Design of 3D Virtual World as a Media of E-Learning

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Abstract: Digital applications in teaching and learning is an urgent need since the online learning system is believed to be able to significantly improve the quality of education due to its nature in passing through time and space which are now very limited. And now, 3D interface system used as a media of online learning has perfected the system of 2D interface system. However, what kind of 3D interface system should be designed in order to increase students' interactivity and engagement towards the system? This paper details a design of 3D interface that can meet the demands of interactivity and engagement required to the system. By applying the Qualitative-Interactive approach, initially data were collected through literature study and interviews with several experienced practitioners in the field of online learning. Based on the results of data analysis, it was concluded that there were two key features that should be included in the design of 3D interface, namely avatar and environment. The presence of both features is expected to increase students' interactivity and engagement towards online learning system. A prototype design was created to provide a more concrete picture on the benefits and the ease of use of 3D interface system equipped with avatar and environment features.

Keywords: 3D virtual world, online learning, learning management system, avatar, environment, gesture animation

1 Introduction

At a symposium in April 2007, Gartner stated in his report that by the end of 2011, 80% of active Internet users including *Fortune 500* company would have a virtual world. Penetration of the virtual world in almost all aspects of human life, such as business, entertainment, commercial, art, health, trade, including education can not be avoided anymore. In fact, the use of virtual world technology in education has been embraced in recent years. 3D e-learning technology is now a blend of synchronous learning tools, web 2.0, social networking, and video games [1]. Virtual 3D technology is increasingly popular and important in the education field because it has the ability to create environments/3D display which is more realistic, interesting, interactive and meaningful. Virtual 3D and its interactivity are the main features that distinguish the 3D learning format with other virtual format types. Educational applications that combine virtual reality can enhance students interactivity and engagement [2,3]. 3D visualization format offers several advantages for educational institutions, teachers and also learners. Those advantages are: (1) 3D can further explore the places that cannot be reached in real life; (2) 3D can deliver teaching and learning process and discussion of some dangerous or risk topics with simpler and least expensive cost; (3) 3D virtualization offers a more realistic interactivity [1,4,5].

2 Problem Formulation

Based on a field observations and interview results, it can be concluded that people in general still have little confidence in the ability of distance learning program in enhancing and increasing knowledge and skills of the learners. This paradigm is caused by a long history of experience in the use of a conventional face-to-face teaching system, a very dominant role of the teacher and the application of a minimum autonomous-learning culture. In order to change people's perception, practical steps to convince public on the efficiency and effectiveness of e-Learning courses in transferring knowledge should be done immediately.

Based on the current conditions mentioned above, two research questions can be formulated as follows:
1. What kind of 3 Dimensional design appropriate with e-learning system?
2. What important features should be available in 3 Dimensional design?

2.1 Methodology

Qualitative-interpretative methodology was conducted to answer the above problems and following are the steps taken:
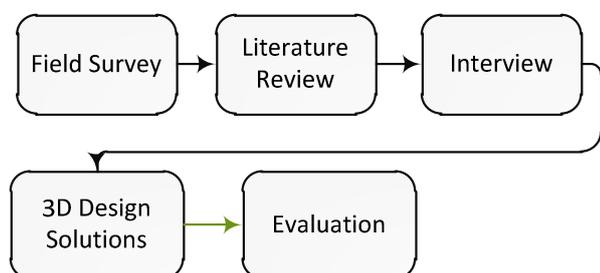

Figure 1. Research Methodology

The research methodology of this study was Qualitative-Interpretative approach. Qualitative approach is a process of understanding the problem deeply based on a holistic picture processed by words. It conveys the detail information obtained from the consultants and conducted in a natural condition. This approach best suits the nature of this study because it is natural and it involves natural subjects such as consultants, research subjects and the researcher who objectively and naturally analyses and interprets data obtained without any intervention.

In order to conduct a research with interpretive method, it requires seven basic principles [6]. Among them are the Fundamental Principle of the Hermeneutic Circle, the Principle of Contextualization and the Principle of Multiple Interpretations. The Fundamental Principle of the hermeneutic circle is a process that focuses on understanding a social phenomenon that is based on the interpretation of existing data on armed with a basic understanding. That understanding should be followed up in the form of communication or action. Meanwhile, the Principle of Contextualization is the second principle of interpretative method which is used as the basic principle by the researcher in conducting this research. The principle of contextualization is the research principle of a place that is timely, historically and socially bounded. And the third principle is the Principle of Multiple Interpretation. This principle is open to the possibility of various interpretations on the subject of the research problem. In this study, the subjects were the practitioners of online learning as consultants.

