Exploring Concept Design of User Experience with Diegetic Approach for Cultural Heritage Virtual Realtity Exhibition

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Abstract: Museum and exhibition event have started to digitalize the artifact or artwork collection for preservation and presentation. Virtual Reality (VR) medium affecting the way people experience and perceive heritage. Virtual museum and exhibition does not only focus on displaying artwork or artifact but also but also the narration of its story. Game interfaces consist of both diegetic and non-diegetic components. Mostly in virtual exhibition, user interface using non-diegetic causing continuous interruptions of the user experience. Player involvement and immersion experience can be influenced by a range of factors, from the controllers to the user interface. It is crucial to represent cultural information and system interaction to the user through interfaces without distracting user's attention. In game industry, the use of diegetic design transformation of graphical user interface has already been used. In this paper, we will look at the benefits and also highlight the possibility and issue of the diegetic approach in designing the features required by the system. In our research, there are 3 features in virtual exhibitions that can be studied using a diegetic approach: interfaces design regarding to artifacts, interfaces to the system, and interfaces to applications. Our findings suggest that using diegetic interface is possible and have a potential to extend user experience.

1 INTRODUCTION

The use of Virtual Reality (VR) has grown significantly, entering many different aspects. Most of the museum and exhibition event have started to digitalize the artifact or artwork collection for preservation and presentation. With device based experiences like Head Mounted Displays (HMDs) with input control like Leap Motion Controller, Microsoft Kinect, VR technologies can create immersive and fun experience. The use of a virtual medium allows artists to display their work. Due to pandemic condition, two exhibition event in Indonesia named "Tales of Nowhere" by Museum MACAN and OPPO Art Jakarta Virtual 2020 by Art Jakarta were held virtually using web-based virtual tour (Kemenparekraf, 2021).

VR medium affecting the way people experience and perceive heritage. VR has been used for reconstructing historical environments (Technology, 2016), for increased visitor engagement and education (Bozzelli et al., 2019), and for creating interactive, engaging, and immersive experiences in heritage environments (Pagano et al., 2020). Instead of just displaying content, the app can also provide visitors or users with knowledge through interactive informal learning (Tengku Wook et al., 2016). Although, according to (Yazid & Jantan, 2019), value in UX is important and should be considered from the holistic point of view to develop a good application and UX also become the key focus in order to create emotion quality into interaction. This sense of presence is not only influenced by a hardware solution but also by graphical user interface (GUI) (Salomoni et al., 2017).

In this research, we introduce the second stage of testing for our exhibition Cultural Heritage (CH) themed VR prototype (Miranto et al., 2020). Designing diegetic interface elements with the latest evolution of GUIs in the gaming industry, to enhance user experience. We aim to analysis of their suitability in the cultural heritage domain and to

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provide users with a natural and immersive environment which, however, does not shift the focus of the user away from the virtual cultural artwork.

The main goal of this research is to analyze the possibilities offered by the application of a diegetic solution to the design of an interface for a cultural heritage virtual application

2 RELATED WORKS

2.1 Current Virtual Museum

There have been many study in Virtual Environment (VE) recently due to the enormous urgent need caused by the pandemic. Several virtual exhibition and museum development studies focus more on 3D reconstructions of building or event(Fazio et al., 2019; Previtali, 2019; Walmsley & Kersten, 2020), artwork (Adamopoulos et al., 2020; McCarthy et al., 2020; Tanasi et al., 2021; Zhenrao et al., 2021) with historical and esthetic value. Apart from the entertainment aspect, virtual museums and exhibitions are also able to display information as a learning medium. With the following requirements, system requires interaction and feedback from the user to the system, then displaying related information through the interface. In our findings, some virtual developments using Head Mounted Device (HMD) present this information with Graphical User Interface (GUI) by using non-diegetic type causing continuous interruptions of the user experience.

For instance, development virtual museum for the Stoa of Attalos (Skamantzari et al., 2017), allowing user to exploring a 3D reconstructed artifact and environment, application provide information about related artifact by using a non-diegetic semitransparent windows shown at the screen layer appearing superimposed over the virtual environment. An investigation of visualization and interaction with reconstructed Archaeological Museum was performed in (Clini et al., 2018). In this case, user can interact with artifact object and gain information using diegetic GUI near the artifact object. However some function like recall map, switch panorama and changing scene still using non-diegetic design.

Extending the analysis to other fully immersive CH applications using Cave Automatic Virtual Environment (CAVE). In (Roussou & Slater, 2020) using CAVE system focusing on the topic of math fractions interactive methods and passive methods. We recognize that diegetic interface is also underexplored in these circumstances.

2.2 GUI Elements and Type

GUI behave like a 2D plate to put stickers on screen. When player exploring the game world, screen GUI stays in the same place. User Interface (UI) in video games is the way players can interact with the game and receive feedback of their interaction. This includes several aspects of gameplay such as the storyline, controls, graphics, visual perspectives (point-of-view), behaviors of AIs and level designs. A suitable description of the design space of GUI for games was initially proposed by Fagerholt and Lorentzon (Fagerholt & Lorentzon, 2009). There are four types of interfaces depending on how linked to the narrative (see Figure 1).

