Virtual IKEA: User Interaction in 2d and 3d spaces
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Abstract
Jupiter research projects that by 2010 nearly half of all retail sales will be influenced or transacted online. Three-dimensional (3D) graphical or virtual environments are a natural evolution (next step) for online retail applications not only because they introduce engaging brand experiences, but because they can improve purchasing experience efficiency enabling customers to inspect merchandise from multiple vantage points, in context and can aid product customization. However, most of today’s 3D interaction frameworks are an inefficient and overly complex representation scheme for ecommerce. This research examines the design implications and intersection between rich media 2D and real-time 3D interactive environments as an effective use for 3D in an ecommerce strategy.
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1. INTRODUCTION

In the past few years we have seen a shift in the way information is delivered and shared on the internet. We have moved away from static, isolated HTML "silos" towards a more participatory exchange of information dynamically delivered. A participatory web has enabled people and businesses to collaborate and share information. This shift is particularly relevant to online retailers as they enable consumers to research products with greater efficiency. Ecommerce sites such as Amazon.com have been refined and enhanced to deliver a degree of efficiency that can match or even exceed that of their brick and mortar counterparts. Consumers are more satisfied with their online shopping experiences because of the vast array of information available to them. Presently, about 65 percent of users in the U.S. shop online. (Jupiter Research) Several trends have fueled this change including:

**Broadband**: About 50% of US homes have broadband, with estimates of 78% by 2010 (Jupiter Research). Broadband access has become the fastest-growing component in telecommunications. This adoption reflects the fact that the Internet is central to our daily lives. The internet increasingly shapes how we interact with our surroundings and how we define ourselves. As broadband continues to penetrate the home market, consumers are instigating and expecting new possibilities for expression and utility. With more consumers accessing the Internet via broadband, retailers have the opportunity to deploy new technologies that will make their sites more engaging—and thus more likely to keep customers shopping.

**Rich Internet Technologies** such as AJAX, Flash and Java have changed our perceptions and expectations of how information on the web can be delivered. Another set of tools that makes the virtual shopping experience more engaging is audio and video. Multimedia technologies enable customers to view product demonstrations before they buy, much as they might in a brick-and-mortar store. Some companies are also using sophisticated Web monitoring tools, enabling them to track consumers' online behavior and identify precisely how to improve their sites.

**Wireless/Mobile**: Wireless connectivity both in and away from the home speaks to our need for connectivity anytime, anywhere. This connectivity feeds the participatory activities of the medium as we can send and receive data from new creative tools and networked devices. No longer tied to our PC’s in the home, we can integrate offline experiences, information and goods into virtual worlds.

**Devices**: Devices are enabling new forms of consumption, distribution and production, furthering the participatory and encyclopedic elements of the web. Digital cameras have enabled people to easily document and share their experiences. We are creating content and experimenting with digital images, video, music, and recordings in collaborative, social environments. Retailers recognizing this trend enable consumers to share their content with others, thus providing not only informative views of the product in a real context but also establishing or affirming a sense of credibility (via the recommendation of another customer).

The aforementioned conditions are helping to facilitate new retail channels as well. As online retailers use technology to replicate in the virtual world the experiences people have in their stores, we will see an increasing trend towards the development of Three-dimensional (3D) graphical or virtual environments. “The entire Internet is moving toward being a three-dimensional experience that will become more realistic as computing technology advances.” (Siklos, 2006)

Video games and emerging networked platforms including Google Earth, SecondLife, and World Of Warcraft, to name a few, illustrate the growth in this space.
Some researchers envision the 3D immersive experience as the next iteration of the participatory web, dubbed "Metaverse" -- an internet dominated by 3D technology, social spaces and economies. We will increasingly inhabit the web in 3D information spaces, in our own personae and with a greater context to our own real lives. (Metaverse Roadmap, 2007)

SecondLife (Fig 1) is an example of blurring of the boundaries between the real and the virtual. Retailers and advertisers are utilizing this virtual environment as a new channel to reach their target audience. While there is little ecommerce taking place in terms of real-world goods, the brands setting up shop in SecondLife recognize that as the attention of consumers is increasingly fragmented, these emerging worlds present a unique, a low-risk marketing opportunity.

As more web services focus on the identity and context of users, 3D environments will provide a synthesis of the real and virtual. The delivery of experiences in a 3D platform will provide new representations of data, new ways to filter content and novel exploratory pathways and possibilities. 3D environments have the potential to add context to interaction by replicating our experiences in the physical world and creating intuitive spatial metaphors. Three dimensional environments have the potential to enhance online retail experiences because of the unique visualization and customization capabilities such procedural environments afford. This is not to say we should map real experiences onto 3D platforms for novelty; rather, 3D experiences should provide more utility, interactivity, context, synthesis, and presence as a means to generate or unveil deeper understanding of the information presented.

2. PROBLEM STATEMENT

Real-time 3D is primarily used in gaming, architecture, medical and geospatial imaging. There has been very little adoption of 3D in mainstream retail or eCommerce application outside of online product demonstrations. While virtual worlds such as SecondLife are providing the environment for marketing experiments, immersive 3D is seen as an inefficient and overly complex representation scheme for eCommerce. Two-dimensional browsing and information archiving tools are more efficient for research, particularly in an eCommerce environment where a consumer is compiling product information and metadata such as price, options, and size (often for multiple products). Comparable research in a 3D environment requires significant cognitive overhead. In the IBM-developed Sears store in SecondLife, consumers can research real-world Sears products (Fig 2). By pointing and right-clicking on an object, the user is presented with a text-based virtual notecard containing the product’s details. Additionally, a second option enables the user to open a traditional web-browser and linking directly to the product webpage (Fig 3). The flat webpage is superior in terms of presenting the large quantity of information. There is a recognized interaction framework as well for purchasing the item in a 2D webpage. One clicks on the large red button labeled “Add to Cart”. When ready, we then enter credit card information and complete the transaction. The standards for a comparable interaction in a 3D environment are undefined. I trust these interaction frameworks will be negotiated and defined as more people participate in virtual communities and economies; however, literal translations like those that make up the bulk of interactions presently in SecondLife are inefficient.
Amazon.com for example, is successful not because it is a facsimile of an endless bookstore or mall (Figure 1), but rather because of the way it organizes information and provides sophisticated, flexible and “intelligent” tools that enable consumers to find and browse items.

The affordances of 3D however do provide some advantages that may be worth the additional cognitive load for many users. I am primarily interested in the intersection between dynamic 2D and 3D content. Not all information design is ideally visualized in a 3D space. As interaction designers, we must consider how 2D and 3D relate and are used by different viewers. Moreover, as the internet moves into 3D networked environments, solving the problem of how to effectively present large quantities of information will be important.

A networked eCommerce application might enable the consumer to browse, search and in some way express an interest for a product using 2D navigation and then enter a 3D space to see that item in context and in the presence of others interested in the same item. Ideally the user should be able to modify, customize/personalize, save and share the presentation of that item. Moreover, a 3D online retail experience should take advantage of the social collaboration, participation affordances of 3D such as recommendation tools and customer feedback.