The Qualitative-Interpretative approach must be delivered in a series of systematic research action which is started with a literature studies strategies in order to get a detailed and deep understanding of the theory design of a 3D interface in e-learning. Literature studies include a study of the sources of materials related to the design of making online learning system. Literature searches conducted using search engines, e-books and online journals. After conducting the literature studies, the researcher conducts interview strategy to obtain detailed and in-depth information about the current design of 3D interface with its existing features and the must-available features required to create an ideal 3D interface design. The interview with some e-learning practitioners as consultants is also to get evaluation feed back on the design of 3D interface made by the researcher as the result product of this study [7,8].

The data obtained were then analyzed using descriptive methods and grounded theory [9]. Then the design result was presented to the consultants to be evaluated using the principles of the Technology Acceptance Model (TAM) which categorizes the attitude factor of each user's behavior into two variables: ease of use and usefulness [10].

3 Problem Solution

After collecting and analyzing the data obtained, this study observed that there were two salient features should be available in a 3D interface design, environment and avatars. Both features were believed to be able to increase the interactivity and engagement of learners towards the use of 3D interface design as e-learning media.

3.1 Environment

There is a classroom as a place to learn virtually with circular seating position.

Figure 2. Environment

Figure 2 above is a portrait of a virtual environment, after login, default displays news, and

quick access menus, other than that there are two people communicating, and each communication (chat) is displayed in bubble along with the picture of the interlocutor. Menu for chat is available at below and above the screen environment. As for the media to communicate is via text or chat, it consists of five types, namely: (1) Local, communication is only heard in a folder/room; (2) Party, type of communication that is only heard by one particular group or in a group; (3) Friends, a type of communication that is only heard by one person alone; (4) Room, this type of communication can only be seen (heard) by everyone who is in the same room or location; (5) Private, personal communication between players. This communication cannot be heard by others, and is done by double-clicking other players twice. Icons, an interactive feature that can increase the engagement such as shaking hands when meeting someone new or meet someone, raising hands if the player wants to ask questions and so forth. Menu icons can be run by clicking the icon selected and the character will automatically performs the movement in accordance with a selected image icon.

A map is on the top right of the screen. It can be activated or deactivated. Map is important to spot the location and existence of the players in one situation.

Menu is available on the bottom right. There are four main menus: home, online, activities, and friends. Home is divided into a menu profile, forums, emails, blogs, groups and settings. Online contains a list of people who are online in a folder. Activities, a list of user activity, such as subjects taken and their scores. Friends display a list of friends who are online or offline.

3.2 Avatar

Avatar creates a more realistic and attractive interaction, such as shaking hands, gripping and others. As shown in the figure 3 below:
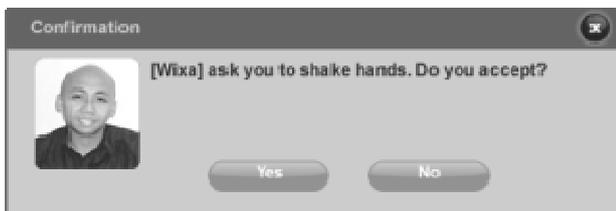

Figure 3. Handshake Request

Figure 3 above constitutes an invitation from a user to another user to shake hands. If "YES", then the user who invites will automatically walks towards the one who accepts the invitation.

Another factor that can increase the interactivity is the gesture animation feature. Users simply clicks the icon on the menu gesture animation or simply types in the column corresponding command on the chat box column.

Before engaging to a situation, a user should create an avatar first. The design process in creating or making an avatar is shown in figure 4 below. An avatar that has been selected can be displayed with 360 rotation and accessories selection process can be instantly displayed on the computer screen.
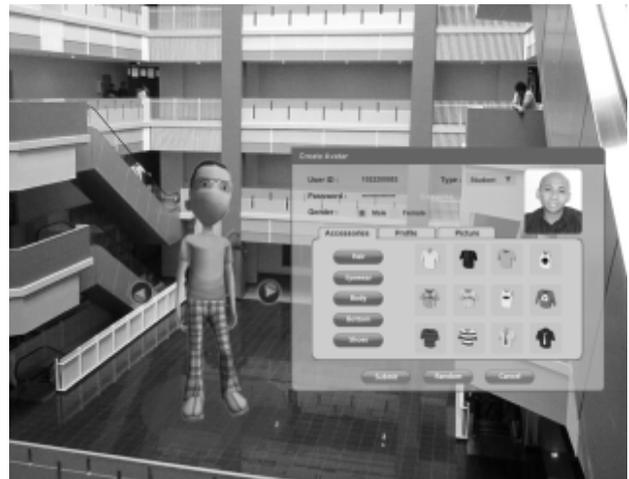

Figure 4. Creating an Avatar

The process of making the above fields are described in table 1 and table 2 below.

