

# 2D/3D WEB TRANSITIONS: METHODS AND TECHNIQUES

**Eric Deléglise, Diponkar Paul, Morten Fjeld**

*Dept. of Computer Science and Engineering, Chalmers University of Technology, Sweden  
eric.deleglise@etu.univ-savoie.fr, diponkar@student.chalmers.se, morten@t2i.se*

Keywords: Transition, 3D, 2D, Web, Transition, Buffer, User Interface

Abstract: While numerous web applications exploit either 2D or 3D technology, the work presented here suggests that it is feasible to integrate 2D and 3D environments. Besides presenting methods and techniques for realizing 2D and 3D web environments, novel ways of putting corresponding technologies to work are suggested. The prospective user benefits and inherent limitations of realized models are presented in our work. Then the issues that arise when switching between 2D and 3D environments are explored. The background and justification for the three methods and corresponding techniques presented here illustrate how to enable and facilitate a fluent and effective transition between 2D and 3D web environments. While some of the methods and techniques presented are still at a conceptual stage, two techniques have been realized and the findings are presented in detail. A video presentation of realized techniques is offered. Usability of the methods and techniques realized is discussed.

## 1 INTRODUCTION

Ergonomic and functional aspects of visual interfaces greatly affect everyday human-computer interaction. Applying two-dimensional (2D) and three-dimensional (3D) technology to user interfaces is becoming increasingly popular, and designers employ alternative methods for interacting with such environments. Here, we started out with a web application for remote project management drawing on a combination of 2D and 3D web User Interfaces (UIs). This web application offers a wide range of functionality enabling an authorized user to distribute tasks to remotely situated programmers, designers and testers, place access constraints on employees depending on their hierarchical level, upload completed tasks to the system, communicate online, etc. However, this paper focuses on the different methods for developing and realizing technology that has 2D/3D elements and enables users to alternate between 2D and 3D. The validity of such methods relies on the assumption that the smooth transition between 2D and 3D interaction is beneficial in such a 2D/3D web environment. While 2D interaction is particularly helpful when interacting with WIMP (window, icon, menu, and pointing device) elements such as menus and dialogue boxes, 3D interaction can offer a more realistic and familiar user experience. The application presented is modeled on a basic concept blending 2D and 3D interaction. We expect related interactive systems to benefit from this concept. Based on a set of three methods and corresponding techniques, the three main questions motivating our research are as follows.

- How can smooth transitions between 2D and 3D be implemented in web applications?
- What different kinds of parameters must be considered e.g. usability and interaction capability when working with 2D and 3D technologies for 2D/3D web environments?

- Do the methods have sufficient generic quality to be taken over and used by other UI designers?

In the following section, related work is described. Subsequently, an outline of the methods that have been used to realize applications is presented including those methods whose applications are in development. Then Table 1 provides a thorough description of techniques for switching between 2D and 3D interaction. The paper rounds off with a discussion and outlook section. A video presents the techniques that have been realized<sup>1</sup>.

## 2 RELATED WORK

Prior research has been done comparing the effectiveness of 2D and 3D user interfaces. On the one hand, as indicated by Massó et al., 2D can be effective for WIMP-based user interface description while on the other hand, a 3D virtual user interface environment is optimal for realistic presentation and behavior. In the STARLIGHT project, Risch et al. used 3D visualization techniques offering a new class of information visualization. Ridsen et al. compared 2D and 3D visualizations of web content, but did not find any significant differences in user performance or satisfaction regarding the visualizations. Given that web technologies have evolved significantly lately, we found it of interest to re-examine Ridsen's results and to realize new methods fusing 2D and 3D web environments. The methods suggested here are intended to help improve user-friendliness in 2D/3D web environments.

Moreover, Cockburn and McKenzie compared 2D and 3D versions of Robertson et al.'s Data Mountain and found no significant difference in performance, but the 3D version received a notably higher subjective rating. Ware and Franck conducted a comprehensive comparison of environments and various 3D modes by examining tasks

---

<sup>1</sup> Video presentation: <http://www.3de.fr/ihm/index.html>

involving the inclusion of 3D graphs. The ability to move or rotate the graph and 3D affordance proved to be valuable features, contributing to the fact that 3D applications consistently outperformed 2D ones. Our work, however, opts to explore the optimal methods for realizing 2D/3D transitions, where 3D is favorable for flexible user interaction and 2D is utilized when there is a significant amount of content present.