I initiated my project by identifying a domain in which 3D navigation would be appropriate and could take advantage of the affordances of a virtual environment such as the visualization of space. As architectural visualization is a well-established use of 3D imaging, it was not a significant leap to interior design and furniture representation. I also wanted to work with a multichannel retailer known for innovative marketing and technological experimentation. Thus my project is an eCommerce application in which consumers are present in a real-time 3D IKEA showroom. IKEA engages their customer via retail stores, a catalog, and the internet. Because consumers may use all three channels at once when considering a purchase, there must be consistency of branding, service, merchandise and experience across all three channels. The IKEA catalog, and IKEA.com are complex and highly visual documents showcasing 22 shopping categories and thousands of products. The existing website provides an elegant text and image-based navigation structure enabling prospective buyers to shop in the comfort of their own home. Users can easily explore the site and make comparisons, see alternatives, price and purchase furniture and household accessories. I looked to this site for much of the information architecture relating to product relationships.
3. JUSTIFICATION:

A furniture showroom provides an ideal platform for examining the possibilities and effectiveness of translating a real experience/environment into a virtual space. IKEA in particular, with a database of thousands of furniture items and customization options, is a rich environment in which to explore the interaction framework of a complex consumer experience.

Many ecommerce applications use 3D models to enable users see a product from all angles using standard move, rotate, and zoom navigation. Furniture shopping is aided by seeing not only an image of the item from all angles, but also viewing it in context of a living space and in relationship to other related products. In the brick and mortar showrooms, IKEA provides an immersive experience throughout the store. Great attention is given to layout, lighting, accessories – creating an environment with a high degree of verisimilitude. This seductive experience enables the shopper to envision the product in their own home and I would argue is a primary factor in converting browsers into buyers. To what degree can a virtual showroom meet the same goal? How can the affordances of the digital medium create an experience that at once, reproduces the persuasive elements and exceeds the possibilities of the real? For example, the physical limitations of the real IKEA prohibit visitors from swapping dozens (if not hundreds) of iterations of similarly sized items in a showroom to see which one best fits with their floor plan. A virtual showroom would be limited only by the users’ imagination and requirements.

Alternately, the extensive and at times exhausting layout of the brick and mortar IKEA utilizes architecture of disorientation to draw visitors into encounters with a range of products. While this serves IKEA by putting more products in front of the consumer, it can be a frustration for many potential customers. A virtual showroom, particularly a collaborative or multi-user environment, would enable a range of browsing and searching capabilities. The system could provide instant access to specific items or allow casual browsing. This project attempts to go beyond a recreation of the real IKEA however. American Apparel created a virtual store in Second Life (fig 4.) to much media fanfare (Jana, 2006). While the approach is novel and is successful in placing the brand in front of its target audience, it does not exploit an environment where anything is possible. American Apparel in Second Life is not an eCommerce experience in the sense of selling anything to the consumer. My project goes beyond the marketing exercise that brands are creating in SecondLife to explore how a virtual environment can extend expressive possibilities rather than reproduce existing 2D or 3D architectures.

In recognition of the multichannel retail strategy, a consumer’s choices and activity in a virtual shopping experience can provide important information for their real world shopping experiences. My project attempts to encourage or aid the cross-over between virtual and real-world experiences. For example, the prototype provides the user with a customized price list and location of products, mapped to the local IKEA.
4. DESIGN IMPLEMENTATION

4.1. Description

4.1.1 Navigation

The goal of this project is to explore design implications and relationships between 2D and 3D interaction metaphors in an eCommerce application. While 3D is well suited for an exploration of spatial relationships, navigation in 3D is unfamiliar to most users. An eCommerce application requires a high degree of usability to be successful; thus the introduction of any novel interaction framework must be considered in terms of how it will impact the end-user’s ability to find the items they seek. Prior research has examined the differences between 2D versus 3D display and the extent to which 3D might improve spatial memory recall. The conclusions of Tavanti and Lind suggest that 3D display improves the way we retrieve textual and abstract data. (Tavanti, 2001) Alternatively, Jakob Nielsen’s work indicates that the use of 3D as a navigation strategy may be ineffective for many aspects of product research. (Nielsen, 1998) In fact, 3D environments have been described as requiring greater “cognitive overhead” (Metaverse Roadmap, 2007) compared to 2D navigation structures. Previous studies have also found gender differences in 2D/3D display preferences. Tina Ziemek’s work shows how the use of 2D and 3D graphics in video games “affects the extent of how attracted a male is to playing an electronic game versus how attracted a female is.” (Ziemek, 2006) Her findings demonstrate that the majority of females prefer 2D games. Likewise Czerwinski, et al examined the reasons for males significantly outperforming females in navigating virtual environments. They found that “women take a wider field of view to achieve similar virtual environment navigation performance to men.” (Czerwinski, 2002) Given that the predominant demographic profile for “Home and Garden” sites such as IKEA, is female (Nielsen/NetRatings), any use of 3D in the interface must factor optimal design strategies and user-testing for a largely female user-population.

In addition to the cognitive and perceptual issues of 3D display, the novelty of a maneuvering in a virtual environment raises a question of standards for ecommerce tasks. The tasks in well-designed and tested 2D ecommerce applications are familiar to all but the novice user. Will we have to reinvent well-established interactions such as “Add to Cart” in 3D virtual environments?

Website navigation often consists of users clicking from page to page in a linear path -- using menus or buttons directing them closer to the product or information they seek. While rich media tools such as Ajax and Flash are changing interaction patterns on the web, two-dimensional navigation and information including metadata, photos, recommendations, comparison tools, etc. are largely standardized and enable the user to reduce the information down to something they can efficiently digest. This efficiency enables the consumer to find what they want and make a purchase. That said, I believe an integration of 2D and 3D may provide innovative eCommerce solutions.

There are prior examples of 3D display as ecommerce enhancements or standalone application. HP Lab’s Virtual Environment Design Automation (VEDA) for example, is a system for dynamically constructing virtual environments and is envisioned as ideal ecommerce-building tool. Apple’s Quicktime VR Object (QTVR) is an image format that shows images of an object taken from multiple viewing angles. While the use of 3D technologies has been primarily 360° product visualization the use of 3D is broadening as developers focus on brand immersion, customer personalization and engagement. With broadband growth and rapid adoption of rich media platforms we will continue to see expressive yet efficient uses of 3D in ecommerce applications.

My project attempts to bridge the strictly 2D elements of IKEA.com and the 3D components of my application. One of the innovations in myIKEA is enabling a user to enter a virtual showroom and thereby customize the presentation of products and alter the 2D elements of the tool. As I will explain in detail, the 3D element of the application is initially accessed from the perspective of a 2D photograph. The 2D product view provides a rich, detailed representation of the consumer goods, artfully arranged and perfectly lit to
showcase the IKEA look and feel. However, if the user is researching a couch that is positioned halfway out of the frame, repositioning the camera would enable the customer to see the item from a preferred vantage point. The procedural, digital environment also enables the customer to change other elements within the showroom.

