In-Situ Content Creation for Mobile Augmented Reality

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ABSTRACT

We present a novel system for in-situ content creation for Augmented Reality targeting mobile phones. The system tracks the mobile device in a large environment based on natural feature tracking whereas the tracking data is provided by a database on a remote server. Our system offers a set of simple, yet powerful modeling functions for in-place content creation. The resulting AR scene can be shared with other users using a content server or kept in a private inventory for later use.

KEYWORDS: Mixed and Augmented Reality, Authoring

1 INTRODUCTION AND MOTIVATION

In the late 1990ies, first experiments were conducted on presenting geo-referenced content in AR. The Touring Machine [3] introduced mobile outdoor AR and showed a campus tour guide. Even with the limited possibilities of this first prototype, the power of in-situ presentation of geo-referenced information became apparent. The emergence of the World Wide Web as a mass phenomenon around the same time prompted Spohrer in his seminal paper to suggest the “WorldBoard” [8], a combination of distributed online information systems and geo-referenced indexing. Information could be published like in the Web, but indexed by a geographical position rather than by a symbolic URL. Unfortunately, his vision has not been fully realized yet, likely because key technologies were not mature enough. Nevertheless nowadays the first commercial AR applications like Wikitude1 were released to the market. That shows the potential of mobile AR. Wikitude and other AR platforms are so called AR browser, as their main goal is to browse information, which are visually overlaid over the real world. These AR applications were made with the mass market in mind and target millions of users. Thereby solving technical problems like tracking and visualization are only some important aspects for mobile AR applications. Especially for the end user the availability of content has a high significance.

Assuming millions of people using mobile AR applications the amount of content should reflect this huge user base. This fact is known as the content problem. Fortunately, the recent development of the World Wide Web showed how to create content for millions of users: User participation. We think this is transferable to the described content problem of AR, which imply that the only solution is to allow the user to participate in such a way that they can create their own content rather than only using content created by a small number of professional modelers. The trend of making users to content creators and not only consumers is one if the main characteristics of the Web 2.0. Following this we define AR2.0 as the next step of Augmented Reality where users can create and share content.

In the following we want to present our current work, which focuses on the authoring process for mobile Augmented Reality. The goal is to develop a tool, which enables the users to participate in the content creation process.

2 RELATED WORK

Although research of content authoring has a long tradition in augmented reality, only little investigations have been done in the field of content authoring using mobile devices. In general, we can distinguish cross-platform authoring (at the desktop) and in-situ authoring. Only few of the latter exist. One example approach that allows the user to create AR applications in place was presented in [4]. The designer can thereby interact with the virtual world by using a marker-based tangible interface.

Piekarski and Thomas described an architecture for supporting mobile augmented reality environments [7]. This architecture enables the user to develop object-oriented applications that perform a variety of complex tasks, such as user interaction techniques and in-situ 3D modeling.

OutlinAR [2] presents an approach for in-situ modeling. With OutlinAR the user is able to build wireframes models by using a handheld camera mouse, which is plugged into a standard computer.

There are a dozen of desktop-based authoring solutions, which extend existing 3D modelers like Maya and Blender. DART [6] for example, is one of the best-known authoring toolkits for AR. It comes as a plugin for Macromedia Director targeting professional content producers.

However, none of the above solutions has been designed with a truly large user base of thousands or ten thousands users in mind. This is particularly important, as in the spirit of Web 2.0 every consumer of AR content is potentially also an author. Thus they are not suitable tools for user-centered content creation.

3 MOBILE AUTHORING

In the following we present an approach for in-situ content authoring, where users are tracked in a large working volume and are able to create and manipulate virtual objects on the fly by using a mobile phone. One of the main aspects is to enable users to replicate real objects and use them in the AR view. Furthermore we give an outlook how the created content can be shared with other users.

3.1 Tracking infrastructure

The tracking technique used in this approach is a pose estimation based on a client-server infrastructure. In the first step the user takes a picture of his environment with the application and sends it to the server. The server hosts a previously built Sparse Feature Model [5], which can be used to calculate the current camera pose from the given input image. This pose is afterwards transmitted back to the phone.

Based on the current position and orientation the device requests the tracking data for the current position from a remote database. After this tracking data has been received the phone switch to a real-time natural feature tracking based on the work presented in [9].

This tracking technique is the basement for all further processes of the project. If the users change the working volume by pointing the phone to another object, losing the current tracked object, the tracking needs to be initialized by beginning from the first step.

1 http://www.wikitude.org/
3.2 Content creation and manipulation

Existing authoring solutions address a specific user group. Most of them target professional content creators and media artists. But the target audiences for the in-situ authoring are people who have never used modeling programs, but can handle their phones (taking pictures, sending short messages).

Therefore we limited the functionality to basic, yet powerful functions to create 3D content. One of these functions is extrusion. The user can create 2D-Objects (polygons, circles, freehand drawings) and later convert them into 3D objects by extruding the ground plane. Hence the supported 3d models range from cubes, tubes and spheres to objects with polygonal ground plane.

After defining the geometry the system allows to assign different colors or textures. The user can select from a set of predefined textures, which can be mapped to the object. Furthermore it is possible to create own textures by using textures extracted from the camera image, which can later be assigned to the objects (see Figure 1). This is especially useful if the goal is to create virtual duplicates of real objects.

In addition to the creation of 3D objects the system also supports a variety of 2D operations to draw or annotate the environment. Similar to basic paint programs the user can choose between pencils, brushes or a Graffiti spray tool.

The creation and manipulation of the content is done directly on the mobile device. Since more and more mobile phones ship with no physical keyboard, all manipulations and authoring functions are controlled using a touch screen. This raises the problem how to accurately touching the screen by holding the device and still pointing the camera to the tracked fiducial. We solved this problem by implementing a Freeze Mode. Once the user is in the position where he wants to start the authoring task he can freeze the view by pressing a button on the touch screen. This simulates a fixed position by freezing the current camera frame and allows moving the device with no implication regarding the tracking. After a successful completion of the selected task the user can unfreeze the view.

3.3 Content providing

Fast network connections like 3G or WiFi are more and more common on mobile devices. This makes it reasonable to use a client server approach for content sharing between many users. Our application enables the user to upload the generated content to a central server and share it with other people.

The generated AR content and all related files are stored in a zip container. Furthermore we create an XML-based markup file to describe the content and add Meta information. We developed our own XML language schema to express all relevant information and call it Augmented Reality Markup Language (ARML). The resulting markup file is also placed in the container and later is used for indexing the content and expressing the relations.

Beside the possibility of sharing the generated content with other users over a remote content server, each user has a private inventory. This allows to place created objects into the local inventory on the device for later use. Hence the user is able to create an object (e.g. annotated with a texture of the current environment), pick it up and insert it into a scene at a different location.

4 CONCLUSION AND FUTURE WORK

We have presented a system for mobile AR authoring, which can be used for user content creation in an AR 2.0 system. We showed how users create content in place by combining simple, but powerful authoring functions. Embedding a client-server approach to support content sharing between multiple users completes the system.

Open issues are the user interface of such mobile authoring systems, as well as the evaluation with real users. In future versions we want to use to the next generation of mobile phone localization presented in [1]. Another exciting research question is how the user wants to get notifications if AR content is within his range. Finally we plan to extend the content server to integrate existing content from various sources like Google Warehouse for 3D content or Flickr for GPS tagged images to benefit from the amount of existing content.

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6 REFERENCES