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Another View of the Empire – Camera Control for Heritage Applications

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Abstract. 'Another View of the Empire' focused on the evaluation of user perspectives and control techniques to help define best practice for the design and implementation of interactive heritage applications. A comparison study was undertaken on two popular avatar control techniques from the field of video games to determine the suitability for integration into interactive heritage environments, where the typical user may not be a regular player of 3D action games. This paper outlines the preliminary research, the design and build of a set of research orientated interactive environments, and the resulting user focused exploratory heuristic qualitative analysis – which found that a hybrid control system may provide the optimum experience for a typical heritage audience.

Keywords. HCI, interaction, heritage, visualisation

1. Introduction

Within the field of video games, first-person perspective is a widely used standard for presentation of, and interaction with, 3D virtual environments. This has been largely consistent and unchanged over two decades, from *Doom* to the latest in the *Call of Duty* series, demonstrating its strengths for human-computer interaction.

The concept involves an avatar, the players' presence in the virtual world, allowing the user to view the virtual world through that avatar's eyes, and viewing the scene from a realistic scale relevant to the players' locations and reducing the requirements for sophisticated player animations or implementation of further camera control functions. Meanwhile, many games also have moved away from the traditional linear style of gameplay, towards the idea of letting users pursue goals of their own choosing. Both of these features drive a feeling of realism into the games they are part of, aiding the high quality user experience.

The first-person free-roaming perspective may be adopted into the field of interactive heritage, and has been attempted in a selection of existing applications, but does this positively affect the user experience? Interactive heritage acts in many ways as a form of 'museum' allowing users to interact with artifacts and architecture of previous generations. With alternative goals to that of video games, and a target audience who may be less familiar with first-person perspective computer games, is it really necessary or helpful to rely on this particular control method, however popular and well known it may be?

A high quality user experience is obviously desired by the users of a wide range of applications, each taking part in a unique process of interaction, bringing their personal

desires, anticipations and previous experiences with them to aid interpretation. These experiences are largely context dependent: Blythe and Hassenzah [1] state the same activity can be interpreted as highly pleasant in some contexts but possibly unattractive in others, affected by their own social contexts. Thus research into potential differences between successful video game interaction designs and effective designs for interaction with heritage environments is required. This research can help develop a more comprehensive understanding of how heuristic gaming models can be effectively translated to interactive heritage applications.

As a demonstration heritage application, we consider a 3D visualisation of the 'Scottish Avenue', part of the 1938 Empire Exhibition, held in Bellahouston Park in the south side of Glasgow. The data set itself was digitally recreated by a team of professional modelers, from the Digital Design Studio at The Glasgow School of Art, working from a diverse range of archival information such as small-scale drawings, photographs and maps depicting the design and layout of the exhibition itself. This resulted in a reconstruction of all of the major buildings, from entrance gates to the main pavilions and Tait's Tower [2,3]. Most of these buildings were designed only as temporary pavilions and exhibition spaces, and only one – The Palace of Art – remains in place today.

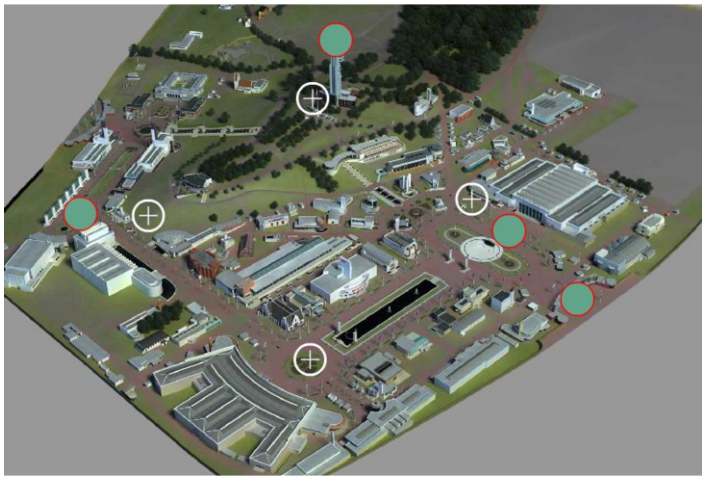

Figure 1. Interactive Map showing the area reconstructed for the original Empire Exhibition project, www.empireexhibition.com

The typical user for a heritage visualisation such as this would be someone with an interest in local history, perhaps an elderly person with some family connection or personal memories of the event – rather than a typical 'gamer'. Thus, we are interested in discovering whether the popular interaction schemes natural to gamers are equally natural to this distinct target audience.

