THE USE OF VIRTUAL REALITY FOR HIGH FIDELITY SIGNAGE PROTOTYPING IN WAYSHOWING COURSE MODULES – BENEFITS, LIMITATIONS AND STUDENT PRE-REQUISITES

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Abstract

High fidelity signage prototyping for public buildings is impractical to teach in Wayshowing classes with many students. To achieve high fidelity, the creation of signs that look like the final production signs is required (but which may differ in other respects, such as using other materials). However, a problem is that physical signs are impractical to deploy in buildings that are in use. Student work with prototype signage may disturb other activities that go on in the space. Access to unused buildings can also be problematic to achieve. It is furthermore impractical because any existing signage tends to interfere with student signage. In addition, it can be very time consuming to swap signage systems between student groups. The use of virtual reality can solve those problems for signage prototyping.

In this paper we present a course design utilizing virtual reality for Wayshowing. Virtual reality is often used for Wayshowing experiments and is then seen as a realistic substitute for reality. We see many of the same challenges as are presented in research as relevant for students to master. This includes for instance tests of sign legibility, comparing sign designs (through usage trials), and evacuation during stressful situations. It is beneficial to be able to conduct design activities addressing those challenges before investing in physical signs. Using 3D blueprints, Wayshowing design can even be carried out before actually constructing a building. Therefore, we believe that virtual Wayshowing will become an increasingly relevant skill in the future.

Placemaking design also benefits from high fidelity, since fine details are important. The course can thus draw on a broad student background in subjects such as 3D modelling, typography, and information graphics design. The amount of study time and course topics is thus highly dependent on student academic background.

Keywords: Signage design, course module, virtual reality, wayshowing, wayfinding.

1 CHALLENGES AND OPPORTUNITIES

What makes our course design unique is that the students will be given the opportunity to learn to use 3D environments as a design tool for wayshowing. They will be given the opportunity to test low fidelity and high fidelity prototyping in a 3D world, and also to view the result on a full-scale projection wall as well as using gaze-tracking equipment. The course requires basic knowledge in Information design, but not in 3D modelling. If the students do not know 3D modelling, then they will use fixed-position signs for the virtual reality prototyping exercises, and only work with graphic design of the surface area of the signs. If they do know 3D modelling then they can use their skills to also work with signage system design in the 3D world as well as design new sign shapes and place them in the 3D world. Regardless of their 3D skills, they will be given equal opportunities to work with signage system design and design of sign shapes. They will also be given the opportunity to try out signage prototyping in the real environment corresponding to the 3D world (and to compare that with the same signs in a 3D environment).

Virtual environments have previously been used to study evacuation (Aizhu et al., 2008, Ren et al., 2005, Tang et al., 2009). Wayshowing through signage design is then important to support human wayfinding. Of particular interest here, previous studies have for instance compared how evacuation behaviour is affected by two kinds of signage (Tang et al., 2009). That study used regular computer screens rather than immersive 3D environments. Earlier research has also used immersive virtual reality to study experiences of mass evacuation in subways. In the study, people were presented with situation snapshots and information about the situation, and their experience was then elicited (Drury et al., 2009). Such snapshots can also be generated from a 3D world that affords moving around. During wayfinding, and in particular in stressful situations such as evacuation, the number of choices
during the way out is an important factor (Tang et al., 2009). This aspect of complexity can be taken into account when designing student exercises. Moreover, a factor is whether one can rely on experience, to use a familiar route. That includes familiar routes that can be dangerous, such as use of elevators (Proulx and Reid, 2006). Based on those studies that use virtual environments to study evacuation, we find it reasonable to also use virtual environments to support wayshowing, to design and test signage for more normal wayfinding situations.

For usage in our course, an existing public building was modelled in high fidelity including light sources. This facilitates comparisons between modelled signage and reality. The virtual building was constructed as a 3D model in Autodesk Maya and 3D studio max. A wall size display of 3640 x1050 pixels was deployed to project the student designs. It provides a wide window of realistic size into the 3d world. This allows groups of students to view the designs and discuss them together on a shared screen.

