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Avatar Implementation in Virtual Reality Environment Using Situated Learning for "Tawaf"

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Abstract

The growing need on learner-centered education in recent years has motivated this study by applying virtual reality learning environment as an approach via engaging problem-solving activities. This study is emphasizing on 3D virtual reality environment using avatar human based immersive and simulation. The avatar will guide learners through virtual reality environment as they participate in a role based problem solving, hold highly potential for situated learning. Simulation allows learners to immerse themselves in a problematic situation by providing a dynamic navigation. Situated learning enables learner to takes on active role in the learning context in system being studied which is learning the Moslem's tawaf practice as one of the hajj pillars. Later, it will provide learners with preliminary understanding by engaging into practice the tawaf virtually before they undergo for actual training by using avatar. Thus, learners will be able to immerse themselves with tawaf process virtually. Finally a virtual reality prototype that focuses on tawaf practice will be developed which can be used by a diversify learners from school students to adult learners.

Keywords: virtual reality; avatar; situated learning; simulation; tawaf

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1. Introduction

Current learning approach has gradually shifted from teacher centered to learner centered particularly for adult learners and tertiary education. Learning by doing and active participation may yielded better understanding and can be enjoyable activities in learning process. Researches by (Bares et.al., 1998) and (Rickel et. al., 1997) exploring the techniques for situated learning in the 3D environment has huge motivation in our work. The avatar based (3D) virtual reality supports learner centered approach by allowing learners to participate in immersive experiences. By incorporating a learning theory such as situated learning, this study was aimed to develop a web based 3D avatar based immersive simulation for tawaf in performing hajj. The target learners were wide ranging from school students to adult learners. However, the main problem of this study was taken from the Hajj trainers' committee lead by Imam of Islamic Center Universiti Teknologi MARA. All Hajj candidates or trainees were required to complete a series of practical courses and tawaf is one of the pillar activities. The trainers at Islamic Center had difficulty in conducting the tawaf activity due to large group of trainees usually exceeded a hundred of adult learners at a time. Having a 3D simulation with avatar prior to practical training would complement the course and can results a constructive learning process.

This paper was organized as the following sections; section 2 summarizes the literature review which had been done in the past. We furthermore described our methodology developing the project in section 3. Section 4 constitutes the main part of this paper which was devoted to results including interfaces regarding the project. Lastly, we end with conclusion in section 5.

2. Literature Review

This study was carried out according to the following literature reviews and related works.

2.1 The 3D Virtual Reality and Avatar

Virtual reality is an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. On a computer, virtual reality is primarily experienced through two of the five senses: sight and sound. The simplest form of virtual reality is a 3D image that can be explored interactively at a personal computer, usually by manipulating keys or the mouse so that the content of the image moves in some direction or zooms in or out.

Meanwhile an avatar is the graphic representation of the self in a given physical medium that other users can see or interact within a virtual environment (Galanxhi and Nah, 2007). It is an "object" representing the embodiment of the user. The term "avatar" can also refer to the personality connected with the screen name, or handle, of an Internet user. Avatars as a "vehicle of the self" (Castronova, 2003) are the inhabitants of virtual worlds. Every day, millions of users interact, collaborate, and form relationships with each other through avatars in online environments. Virtual worlds, such as the most prominent example Second Life, are computer-generated physical spaces, represented graphically in three dimensions, that can be experienced by many users, or the so-called avatars, at once (Castronova, 2005).

In fact, the playful environment of virtual worlds has been described as engines of creation that provide the freedom to experiment and lead to unprecedented rates of innovation (Ondrejka, 2007). None of these tools invoke the Earth and a body as metaphors for interaction. The 3D worlds allow people to experience human social life in an environment in which people interact with a body (avatar) they desire or choose. This feature of synthetic worlds removes from the social calculus all the unfortunate effects or any inhibitions that derive from the physical body (Castronova, 2005).

2.2 Virtual Reality Modeling Language

Virtual Reality Modeling Language (VRML) or VRML97 version allows to create virtual worlds via the internet commonly access through world wide web (WWW). It is a standard for creating a file format for interactive 3D graphics. By using a VRML browser as a plug-in to an Internet browser, a user can click on an HTML page, causing a VRML file to be downloaded and displayed (Loughran and Stahl, 1998).

2.3 Situated Learning

Situated according to Lave (1998) argues that learning as it normally occurs is a function of the activity, context and culture in which it occurs, contradicting to formal classroom learning process where knowledge is abstract and out of context. In the view of situated learning, knowledge and understanding is fundamentally a product of the learning situation and the nature of the learning activity (Lave and Wenger, 1991). It is also a theory about the nature of human knowledge, claiming that knowledge is dynamically constructed as we conceive of what is happening to us (Clancey, 1995).

