Rendering Virtual Worlds in Audio and Text

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ABSTRACT

To achieve non-visual virtual world accessibility, an alternative output channel to graphical output must be used. Audio is one alternative channel to graphical output, however care must be taken not to overload the channel. One method of avoiding channel overload is to provide exploration tools which will enable the user to select relevant information to here. In this research we propose an evaluation framework by which the optimal combination of exploration tools can be determined. This framework will also aid in the creation of an accessibility standard for virtual worlds, similar to the accessibility standard found on the world wide web.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: Miscellaneous—*voice I/O*

General Terms

Human factors, design

Keywords

Accessibility, auditory interaction, virtual worlds

1. INTRODUCTION

Virtual worlds are commonly used in many different situations including gaming, communication, and education. In a virtual world, software is used to simulate reality by defining objects, and rules on how these objects should behave and react. The state of the virtual world is communicated to the user by using a medium which can be understood by the five senses. Today the main rendering method is usually a graphical representation of the world, or of the portion the user would have been able to see in the physical world. Sound is also used, although mostly as a secondary method of communication.

Because of the graphical rendering of virtual worlds, they are mostly unusable by people who are blind or visually impaired. The secondary sound rendition is typically inadequate to provide the blind user with enough information to understand the state of the virtual world. Our work focuses on the development of methods to convey adequate information of the virtual world to the blind user.

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2. BACKGROUND

To enable virtual world accessibility for blind users, an alternative output channel to graphical rendering must be used to convey the state of the world. This alternative output channel can be by means of either a hardware device or a software program. An example of a hardware solution is found in the work by Iglesias et al [3]. They proposed the use of a hardware device for exploring the 3D structures within the virtual world. The user can use two fingers to explore the object, and receives haptic and audio feedback from the device, which can be used to identify the object's shape. One problem with hardware solutions is that the user will need to acquire the hardware device to access the virtual world.

A software solution, on the other hand, is limited by the hardware platform it is running on. On most systems, audio is the only output channel available besides graphical output, which means that a software solution will necessarily need to use audio as the alternative output channel. The use of textual descriptions has also been proposed as an alternative output channel – see for example Folmer et al [2]. Their TextSL viewer for Second Life describes nearby objects in plain text to update the user on the state of the virtual world. However, text must be read out to the blind user using synthesized speech, and thus we consider text to be part of the audio channel. Another utilization of the audio channel was described by Westin [5], with the description of the game Terraformers. In Terraformers the state of the virtual environment is communicated to the user by using audio cues. Every object in Terraformers has a corresponding sound icon which is rendered using 3D spatial audio. This method was also used by Trewin et al [4] with their PowerUp game playable by people with different disabilities.

Given that software solutions are based on the audio channel, one should consider what type of information about the virtual world needs to be conveyed to the blind user. The two main groups are navigational information, and object information. Navigational information is used to help the user orient himself to the world, while object information is used to inform the user about the characteristics of objects in the virtual world. This includes the name and role of each object, the distance between the user and the object,

direction relative to the user, and so on.

The use of audio to convey the state of the world invariably leads to an extreme overload on the audio channel, due to the amount of information involved. A solution to this problem is to provide the user with a set of tools to selectively explore certain aspects of the virtual world, which limits the information that pass through the audio channel. Examples of such tools include a virtual sonar [5] which can be used to identify the objects surrounding the player, and key commands [4]. Key commands can be used to identify the object at the player's viewpoint, or to identify the objects to the left or right of the viewpoint. Key commands can also aid in navigation: in PowerUp, a key command will move the player to the object where the viewpoint is situated, or follow the object if it is moving.

At present a number of tools has been described in the literature, but the contribution of each tool to the user's perception is not always clear. It is also difficult to compare different tools, because there exists no single evaluation framework in which to do so. An evaluation framework would enable comparative user evaluations with each tool, and combinations of tools. Such comparative evaluations would assist in the optimisation of the use of the audio channel, by identifying the tools which are necessary for the best user experience in terms of accessibility.

Another advantage of such an evaluation framework is that it could also be used to develop an accessibility standard similar to the ARIA accessibility standard for HTML5 [1].

3. OBJECTIVE

In this work we present the implementation of a single evaluation framework for the comparative analysis of tools to assist blind users in accessing mainstream virtual worlds.

4. IMPLEMENTATION

The Perspective evaluation framework was developed in the form of a viewer for Second Life and Open Simulator based virtual worlds. This viewer enables the investigation of different combinations of exploration tools. Tools are implemented as modules which can be enabled or disabled at will. Using this approach, one can compare the tools described in the literature, as well as new tools that are proposed and developed in the Perspective framework.

The first new tool implemented in Perspective is a spatial speech module. To our knowledge, such a tool has not previously been described in the literature. This tool speaks the name of each object within a specified radius using synthesized speech, but each object name is positioned in 3D audio at the position of the object in question. Each object name is also spoken within a time period indirectly proportional to the distance of the object from the user. This has the effect that objects near the player can be easily identified, but the spoken names of objects far from the player is perceived as a cluster of voices.

The second tool is an occlusion module which helps with navigation by playing white noise in the direction where no objects are blocking the user's path. Narrow band noise is played with distinct pitches for the four primary compass directions. This enables the user to identify open directions. It also serves as a way for the user to orient himself.

The grid explorer is another tool not previously described in the literature. When using this tool, the current region in the virtual world is divided into a grid of cells. The user can explore each cell with the arrow keys on the keyboard, much like the navigation around a spreadsheet. When visiting a cell, the user hears the number of objects in the cell, and can also request the name of each object. Keystrokes can be used to increase or decrease the number of cells in the grid, effectively changing the resolution of the exploration. The user can use this tool to get an overview of the entire region, and identify areas to explore with usual navigation commands. Although similar to key commands, the gridlike approach is new.

5. RESULTS

The software is currently in a testing phase, but preliminary results indicate that the tools described enable quicker navigation around a region than the solutions previously developed for Second Life. The grid explorer enables the user to get an overview of the region along with approximate positional information for the objects within the region. This results from the ability of the cells to be navigated by arrow keys, which is familiar to users who use this method to explore tables and spreadsheets in other software. The accessibility of regions are still very much dependent on whether names and descriptions were assigned to objects within the region. The software attempts to infer the role of objects in the virtual world. That is, the object action resulting from a click on the object may indicate its role. For example, clicking on an object may result in a 'sit' action, which indicates the role of the object. However, only a few roles can be inferred that way. A dedicated accessibility standard would enable more roles to be specified by world developers, enabling blind users to more easily find objects of interest.

6. CONCLUSION AND FUTURE WORK

Accessibility in virtual worlds is a problem for users dependent on sound for navigation. We presented the outlines of an investigation into the optimal use of the audio channel, with the ultimate aim to establish a standard for accessibility in mainstream virtual worlds.

7. REFERENCES

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