Each system of signs can be placed in a separate data file for deployment in the 3D world. They can then be evaluated using virtual walkthroughs, and different designs (from different student groups) can be compared. Typeface selection and detail design can also be evaluated with respect to for instance readability and placemaking. The placemaking design concerns how the signage fits and creates the identity and experience of the place. All aspects of the signage system contribute to placemaking as well as to more instrumental aspects such as informing. The signs contribute to the experience of what the place is about and the system of signs to the experience of the place as a whole.

In the following sections, we will present our course design; traditional signage system and signage design theory, and then focus on virtual environments as a tool in way showing education.

2 OVERVIEW OF COURSE DESIGN

Our course has wayshowing design with virtual environments as a design tool as the main focus, but we also include other aspects such as human perception in 3D environments (way finding). The following points summarize what we want the students to be able to do after completion of our course:

- Design and implement wayshowing systems in virtual environments
- Evaluate the efficiency of wayshowing systems
- Evaluate design options based on criteria related to (physical) material and graphic form
- Describe advantages and limitations of a 3D representation of an environment, compared to the real physical environment.
- Describe perception and cognition in 3D environments.

The students will conduct:

- Lab work in 3D wayshowing
- Way showing assignment that they can choose to do using the 3D environment as a design tool, or using traditional methods.
- Seminars that cover theories about human way finding in 3D environments.

In this paper, we will focus on the use of virtual reality as a tool for wayshowing education. Firstly, and as we will exemplify through a first test of a course module, the students can do rapid prototyping of signage. They can sketch on paper, scan, and place the signs in the 3D world. However, they will also be doing high fidelity prototyping, placing realistic images in the 3D world. In that course module, they will both view the signs on an immersive large-size wall rendering of the 3D world, and print the signs and place them in the real environment. They will then use the building that we have based the 3D model on, and compare their experiences of the signage. This will give them an impression of benefits and limitations of 3D modelling of signs. Furthermore, they will test their signage using a gaze tracker. It will give them an impression of how easy their signs are to find in the environment – especially when other disturbing objects (large and colourful) are simultaneously placed in the 3D world.

3 SIGNAGE DESIGN AND TYPOGRAPHY

In this chapter we will focus primarily on typography and to some extent on signage design. We will treat signs with horizontal text and but we will however not address the problems that can occur when text is set vertically. A further limitation is that we will not raise factors relating to material or surface on
the signs, nor different types of lighting situations and how it affects the perception of a given sign. We furthermore do not address different types of screens and screen resolution, or their impact on the perception of signs in a 3D environment.

Regarding the typography it is primarily choice of font, size, character spacing, line spacing that will be discussed. A basic rule is that letters, words, sentences, and larger blocks of text on signs must be easy to read and understand. The purpose of the signs that we focus on is that they should be seen and read. Readability is more important than fashion and trends regarding fonts and typography. Unclear type negatively impacts on perception and understanding. It is noteworthy that in principle, the same typographic rules apply to all forms of signs, whether it is signs for "Identification", "Explanation" or "Instruction" [1].

3.1 Grid

The grid might be the most important part of a style sheet. It’s a physical plan - a framework or structure - for consistently placing the elements within an information design [2]. A designs empty space is a key ingredient when designing using a grid.

3.2 Space economy

Some fonts require more space than others and that is something that must be taken into account when selecting fonts. The required size of signs also has financial consequences, as cost and size of signs are related.

3.3 Contrast

The primary purpose of contrast is to get the most important elements in the design foreground stand out from the rest. The proper use of size, colour, weight, strength and background is central to work with contrast. All of the above variables also affect each other. Concerning size there is a rule of thumb that the x-height of a text should be 1/500 compared to the reading distance. For example, having an x-height of 1 cm the sign will be legible at a distance up to 5 m. There are exceptions to this rule, such as in hospitals where they rather choose 1/400 or even 1/300.