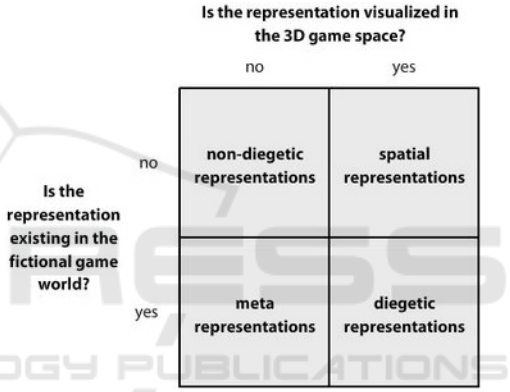


Figure 1: Four interface type Fagerholt and Lorentzon's terminology

1. Non-diegetic interface is the category that a game's HUD. This information exists purely for the player to view on screen, and the characters within the game are not aware of its presence.
2. Diegetic interface is one that exists within the game world and the characters within the game are aware of its presence.
3. Meta interfaces are interface that the characters in the game are aware of, but they are not physically display within the scene.
4. Spatial interface exists in the scene, but the characters within the game are not aware of it.

In the previous topic about VR in CH application, GUI mainly use to display information consisting of text, icons, button, simple effect and other multimedia

source that occasionally obscure areas of the screen. Therefore, the first attempt with an HMD should focus on putting GUI components into the Virtual Environment (VE). This way provides visual comfort by reducing the range of parallaxes, which may interfere with the fictional experience and consequently with the final immersion perceived by the user. As a result, deciding how to arrange the GUI elements in 3D space becomes critical.

Diegetic concept in (Fagerholt & Lorentzon, 2009) describe that all indicator line menu bar or status icon on screen are considered as not being part of the game world, because a game character is unaware about them. They are defined as extra-diegetic. On the other hand, the intra-diegetic comprises the characters, its objects, narrative of the game and actions.

In (Schild & Masuch, 2012) proposed GUI element and game information into three group : extra-diegetic, intra-diegetic and spatial references. Extra-diegetic is common UI elements to show information to the user. Intra-diegetic object element in game to show information to the user (e.g. watch to show time). Spatial reference which are technically part of the Head-Up Display (HUD) like a crosshair in shooter game.

2.3 Diegetic UI Experiences in Video Games

In game industry, there are some games have totally or partially integrated information in basic HUDs into the narrative. Dead Space is one of the famous example, which places the life bar on the back of the armor. With third person view, player can see health bar from the back of the armor without needed to use HUD. Also another game element in Dead Space is show in form of holographic view near the object like basic information about pick able object or near the weapon to indicate ammo.

Removing non-diegetic elements increased immersion only from a certain level of expertise and difficulty (Iacovides et al., 2015). Without HUD, using only diegetic interface, experts were less distracted. However, for novice user level, the presence of a basic HUD was essential. HUD giving the important information that, if absent, significantly affect their gaming experience. Another study with experts only (Peacocke et al., 2018) have a relatively similar result for first-person shooter task like ammo monitoring performance was higher when the ammo indicator using diegetic design that plant in to the gun.

Experiencing full immersion experience from player character in a first-person perspective serves to enhance the user engagement. One recent study found that perceived sense of presence was higher using HMD VR compared to the desktop application (Pallavicini et al., 2019). Diegetic interfaces designed to respecting the narrative of the game without compromise user immersion, seem to offer a possible solution to the basic HUD problem.

3 ROLE ANALYSIS OF DIEGETIC INTERFACES FOR CULTURAL HERITAGE VR APPLICATIONS

The emerge of VR technologies in video games industry has led to a re-adapting of game mechanic and their interfaces study, we argue that a similar change ought to be attempted for the enjoyment of the digital heritage. However, the solutions applied to game are not suitable for cultural heritage domain due to the few but fundamental differences between the two areas that require a specific analysis.

1. In game development, player may have complex status and list of task. So all the information needed at that point must be display on screen to make easier for player to see. On the contrary in CH application, player only need to interact and gain information related to artwork through an interface that must not occlude the artwork.
2. In game development, sometimes it is the interface itself that tries to draw the player's attention (e.g. flashing bar to emphasize a low health). While in CH application, it is the user who decides when to pay attention to the interface.

In this context, with a proper design interface, will enhance the sense of presence and immersion of the user. It becomes important to evaluate, depending on requirement system and on the type of information or data to be presented, the most suitable non-diegetic or diegetic design solutions that may contribute to the enhancement of the virtual environment.

3.1 Cultural Heritage Virtual Exhibition

For the test mockup, we using our early development research Cultural Heritage VR Exhibition (Miranto et al., 2020). The application using HMD with VR input control to interact with object and system. For now,

player can explore the exhibition area. Exhibition area fill with quantity of booth from several vendor or artist (see Figure 2).

