Tangible User Interfaces... (TODO)

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Abstract

In this paperl compare and analyze different Tangible User Interfaces. TUIs move away from the common input devices like mouse and keyboard and towards a direct interaction with physical objects in order to make the operation with devices more natural. This includes for example the handling of physical objects on tabletops, projections of information onto pieces of paper [**?**] or using additional devices to get more detailed data. The examples we are going to cover in this paper include applications in architecture, information visualization and learning tools.

CR Categories: K.6.1 [Management of Computing and Information Systems]: Project and People Management—Life Cycle; K.7.m [The Computing Profession]: Miscellaneous—Ethics

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1 Introduction

In common user interfaces the ineraction is limited to indirect input methods such as mouse and keyboard. A more natural way of interaction would be to be able to directly touch and manipulate the objects of interest. One of the main goals in using Tangible User Interfaces is to combine visualization of data with direct interaction.

In this paper we first give a general overview on how Tangible User Interfaces (TUI) work and what the main challenges are.

In the next section we will give some examples of TUI and describe how some of the challenges can be solved.

2 Typical designs of Tangible User Interfaces

3 Examples of Tangible User Interfaces

There is a wide variety of Tangible User Interfaces (TUIs). Possible applications for TUIs are literally endless. Many systems of TUIs have been explored and published in the past, but still a lot of new a ideas are coming up and new applications for TUIs are going to be explored. In this section, we will give examine some examples of TUIs and give an overview of different domains where TUIs have been successfully deployed.

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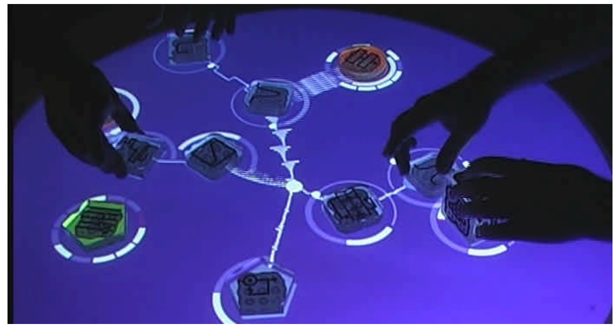

Figure 1: The reacTable in action (compare [**?**])

3.1 Table-top environments

Many TUIs rely on table-top environments as their interaction technique. In these environments, a IR camera is set underneath the table-top to track fiducial markers placed onto the table. The camera can also track touch interactions of users. Marker and touch-based interactions are used as user input to the TUI system. The system responds to the user interactions by projecting visual feedback onto the table-top.

3.1.1 reacTable

The reactAble, presented by [**?**], is a musical instrument based on a table-top TUI. Fiducial Markers represent musical objects, which generate sound according to their relation to each other. The markers are tracked by an IR camera. According to their attached symbol, each object has a dedicated function. The objects can be categorized in six different functional groups: audio generators, audio filters, controllers, control filters, mixers and global objects. [**?**]

ReacTIVision, the computer vision system behind reactAble, tracks the fiducial markers and sends the output data to an audio synthesizer. The waveforms generated by the synthesizer, as well as the data from the ReacTIVision tracker are sent to a visual synthesizer. The visual synthesizer projects visual feedback back onto the table-top. The audio lines that connect objects show the real resulting waveforms. Visual feedback is also used to monitor the objects state and internal parameters. Fingers can be used to either modify the objects parameters, or to cut (i.e. mute) audio connections between objects. [**?**]

Modular synthesis is used for the sound generation process. Modular synthesis is based on the interconnection of sound generators and sound processor units. In reactAble, automatic connections between objects are made depending on the type of objects involved and the proximity between them. By moving objects around and bringing them into relation to each other, performers construct and play instruments at the same time. reactAble is also a collaborative tool for interactive live music. Because of the rather big size of the table-top, multiple artists can perform together on a single reacTable. [**?**]

3.1.2 TARboard

TARBoard is a tangible augmented reality system designed for table-top game environment. The purpose of TARboard is is to let users enjoy games in a more interactive and intuitive way and to make games more realistic and immersive. [?]

Markers are attached to objects or cards used in a game. Similar to reactAble, these markers are tracked on a table-top environment by a camera underneath it. The augmenting camera is placed above the table-top. It provides the video stream for augmenting a game with virtual objects. [?]

[?] implemented a card game as a prototype for TARboard. Each player has cards which represent mystic creatures. The marker on the bottom of each card is tracked by the tracking camera. When the players flip a card and place it near the battle zone, the creatures get augmented on the battle zone and fight against each other.

3.2 Urban planning workbenches

3.2.1 The Luminous Table

3.2.2 Urp

4 Tangible User Interfaces in Visualization

5 discussion

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