3.4 Choosing fonts

The graphic system gives structure, form and style to the information being communicated on signs. Typography is the backbone of the sign graphic system since most of the informational content of a sign program is conveyed by words rather than pictorial elements [3].

The use of existing fonts are most common for sign systems, for the simple reason that there are already a large number of proven fonts that works well. Partly, because it is an extensive and time-consuming sub-project to create a completely new font. However, one can see sometimes that existing fonts have been used, but modified. Font selection is a very important parameter for how the signage system will be perceived, especially as typography is the predominant graphic element to the communication of information through signs. Generally three factors affects the selection of fonts to be used for a given sign system. These are Formal suitability, Stylistic longevity and Legibility. Formal suitability mainly refers to how well a chosen typeface suits a given project. Stylistic longevity is an important selection factor for signage programs since such a program might endure for 10 years or more. Legible typefaces have the following characteristics: clearly defined, easily recognizable letterforms, a large x-height, they are of medium weight, have stroke widths that are neither too thick or to thin and they are of medium or normal character width (not to condensed, nor to expanded) [3]. An example of detail design can be carried out in Adobe Illustrator and Photoshop is presented in Table 1. This is an exercise that the students will also perform. Table 2 presents design choices that depend on the placement of the sign in the intended location (using the 3D world as a design tool).
Table 1. Signage design

Adobe Illustrator and Adobe Photoshop were used as tools to design this sign before it was placed in the 3D environment. An area of 200 x 200 pixels were used and divided into a grid of 10 x 10.

One unit was reserved as margin. Arrows was 1.5 square concerning width and height. The three words were adjusted evenly spaced in height and in width end at the margin.

The used font is Frutiger Next LT. The reason for the choice of Frutiger depends on several things. It is a common font in wayshowing, it is a font with high legibility even at a distance, and it has character shapes that are relatively unique and not easily confused (for example, c and o in some fonts are confused in small sizes). Furthermore, it works well in an environment of exhibitions.

The images 1-3 are screenshots from the design-work in Illustrator and image 4 shows when the image is imported into Photoshop.

The reason that the finished image (4) in Photoshop looks like it does is that it is placed in an (invisible) grid that covers the front, back and edges of the finished sign. Work with this invisible grid is described further in Table 3.

Table 2. Signage placement and content.

It is very important to think through the placement of signs to be as clear as possible. Not only regarding content, but also concerning the location in relation to the directions they point out.

As exemplified in the top image with the sign located to the left of the entrance to the stairs, it creates ambiguity about the way to the restaurant (is it to the right, or is it through the stairs to the right?). In contrast, in the lower image with the sign to the right of the entrance to the stairs there is no doubt about the way ahead to get to the three designated targets.

This is something that is possible to test in our 3D model, an aspect that the students will be working with in the course. They will then be able to try out both placements for themselves and reflect on their respective merits.
3.5 Important factors for high legibility

A crucial factor for the readability of a text is the character spacing. This should not be confused with kerning made by the designer of the font and is spacing between all pairs of letters in the font. Letter spacing (tracking) refers to increasing or decreasing the distance generally in a whole word or whole paragraph.

The length of ascenders and descenders is also an important factor for the legibility of a typeface. The use of lowercase or uppercase letters is also of importance for readability.

3.6 Symbols

In conjunction with the text on a sign it is very common to also use a symbol of some kind, which is often referred to as an icon (illustrating an object) or a pictogram (illustrating something to do, that is allowed, or that is forbidden to do). The crucial aspect to consider is mainly that the selected symbol is understood by the potential viewers who use the sign for wayfinding (if it is a sign system for Wayshowing).

4 HOW TO PROTOTYPE SIGNAGE SYSTEMS USING VIRTUAL WORLDS AS A TOOL

We here consider four main categories of varying realisms of 3D rendering of signs, and two broad categories of 3D world realism levels. Firstly, the 3D world at large may be either a wireframe or a realistic rendering. The benefit of a wireframe is quick rendering from 3D blueprints, whereas a realistic rendering also conveys a feeling of the place – what it would be like to actually be there, considering the style and “feel” of the place.

