Digital Heritage Inventory using Open Source Geospatial Software
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Author Keywords: digital heritage inventory, open source geospatial software, PostgreSQL, Arches, virtual reality, panoramic images, photo sphere, digital humanities, heritage conservation

This paper reports the development of a digital heritage inventory system using open source geospatial software. In particular, we used the Arches project, which is a system jointly developed by the Getty Conservation Institute (GCI) and World Monuments Fund (WMF) to inventory immovable heritage. The study sites are several rural villages located in Hualien County of Taiwan. The field data includes GPS-tagged images, video clips, audio recordings, and panoramic images of historic buildings and sites, artifacts, activities, cultural and natural landscapes. Smart phones were used to record the GPS waypoints of field survey, and a panoramic system was used to acquire panoramic views of various resources. We used the PostgreSQL database system to build a geospatial database for storing the spatial and temporal information of all heritage resources. The Arches system is built upon numerous open source software components that provide powerful functionalities, including database management, search engine, mapping, geospatial analysis, and interactive visualization tools for showing relational network graph. By using the Arches system, we established a web-based geographic information system to provide digital heritage resources management system that provide ease of use tools to query the location of any individual heritage resource, and ancillary information of the resource, including documents, images, multimedia data, and related sources. The query results are depicted in maps, dynamic graphs, and relational network graph, which can provide more detailed information of the heritage resources that are not feasible by using texts and tables.

A comparative study of walkthrough paradigms for virtual environments using Kinect based natural interaction
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Author Keywords: Culture & Heritage, Natural interaction, Kinect, Virtual museum, Virtual archaeology, Gesture based walkthrough

The problem of controlling the movement of a user inside a virtual environment without using apparent physical interfaces exists since the arising of Virtual Reality installations in the 90’s. Authors like Bowman [1] have already pointed out that the detection and interpretation of user natural gestures could be used for implementing forms of movement inside virtual models. The ability of those VR installations to grasp user’s gestures was very limited in those times considering that only gaze direction (obtained from HMD orientation) as well as hand location and orientation (taken by special pointing devices) could be used to interpret user desires.
In fact, depth camera technologies, such as the Kinect® system, allow obtaining a very comprehensive description of user’s pose and gestures. Therefore, this device is being used profusely in multifarious fields, where virtual environments have to be explored by means of natural interaction. Among those fields, Architectural Visualization and Virtual Museums demand good walkthrough paradigms to explore the space and contemplate the environment and the objects on display, prior to enabling further interactions [2].

There are several interesting examples developed in recent years, which implement different walkthrough paradigms [3][4][5][6][7]. Some of them support their validity offering tests of usability and results of their UX analysis, but there exist important conceptual differences among them. Until now, one cannot find a real comparison, a study that contrast the results of the use of several of them applied to the same general case. Such study could throw light on their suitability in relation to the criteria utilised on interaction design for every virtual environment.

Virtual walkthrough requires the combination of two different groups of gestures. The first of them is related to movement along the scenario, changing the representation of the user position in the virtual world by moving forward and, in some cases, allowing moving backward or sideways as well. The other group of gestures deals with changing user’s orientation in the virtual environment, affecting the user direction of displacement, which is mostly coupled with the view direction. Other gestures can be used for further interaction like selecting, manipulating objects, etc.

The catalogue of possible gestures is extensive. Apart from the cases found in existing examples, other possible gesture combinations have been proposed [8]. This study measures and compares six different gestural walkthrough schemes. Five of them were used in previous works developed by different teams, while the authors of this paper developed the sixth to accomplish this work in a befitting manner.

Those six walkthrough schemes combine a user gesture to move forward with another gesture of turning. Based on the aforementioned cases, the gestures analysed were: Point with arm for moving and turning [3][4], right arm forward/body rotate [5], Lean forward/body twist [7], step forward/point with arm [3], swing arms/body twist [6] and lean forward/body tilt.

All of them showed pros and cons and yielded different outcomes in terms of speed, accuracy, spatial awareness, ease of learning, user comfort, ease of use and information gathering. Moreover, this work also deals with four aspects of UX, namely utility, learn-ability, efficiency and stimulation [9]. Those performance metrics and UX results would be useful for designers of virtual environments in order to choose the natural interaction walkthrough scheme that could best fit their needs basing on these criteria.