As I initiated the design of the project I realized that while this 3D application offered unique eCommerce possibilities, there were high-level usability concerns to address, namely the gap between good information architecture practices (helping user find the product) and the innovation of the 3D application. I didn’t want to drop users immediately into a 3D environment, but rather introduce the immersion gradually using camera zoom navigation with simple point and click functionality. My goal was to move the viewer into an immersive, fluid, perspective-based environment, prior to entering the full 3D space.

4.1.1.1 Movement

Upon entering the myIKEA environment (Fig. 5) the user sees a top level, world navigation that includes the general categories of items sold at IKEA. (e.g. Sofas & Chairs, Bedrooms, Lighting, etc.) On the right side of the screen is the summary of the user’s activity in the application (see: 4.1.2.1 myIKEA). After selecting a top-level category, the camera view moves along the z-axis, adjacent to a series of panels identifying the category. The camera stops next to the selected category. The panel slides from the left size of the screen in front of the camera. Here, dynamically loaded images and text provide a range of style choices thematically organized with titles such as (“Timeless Comfort” or “Simple Chic”). Upon selection of an image the camera zooms in again to a close up view of the same image. It is here that the predominance of interaction with individual products takes place. While the category may be Sofas and Chairs, related complimentary products are also identified such as a coffee table, a lamp or a shelving unit. This “Showroom View” corresponds to the IKEA print catalog as well as the brick and mortar (B&M) showrooms. The Showroom View enables the consumer to view the primary object (sofa) in context. As the user moves into progressively more detailed product information spaces, the navigation structure mirrors that concept as a camera zoom along the z-axis.
I designed the application to be fluid, organic and to be understood instinctually by pointing and clicking. My design inspiration draws from the groundbreaking iTV work of Dale Herigstad. Use of the z-axis and perspective introduces the user to the virtual space while maintaining a full array of 2D information. In this dimensional navigation scheme a user can move forward and back while flat panels move in and out of a central position. (Fig. 6) This project only takes the zooming metaphor two levels deep, but as there are multiple levels of customization of IKEA products, this zooming effect could be extended into additional layers.

Meaningful directional movement is again tied to the navigation as up and down arrows are mapped to the user’s options. In the example of the Category Panel (Fig. 7) the arrows represent a single layer of choice – different room styles. However, up and down navigation could be mapped to additional options such as color or fabric. In other words, the z-axis is mapped to increased detail, the y-axis is mapped to choices within the detail and the x-axis is mapped to a shifting of importance or need.

4.1.2 panels

The navigation element of the application is a visual and graphic experience that gives the user the impression of moving within a virtual environment, along the z-axis -- a metaphorical “drilling” for more detailed information. Panels within the environment contain the 2D information and are the locus of interaction. These panels move in and out of the central position as they are required by the user.
4.1.2.1 myIKEA panel

The myIKEA panel is a summary of the user’s activity in the environment. This panel has 4 tabs: Summary, Products, Views, and Rooms.

**Summary**: The summary tab is initially visible by default. This tab contains information about the user such as their log-in name and preferred IKEA location. The summary panel lists the number of products, views and rooms that have been saved by the user -- a synopsis of the other 3 tabs. The most prominent element of the summary tab is an editable “wishlist” of products identified by the customer. This list can be filled-in manually by the user or dynamically updated when a user chooses to add a product anywhere in the application. The list can be utilized offline as a shopping list like those provided at a BRICK AND MORTAR IKEA. The system automatically fills in the aisle and BIN number for the user’s preferred real-world IKEA. A future version might map to the product location in the BRICK AND MORTAR showroom. This element of the application is designed to be flexible and open-ended – a list of items in which the user is interested. The products can be transferred to a shopping cart, or the list can be printed or shared. Additionally future development would enable the system to link the individual product back to its detail page or to any of the instances in the online catalog.

**Products**: The products tab contains the same information as the Summary list – an array of products selected by the customer, though organized visually. In this view, the products are arranged on a grid and include a thumbnail of the item, the name, a simple description and a price. Clicking the thumbnail displays the item’s details and a larger photograph. Future iterations of the design would enable the user to sort this view based on preferences including last visited, price, theme, product category, etc. As with items on the “wish list” products can be sent to the shopping cart and in future iterations would link back to products anywhere in the online catalog.

**Views**: The views tab contains a summary of showroom images saved or generated by the user. The purpose of saving a view is to enable sharing with others -- a contextual representation for the user’s design preferences or taste. Views are also the visual artifact of the user’s interaction with the 3D component of this application. A “view” as I have termed it is a 2D representation (either procedurally generated or photographic) of a showroom. The distinction in this application is that views can be procedurally generated by the user repositioning the camera in the 3D virtual version of the showroom. IKEA photographers create the original “view” (Fig 11) and a 3D model version of that showroom is also developed (Fig 12). If the user considers an object poorly positioned, they can access a real-time 3D
recreation --“enter the view”—(Fig. 12) of the showroom and reposition the camera thereby changing the “view”. The affordances of a virtual showroom enable the user to change the objects in the view as well. That is, unlike a BRICK AND MORTAR IKEA, a user in a virtual showroom can interchange products and options (fabric, color, etc.) as they prefer. In turn, once the room is suitably redesigned, the user can save and share the view. One might think of a “saving a view” akin to capturing a postcard in SecondLife. The views tab thus is a repository for the user-created images as well as the standard IKEA “views”.

Rooms: Rooms are representations of actual homeowner spaces that have been modeled and custom designed by IKEA in a 3D virtual environment. This application could be a partnership between IKEA and residential developers, college/university residence halls, apartment building/loft/condo owners as a service for prospective residents. The user can find their home in the system and navigate, using a provided floorplan, to a room either pre-designed by IKEA or an empty floorplan ready to be filled with saved IKEA products and/or views. User-generated designs could be accessed by subsequent inhabitants of the same space. The rooms tab, like the products, and views tab is the storehouse for the user to save their work.

4.1.2.2 Category Panel

The Category panels (Fig 7) represent the top level product categories defined by IKEA such as Bathroom, Bedroom, Bookcases and Storage, etc. These panels are stacked and aligned along the z-axis, alphabetically. Upon selecting a category from the navigation panel at the front of the environment, the camera zooms to that location and the panel emerges from its place in line to be centered in front of the camera. (Fig. 6) Each panel has multiple sample showrooms thematically organized in a slideshow-like selector. Each sample showroom image has corresponding text that describes the showroom theme. On the left side of the panel is a link returning the customer back to the initial state of the application. While a Category panel is centered on the screen, the myIKEA panel is still in view though diminished to the right of this panel. This is designed to
enable instant access to the myIKEA tool positioned in the periphery. Future iterations might enable category to category navigation and the ability to identify comparable thematic views in different categories. Moreover, it may be useful to identify individual products in the showroom prior to zooming to the next, individual showroom view.

4.1.2.3 Showroom View Panel

After the user selects a showroom view of interest, the camera zooms to a close-up detail view of that showroom. (Fig. 14) The myIKEA panel is still visible in the background and can be clicked to bring it to the foreground.