Considering signs, we consider four levels of realism. Firstly, signs can be made to look as realistic as possible, by rendering light and shadows of a high fidelity sign placed in the 3D world. With high fidelity, we mean that it looks as closely as possible like the real finished sign. In contrast, a low fidelity sign can be a drawing on a paper grid, placed as a texture in the 3D world. That is much quicker process than producing a high fidelity rendering, and can provide a first impression of the signage design. With “placed as a texture” we mean that the surface of the sign is put in the 3D world without projecting the light conditions of the building on it. In our tool, all signage surfaces are present on the computer as normal image files that can be replaced to replace the look of the signs. In between low and highest fidelity, there is mid level fidelity, where a high-fidelity image of the sign is placed in the 3D world, but without rendering realistic light conditions onto it.

As outlined in the introduction of our paper, 3D modelling skills are a benefit but not a requirement to take part in the course. A lack of 3D skills means that students can only replace textures of signs that is already in place in the 3D world. This either requires preparation of the lab work, or that students form groups where at least one student have 3D modelling skills. Regardless, the process involves four main steps in Autodesk 3D studio Max (see Table 3).

Table 3. Creating signs, extracting, and importing signage surface textures in Autodesk 3D studio Max
Second, their textures must be extracted as images.

Third, each face of the sign that needs to be designed must be identified so that the final image will map correctly to the signs in the 3D world.

After designing the sign surface texture in an external application, it must be imported back into the 3D world. At this point, there are several options of how to continue. Either, the real signs can be rendered with realistic light. Or, the signs can be used as placeholders, for the students to merely replace the texture files (which will result in the sign surfaces to change in the 3D world). In our courses, the 3D objects with surfaces will be exported, to be opened in an environment more suitable for only viewing (and not altering) the 3D world.

5 FIRST IMPRESSIONS OF THE RAPID PROTOTYPING COURSE MODULE

In the rapid prototyping course module, students will use paper and pen to quickly draw alternative signage designs. Those will then be scanned in, and deployed in the 3D world. We have tested this approach with a small sample of two students and a professor (doing the same design work as the students), who during a 2-hour lecture were given basics of signage design, who then drew their first signs, and then viewed them and reflected on their designs (see Table 4). The idea was to give them a quick impression of what is important in signage design before giving them further education in signage and signage system design. It therefore did not matter that the brief first lecture left them with a rather weak idea of how to design signs. We will now substantiate that claim. Although the signs may not be representative of what the students could achieve at the end of the course, the exercise delivered some main points. By viewing the signs in the 3D worlds, the students (and the professor) were able to grasp the importance of using high contrast colours (the sign on the staircase far away in the image uses weak colours). They were also able to grasp the importance of line weight, since fine details vanish at a distance. Although they were told this both during the short lecture and during the sketching session, to actually see the effects gave the students insight in the importance of the principles. This mirrors what Schön [8] describes about the importance of reflection on action in design education.
Table 4. Rapid signage prototyping

This image illustrates the scanned drawings that have been cropped to only contain the actual signage sketches. This image shows the texture that the 3D software then uses to render the signs in the 3D worlds. (As Table 3 shows, illustrations are placed within an (invisible) grid, corresponding to the faces of the signs. Other parts of the image correspond to back sides and edges of the signs).

This image shows the rendered signs (two of them) in the 3D world.

6 SUMMARY AND FUTURE WORK

Our first tentative test and evaluation of the first course module was very promising. The students were able to see and experience aspects normally only apparent when viewing signs at a distance in a real environment. The difference was that they were instead viewing it through a computer screen, several kilometres from the real building. Future research will focus on the following aspects:

- Student experience of using virtual environments as a design tool.
- Efficiency of lab work with 3D worlds in large classes, versus each student or student group printing and testing in the real world.
- Benefits and drawbacks of large-screen immersive visualization of the signs in the virtual worlds
- Benefits and drawbacks of using eye tracking to test the signs in the virtual world, compared to deploying printed signs in the real world.

REFERENCES

