

Developing a Virtual Tour of a Community Pharmacy for use in Education

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Abstract— This paper reports on the development of a virtual tour of a community pharmacy. The interactive walkthrough was designed to be used as an adjunct to placement training for Pharmacy students. This paper reports on the limitations and issues associated with developing a virtual tour using currently available hardware such as the GigaPan Pro and software such as the GigaPan Stitch and Krpano. These tools are relatively available and claim to allow for automatic generation of virtual tours along with the addition of interactive element such as text and sounds. We found that in general producing a standard walkthrough was straightforward. We also found that with patience and some experimentation high quality outcomes could be achieved as long as only simple navigation was required. However, adding even simple interactive elements such as sound objects, pop up text and modified hotspots for more natural zooming between locations added significantly to the required IT skill set. We conclude that programming knowledge and subtle interface design skills, consistent with a trained IT professional are required if anything beyond a very basic walkthrough is to be produced.

Index Terms— GigaPan, Krpano, Pharmacy Education, Virtual Walkthrough, Virtual Tour.

I. INTRODUCTION

Desktop virtual walkthroughs or virtual tours provide a simple, low-fidelity, application of Virtual Reality (VR) that can allow users to experience an existing real world location on their web browser. A low-cost virtual world can be developed by simply linking together a series of previously prepared panoramas. These panoramas are themselves created by stitching together a sequence of high-resolution images taken at a strategic position in the scene. Users can then navigate via hotspots through the linked panorama, at any point orienting their viewpoint to look around the space. Interaction is generally simple by way of the mouse and keyboard. Probably the most well-known technology associated with the virtual walkthrough of this type is Quicktime VR which has been used since the mid 1990s to develop a broad range of virtual tours [1].

Some of the most common commercial applications of this technology are in tourism [2], [3] and the real-estate industry [4]. However, virtual tours also provide an opportunity for education and training in general, especially where visiting a site is difficult [5], [6]. The technique is effective as it

provides users with spatial orientation and situational awareness prior to the person entering the real world location.

This paper describes the development of a virtual tour for use in Pharmacy education. A key goal of the project was to assess the difficulty of developing and maintaining such a virtual walkthrough for someone without expertise in key IT skills such as interface design and programming. Many automated tools now exist to help with this process and this paper provides a critique of both the process and these tools. We discuss some background to the application of virtual walkthroughs in the context of pharmacy education before describing the key steps in our development process. This description includes an overview of the various technologies we used and problems we faced along the way. These problems provide a good checklist of risks associated with developing such walkthroughs. We conclude that although current technologies are very supportive for various parts of the development process, overall, such applications still require a considerable level of IT expertise in the integration of elements.

II. PHARMACY TOUR

A. Pharmacy Education Requirements

Simulated learning environments in pharmacy education can provide students with a way to develop confidence and gain an understanding of the pharmacy environment [7]. Although students often undergo placement during their programs, the placement experiences can be inconsistent and provide only limited opportunity for learning. Augmenting the placement with prior experience in a virtual pharmacy environment may not only mitigate these inconsistencies, but also better prepare the student for their placement.

Indeed the use of simulation in healthcare education is increasing as it offers the opportunity to practice skills used in clinical situations in a safe environment without risk of harm to patients or students [8]-[10]. For example, patient simulation software has been used to augment teaching in pharmaceuticals lectures [11], therapeutics and problem based-learning [12], [13]. Simulated families have also been created and used in teaching that integrates context with theory, linking professionalism with academic content [7].

Pharmacy students are required to spend some time in the workplace environment in community pharmacy as part of their program of study. An identified problem with students first experiencing this work placement is that they have little to no knowledge of a pharmacy layout and workings. Therefore the aim of this research was to develop a Virtual Pharmacy; an interactive walkthrough that could help students gain a basic working knowledge of how a typical community pharmacy is configured prior to attending their placement.

B. The Virtual Pharmacy

The Virtual Pharmacy was designed as an interactive tour of a typical community pharmacy. It provides a first-person view of a pharmacy that allows the user to change their viewpoint, zoom in and out on objects and also move to and from additional locations in the pharmacy. The process of creating the Virtual Pharmacy walkthrough involved taking a series of approximately 1500 photographs at a local community pharmacy before opening hours. Prior to the photography, pricing and pharmacy branding information were removed where possible. Sixteen locations in the pharmacy were selected to act as key focal points in the final walkthrough. The store was photographed at each of these 16 locations using a GigaPan Pro [14], a panoramic, tripod-mounted head, to which a Canon EOS 350D camera [15] was attached. The GigaPan Pro can be programmed to rotate and pivot automatically to take an overlapping sequence of photographs. A sequence of between 63 and 108 images were captured at each location.