Navigational breadcrumbs identify the title of the showroom, enable the user to move back to the category panel and/or return to the initial state. (Fig. 5) The individual showroom view panel and the adjacent Details panel (Fig 16) is where most user selections occur. As the user points to products in the view, the products are highlighted and basic details are presented as a tooltip. This information includes the name of the product, a simple description and price. A link to open the adjacent Details panel is provided. Clicking the details button rearranges all panels to share the primary focus between the showroom view and the details panel. (Fig.16)

In addition to accessing individual product details, the user is also provided view options via the individual showroom view menu. This menu provides the following options: add view to myIKEA, add all products to myIKEA, share view, edit view and go to myIKEA. As mentioned previously, the system is designed to be flexible to enable the user to interact with (research, buy, share, comment, etc.) an overall view or individual products. Clicking the “add view to myIKEA” button adds the photographic view to the views tab in myIKEA. The “edit view” button takes the viewer to the 3D virtual showroom, where they can edit the view.

Fig 14 Showroom View and Options menu

Fig 15. Upon selecting "add view to myIKEA", the photographic view is placed in the Views tab of myIKEA
4.1.2.4 Details view panel

Fig. 16. Details view foregrounded

The details view presents the information consumers regularly use to research products as well as to make recommendations, provide feedback and engage a broader community interested in the same products. This detail information includes a larger product image, title and description, product metadata such as size and dimensions, materials used, features and functionality and more descriptive text. Below this text window are customer examples -- user submitted photographs of the product in real world settings, user comments and reviews. In this panel the user can save the product to their myIKEA panel and/or to the shopping cart. Upon selecting “add to myIKEA, the application adds the product information to the summary view of myIKEA and to the products view. Additionally the user can navigate back to the showroom view or navigate to their myIKEA panel by pointing and clicking on the panel or by using the provided links. Because I want to keep this dynamic viewing tool entirely visible (rather than requiring scrolling) I have limited horizontal real-estate. The fluid pushing back and pulling forward of panels, based on their required presence at any given moment, creates a scalable solution in a limited space. By utilizing the z-axis, the user can control the amount and relevance (based on position and opacity) of information they wish to take in. The z-axis not only compliments the metaphor of going deeper in detail but also enables unlimited possibility for modification, personalization and customization of the user experience.
4.1.3 Virtual showroom

The virtual showroom enables the user to see in 3D the 2D elements they are researching, but more importantly, it is here that they can alter those elements, thereby changing the 2D presentation. In essence, the user can create a customized catalog. Rather than scribbled notations in the margins or dog-eared corners of a print catalog, myIKEA is a customized catalog including fully visualized photographs, detailed dynamic notations and a clearly documented path of the customer’s preferences. Further, the system is tied to the layout of a brick and mortar IKEA so the user can easily locate their goods offline should they wish to.

4.1.3.1 Virtual showroom views

Each two dimensional representation in the myIKEA application is a single perspective within a 3D showroom. (Figs. 11, 12) That is, all physical showrooms have been reproduced as 3D models in which the user can interact. Once the customer decides to enter the 3D showroom, the initial perspective is that of the 2D view (Fig. 17a). From this starting point, they can move within the space using keyboard controls. Presently, the model is designed like a large home or apartment with adjacent rooms so that the user can see a living room, kitchen, bedroom, etc. This is a limitation that would need to be addressed in future iterations to enable the user to iterate through showrooms of the same category. For example, a user may want to see only livingrooms.

One purpose for moving around is to acquire a different perspective of a particular item. In the scenario of my prototype, the customer is researching sofas. They find a style they prefer in the catalog (Fig. 11) but the sofa is positioned too far outside of the frame to get a complete understanding of its overall design. Using the 3D virtual showroom, the user can change the camera view and get a better sense of the item by facing it frontally. (Fig. 17b) Once the customer repositions the camera, (Fig. 18a) they can save the view (Fig. 18b). This view is then a procedurally generated image of the same showroom but from the perspective the customer prefers.

![Fig. 17a Initial view inside virtual showroom](image1)

![Fig. 17b View after camera repositioning](image2)

![Fig. 18a View as user makes final adjustments](image3)

![Fig. 18b Changes reflected in myIKEA “views” tab](image4)
Alternatively, another reason for utilizing the virtual showroom might be to make changes to the products in the view. In this example, one could enter the scene, reposition the camera if necessary and replace objects with other comparable (or dissimilar) objects. In my prototype, I am using a set of furniture attributes such as “furniture type” that the system uses to identify which objects can replace one another. For example, cupboards can only replace cupboards, sofas can only replace sofas. Upon the necessary interaction from the user, (pointing and clicking) the system cycles through the available alternatives. This functionality is very crudely realized in my prototype, but it illustrates the encyclopedic affordance of the digital showroom. That is, any of thousands of products could be replaced with any other based on the users’ requirements and sensibilities. Again, as with changing the camera angle, once the user completed the design of the space, they could save the view as a 2D representation or preserve the 3D model for later return. I am primarily focused on the translation from 3D model to 2D image as a means to facilitate the sharing with others, and as an aid to real world purchase. In other words, the 3D adaptation might lead to an online purchase, but I think many users will prefer to create a virtual room then visit a BRICK AND MORTAR to see the actual goods. Because each object in the 3D environment has an array of associated data, the system preserves a list (in the myIKEA summary, myIKEA products tab and myIKEA views) of the items in the space. This flexibility enables the user to save some or all of the products and purchase them electronically or take a wish list to the store. (Fig 19)

4.1.3.2 Virtual rooms

Virtual rooms are actual living spaces modeled as 3D environments. My initial draft of this project considered how a 2D photograph might be procedurally translated into a 3D model in order to enable anyone with a digital camera to create a virtual showroom. Because the technology is still developing in this field, I decided to modify the assumptions of this feature. In my prototype I am assuming the cooperation of large-scale residential developers in providing floorplans which would be translated into 3D models. IKEA designers would then create sample virtual showrooms in these models. The Virtual Room enables the occupant or prospective occupant to preview actual living spaces fully furnished with IKEA furniture. Alternatively, the models can be left empty-- a blank canvas upon which the user can place IKEA items as they desire.

IKEA offers a 3D planning tool (see related work) that enables the user to plug in the dimensions of their room, then drag and drop IKEA items. This tool is a precursor to what could be a user-generated version of the virtual rooms I have envisioned.

Fig 20 myIKEA “Virtual Rooms”: The user can locate their home and view/edit a customized virtual showroom
4.2 Functionality

4.3 4.2.1 Browsing

There are three ways people use IKEA.com that relate to this project.

1. Browsing without specific requirements. For example, a user wants to remodel a living room and likes the IKEA style yet they are not looking for any specific products.

2. Researching or comparing a product(s) already identified, prior to going to IKEA. In this case the user knows what they want but requires more information or comparative data. Search or direct navigation to the product category would typically be the interaction.