Table 1 Avatar Field Definition

Item	Table	Field Name	Data Type	Rule & Description	Remark
Name		user_ username	varchar	Textbox, mandatory	User name for login
Password		user_ password	varchar	Textbox, mandatory	User name for login
Gender	3D_user	user_ gender	integer	Radio button, mandatory	0 = male, 1= female
Type		user_ type	integer	Dropdown list	0 = student, 1 = lecturer
Hair		visual_ hair	integer	Choice of hair	Changes automatically appear in the avatar
Eyewear		visual_ eyewear	integer	Choice of eyewear	
Body	3D_visual	visual_ upperwear	integer	Choice of upper wear	
Bottom		visual_ bottomwear	integer	Choice of bottom wear	
Shoes		visual_ footwear	integer	Choice of shoes	

To execute the blue print shown in figure 4 above, it requires 2 tables. First, the table of 3D_user containing user data such as user name and password (table 2). Second, table 2, the table of 3D_visual containing data about the accessories used by the user, and also specific data for special avatars, such as the avatar of the instructor. Please note that this is a sample table that will be created in the process of making an avatar. As for other supporting tables, they were not included into this paper.

The explanation on the process of avatar creation and the process run by the buttons can be found in the following table 2 below.

Table 2. Avatar Process Definition

Item	Name	Process	Remark
Button	Rotate Right	Turning an avatar around 360º to the right	Seeing the look of an avatar from the side and back angle
Button	Rotate Left	Turning an avatar around 360º to the left	
Button	Submit	When clicked, the selected avatar will be saved to the database	
Button	Random	When clicked, the avatar will be randomly selected by the system	
Button	Cancel	When clicked, it will cancel the selection	
Button	Eyewear	Featuring 12 types of eyewear options	
Button	Body	Featuring 12 types of upper wear options	
Button	Bottom	Featuring 12 types of bottom wear options	
Button	Shoes	Featuring 12 types of shoes options	
Button	Icon	Showing direct model chosen on the avatar	Icon eyewear, upper wear, bottom wear, shoes

Figure 5. ERD Diagram

Figure 5 displays the relationship diagram where inter-relationship of the main tables is displayed. The tables include (1) 3D_friendlist, containing friends list data; (2) 3D_last_position, containing the last position before the user logs off, so that the user

can log back in the last position he logs off; (3) 3D_friend_request, containing a list of requests to be friends; (4) 3D_user, containing the user data; (5) 3D_visual, containing the accessories of user data; (6) 3D_profile, containing complete data from each user; (7) 3D_room, containing data of users in a room that can give information of all the active users playing in one room or folder.

The further explanation on the properties for table 3D user shown in the following table 3 and table 4 below. The tables include field names, data type, length of character, and other explanations.

Table 3. 3D_user

3D_user		Detail						
No	Column	Type	Size	Not Null	P	F	I	Remark
1	user_id	varchar	10	x	x			Student number
2	user_name	varchar	30	x				User login
3	user_type	integer	5	x				0 = Dosen, 1= mahasiswa
4	user_gender	integer	4	x				0 = male, 1=female
5	user_password	varchar	14	x				encripted
6	user_playtime	integer	8					
7	user_lastlogin	datetime	0	x				Default getdate()
8	user_specialvisual	varchar	32					Special avatar special for lecturer
9	user_datejoin	datetime	0	x				Default getdate()
10	user_lastlogoff	datetime	0	x				Default getdate()

Table 4. 3D_profile

3D_profile		Detail						
No	Column	Type	Size	Not Null	P	F	I	Remark
1	profile_id	integer	10	x	x			autonumber
2	user_id	varchar	10	x		x		
3	profile_firstname	varchar	15	x				
4	profile_lastname	varchar	30	x				
5	profile_birth_mm	varchar	2	x				
6	profile_birth_dd	varchar	2	x				
7	profile birth_yyyy	varchar	4	x				
8	profile_status	integer	1	x				
9	profile_address	varchar	100	x				
10	profile_city	varchar	20	x				Lookup table city
11	profile_handphone	varchar	14	x				
12	profile_email	varchar	30	x				
13	profile messenger	varchar	30	x				
14	profile description	varchar	200					
15	profile_class	varchar	40					Lookup to course
16	profile_exam	integer	4					Lookup to course table
17	profile_score	integer	4					Lookup to course score

The important role of avatar in 3D virtual world application as media in e-learning can be clearly seen in the process of design making, starting from the drafting of interface design, field definitions, field process until the design of database.

4 Conclusion

The use of environment and avatar in a 3D interface design is very crucial. They play an important role in improving the interactivity and engagement of learners towards e-learning media. The presence of the environment featuring bright, colorful up-to-date and close-to-real atmosphere can improve attachment to the application used. While the avatar feature matches the character and personality of the user as well as having a physical resemblance with the original character that might increase the interactivity and engagement of learners towards the 3D interface design as e-learning media.

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