Each sequence of images was stitched together to create a single, large, panoramic image at each location (Fig. 1). The stitching process used the Gigapan Stitch software (version 2.3) [14] that accompanies the GigaPan Pro. This stitching software processes each image sequence by matching the areas of overlap in the images and adjusting their colour, rotation and pixel positioning to produce a continuous, panoramic image spanning up to 360° horizontally (Fig 2). After creating the 16 panoramas, minor final post processing of the images was used to remove any residual pricing and branding.

Once completed, the final 16 panoramic views were then processed using the krpano panorama software package [16] to create the panoramic Virtual Pharmacy Walkthrough. The krpano package was used to assist in the creation of a series of interactive, 360° panoramas suitable for online access. A range of other web technologies, including HTML, HTML5, XML, CSS, Flash and JavaScript, were then used to further customise the navigation, interaction and presentation style of the Virtual Pharmacy.

Importantly, the web-based display of the Virtual Pharmacy was enabled by krpano's manipulation of Adobe Flash [17]. A key feature of a krpano scene is that it allows zooming in and out when viewing elements in a virtual scene. This allows any part of the scene to be studied in high detail (Fig. 3).



Fig. 1. One of the 16 panoramas used in the tour.



Fig. 2. A typical view at one of the navigation points in the tour.



Fig. 3. Zooming in allows the user to read labels on items.



Fig. 4. Pop-up text and audio is used to display additional information.

A potential limitation of high-resolution interactive walkthroughs being delivered on the web is that lag may occur as large images are loaded into a browser during the walkthrough. This problem is overcome in Krpano by breaking the panoramas into tiles with a range of different resolutions, and then only loading images of the required detail when needed. This effectively ensures a consistent image size is being loaded, and therefore the user experiences a consistent and interactive refresh rate when they zoom or rotate their viewpoint within the scene.

Interaction with the environment occurs principally via the computer mouse. On opening the application participants find themselves positioned at the front of a store looking down the aisles of a typical community pharmacy. From here they can navigate, to and through, between any of the 16 locations that are available in the Virtual. This navigation is by way of clicking on one of a series of arrow icons that effectively allows the user to change their viewpoint and hence explore the environment.

While positioned at any of the viewpoints the participant can rotate their current view by using click-and-drag actions. This effectively allows the user to move their head position and look around the pharmacy. With a given viewpoint and rotation, participants can use a magnifying glass shaped icon to zoom in and out on elements in the pharmacy. Due to the stitching process, the panoramas produced allow for high resolution when zooming onto objects. For example, it is possible to read detailed labels on products within the pharmacy (Fig. 3).

An information 'i' icon was used to indicate areas or objects within the pharmacy that contained further detailed information (Fig. 4). These were pop-up text displays designed to provide additional information on products in key locations, such as the dispensary. The environment also included further auditory information displays (Fig. 4) containing longer contextual descriptions of some key parts of the dispensary.

The Virtual Pharmacy was stored on the University of Newcastle [18] servers, and made available to students of the Masters of Pharmacy via the University network.

C. Key Outcomes

This research was intended to have four major outcomes. Firstly we wished to review the limitations and problems associated with developing a virtual walkthrough using currently available technologies. Secondly we wanted to assess the feasibility of a domain expert in the area of pharmacy education being able to use these technologies and if possible maintain or extend the walkthrough as required. Thirdly, we intended to measure the perceived effectiveness of the technology used for supporting pharmacy placements by gaining feedback from Pharmacy students. Finally we wished to evaluate the application for any key usability issues.

In this paper we report on the development process of the Virtual Pharmacy, highlighting the key steps required and drawing attention to the key issues that arose at each step.

Finally we discuss the level of IT expertise required to design, build and maintain an interactive virtual tour.

III. DEVELOPMENT PROCESS

The walkthrough was developed over a four-month period and involved the collaboration of IT and design experts along with academics responsible for developing and teaching Pharmacy education. Our Pharmacy domain experts managed the interaction with the community pharmacy where the tour was developed. They were also responsible for initiating the project, providing basic user requirements for the walkthrough and measuring the effectiveness after implementation. Our design experts were involved in taking the photographs, post-production phases of image preparation and assisting with interface design. The IT expertise was directed at managing the risks associated with the various technologies, designing the key interactions, building the application, deploying it and final usability testing. The four main steps in the development process were: Onsite Preparation, Onsite Photography, Panorama Stitching and Walkthrough Integration. The key problems we found at each step of the process are discussed in more detail below.

