Interactive Mediated Reality

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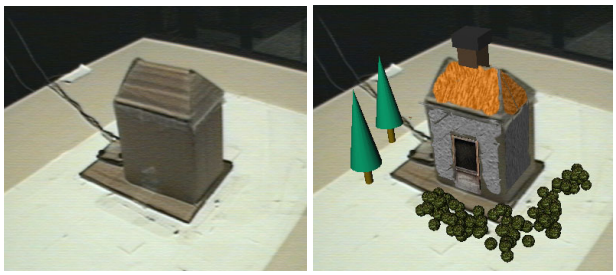

Abstract

Mediated reality describes the concept of filtering our vision of reality, typically using a head-worn video mixing display. In this paper, we propose a generalized concept and new tools for interactively mediated reality. We present also our first prototype system for painting, grabbing and glueing together real and virtual elements.

1. Introduction

All augmented reality (AR) system share the goal of integrating virtual elements into the real world. All these approached can be subsumed to the idea of *mediated reality* introduce by Mann [3]. Mediated reality describes the idea of filtering our vision of the real world with and through virtual information. Until now, AR systems are altering the reality either by off-line placement of virtual elements in the real world, or use – like Steve Mann – hardware filtering for changing the vision of reality.

In this work we explore the possibilities of "modifying the reality" by computer graphics. We do so by providing interactive tools for changing our vision of reality in real-time, restricted here to modify real objects.

The most interesting system for modifying the appearance of real objects is certainly UNC's works on shader lamps [1] based on a projection approach. Unfortunately, the system is limited to dull object surfaces, suffers from bad lighting conditions during work and limited mixing of real and virtual object properties.

In contrast, we chose a video-see through approach, that resolves some of these problems and introduces new possibilities like painting on everyday objects, adding of 3D matter, real-time texture acquisition from video.

2. Interactive Mediated Reality Metaphor

2.1. Concept

Acting on reality with a computer graphics approach can be decomposed into four phases: acquisition of information on reality, modification of virtual or real elements, registration and display.

In this work, we are primarily interesting in analyzing the details of the second stage. We distinguish the following parameters: type of content modified, type of temporal references used, type of spatial references used. As for the the spatial reference, we distinguish the following possibilities :

- *On image*. The final image perceived by the user can be modified (e.g add label on screen).
- *On environment*. The user acts on global properties of the perceived real environment (e.g change lighting).
- *On object*. Modify properties (geometry and appearance) of a real object on a global or local level with respect to the object (e.g twist, paint object).

2.2. Our Approach: The Virtual Studio

We based our approach on real techniques and setups choosen by artists, like painters, sculptors, and designers in their everyday activities. In a real studio, the main ingredients are workspace, tools, matter, and medium (object). We adapt these elements in our system by providing a working surface, tracked tools, a tool palette, and a scratch area for sketching and experimentation.

We propose three metaphors:

- *Painting tool*. The user interactively adds color, texture, matter, video, real text etc.
- *Grab tool*. The user selectively grabs real visual information from the live video of the real world.
- *Glue tool*. The user can copy and paste content. Content can be real or virtual, including 3D models, labels, textures etc.

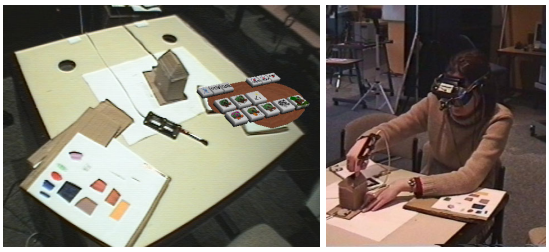

Figure 1. The virtual studio.

3. The Prototype System

3.1. Setup

The user is equipped with a tracked video-see through HMD, and acts on content placed on the working surface (figure 1) with a tracked brush and tool palette. The application has been developed on top of *Studierstube* [4].

3.2. Object Modification

Pixel Level : Users can change the appearance of a real or virtual object by painting on it with the tracked brush. The painting algorithm is based on approach similar to ArtNova approach [2]. Depending on the available information on the object, we provide different painting methods:

- *Only geometry of object available*. Depending on the painting mode, the applied color is mixed with the transparency texture of the virtual model of the real object.
- *Geometry and reflectance of object available*. In this case the mixing is done between the current brush and the real texture of the real object [1].
- *Acquisition of reflectance on the fly*. Texture is extracted from the video image using the current viewpoint.

Patch Level : While manipulation of individual pixels is to ineffective, the user can select a specific patch area of an object and operations can be efficiently applied to it as a whole, for example changes to color, texture or material properties. Another powerful tool is the placement of textured labels : the label is a textured patch which is projected onto the texture of the destination object.

Matter Level : User can also modify geometry of real object : the geometric additions can be chosen from a browser on the palette, then manually aligned on the destination. Matter modification is complemented with sculptor tools for interactively adding matter on real object deposited at the brush location.

4. Results and First Evaluation

Our system run in real-time (25 fps) with 256x256 texture size per element. Applications of this system are found in architecture, industry, art, but also in rapid prototyping or packaging design. For example, the user can paint on a real mockup to experiment with different materials for a future renovation of a building (figure 2). In collaborative game domain, children can easily use simple rough real model, and use them for a new kind of game (create their own virtual playground).

Figure 2. Applications : architecture and virtual playground.

We have asked several users to evaluate our system by creating a scene from a simple cardboard box. We briefly describe theirs comments:

- Pros: User have the sensation that painting is really applied to the object, but with a little decal. They had no problems manipulating the palette, and choose options and elements in the hierarchical menus. The environment (workspace, tool palette, and brush) seemed familiar.
- Cons: The stylus is too heavy and the tracking is not sufficiently stable. Misregistration of virtual and real elements sometime caused problem for painting (can be improve by a vision tracking system with a model-based approach).

5. Conclusion and Future Work

We present a new system for interactively modify our vision of reality based on an artist's metaphor. In the future, we plan to perform a more in-depth evaluation with domain specialists, like architects, beauticians, children etc.

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References

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[1] We define the reflectance of the object by texture and Phong material parameters.