We note that other control and camera schemes are used in games and interactive visualisations – such as third-person 'over shoulder' camera views, 'top down' views, two-dimensional views, and fixed position cinematic camera systems – but for this current work we restrict our comparisons to the use of a free-roaming first person and fixed position camera systems.

2. Research Methods

Two distinct versions of the 'Interactive Scottish Avenue' visualisation were developed, with identical 3D content but with distinct user control mechanisms. The 3D data used was a subset (Figure 2) of the Empire Exhibition data developed previously [3], and which had been optimized for real time applications. Unity3D, a popular game engine, was then used to create the interactive visualisations.

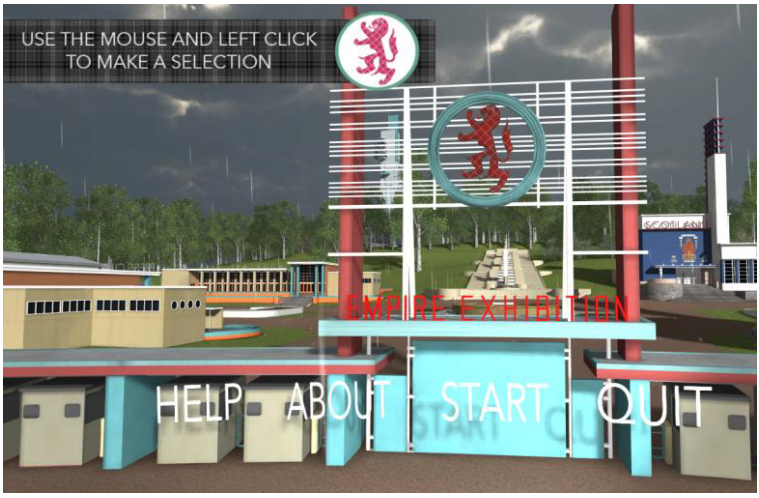

Figure 2. Entrance Gates of the Empire Exhibition, acting as the introductory screen for the application

Although there are issues with relying on user reported qualitative feedback and responses – including a lack of rigor and objectiveness and a bias towards the subjects and researchers personal feelings and opinions – Patton & Cochran [4] outline how this can form a base on which to further build quantitative research. Accordingly, for the pilot study detailed here, a simple qualitative survey was developed to collect feedback from users on the two control mechanisms implemented, these results to be used in informing further research and development work.

2.1. Research Design

Pinelle, Street and Hall [5] describe how the video game industry has often approached evaluation in a very informal manner, directed towards user opinions and enjoyment, more than scientific assessment. With adoption of techniques from the field of human-computer interaction, more formal methods are also used and considered. Some approaches focus on, for example, the continuous monitoring of data that indicates emotional state during game play as a means of supporting a more rigorous assessment of user experience [6]. However, Sánchez, Zea and Gutiérrez [7] believe that there is still a lack of solid evidence regarding the application of standardized research practices to measuring gameplay experience, and note a need to evaluate against a range of aspects, or facets, of game play experience. Detailed understanding of both conceptual and individual factors that describe gameplay are defined by the heuristic-based evaluation approaches regularly employed, but are regarded as limited in terms of the experience of the evaluator [8].

Existing models give insight into potential methods and techniques relevant to define the quality of a user's experience, but these specific terms of quality are still debated. One of the practical approaches to evaluation is to use the standard ideals of play testing in conjunction with different sets of design heuristics to create a board categorical model of the desired gameplay experience, as no single method provides an inclusive theoretical stance. Play testing in general has generally been conducted with a large degree of informalism, leaning on aspects of the user's enjoyment, although Isbister and Schaffer [9] demonstrate how considerations from human-computer interaction can be used to develop a more comprehensive game-play evaluation. Within existing human-computer interaction approaches, Drachen and Gobel [10] describe different categories to define different aspects of the user experience over time. In terms of this research the focus will be on the quality of the user interaction with the virtual heritage environment, taking into account the impact of interaction mechanics and player behaviour.