A. Onsite Preparation

There were a number of issues that needed to be resolved around the site being used to create the walkthrough. Firstly we had to decide on the layout, the key navigation points in the virtual pharmacy and map this to locations in the real pharmacy. There were concerns for the security of the pharmacy as the walkthrough would display the location of items in the pharmacy, including the drug safe, restricted pharmacist only medications and general medication. To overcome this problem we had to reconfigure the store layout. Choosing the number and locations of the panoramic views within the pharmacy also needed to consider aisle content, with some non-medical or incidental aisle content being deemed not relevant and being excluded. In order to get a decent view of the majority of items in each aisle section, we decided on two viewpoints per large aisle, and one viewpoint for smaller aisles or where we wanted to focus on a specific area such as the dispensing section of the pharmacy.

There was also a need to de-identify the pharmacy by disguising contextual elements (branding, prices, store location). This was partially managed by the selection of aisles. However, prior to photographing the location we were required to obscure all price tags, pharmacist names as well as branding and key store elements that identified the store, such as the entrance. This was a time consuming process, but preferable to trying to remove information later in the process. Despite this it was not possible to remove all identifying features and some adjustments were required to the stitched panoramas to remove sensitive information.

B. Onsite Photography

We had to ensure that no people were present during the photographic process. It would have been implausible given the nature of the photography to have people standing in the aisles whilst the photos were being taken. The reason for this is that the stitching process is not friendly to people - cutting

them out or into pieces depending on the positioning. If a person were to be photographed, they would need to be absolutely still for the duration of the shoot, which could be anywhere from 5 to 10 minutes. The lack of people in a retail setting gives the final walkthrough a somewhat unnatural and empty feeling. We looked into using silhouettes of characters or people, having them pose in certain ways to then paste them into the walkthrough - which may still be a possibility at a later date, but was not included due to limited resources.

To ensure no people were present during photographic sessions we needed to come into the pharmacy before opening hours. This gave us a window of approximately 1.5 hours, in which we could get anywhere from 2 to 5 panoramic shots done. Since we required 16 locations, this entailed a number of return visits to the site and the appropriate preparation of removing sales banners/posters/tickets, and disguising price tags if possible. These changes needed to be reversed once photography was completed in each location. We found that even small things like the cleaning schedule impacted on our shooting schedule and this also had to be managed in collaboration with pharmacy staff.

Even though the programmable rotating head of the GigaPan allows for automatic capture of the images required in the panorama we found a number of manual operations were required to ensure the final quality. There was a tradeoff here as we also wanted to minimize the number of images in each panorama. Therefore at each of the 16 panorama locations we had to ensure that we obtained a sufficient number of photographs to provide enough visual information for the stitching program to put the larger panorama together. Depending on the settings of the GigaPan this was anywhere from 63 to 108 photos per panorama. As a result we needed to carefully track the number of photos for each specific panorama (total number, horizontal and vertical numbers, and starting number given that the panoramas were taken one after the other and the camera managed sequential numbering).

We also found that the camera focus needed to be specific to the aisle and positioning due to the camera being automatically rotated, with different elements in focus range for each photo. To solve this we manually set up focus with a large depth of field (i.e. keep as many things in focus as possible) to set things up, then turning on autofocus allowed the camera to make mild adjustments to each photo to keep focus consistent. This worked the majority of the time with approximately five photos in each panorama being blurry. If the photo did turn out blurry, or not quite right for lighting, we paused the capture process and retook the photo however many times were needed to get the right focus. This added complexity to tracking the individual photos that would be used in the final stitching process. We had to reorganise the image files into panorama groups, deleting the additional shots as required. This was a manual task that would have been

simplified if no photos were required to be retaken as the automatic sequential file naming of the camera would have sufficed.

C. Panorama Stitching

To produce a panorama requires a number of overlapping images to be stitched together. A number of alternative types of automatic stitching software are available. We used the GigaPan Stitch software that came with the GigaPan to perform this stitching. This was not a difficult process but it did prove time consuming. While each panorama took about 5 to 10 minutes to construct, the outcome required checking once the process had been completed. The GigaPan Stitch settings were not well documented and some trial and error was required to find the optimal stitching settings and avoid unrealistic joins in the panorama.