3. Purchasing a product directly. Because IKEA has limited locations, many people will not visit a brick and mortar IKEA. The user is familiar enough with the brand to make a purchase without seeing the physical item. This user would find the item on the website via search or direct navigation to the product category.

IKEA.com mirrors the display strategy of its other distribution channels by offering photographic showrooms as well as single image detail pages. The photographic showroom highlights specific products in the same way as in the store, and enables consumers to determine their style preferences. In the myIKEA application I am primarily focusing on browsing and research interactions rather than search or direct navigation. My application enables the consumer to use the showrooms to determine the IKEA style that matches their taste. Like IKEA.com, my application also supports a customer’s general understanding of the products by displaying them in a contextual setting. The major advantage to my tool over both the print catalog and the brick and mortar channels is that in a virtual environment the style options that can be presented and controlled by the user are unlimited.

The experience of browsing creates multiple streams of information requiring the user’s attention at once. My project attempts to utilize 3D in a way that compliments the browsing for data by using navigational movement in a meaningful and consistent way.

4.2.2 Editing

The editing functionality of the myIKEA application enables the customer to view products from any perspective they wish, and design custom showrooms by substituting products. The digital medium affords the viewer an extensive pallet of options. Editing occurs in the real-time 3D environment and changes are preserved procedurally and saved to the myIKEA panel (Figs. 18a, 18b). Customization and personalization of goods and services is a trend that has been growing for several years due to the flexibility of manufacturing and the creative expectation and capacity of the consumer. (Trendwatching.com, 2006) The 3D virtual environment is a natural space for this kind of consumer control--particularly for designing an interior living space.
4.2.3 Saving

I designed the myIKEA experience to be flexible regardless of the retail channel (online, catalog, b&m) used to make a purchase. Thus, the system saves the elements of the experience the customer deems most important. A product or complete view (showroom) of products can be saved as a list for purchase or for convenience when the user visits an IKEA in person. (Fig. 21) Saving is evident in multiple areas of the application. When a customer identifies a product of interest they can “save to myIKEA” and the Wish list and products tab are dynamically updated. For those customers who edit or create showrooms, the save functionality enables them to return to their work, but more importantly it enables them to share their work with other stakeholders or interested parties. “Save”, in this regard is not only a preservation of state but also a translation – saving the 3D environment as a 2D image. As mentioned previously, the save functionality is like creating a PostCard in SecondLife. (Fig. 22) Future work on myIKEA would require this community sharing feature to be more fully realized as I think there would be ample opportunity for sharing, ranking, tagging, modding, commenting the creative efforts of others. Particularly if the 3D environment were developed as (or within) a networked, multi-user space, community functionality would be critical.

4.2.4 eCommerce.

While not forefronted, there is an important eCommerce functionality in the application. myIKEA simplifies the homemaking process for semi-nomadic urban populations such as graduate students (See Personas and Scenario). This application enables the customer to find and enter virtually their home, pre-designed (though editable) by IKEA. The selections by the customer can be purchased, delivered and installed or picked-up in true IKEA self-service fashion.
5. PERSONAS & SCENARIO:

Primary Personas
Steve & Mary Goldenblat
International Graduate Students, Georgia Tech

Steve and Mary are both starting Masters programs at Georgia Tech. They are moving to Atlanta from Argentina. They will be living in GaTech student housing. They are newly married and have little furniture.

What are their Goals?
The couple wishes to furnish their first home together tastefully and inexpensively. They want to identify items from IKEA to put in their new apartment, using the myIKEA application. Because IKEA is only a few blocks away, they can pick up the items with little difficulty or have the items delivered. Most importantly, they need to get their living environment organized very quickly as they are completing jobs in Argentina and will arrive only 10 days before classes start.

Because Steve and Mary are international students, they will furnish nearly all of their apartment with new items purchased in the US rather than ship furniture. They want something that looks good, but not too expensive. Additionally because their classes will start shortly after their arrival, they need to get their home set up as quickly as possible. In addition to setting up a home, they have to buy a car, get drivers permits, tax ID's, banking, etc.

As residents of Georgia Tech's new family housing, they are invited by email to participate in the beta test of the 10th&Home/myIKEA Home Planner on IKEA.com. Mary is interested in visualizing the items in their living space prior to moving in and as former SIMs2 fanatic Steve is intrigued though skeptical.

While Steve packs, Mary logs into the system to get started. She first sets her location preference to Atlanta and then proceeds to find their exact 10th&Home apartment in the myIKEA system: Building A, apt. 301. Mary chooses the pre-designed showrooms just to see the possibilities and to save time. While the “Urban Nomad” theme is not exactly what she wants, the designs are a good start as the furniture proportions are ideal for the apartment. Mary changes the Klippman Sofa cover from coral to beige, makes a few other color adjustments, selects different rugs and eliminates a few unnecessary items such as the KELIG GRODA cushion. Mary quickly designs a tasteful ensemble that fits the couple’s budget. She adds plates and dishes, garbage cans, lamps and other accessories she knows they will need. Prior to making her purchase she saves the views of each room she has edited and emails them to her mother and sister for their opinion. Her work is met with approval though Mary’s mom suggests a set of HOKUS curtains with tie-back to “add a little color to their extremely beige living room.” Mary and Steve continue to tweak their designs for a few days before deciding to purchase a complete delivery and installation package of their new IKEA living room and bedroom. They save the other items to their myIKEA wish list for picking up at the store.

Upon arrival to Georgia Tech, the items are already installed and the couple can concentrate on other pressing issues as they start their new lives in their new home.

6. GOALS

The first goal of the design is to facilitate browsing and enabling customers to identify the IKEA style they prefer. The second goal is to provide a means for consumers to customize their browsing experience in a way that is not currently available in traditional eCommerce applications. I want to demonstrate a use for 3D spaces that is broadly relevant to an eCommerce application(s) beyond product demonstration. The third goal is to
create a 3D virtual environment that the user can enter and modify. As a retail application, the tool should make it easier to preview items in users’ actual homes, rather than in a generic showroom. Finally as interaction designer I want to experiment with a 2D navigation structure that is effective in a 3D environment.

7. EVALUATION:

User testing is required to evaluate the effectiveness of the system. Users should be able to:

- Navigate from one panel to another
- Find a thematic category based showroom (e.g. sofas)
- View multiple showroom options and select a showroom
- Browse available products in selected showroom
- Visualize product details
- Evaluate the product, visualizing both the product and product information
- Compare the product to other similar options.
- Save the product to wish list in myIKEA
- Open the view options panel
- Save view
- Navigate to myIKEA
- Navigate to each tab in myIKEA
- Edit view (access 3D environment)
- Substitute one product for another
- Rotate and or move item
- Save view
- Return to myIKEA
- Purchase a product
- Remove item from wish list
- Print wish list
- View cart
- Purchase product

To date, I have accomplished little user-research aside from personal anecdotal evidence. The design of myIKEA is effective in the sense that the functionality is there for a user to accomplish most of the goals I set forth. A consumer can browse different styles of sofa showrooms, view a close-up of that showroom then enter a virtual version of that showroom. Once in the virtual environment, the user can replace furniture with similar products and move, rotate the items, view metadata about the product and save the view. However, the research is incomplete on the effectiveness of the system. Though the prototype does not provide the functionality of many of the features I designed, the implemented prototype demonstrates the capability and future direction.