Figure 2: Early development cultural heritage VR exhibition

First, we describe some of the features of the exhibition system that need to be design for user interface. Based on early development:

1. User is able to view additional information about the related artifact, general information about exhibition event and each vendor,
2. User are able to use the functions offered by the system to explore the exhibition area, like using a map.
3. User are able to set configurations on the system.

With this requirement, next we plan concept for user interface based on diegetic approach.

3.2 Diegetic Interface for Virtual Reality Exhibition

The primary objective of this study is to look at the possibility of using a diegetic solution to build an interface for a virtual cultural heritage application. In this research, we focused on the creation of a virtual exhibition where visitors may appreciate the artworks while learning new things about them. In order to optimize user experience, we specify the sorts of cultural data that should be supplied to visitors throughout an exhibition. The identification of a feasible method for integrating this information into the interface will be presented for each type of data, as well as our thoughts on the issues that arise from attempting to include fiction into the design of UI components in the CH domain.

Our virtual exhibition may be divided into three categories based on this requirement: those connected to the artefact, those related to the user experience, and those related to the application. The three groups are based on common design patterns found in gaming interfaces.

(a) (b)

Figure 3: Possible visualization of cultural data related to the artwork. (a) the non-diegetic representation. (b) the diegetic visualization.

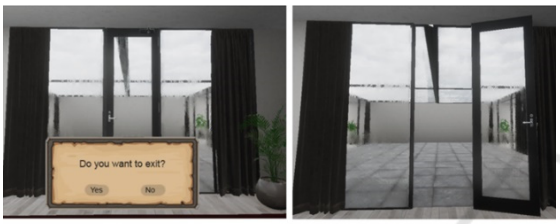
First about data related to artwork. These data are related to the visualization of all that additional information that is used to augment a virtual object. In a GUI design for a cultural heritage experience, this represents the main requirement that needs to be satisfied by developers. Data mostly composed of text, images or even videos. As demonstrated in Figure 3, with non-diegetic and diegetic concept, user will have optimal readability of the content. However with non-diegetic, GUI will covering half of the screen. With diegetic concept, user can control where to see or read base on VR hand control position. This requires the designer to add a new 3D objects fictionally integrated only for this case, like books, electronic tablet or multimedia boards into the scene or attach to the player. In our opinion, with diegetic solution in addition to offering a good readability of the data, and more flexible with the position based on player input control.

(a) (b)

Figure 4: Visualization of information related to the user experience. (a) non-diegetic represantation placed at the screen layer. (b) the diegetic version.

Next visualization of information related to the user experience. For this case, we are referring to all function that offer from the application to the user. As

an example, we can consider information related to user's position using some kind of map or GPS tracker. As demonstrated in Figure 4, with non-diegetic design have similar problem as before. Occluding the virtual environment and can disturb the user. Here again, a diegetic design solution appears as the most reasonable. With using VR controller, user can grab object like a map or GPS tracker to show their location. The map should be designed also as a multimedia map able to show other information such booth logo or brand or exhibition area that already been visited. In this way, the information which contributes to improving the user experience is presented in a discreet manner without diverting user attention.



(a) (b)

Figure 5: Approaches to show information related to the application. (a) the non-diegetic representation. (b) a possible representation.

Lastly about data related to the application. This section refers to the configuration of the virtual environment. While in the gaming context this generally corresponds to configuration such as the exit or changing location, lowering music volume in the exhibition, saving and loading of a game state. Certainly, this group consists of the most complex interaction and information to manage.

As demonstrated in Figure 4, in our opinion, a fully diegetic design solution requires a greater effort. To exit the exhibition, user need to walk through exit door. With simple animation, application can tell to the user that they can interact with the exit door. For another idea about lowering volume music in exhibition area, designer need to create object and interaction system for user. Design of the object must be self-explanatory for the user to avoid confusion.

Finally, the solution involving the creation of diegetic design interfaces applicable to all three types of group. However, in some cases, this diegetic solution will limit the user interaction with the object. These solutions could be more suitable for the first two types of group we have analyzed because they do not need to be always available to the user. Recent studies have shown that the diegetic interface approach is very suitable for VR applications that focus on story-driven games that require immersive experiences with the surrounding environment (Hoppe et al., 2021). Our future research is to testing the diegetic approach by users with a varied background regarding their experience in virtual reality.

4 CONCLUSIONS

A virtual museum or exhibition not only represents an artwork or artifact, but also tells the story behind it. The challenge in designing immersive virtual applications is presenting such information to the user without sacrificing the system's usability, and in particular in the cultural sector, maintaining the work of art at the center of the user's attention.

The purpose of this study was to explore the possibility of diegetic design UI using HMD and VR control that already implemented in games can also be implemented to cultural heritage domain. With more effort on the UI design side of implementing a diegetic interface, give a possible solution to represent more value to the work. In conclusion, we believe that with using diegetic design interface may enhance involvement and immersion user to the cultural heritage content.

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