Conceptual Analysis of SoA (1 month)

Phase 3 – Technical Analysis of Use of *Kinect™* for Tangible User Interfaces and Natural Interfaces (2 months)

Phase 4 – Choice and elaboration of most relevant interface concepts, and definition of demonstrator (2 months)

Phase 5 – Implementation (3 months)

Phase 6 – Final Documentation and Final Elaboration of the Dissertation (2 months)

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