The online experience needs to be consistent with the other retail channels; (b&m, and catalog) thus, a virtual IKEA should be easy to navigate and provide the same information as the other touchpoints. The IKEA user experience is distinct in terms of design, navigation and look and feel. Moreover the website is already experimental in its use of rich media FLASH applications (see related work) including a flash-based version of the catalog, and multiple interactive room design applications. IKEA and its customers are familiar with experimental product demonstrations and displays. Thus, I think myIKEA is a project that could actually be deployed, albeit in a further developed state.
8. PRIOR WORK

**Zoomable User Interfaces (ZUIs)**

**Pad**

In 1993, Ken Perlin and David Fox developed Pad. The main concept of Pad was the belief that navigation in information spaces is best supported by tapping into our natural spatial and geographic ways of thinking.” (Perlin, Fox, 1993). Pad is conceived as an infinite two-dimensional information plane. Using “magic magnifying glasses” the user could read, write, create cross-references on this zoomable surface. Perlin and Fox also introduced the concept of semantic zooming, whereby data is represented differently at different zoom levels (Perlin, 1993). The notion of the user controlling and assigning objects various levels of importance based on their position is a key element of my design. In the successor to Pad, Pad++ animation was added to bring views to specified locations and help users understand their location in the information space. (Perlin, 1996). Likewise, in my application as the user moves from overview to category to thematic view, animation of both the camera and information panels suggests movement in the space. As they select or deselect information of importance, the panels animate in and out of central view. Interest in ZUI’s has continued to grow since the research by Perlin and the Pad++ team. Practical applications for ZUI’s have been demonstrated by such projects as PhotoMesa and Counterpoint (developed at the HCI Lab, University of Maryland.) (Benderson 2001, 2002)
**SOFAKE.COM**

This example of a ZUI has 11 layers of depth navigable by clicking on the white icons located at the bottom of the frame. These icons are buttons that move the camera/user forward and backward. In addition to the use of the z-axis, this prior work is relevant to my project because of the use of navigational breadcrumbs. The user can see their position in the application (e.g. “4 ‘steps’ in”, “1 ‘step’ from the end”, etc.) Part of the difficulty in using most ZUIs is that once the user is zoomed in, they may lose sense of where they are in relation to the whole. Sofake.com eliminates this problem elegantly using the square buttons as a breadcrumb trail. An innovative strategy used here is audio feedback. As the user moves through the space, the volume of different audio tracks is heightened or dimmed. It is though the user is passing through different rooms each with its own unique soundtrack. This technique is particularly convincing as the sounds commingle at multiple junctions.

**SONY Surf Space**

Dale Herigstad developed the Sony Surf Space prototype, an iTV application with integrated television watching, web, email and home networking. This example directly relates to my project as a prior solution for accommodating a vast array of content. Thinking about the 10,000 channel viewing environment, Herigstad utilizes the z-axis as the means to organize a limitless content catalog. Two-dimensional content is stacked along the z-axis while the use of semantic zooming abstracts the options behind the item in central focus. The user can see and navigate to the other choices by zooming into the space. Herigstad’s application is also related as it ties meaning to directional movement on all three axes. “Navigation of the Sony Surf Space is primarily a visual and graphic experience giving the user the impression of surfing left, right up, down, forward and backward in three dimensional space.” (Curran, 2003) Once the user makes a selection, that content becomes the central focus of the screen. When the user wishes to surf associated content, the program currently watched is diminished in scale. My application incorporates a similar movement. For example, the myIKEA panel can be brought forward or pushed back based on the user’s need for a summary view. Surf Space organizes metadata such as the episode’s synopsis adjacent to the central video window and maximizes the use of vertical space. This is important for an iTV application as font sizes need to be large enough for the 10 foot viewing experience. Alternatively, myIKEA is a 2 foot experience and maximizes use of the horizontal space even to the extreme of overlapping elements. Moreover the input device for a television experience
differs from that of a web experience and thus I could incorporate direct, point and click interactions where the Surf Space navigation is dependent upon buttons. In my application, overlapping elements are quickly rearranged by clicking on the desired item. In an iTV application access to particular items requires navigation by button.

**ROOM PLANNERS**

**IKEA ROOM PLANNERS**

IKEA provides customers several 3D visualization tools, including the IKEA Office Planner, Kitchen Planner and Bedroom Planner. These tools enable users to drag and drop virtual IKEA pieces into a layout, view the objects in 3-D, try different colors, and obtain a price quote. This is a great tool for space planning because the customer can recreate a real or imagined/planned room in their home or office visualizing the specific items they are considering for purchase. The kitchen planner for example enables the consumer to “Fit cabinets and appliances into available space, avoiding common planning mistakes.” Upon completion, the user can save the plan and list of items to the IKEA server and complete the transaction in the store. Users are provided with overhead and 3D views. This 3D tool is a means to understand the spatial relationship of objects in the room. While useful, it lacks the authenticity of an immersive environment.

The user can measure and layout a space however our viewpoint is always outside of the room looking in. One does not get a sense of the physical texture of the objects. The navigation utilizes buttons (e.g. clockwise and counter-clockwise) that provide a delayed feedback response. A more immediate and perhaps natural movement/control into and around the space would obtained using the mouse. Again, while this tool demonstrates the look of furniture in some limited context, the lack of metadata filtering makes it useful only if the user knows specifically what they want to buy. There is no ability to compare furniture items by style, shop by price or identify the objects in any other way than by title/designer name. This is a novel tool that may attract some users, and aid those in the initial stages of planning. It does not however provide much control to the user, or directly meet the business requirements of selling more furniture. The main functionality that I appreciate however is for the kitchen planner. Because cabinets and countertops must meet specific space requirements, this tool could prevent a costly mistake. I think IKEA makes a big mistake by not providing some sample layouts in the tool. Most people are intimidated by a blank canvas, and a few design examples would go a long way. Additionally, many of the office items are table tops and desk extensions that are difficult to understand in isolation.

**ICOVIA SPACE PLANNER (http://www.icovia.com/)**

The Icovia Space Planner allows users to configure a room with the furniture they want, or the furniture that they already have. Once configured, the user can print, save, share and collaborate with sales representatives or others.

The Room Planner has a collection of hundreds of furniture items and structural elements. Users can also resize or reshape the dimensions of the room.
by editing the borders. The room is presented from above as a floor plan -- a view that most people never see in their houses. The furniture available is a generic and very limited representation of what a couch or table look like. Users will not make purchase decisions based on the icons. Users might decide the types of furniture that they need after using the room planner, but there is no connection between this tool and items for sale. The application is built in Flash and very responsive. I particularly liked the sample layouts provided. Most people could benefit from some elemental space design education that this tool provides. Future iterations, perhaps when 3D Flash is developed could translate this tool into a fully immersive tool. Until then, I would argue it is best for interior designers.