All those movement schemes were implemented on a common virtual environment depicting a reconstruction of a 4th century Roman villa, which is actually used as a virtual museum in a real world installation. Such virtual architecture provided a good and comprehensive set of scenarios that were used to obtain all the measurements required for the usability tests, being at the same time an entertaining and educative experience for the users involved, hence allowing the authors to also obtain results about the suitability of every paradigm for this kind of virtual museums.
The problem of controlling the movement of a user inside a virtual environment without using apparent physical interfaces exists since the arising of Virtual Reality installations in the 90’s. Authors like Bowman [1] have already pointed out that the detection and interpretation of user natural gestures could be used for implementing forms of movement inside virtual models. The ability of those VR installations to grasp user’s gestures was very limited in those times considering that only gaze direction (obtained from HMD orientation) as well as hand location and orientation (taken by special pointing devices) could be used to interpret user desires. In fact, depth camera technologies, such as the Kinect® system, allow obtaining a very comprehensive description of user’s pose and gestures. Therefore, this device is being used profusely in multifarious fields, where virtual environments have to be explored by means of natural interaction. Among those fields, Architectural Visualization and Virtual Museums demand good walkthrough paradigms to explore the space and contemplate the environment and the objects on display, prior to enabling further interactions [2]. There are several interesting examples developed in recent years, which implement different walkthrough paradigms [3][4][5][6][7]. Some of them support their validity offering tests of usability and results of their UX analysis, but there exist important conceptual differences among them. Until now, one cannot find a real comparison, a study that contrast the results of the use of several of them applied to the same general case. Such study could throw light on their suitability in relation to the criteria utilised on interaction design for every virtual environment. Virtual walkthrough requires the combination of two different groups of gestures. The first of them is related to movement along the scenario, changing the representation of the user position in the virtual world by moving forward and, in some cases, allowing moving backward or sideways as well. The other group of gestures deals with changing user’s orientation in the virtual environment, affecting the user direction of displacement, which is mostly coupled with the view direction. Other gestures can be used for further interaction like selecting, manipulating objects, etc. The catalogue of possible gestures is extensive. Apart from the cases found in existing examples, other possible gesture combinations have been proposed [8]. This study measures and compares six different gestural walkthrough schemes. Five of them were used in previous works developed by different teams, while the authors of this paper developed the sixth to accomplish this work in a befitting manner. Those six walkthrough schemes combine a user gesture to move forward with another gesture of turning. Based on the aforementioned cases, the gestures analysed were: Point with arm for moving and turning [3][4], right arm forward/body rotate [5], Lean forward/body twist [7], step forward/point with arm [3], swing arms/body twist [6] and lean forward/body tilt. All of them showed pros and cons and yielded different outcomes in terms of speed, accuracy, spatial awareness, ease of learning, user comfort, ease of use and information gathering. Moreover, this work also deals with four aspects of UX, namely utility, learnability, efficiency and stimulation [9]. Those performance metrics and UX results would be useful for designers of virtual environments in order to choose the natural interaction walkthrough scheme that could best fit their needs basing on these criteria.
Merging the Real with the Virtual: Crowd Behaviour Mining with Virtual Environments

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Author Keywords: crowdsourcing, crowd behaviour mining, virtual environments, landscape archaeology, digital heritage

The first recorded crowdsourcing activity was in 1714 [1], with intermittent public event occurrences up until the millennium when such activities become widespread, spanning multiple domains. Crowdsourcing, however, is relatively novel as a methodology within virtual environment studies, in archaeology, and within the heritage domains where this research is focused. The studies that are being conducted are few and far between in comparison to other areas. This paper aims to develop a recent concept in crowdsourcing work termed ‘crowd behaviour mining’ [2] using virtual environments, and to develop a unique concept in crowdsourcing activities that can be applied beyond the case studies presented here and to other domains that involve human behaviour as independent variables. The case studies described here use data from experiments involving separate heritage projects and conducted during two Royal Society Summer Science Exhibitions, in 2012 and 2015 respectively. ‘Crowd Behaviour Mining’ analysis demonstrated a capacity to inform research in respect of potential patterns and trends across space and time as well as preferences between demographic user groups and the influence of experimenters during the experiments.