### 3 METHOD AND TECHNIQUES

Table 1 offers an overview of different methods and techniques combining 2D/3D content and supporting 2D/3D transitions. Methods and techniques realized are in

white, partly realized ones are in light grey, and realized ones are in grey. The techniques that have been realized are presented in a video<sup>1</sup>.

#### 3.1 I: 2D and 3D with same technology

As seen in the table, a method is presented which is based on the utilization of the same 3D technology to display 2D and 3D content. Displaying 2D content using 3D technology is not technically sound. It is better to use Flash or php and html than 3D technology when attempting to improve 2D interfaces. 3D technology is not proficient at displaying WIMP components compared to alternative technologies.

Table 1: Methods and techniques supporting 2D/3D transitions: Planned in white; partly realized in light grey, realized in grey.

Methods and Techniques	Projected User Benefits	Technologies employed	Limitations and Remarks
<b>Method I</b> Display 2D content in 3D environment with 3D technology	<ul style="list-style-type: none"> <li>• User friendliness</li> <li>• More playful interactions</li> <li>• Better immersion</li> </ul>	<ul style="list-style-type: none"> <li>• Second life</li> <li>• Google Lively</li> </ul>	<ul style="list-style-type: none"> <li>• Not stable for professional tasks</li> <li>• Not compatible with technologies like Flash and Joomla</li> </ul>
<b>Method II</b> Smooth transition between 2D content and 3D navigation	<ul style="list-style-type: none"> <li>• 3D navigation richness</li> <li>• 2D content richness</li> </ul>	<ul style="list-style-type: none"> <li>• Virtools used to build the 3D environment</li> <li>• Web 2.0 application like Joomla or drupal used for building 2D pages</li> <li>• Frame system used in transition mechanism</li> </ul>	<ul style="list-style-type: none"> <li>• Only one 2D page can be shown at a time</li> </ul>
<b>Method II, Technique a</b> Same template is used for 2D and 3D content for system consistency	<ul style="list-style-type: none"> <li>• System consistency (user feels that he remains in the same system)</li> <li>• Smoothness of transition</li> </ul>	<ul style="list-style-type: none"> <li>• Template displayed in both systems (position and size remain the same in the CSS)</li> </ul>	<ul style="list-style-type: none"> <li>• User can become lost</li> <li>• When user is viewing 2D content, there is no visual information to show position in the 3D world</li> </ul>
<b>Method II, Technique b</b> Transition with icon that represents position of user in 3D environment	<ul style="list-style-type: none"> <li>• User orientation (user knows where he is in 3D environment)</li> </ul>	<ul style="list-style-type: none"> <li>• Icon displayed on 2D page</li> </ul>	<ul style="list-style-type: none"> <li>• User feels that there are two different environments</li> <li>• Discrepancies between the technologies are evident</li> </ul>
<b>Method II, Technique c</b> Transition with picture of 3D environment	<ul style="list-style-type: none"> <li>• System consistency (users never feel like they leave the 3D world; they remain in same system)</li> <li>• Transition smoothness</li> <li>• Information consistency</li> <li>• Information as to position in 3D world appears on the screen</li> </ul>	<ul style="list-style-type: none"> <li>• Picture taken in 3D world used as background for 2D content</li> </ul>	<ul style="list-style-type: none"> <li>• Not possible to view much 2D content at one time</li> </ul>
<b>Method III</b> Wrapper utilized in 3D environment in order to display 2D content	<ul style="list-style-type: none"> <li>• Multiple 2D page display capacity</li> </ul>	<ul style="list-style-type: none"> <li>• Used a wrapper in 3D world in order to display a 2D page created with Flash or other web 2.0 technologies.</li> </ul>	<ul style="list-style-type: none"> <li>• Can be confusing for users</li> <li>• Too much information presented simultaneously</li> </ul>

#### 3.2 IIa: Same Template Transitions

Method II is mainly presented through technique IIa including a 2D/3D transition mechanism, a rich 3D universe, an information display, a transition Fx, and a 2D page.

##### 3.2.1 2D/3D Transition Mechanism

The methodology of our concept will be explained in the description of our product. This sample can be reused

when creating new applications based on the same model. The system is composed of three elements: the frame system used for the transition, the 2D page, and the 3D page. Each element has its own script used in the process of transition. The frame system has two frames: one displaying 3D content and the other, 2D. The two frames work like buffers (Fig. 1); when one is displayed the other is hidden. The 3D buffer accompanies a 3D page and the 2D buffer corresponds to a 2D page. The system can be used in order to transit between 3D and 2D states. First,

the 3D buffer is displayed in full screen, and the 2D buffer is hidden. Subsequently, a JavaScript is used in order to go from one buffer to the other. When the script is called, it modifies the size of each buffer. The system can also be used in order to move from 2D to a 3D state. The 2D buffer leaves 50 pixels at the top of the screen for the 3D buffer to display the icon which is used to return to the 3D state. When the icon is clicked, a script operation is performed making the switch from the 2D to the 3D buffer which then assumes full screen size.