A fundamental concept of situated learning is that all learning takes place in a specific context and the context significantly impacts learning (Alessi & Trollip, 2001). Consequently, situated learning need not employ the linear approach to instruction which is most commonly used in a classroom setting (Lunce, 2006). Situated learning involves a practice-based approach which may not employ the linear approach to instruction which is most commonly used in a classroom setting. A second key concept of situated learning is a collaborative process which learners can interact among other learners that have same interests. The third component is the presence of tacit knowledge. A tacit knowledge is defined as knowledge that is personal, experiential and context specific (Nonaka & Takeuci, 1995). Finally, according to Lunce (2006) taken from researcher Henning, stated that part of situated learning refers to the process of learning to use a tool or artifact in a real-life situation to accomplish a real-world objective.

According to Lunce (2006) taken from researchers McLellan, Brown et. al., Duffy & Cunningham and Land & Hannafin that key strategies often utilized in situated learning environments are stories, reflection, anchored instruction, cognitive apprenticeship, modeling, collaboration, coaching, scaffolding and judging, multiple practice, exploration and articulation.

2.4 Situated Learning in Virtual Reality Learning Environment

A similar application has been produced for learning hajj through websites such as hajj.al-islam.com. However, the limitation of this web site is that they use 2D sketching to demonstrate the tawaf activity. Other applications that applying learning theories with VR environments were developed by Bares et. al.(1998) for CPU CITY and Shuih & Yang (2008) for Virtual English Classroom 3D (VEC3D).

Bares et.al. (1998) developed CPU CITY in a 3D learning environment for the domain of computer architecture providing learners with virtual computer housing a computer processing unit (CPU), random access memory (RAM) and a hard disk. This application was aimed to develop an understanding of the activities comprising a computation using an avatar. A avatar named Whizlo to to pick up, transport, and insert data packets into registers which learners can have direct interaction with the VR environment. Pilot studies of the CPU CITY testbed indicate that habitable learning environments offer a new paradigm for educational software that can offer significant potential for situated learning (Bares et. al, 1998).

Shuih & Yang (2008) developed a collaborative virtual environment for situated leaning named VEC3D. The main goal of VEC3D was to design a contextualized and playful 3D Virtual English Classroom offers an appropriate and appealing context for foreign language. VEC3D was a 3D campus-

like interactive learning environment designed to help learners develop English communicative competence. VEC3D is significant in that the immersion and interaction inspire students to take part in a virtually situated 3D learning environment (Shuih & Yang, 2008). The researchers claimed that VEC3D was a novel platform with real-time voice as another option for online chatting where students conduct synchronous communication and real-time interactions in written and spoken format.

3. Development Method

3.1 Project Development Method

The ADDIE process model was used to describe a systematic instruction development. It consisted of five phases of analysis, design, development, implementation and evaluation. However, this paper only focused on the analysis, design and development phase of the project.

3.1.1 Analysis Phase

The secondary data will be used for this phase. All of the collected information will be analyzed, studied and integrated. All information about Hajj performance and web base 3D simulation and the data related to the topics will be integrated and applied in this project.

3.1.2 Design Phase

The interface development of the 3D environment was based on a storyboarding as the output to guide the flow of the simulation. Storyboard was a graphic organizer such as a series of illustrations or images displayed in sequence for the purpose of pre-visualization a motion graphic or interactive media sequence.

3.1.3 Development Phase

The development of the 3D model was done by creating the animations and training scenario in the 3D environment. The basic data flow for creating Virtual Manual Project (VMP) was done accordingly and stated by ParallelGraphics(2007):

1. Exporting 3D data into VRML97.
2. Creating Virtual Manual (VM) with Virtual Manual Generator (VMG).
3. Adding Data to the VM project with VMG.
4. The basic data flow is shown as an upper right branch in Figure 1VM Project:
5. Exporting Data 3D data from arbitrary systems in VRML97 format.
6. Data processing with Internet Model Optimizer (IMO).
7. Creating a new VM project and adding 3D data to it with VTE.
8. Adding a new level of detail to these newly added models with program.

3.1.4 The 3D Environment Software

A software name Blender 2.42 has been used to develop this project, which was open source application that can support many platforms. The installations file of this software about 61.4 MB. The 3D should have the environment during the tawaf activity and contain a human representation that can be control such as walking around the kaa'bah in the environment.