To define the quality of the user experience, the human-computer interaction definitions of immersion, presence, interactions and relevant studies were chosen to help define relevant evaluation criteria. Immersion is viewed as a critical piece of any virtual enjoyment, describing the ability of people to become so engaged with a virtual experience they lose recognition of the world around them, a desirable outcome of the intended virtual environment. Studies focus on the descriptive rather than the predictive, although Jennett et al. [11] makes clear factors that aid in achieving these levels of immersion, such as a lack of awareness of both time and the real world, whilst experiencing a sense of presence within the interactive environment. In regards to how user's interactions affect the sense of presence, it can be considered a level of experience where the technology and the external physical environment disappear from the user's intrinsic sense of awareness. Riva [12] states that the illusion of presence causes the human cognitive, processing and sensory systems to define 'entities' within the virtual experience as parts of a genuinely perceived environment.

3. Interactive Application Design

Using Unity3D, two interactive Empire Exhibition applications (Figure 2) were developed – identical in content other than the control systems employed. These are detailed below.

3.1. Free-Roam Perspective (FRP)

The concept of the 'free-roaming' perspective is directly related to a common viewing and control method for video games (namely the 'First Person Shooter' genre although it is not confined to this particular style) and can be seen in its infancy as early as 1993 with the release of the iconic title 'Doom'. Rollings, Andrew and Adams [13] define the concept of a first-person free roaming control method as the graphical perspective rendered from the viewpoint of the playable character, controlled by the user and related to normal movement through three dimensional space. Over the course of the past twenty years this system has been highly refined from its basic origins, delivering viewing method which enables a high degree of fine control over position and view within a virtual environment. This particular method was selected for evaluation due to

its popularity in terms of deployment and the familiarity of this method to a portion of the intended user group.

Figure 3. Digital Environment used for the Interactive Scottish Avenue

3.2. Fixed-View Perspective (FVP)

A 'fixed-perspective' camera system is exemplified by the system seen in existing software, derived from Google maps street view (https://maps.google.com), utilizing a fixed position navigation system. Within the software, a user can only navigate by iterating through a pre-set selection of different viewing locations. Variations of this system have existed in games for many years [14], and this approach is recognized for providing a more cinematic view of a virtual environment.

In our case, a fixed position camera was designed to provide a control mechanism that would allow for a selective display of heritage architecture, with the application designer able to specify chosen, and curated, viewpoints and positions. Selection of this method to be used as a comparison also comes from personal experience, with the designer implementing this method with success in a previous project, namely the 'Interactive Blacadder Aisle', [15]. Here users can manipulate the camera's location and cycle through multiple pre-defined locations across the environment, providing focused and views of the Empire Exhibition buildings themselves, and their spatial relationships.

4. Research Analysis

A survey was developed, with reference to Witmer's Presence Questionnaire [16]. The questionnaire generated a range of numerical responses, evaluating different aspects of the users cognitive responses, immersion, presence and interactions, demonstrating each aspect on a five point Likert scale, defining preferred user categories as laid out by Morrill et al. [17]. Participants were recruited through snowball sampling, and from this a number of participants fitted Morrill et al.'s pre-defined categories (e.g. 'experienced gamer' or 'non-gamer'), but did not provide a sufficient number of

responses to satisfy independent analysis of each different category. Overall only a small number of users would fit into either the 'high' or 'no' experienced categories (of expert gamer and non-gamer), thus user groups were more generally defined and evaluated in terms of two categories defined by existing experience in either interactive heritage applications (direct) or computer games (indirect). 17 respondents completed the survey after playing the fixed-view perspective variant, and 14 completed the survey after playing the free-roaming perspective variant of the visualisation.

4.1. Preliminary Analysis

Overall, user experience evaluated under the concepts of immersion, presence and user interactions, the FVP demonstrated slightly stronger scores overall, showing a slight improvement over FRP. While noting the small sample size of this study, this shows a slight, but not statistically significant, improvement over FRP. Using a two-tailed T-Test to compare the results from users with limited experience of virtual heritage applications (n = 21), some differences between FVP (n=11) and FRP (n=10) become apparent. In FVP, the low experience users felt more able to examine objects from multiple viewpoints (M=4.4, SD=0.67) in comparison to FRP (M=2.8, SD = 0.92, t(16)=2.12, p= 0.0004). The users also reported that the controls were more easy to pick up (M=4.3, SD=0.81) in comparison to FRP (M=3.1,SD=0.99, t(17)=2.11, p=0.006), and that the control mechanism was less distracting (FVP: M=2.36, SD=0.81, FRP: M=3.3, SD=1.06, t(17)=2.11, p=0.037). No significant differences were recorded for other questions.