MYVIRTUALMODEL: (www.sears.com/sr/javasr/viewAllDept.do)

Sears.com shoppers can use a "Virtual Decorator" to redecorate a pre-populated kitchen, bedroom, garage or dorm room. Users browse through a selection of Sears' proprietary home goods in a generic spatial configuration. As shoppers click on choices the items are placed accordingly throughout the room. Likewise when you click on the items, pricing, description and related items are presented in a dropdown menu. This tool has many of the collaborative functionalities I am implementing. However this detail menu, while not persistent, regularly drops down to block the view of the space. Users can customize these pre-built spaces by hanging artwork or "painting" their room with a choice of “Easy Living” paint and choosing flooring finishes. This tool lacks the ability to alter the architectural dimensions of the virtual space so it hardly relates to any real world living space. Like the IKEA version, the user is positioned outside of the cube looking into the space. With this tool, no rotation is provided. The room is a static 2D view of a 3D representation.

THE FLOOR DESIGNER

FLOR Designer is a web-based planning tool that allows Design Within Reach customers to map out a wall-to-wall carpet, area rug, or runner using any of DWR's 11 FLOR carpet tiles with more than 60 color and pattern options. The initial view is again from above, but I think that is an appropriate use of the view as most people do look down on their floors. The 3D component lets the viewer shift perspective and see the pattern they’ve created. From this project I have taken away the simplicity with which the customer can create a real product that will be delivered to them. Based on the customer feedback this tool has been effective in converting sales. Likewise, customers like to share their creations as many people posted photographs of their new rugs, installed in their home.
IKEA PROJECTS

Virtual IKEA Catalog

The virtual catalog feature is literally that: a scan of each print catalog page. Visitors can choose to view any catalog produced that year. A nice detail of this feature is an arrow icon that appears, allowing the visitor to turn the page or click on certain sections for more detail.

Not only is the look and feel of IKEA represented well online, information about many facets of the business are easily accessible to users, further perpetuating the "self-serve" sensibility of IKEA. Because the catalog is flash-based, there are additional interactive features such as tool-tips and customized (close-up) views. The page-turning animation is a bit gimmicky, but I appreciated the thumbnail view when I wanted to rapidly scan the catalog for a page I knew the look of, but not the page number.

"Drömkök åt alla" ("Dreamkitchens for everyone")

This Flash-based internet commercial shows six kitchens in a time slice format (reminiscent of The Matrix) which turn 360°. The viewer sees a glimpse of different lifestyles that each kitchen can inspire. For example we see an older man in his classic kitchen reaching for his bottle of wine accompanied by opera music and a younger couple in a funky circular minimalist kitchen accompanied by jazz music. The viewer can click on the products shown to find out more about them. While this is an advertisement, it attempts to accomplish a similar goal of my project – enabling prospective customers to kind their IKEA taste preferences in a pseudo-3D environment.
Dreamkitchens for everyone is an award winning use of Flash and was heralded as one of the best internet advertisements of 2005. The piece showcases interactive elements that enable the visitor to open drawers and cupboards to see efficient uses of particular IKEA products. This works speaks to IKEA’s experimental receptivity. The company’s marketing team recognizes that users like to play with and imagine the myriad of uses for IKEA products.

VIRTUAL ENVIRONMENTS:

Collectively, today’s online virtual worlds have millions of inhabitants (source: Business Week). While they are not all real-time 3D environments, the numbers reflect a surging interest in virtual living worlds and a significant opportunity for business development. Many of these environments have an economic component. In SecondLife, residents explore, meet other residents, socialize, participate in individual and group activities, create and trade items (virtual property) and services from one another. SL has leveraged its open platform to encourage brands to create virtual stores. The representation of virtual architecture and consumer goods is an eCommerce is an obvious antecedent to a virtual IKEA and I have drawn inspiration from these environments as I will detail below. However, I believe in future iterations of virtual environments will see greater connection to eCommerce that deals in real-world goods and economies, more so than we are today. I think part of the reason for the lack of virtual – real world cross over is that most of the environments are not broadly mainstream though they are gaining media traction. My project is less about the consumer utilizing a virtual environment as an end unto itself, but rather as a means to aid in a user’s understanding of a real-world product. Moreover I envision my project not within any one proprietary system but rather as an independent node within an open platform. Ideally, standards will be established enabling users to navigate freely (or at least universally) from one virtual system to another. The existing conditions are much like the early 1990’s internet environment with walled gardens such as AOL, Compuserve and others. Virtual environments are closely related to my project in that many of them have a foundational activity of decorating or customizing a living environment, such an apartment or home with furniture and accessories. Users of these systems represent themselves to others in the system by the way they decorate their virtual homes. Likewise our real world homes are a primary place where we express ourselves. We decorate our homes extensively as a way of showing who we are to our friends and guests.

The SIMS FRANCHISE

On February 4, 2000, Will Wright’s The Sim’s was released. Since then, The SIMS franchise has sold more than 85 million (Chaplin, 2007) copies and is the number one selling PC game of all time.
The SIMS offers the ability to create a virtual house, wherein players control their characters and try to make them happy (or not). The success of the SIMS franchise suggests there is a pleasure in designing ones living space. According to Psychology Today, "most long-term players say designing Sim households is the chief delight of the game" (Thompson, 2003), and indeed, The Sims' construction and interior design aspects are the primary interaction for new players. Players can easily mirror their real-world homes. From the outset, Wright envisioned The Sims as "a laboratory for understanding not only our personalities, but also our personal spaces" (Thompson, 2003). Mary Flanagan notes in her paper SIMple & Personal: Domestic Space & TheSims “the space of the game is a site of negotiation between the real and the virtual domestic experience”. “After purchasing the game, most new Sims players spend hours (and usually days) in non-stop manipulation of the simulated house. The SIMs is an example of technology and innovation to simulate daily life. In terms of my project, I am interested in the possibility of that simulation then affecting action in the physical world.

The SIMS has been dubbed a virtual dollhouse, and in that regard, the end-purpose diverges from my project. In my project, the virtual environment can be customized to mirror the real-world home environment and then that space can be purchased, put together and created.

SECOND LIFE (http://www.lindenlabs.com/)

Currently, several million people have accounts in massively multiplayer online games “SecondLife has been largely about moving social interactions in the real world into a networked space, optimizing, lessening the constraints of time, space, and energy, and offering novel features.” (Bar-Ze’ev, 2006). One of the most closely related examples of related or prior work is some of the retail activity in SecondLife. Like the first ecommerce retail websites, SL is seen as a new channel or virtual touch point for retailers. Being that it is in its infancy, we are just figuring out how to use it. Like the SIMs, users customize their avatars and landowners modify their virtual environments.

Interaction frameworks in virtual environments will have to become somewhat standardized. For example in SL when you want to buy something, you point to it, and right click. A radial menu is presented and if the object is for sale, a “Buy” option is presented. In my project, the user interaction is not addressed, in terms of manipulating the objects, rather only that the functionality is there.