If not enough visual information or overlap was available between the images, either holes would appear in the panorama or the stitching program would warp and mismatch the imagery. We found the best way to avoid this was to ensure we used enough photos, with greater overlap of the scene. On average we found that 90 to 108 images provided reasonable matching to create a good panorama. We did however run into specific problems with some parts of the scene. A foreground column in one aisle the pharmacy blended with the background, thus the stitching program tried to blend the column with the background. This was likely due to the contrast issue that made the column look solid white rather than a prism shape as the close edge was not defined, or not defined enough through shadow. Fixing this required manually drawing a contrasting line to define the edges of the column, restitching, and finally editing the harsh line out once a good stitch was obtained.

Despite our best efforts, in some cases we found problems of poor overlap in the images or different focus levels, both of which impacted on the quality of the stitching. In a number of cases we had no choice but to reshoot the imagery, manually adjusting focus and using more images for higher degrees of overlap.

After creating the panorama we still needed to tidy up the images, in Adobe Photoshop [17] to remove any residual branding information and price tags from the aisles. A general problem with processing the panoramas was the large file size of each stitched image. This slowed considerably the post-processing we were required to do on the images. In all about 40 hours were required to perform the stitching and editing phase to produce the 16 panoramas to be used in the walkthrough.

D. Walkthrough Integration

The production of the final walkthrough was dependent on the automated support of the krpano software [16]. This software is designed to automatically generate a collection of tiles at different resolution that can be loaded and zoomed as required in a standard browser. This tile set is an essential feature of the krpano walkthrough as it enables interactive rates over the internet even when the walkthrough is constructed from a number of large high-resolution

panoramas. In general, operating the krpano software required only a few experiments before creating a panorama became quite straightforward using the command line interface.

The process of using krpano also generated a 'tour.xml' file that allowed navigation between the various panoramas. By contrast, customisation of this virtual tour by adding navigation hotspots from krpano objects was a complex manual process. The process of adding hotspots, which uses spherical coordinates to position the image, was made somewhat easier by being able to manually position the image/hotspot link in the panorama itself. However, it also required a manual copy of the code that was generated for the hotspot into the tour.xml.

While linking navigation hotspots between panoramas was relatively straight forward, creating an effective zoom animation between each hotspot proved challenging as it would zoom into the wrong area of the panorama. To overcome this problem we had to manually create an invisible target at 'eye level' for the viewpoint to zoom into in order to appear as though it were moving down the aisles at head height. In a similar way we also had to manually set the view angle of the panorama that was being navigated to so that it loaded facing in the same direction that the viewer was travelling. Without this adjustment the user would quickly lose orientation and get lost while navigating the pharmacy. This required overwriting the view angle of the panorama that was being opening in the link code of the tour.xml

The addition of the dispensary section with information icons and audio elements also required the manual insertion of hotspots in the panoramas. The audio elements were integrated by launching sound objects, rather than opening a new panorama, when the auditory hotspot was clicked. The textual information popups that displayed when hovering over a hotspot also required setting up an xml data node for each information set and to allow for the html formatted text to load. While this was a built in function of krpano the text styles were limited as the html had to be parsed through Flash.

IV. REQUIRED IT EXPERTISE

One of the key items we wanted to evaluate in this case study was the level of IT expertise required to build and maintain an interactive virtual tour. This is an important issue as personnel without extensive IT training, in this case the domain experts from Pharmacy would like to maintain the tour, adding in content as required.

We found that certain elements of the process, such as the photography, basic stitching and generating a simple walkthrough with automated krpano program could be achieved with minimal IT expertise. Although the krpano command line interface is likely to be unfamiliar to anyone used to graphical user interfaces, and provides a shortage of instructive documentation targeted to a non-IT audience.

The key area that requires some level of IT programming expertise is in adding the interactive elements to the tour. This included adding hotspots to support auditory information and popup text, both of these features were considered essential in providing the education element to the tour. During the

construction and evaluation of usability we found a number of problems that required further programming and interface design experience to provide a more intuitive navigation mechanism. In conclusion, even though available tools assist the development process, programming knowledge and subtle interface design skills, consistent with a trained IT professional are still required if anything beyond a very basic walkthrough is to be produced.

ACKNOWLEDGMENT

Thanks to Brendan Reynolds for assistance with photography and image manipulation.

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