In general, experienced users demonstrated greater satisfaction with the user experience whether using the FRP or FVP variant of the visualisation, with only a few discrepancies in either the cognitive response or immersion categories.

4.2. Qualitative Analysis

To gain an interpretative understanding of the generated data, a deductive approach was undertaken from a hermeneutic perspective to construct an interpretative analysis. One of the key aspects demonstrated by the outcomes and user feedback suggests that the FRP delivered a definite sense of freedom to the user experience. Users also felt it was easier to navigate the terrain to exact locations by being allowed to freely move around, in comparison to cycling through the selection of pre-defined locations. This sense of freedom seemed to improve on the grounds of a naturalistic response, presumably down to the 'realistic' control setting directly related to real world movement, making users feel more comfortable.

Within the sample group, a number of users reported that they found the FRP system very natural to use, while other users reported the opposite. We posit that this is most likely the result of some respondents being familiar and comfortable with the first-person controls commonly used in computer games, with other respondents finding this more challenging to learn than FVP – and this would seem to be supported by the differences noted above.

Overall, the FVP responses indicated greater satisfaction with the control mechanism and virtual heritage experience. This was particularly true with regards to the ability of users to evaluate and examine objects (in this case the architecture) in the scene. As allowing users to gain an appreciation of the architecture of the Empire

Exhibition was one of the motivations for developing the models to begin with, this would seem to indicate that while FVP restricts user freedom, it does bring benefits appropriate to our specific desired outcomes. This control system offers users the ability to pan around the buildings from a selection of positions above the ground, providing the user with aerial views, and allowing access to cinematic views with ease. This system may have been preferred in this specific case because the focus of the modeling work is directed towards the architecture over a large area. This technique may not prove to be so effective for projects involving smaller scale environments, such as interacting with heritage objects inside a single virtual room or building.

5. Conclusions and Further Work

The basic research comparing the two alternative control techniques, suggests some distinct advantages of a 'Fixed-View Perspective' for interactive heritage visualisations. The control techniques were both found to score fairly well for ease of use and ease of adoption across the different user categories, but with a small increase in satisfaction for FVP over FRP.

We note that when designing interactive heritage applications, it may be difficult to define a specific target market, but note a need to appeal to 'non-gamer' audiences. This broad user range, demands considerations are made for every different type of user, demonstrating that a technique such as the 'Free-Roaming Perspective', typified by common keyboard and mouse controls for first-person shooter type games, is not necessarily ideal for non-experienced users.

Key advantages have been demonstrated by the FVP, namely the manipulation of the camera to allow for an improved viewing of the models and assets used to populate a 3D virtual heritage environment. The ability to survey a broad range of buildings and views from an assortment of different designer selected camera positions, designed to highlight different aspects and relationships of these buildings was found to be an improvement over the more realistic FRP. The FRP is based on natural human movement and follows the basic laws of physics, resulting in constricting the user to the ground level, restricting potential view of the environment. Even liberated from the laws of physics, the FRP user might still miss the benefits of having carefully curated sets of viewpoints from which to experience the virtual environment as presented in FVP. As gaining an appreciation of the virtual environment's architecture and spatial context is a core reason for the virtual environment's very existence, this is a major negative aspect of the FRP. However, despite these findings, a contradictory note is observed by the increase in freedom of movement enjoyed by users when using FRP.

5.1. Suggestions for Further Work

There is a need for further research of this nature to further explore alternative control mechanisms, and the suitability for a range of audiences. Adaptation techniques might allow applications to offer a range of methods for user control and interaction, but how users can be effectively and accurately matched with specific control systems is far from certain. However, this much is clear – the default control mechanisms common to a wide range of games – and offered as default by 3D development environments such as Unity – are not necessarily the best for virtual heritage. There is also further work to be done on developing tools to support shared exploration of virtual spaces, for a range

of collaborative purposes and tasks, potentially building on existing work already conducted with the Empire Exhibition data set.

A further iteration of the interactive heritage environment detailed above allows users to experience both the guided views of FVP and fuller control of FRP. In this, a user can wander round the exhibition area with free movement and full control, being offered the opportunity to view buildings from a range of fixed viewpoints when entering a 'trigger' area near each building. This is yet to be evaluated, but we feel that this may offer a best-of-both-worlds approach for interactive heritage visualisation.

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