

Graphical Tangible User Interface for a AR Authoring Tool in Product Design Environment

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Abstract—We are suggesting a graphical tangible user interface for augmented reality (AR) authoring tool in product design Environment. This user interface can be used for more efficient and intuitive manipulation of a 3D virtual model in initial prototyping. A game-phone of portable electronic products is selected for our target authoring product. The suggested authoring methods exploit the advantages of both graphical user interface (GUI) and tangible user interface (TUI). Authors can intuitively make adjustments for many parameters using the TUI, and then they can do the same thing more precisely using the GUI. Through many tries and experiments, the suggested combined GUI and TUI authoring method was easier to make a prototype, also it contained fewer errors and took a shorter time to manipulate.

Index Terms—Augmented Reality, Authoring Tool, Tangible User Interface, Product Design

I. INTRODUCTION

Conventional user interface, in augmented reality authoring tools for product design, is focus on graphical user interface (GUI) or tangible user interface (TUI), but they cannot support precise and intuitive manipulation both of them.

DART [6] is a conventional GUI based authoring tool, authors can exactly manipulate, but they cannot author without any technical background about the configuration. On the other hand, an AR authoring interface that is as easy to use as desktop WYSIWYG [9] interfaces, uses tangible AR interaction techniques and an authoring method called ‘immersive authoring’. This method enables novice authors to carry out complex authoring without any knowledge of detailed configurations. But overall performance is dependent on tracking of the AR markers and many markers related to the authoring have to be captured in a camera. Several markers cannot be detected because of the occlusion of the user’s hands. Also users must always wear an uncomfortable HMD while authoring and a virtual line of the manipulator marker can cause a depth perception problem. Therefore, the authoring method using only TUI is hard for exact manipulation and seriously influenced by experience environment. In CATOMI [10], TUI authoring interaction is used only in translation, rotation, and scaling of a 3D model. More efficient authoring methods are

required for GUI as well as TUI.

It is suggested that graphical tangible user interface based authoring method enables more efficient and intuitive authoring, if they are used according to guidelines though many tries and experiments. The proposed authoring method uses the TUI at first, and then the GUI, using a mouse or a keyboard, in stages. Through comments from subjects, the suggested combined GUI and TUI authoring method was easier to prototype, it also contained fewer errors and took a shorter time to manipulate. We are planning on evaluation of a qualitative/quantitative usability test in the future.

In this paper, Section 2 provides requirements about a user interface of authoring tool in AR-based product design, and Section 3 addresses suggested guidelines for the user interface. Section 4 shows implementation of user interface for precise and intuitive manipulation. Finally Section 5 presents conclusion and future work.

II. REQUIREMENTS ABOUT A USER INTERFACE OF AUTHORING TOOL IN AR-BASED PRODUCT DESIGN

Most existing authoring tools have absolutely focused on one of the graphical or tangible user interfaces. GUI based authoring tools are mainly used in a desktop AR authoring environment. Typically users use a mouse or a keyboard and in this case more precise authoring may be possible so that users can set more specific values exactly. But the more properties (functions users can set) which are increased, the more time or efforts by normal users to learn the tool is needed. It will be an authoring tool for the developers.

On the other hand, the tangible user interface based authoring tool such as Immersive Authoring [2] has showed possibilities for the intuitive user interface. In this case, specialized works that require an understanding of the 3D environment, such as 3D rotation of a virtual model could be preferred, since the environments of manipulation and usage could be seamlessly connected. Also it is easier for novice authors to manipulate the 3D models. But delicate manipulations are more difficult with the GUI based authoring tool.

III. SUGGESTED GUIDELINES FOR THE AUTHORING TOOL

In this paper, the proposed authoring method can manipulate visual, sound, and haptic effects at the same time. We suggest a combined authoring method based on the graphic tangible user interface. A combined GUI/TUI authoring method has the

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advantages of each method.

In stages, the proposed authoring method uses the TUI at first, and then the GUI through a mouse or a keyboard.

Figure 1 (a) shows manipulations of the 3D model, which include translation, rotation, scaling as well as transparent properties of the 3D model to identify that the virtual model fits the physical virtual model well. Also by rendering grid lines based on the mock-up model, authors can see the unit of scale in the AR environment.

With regard to authoring methods, if users use only the manipulator tool in these cases, they cannot accurately fit the 3D model to the mockup model. Therefore in this case, use of the GUI based property window enables correct modification. As well as using the property window, by pushing the specific keyboard button authors can accurately adjust the fitting of the 3D model.

In Figure 1 (b), authors can easily make the configuration (e.g. direction, intensity, etc) for lighting such as ambient, spotlight, xx light by positioning the manipulator tool around the 3D model fitted on the tangible object. Additionally, authors can accurately adjust lighting properties based on GUI. Figure 1 (c) shows the functionality test of the 3D model by pressing buttons. Figure 1 (d) is the configuration method for the interaction techniques in a racing game, using the manipulator tool for adjusting tilting angle, by positioning the manipulator tool on the surface and tilting until the wanted angle is obtained.

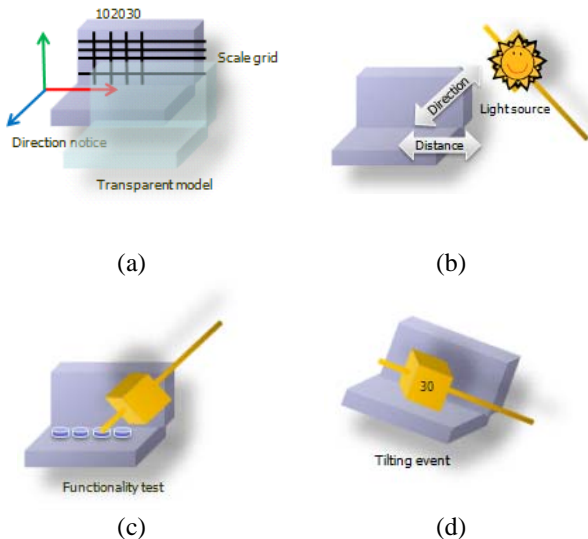


Figure 1. TUI based authoring methods (a) Manipulation of a 3D model (translation, rotation, scaling, and trenchancy) (b) light adjustments (ambient, diffuse, specular, position, direction) (c) functionality test by pushing buttons of a virtual model (d) setup tilting angle with respect to interaction techniques

IV. USER INTERFACE FOR PRECISE AND INTUITIVE MANIPULATION

The implemented authoring tool is originally based on [1], a

test bed enabling immersive interaction in AR-based product design environment.

Authors can use GUI to change general information, upload/save properties files, and change the properties of the 3D model as shown in following Figure 2. As a primary result of the game-phone authoring, there are an upper surface, a down surface, and the other buttons, a 3D model for each exists. Initially the properties are already set. Authors can change the properties for each model including translation, rotation, scaling, or texture as represented in Figure 2. Same thing can be done using a manipulator tool in TUI.



Figure 2. (a) GUI based Adjustments for Visual Feedback. (b) TUI based Adjustments for Visual Feedback

V. CONCLUSION

This paper suggested an authoring tool for normal authors without any engineering background to carry out AR based prototyping. The suggested authoring techniques integrated the advantages of existing GUI/TUI based authoring tools.

Through comments from subjects, the suggested combined GUI/TUI authoring method enables users to easily carry out authoring. Our methods were more efficient, with a lower number of errors and a shorter time to complete the task.

Our results can contribute to an efficient initial electronic product prototyping. The proposed authoring method can be used for authoring AR based entertainment or for education contents. As a result of future work, we are planning on evaluation of a qualitative/quantitative usability test.

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