American Apparel uses their virtual store to test-market products before they reach physical stores. Moreover, to drive traffic to both the virtual and physical stores, anyone who buys clothes in the Second Life receives a coupon for a 15% discount on merchandise bought in real world stores. This real/virtual crossover is the kind of marketing effort a virtual IKEA could also employ. The store is intended to spread the brand and engage the interest of Second Life citizens. "Perhaps they’ll try our avatar clothing... then perhaps try it for real.” (Reena, 2006)

And again the fact that Second Life is unbounded by real-world geography is a huge advantage. Another example of a SecondLife/real world crossover is Stylehive.com’s virtual headquarters. This collaborative fashion website enables visitors to purchase designer furniture items both for their SecondLife and home environments.

HABBO HOTEL:

The game is centered around Habbos, virtual representations of its members. One of the service's focus point is virtual furniture which can be bought by Habbos using credits bought via a variety of methods, including
SMS, home phone, and money order. This furniture can also be traded between users. While the virtual IKEA incorporates few social networking tools, the collaborative, participatory element of Habbo Hotel is an important reference point. Additionally Habbo offers a service that will allow its Chinese users to purchase items that will be both virtual and physical items. Through the service, users can purchase items such as flowers, clothes and movie tickets online in the virtual community, while the physical items are delivered to their homes the next day. This is exactly the kind of blurred boundary between real and virtual, I envision for my project.

**Google earth:**

Google earth is a virtual globe program. The tool allows users to publish data layers including 3D models that can be downloaded to sit on top of Google’s 3D earth. The tool application also “enables users to "fly"(Google.com) from space to street level to find geographic information and explore places around the world. Google Earth is more like a video game than a search engine – it's basically a 3D model of the entire planet that lets you grab, spin and zoom down into any place on Earth.” Individuals and businesses have created models that can be freely downloaded and added to the application and Google provides a free version of its easy-to-use 3D modeling tool, Sketchup, allowing the user to export a 3D model in Google Earth. This allows “accurate geo-referencing of SketchUp models and accurate placement of those models in Google Earth. It also allows SketchUp to import modeling context (photographic + terrain model) from Google Earth for modeling reference.” There are speculations that Google envisions this tool as a metaverse and businesses are already participating. The appliance manufacturer Whirlpool for example offers 3D models of their appliances for Google Earth. Homeowners using Sketchup can create virtual versions of their kitchen and see the appliances in perfect detail. This kind of planning tool is relevant to myIKEA particularly as businesses can promote their products that consumers can see virtually then go and purchase. Despite its relatively low learning curve for a 3D modeling program, however, Sketchup requires a technological sophistication too great for broad consumer saturation. Most people won’t take the time to build models and would need some pre-built or ready-made components before they would use the tool.

**9. FUTURE WORK**

Use of virtual worlds and immersive 3D applications has reached what might be considered a tipping point. These environments are getting more popular; however, just like the early days of the web, we are still figuring out what they’re going to be used for beyond entertainment and beyond novelty in an eCommerce application. myIKEA is an exploration of where the uses for 3D virtual environment might exist. As I have conducted my research I have seen strong examples that have solved the 2D/3D navigation in elegant ways, such as the Sony Home environment. In this example, when a user needs to access a 2D menu, they pull up/look down at their virtual PSP. The focus on the 2D screen inside the 3D world is a solution that doesn’t take the user out of the
world or the immersion, but utilizes the efficiency of a 2D navigation scheme, and moreover, affirms the Sony brand. Future work in myIKEA would strive for greater integration of the navigation and virtual environment spaces.

In the sections above, future work or improvements have been considered for several elements of my project; however, the following is a list of general improvement:

- Filtering: Presently the content panels are organized with little connection to one another. The prototype does account for how users want to control the organization of their data. For example, the system should provide filters for researching items in terms of style, price, dimensions, etc.
- The actual eCommerce component of the tool is suggested, but not fully realized.
- The navigation, while fluid is still quite linear and could be improved.

The real/virtual intersection should be extended to a greater extent both ways as users in a real IKEA could “tag” or identify items using a mobile device. Tagged items would be available for later review in the virtual space. Likewise, kiosks located throughout IKEA could allow users to log-in to their virtual showroom to print forgotten layouts, update items of interest or compare the real to the virtual. Users might visit the virtual world, following a purchase to watch instructional videos on assembly guidelines.

Videoshopping, an interactive 3D e-commerce application could be developed for shoppers desiring 3D video of their product. Most obviously, the details panel could include prerecorded video and 3D simulations. Inside the 3D environment could be live views of merchandise in a local brick and mortar IKEA. If developed as a networked 3D environment the virtual IKEA could also offer a dedicated attendant who can be in the aisles for the customer, showing products and answering questions.

A multi-user design would require a re-design of specific elements, but would be possible for future iterations. The Sears in SecondLife is an example to study.

10. TECHNOLOGY

The application uses Flash for the navigation and Virtools for the 3D environment. The camera view inside the Flash element is a 3D component that enables the developer to program movement of the camera and objects to desired locations inside the environment. The component uses Actionscript and a pre-defined library of methods to enable x,y and z-axis configuration. Each element of myIKEA is a separate movie clip(s) and the 3D component uses Actionscript linkages to identify the required movement of each movie clip or relative to each movie clip. The dynamic elements of the application utilize XML to feed unique data based on user interaction. The sofa themed views for example use the following structure:

```xml
<images>
  <pic>
    <image>images/menu/living1.jpg</image>
    <caption>Timeless Comfort</caption>
    <thumbnail>images/menu/thumbs/living1sm.jpg</thumbnail>
    <object>living1</object>
    <caption2>Curl up with a good book and relax! A classic MYSINGE sofa matches well with a traditional coffee table. Soft textiles add to the coziness factor, but you can change them when you like - the sofa covers are removable and can be washed or replaced when you're ready for a change.</caption2>
  </pic>
</images>
```
11. REFERENCES:


APPENDIX

DESIGN CONCEPT

IKEA Shopping Model: Online Catalog

BROWSE

We browse when we may be actively or casually looking to purchase but not necessarily have one exact item in mind. Browsing is core IKEA IMM and catalog model. Website also facilitates browsing

Browse Featured products
Browse items in store

SHOWROOM: Photography of IKEA designed spaces. SHOWROOMS are the core browsing element. Lead to list of products in that area. Includes related items.

Browse via CATEGORIES

CATEGORIES

Categories are starting point for most shoppers who have broadly the item they are shopping for. CATEGORIES use common nomenclature like IKEA product names.

CATEGORIES lead to list or slideshow of products in that area.

CATEGORIES can lead to SHOWROOM examples

Includes related items

SEARCH

SEARCH offers results based on values of taxonomy or parameters of items (e.g. “leather” instead of using soft filter then leather filter.) Search is in two locations though not prominent in scale relative to other methods

Search leads to examples in SHOWROOM

NOTES

1. IKEA offers a flash-based version of their paper catalogs in addition to the HTML catalog.