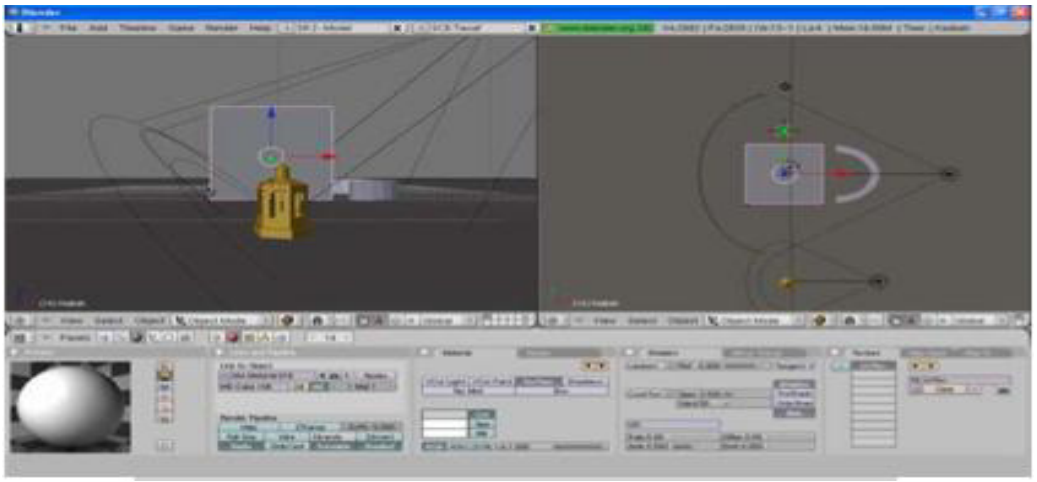

Fig. 1: The 3D environment construction 1

Figure 1 showed some development of the environment around ka'bah using Blender 2.42. The yellow monument was indicating a tombstone or Makam Ibrahim and a cube behind that it was indicating the kaa'bah. A monument next to the kaa'bah was indicating Hijir Ismail. That was some progress developing of the 3D model in the development phase.

Figure 2 showed the starting line of the tawaf activity. Ritual tawaf activity was to walk around the kaa'bah 7 times. The figure 2 used an avatar that represented a human model was ready to start the tawaf activity. The camera always followed the avatar, user can view the environment dynamically. The images were limited to the screen of the camera only. The starting line started at Rukun Hajar Al-Aswad. At the top on the right was the clap counter. It showed how much round user have done doing tawaf. The lap counter increased when round complete from 1 until 7 times. At the top left of the interface was a map navigation that shows the top view that also changed dynamically while user was moving on the main screen. This scene has background audio that will give the user more feeling like they are doing tawaf in the real place. At the corner of the kaa'bah (the black cube) there is a rock that called Hajar Al-Aswad. The movement around the kaa'bah must be an anti-clockwise direction. If users were in the wrong direction, then they had to start it again from the starting line.

Fig. 2: The 3D environment construction 2

4. System Interfaces

This project focused on developing 3D model of the area of tawaf activity. This section will elaborate how this project has been completed from the designing phase and the construction of interfaces.

4.1 System Interfaces

In system interface summarized the relationship between design processes and the analysis process whose products were visualized the stages of 3D kaa'bah area.The avatar representing a male in ihram were showed in the interface. The backgrounds in the interfaces were developed to mimic the actual situation.

Fig. 3: The 3D environment construction

Figure 4 showed the main page for ritual performance hajj training and visualization of the environment construction in 3D. In the main page showed the kaa'bah with the view around it including a sky view in blue color. User can choose either tawaf of help option button.

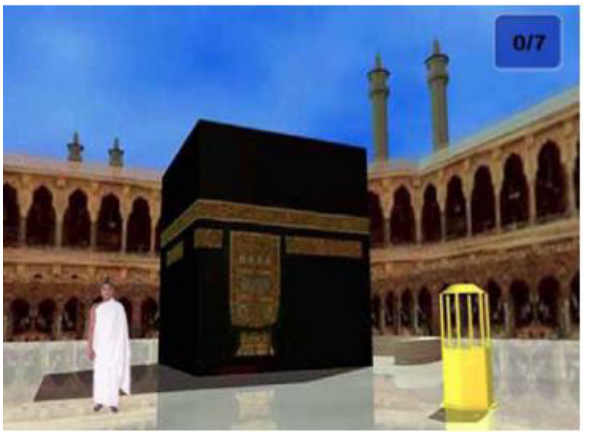

Fig. 4: Ka'bah and the view around it

Figure 5 displayed an avatar in the environment in performing the tawaf. The avatar will stand on the starting point of tawaf as shown in the figure. On top of right is lap counter, showing the total lap done by user.

Figure 5 showed the starting interface of tawaf simulation when the user downloaded and played it on the users' computer. Besides that it will also showed the rules during the tawaf. Finally the user can practically used it and practice the tawaf activity in the environment of kaa'bah.

Fig. 5: Starting page of tawaf simulation.

5. Conclusion

This project represented the tawaf training can be developed in the 3D environment. By implementing avatar in the 3D environment, hajj trainers can immerse with the simulation and increased their understanding on the ritual tawaf easily. Furthermore, the visualization of the tawaf activity in the project can be closer to actual image compared to the situation at the training center. Hence, having this system as an assistant or part of the content while conducting the Hajj course, the trainer can instill the learning process and at the same time highlighting the participation of trainees socially during the tawaf activity.

The 3D virtual learning using avatar offers significant potential for fostering situated learning. By implementing avatar to perform tasks in the 3D virtual reality, learners can actively immerse with the situated role based environment. With the combination of high-end graphical supports such as VRML, learners can be motivated to interact with what may become a trend in education software that covers a wide range of target learners.

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