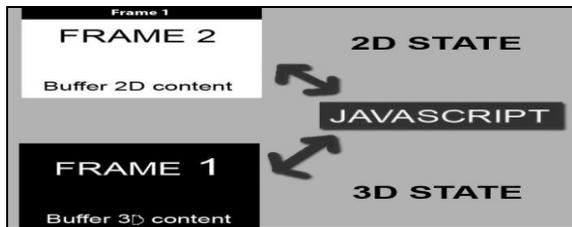


Figure 1: 2D/3D transition mechanism (Frame).

### 3.2.2 Create a Rich 3D Universe

In our sample, the 3D universe is a circular virtual room composed of seven stands (Fig. 2). The user can interact with this environment using an avatar. A chime or other sound welcomes the user and supplies him/her with complementary information. Each interaction with the environments is linked to a sound effect (push button, movement, transition, and loading) in order to alert the user of activity.

Navigation is designed to be simple and natural for most users. There are two kinds of users with which we are concerned. We assume that users accustomed to gaming generally navigate the room easily when utilizing the directional keys on the keyboard as well as the mouse. Beginners in this kind of environment may find a classic 2D menu preferable. All principal points are highlighted on such a menu. Hence, users can move from one target in the room to another simply by clicking a button on the 2D menu. User friendliness should be analogous to that of a classic 2D website. However, sharp animation movement facilitates free movement about the room.

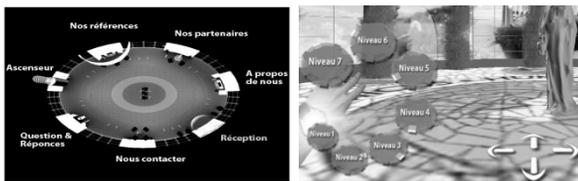


Figure 2: Map of the 3D room (left) and 3D navigation (right).

### 3.2.3 Display Information for the User

The scenario is designed to present users with information in a certain order. First, the system displays navigation information, then each stand's title followed by its description. Lastly, the full content is shown in a 2D state. The other stages are presented in a 3D state. In the beginning, users start in an elevator where they can select a performance level, each with its own theme (Fig. 4). When users arrive in the room, seven stands are depicted. In their first position, users can only read the title of stands (Fig. 3).

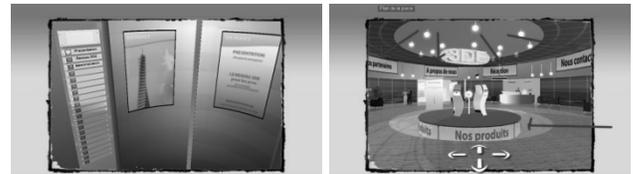


Figure 3: 3D elevator (left) and titles of 3D stands (right).



Figure 4: The 3D stand (left) and full 2D content (right).

Upon approaching a stand, the user is able to read more information on posters providing descriptive details about each stand (Fig. 4). If the description interests the user, he/she can launch the transition and transfer to the 2D web page, where the content is very rich and dynamic (Fig 4, right).

### 3.2.4 Transition Fx

A transition mechanism is used in order to switch over to the 2D page. To facilitate smooth transition between the environments, an artifact is designed in the 3D environment for each stand. In this sample, we used a TV screen and paper (Fig. 5). In the 3D environment, pictures of 2D web pages are printed on each screen. When users activate the transition, the camera focuses on the transition artifact, and zooms in on its content. When the camera is in the correct position, the 3D transition script operation is launched. Navigation in the 3D environment system is suspended and the 2D page is launched in the 2D buffer. The 3D content is not in full screen and a 2D template appears on the borders of the content.

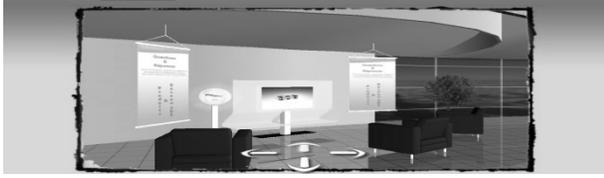


Figure 5: Television artifact for transition and 2D template around 3D environment.

### 3.2.5 Design of the 2D Page

The same template as the one around the 3D content is used for 2D content, making the transition smoother. To ensure functionality, we used the CMS open source Joomla for all the 2D content. Each page of the 2D content has its own script which is activated when the page is fully loaded. The main purpose of the script is to change the size of each buffer.

### 3.3 Iib: 2D/3D Transitions with Icon

The model is the same as Iia. We just add an icon with the purpose of displaying the 3D world before transition. This icon appears on each 2D page in order to keep the user mindful of his/her position in the 3D environment.

### 3.4 Iic: Maintain 3D Info in 2D Content

Again, the model is the same as Iia. However, on the 3D page the content is entirely in 3D. There is no template around the 3D content as with the Iia model. During transition, the 3D world is suspended, and a snapshot is taken before departing the 3D state. The snapshot appears as the background before the 2D page takes over. Fig. 6 shows the method for enabling some 3D visual information to appear on the 2D page.

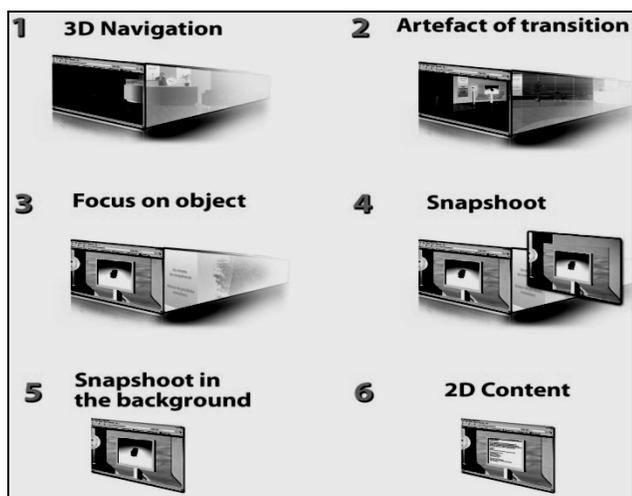


Figure 6: 3D visual information in 2D page.

## 3.5 III: Wrapper in 3D Content

Another method enlists the assistance of a wrapper in the 3D environment to display the 2D content as a texture directly in 3D. We did not choose this approach because the technology is not suitable for supporting graphic quality and efficient rendering.

## 4 DISCUSSION AND OUTLOOK

The presented methods and techniques are designed to improve 2D/3D web applications by offering bridges between high quality content and rich 3D navigation. As an example of a smooth transition system, we suggest applying 3D to a professional web site in order to improve product or company marketing tasks by offering the intended user better immersion in and interaction with the environment. It is feasible to create a web site with high quality content and rich interactive space by using the aforementioned methods. Though each method has sufficient potential to be used in real-life projects, not all are taken into consideration due to limited resources. The techniques which are adopted in the systems have variables that can and should be modified in accordance with the structure of new systems. In the future, each method will be taken into consideration when designing 2D/3D web environments and the most efficient techniques improving usability will be further explored.

## REFERENCES

- Molina Massó, J. P., Vanderdonckt, J., Simarro, F. M., López, P. G., 2005. Towards virtualization of user interfaces based on UsiXML. In *Proc. Tenth International Conference on 3D Web Technology*. Web3D '05, ACM, 169-178.
- Risch, J.S., Rex, D.B., Dowson, S.T., Walters, T.B., May, R.A., Moon, B.D., 1995. The STARLIGHT Information Visualization System. In *Proc. Human Factors and Ergonomics Society 38th Annual Meeting*, 16-20.
- Risden, K., Czerwinski, M., Munzner, T. Cook, D., 2000. An Initial Examination of Ease of Use for 2D and 3D Information Visualizations of Web Content. *Int. J. Human-Computer Studies*, 53, 695-714.
- Cockburn, A., McKenzie, B., 2001. 3D or Not 3D? Evaluating the Effect of the Third Dimension in a Document Management System. In *Proc. CHI'2001*, ACM, 434-441.
- Robertson, G., Czerwinski, M., Larson, K., Robbins, D., Thiel, D., van Dantzich, M., 1998. Data Mountain: Using Spatial Memory for Document Management. In *Proc. UIST'98*, ACM, 153-162.
- Ware, C., Franck, G., 1996. Evaluating Stereo and Motion Cues for Visualizing Information Nets in Three Dimensions. *ACM Trans. Graph.* 15, 2, 121-139.