Collaborative Virtual Travel Experience in a Dome Augmented by a Context-Dependent Text and Audio Guide

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Abstract

This paper proposes a collaborative entertainment system for virtual travel inside a dome. The users are expected to appreciate a distant scene projected on the wall of the dome while the system provides context-dependent information for the purpose of having them experience satisfactory travel activities. The context is inferred by measuring user's head position and orientation in a 3-D space with a smartphone-based sensor. The user data is wirelessly transmitted to a content server from which context-dependent information is extracted and is sent to a tablet wirelessly. The tablet provides the information in text and/or audio to the user. The system considers human-human interaction in the dome as well to make collaborative experience among users possible.

1. Introduction

Virtual Reality (VR) has drawn much attention in recent years. Gadgets like the Oculus Rift, development platforms like Google Cardboard among others have brought VR to the masses, making them accessible to anyone that has an interest in it.

VR and Virtual Environments are terms used in the computer community almost interchangeably and have several definitions [1]:

- Real-time interactive graphics with three-dimensional models, combined with a display technology that gives the user the immersion in the model world and direct manipulation.
- The illusion of participation in a synthetic environment rather than external observation of such an environment. VR relies on a three-dimensional, stereoscopic head-tracker displays, hand/body tracking and binaural sound. VR is an immersive, multi-sensory experience.
- Virtual reality refers to immersive, interactive, multi-sensory, viewer-centered, three-dimensional computer generated environments and the combination of technologies required to build these environments.

There are some differences between these definitions but they all agree in that VR is characterized by being two things: interactive and immersive.

This ability of VR to be immersive has a lot to do with its popularity. From videogames to training simulations, immersion helps improve the experience in the opinion of a lot of people. This has given people the idea of Virtual Travel, which takes advantage of the simulated realities that VR can create and uses them to let people visit other places of the world.

The idea of Virtual Travel is not new. Attempts to make people feel like they are in a different place have been made since as early as the beginning of the 20th century. Rome through the Stereoscope [2] was a set of pictures and a guidebook that attempted to make people feel like they were visiting Rome.

With the growing availability of VR technologies, the idea of Virtual Travel (VT) has gained strength and become a viable option. Tourism agencies can use VT to make tourism available to more people, expanding the tourism demographic and allowing them to improve their earnings.

For the purpose of this paper, the definition of VT that we will use is the following: VT is a way for people who are unable, either for economic, time, or any other reasons, to travel to any places in the world. The objective of virtual travel is to allow those people to see the sights and get information about them.

This paper presents a way to let the user share his/her experience at the same time with other people and through sharing with each other enrich their experience.

The tool proposed here works by using a smartphone as a head-tracking device that allows a server to know what he/she is looking at. The intention is to use these devices inside a dome or a similar structure, where a projection of the place they are visiting is displayed. This will allow several people to experience the trip at the same time and talk about what they are seeing. At the same time, each user will receive information in audio and text form on a personal display device (PDD), which is updated using the head-tracking device's information.

The objective is to make VT an attractive alternative to regular travel and accessible enough that people from all kinds of economic backgrounds can enjoy it.

2. Design

2.1. Objective

The objective of this system is to create travel experiences that can be shared among several people. Current VR trends tend to focus on immersion and use headsets that block you from the outside world in order to achieve this. While this is a great way to create a very immersive experience, it has the disadvantage of not being able to be shared with other people in real time. In order to solve this, we propose a tool that will allow several people to use it at the same time while interacting with each other.

2.2. User

The target users of this system are people that want to experience VT. This means that the users' knowledge for operating the system or ICT literacy is expected to be normal. An expected user's activities are moving around the environment and seeing the sights of the places he or she travels to. Through this experience the users will enjoy travel experiences. Of course, users may enjoy the experience with just single scene videos or other types of content, but if there is more explanatory information provided in the form of text/audio, they might be more immersed and thus enjoy the experience even more. As for our point of view, we focus on how the system provides explanatory information effectively and with ease for the users.

The user will also share their space with other similar users at the same time and may be talking about what he/she sees or pointing other users in the direction of something he or she found useful. Since the user will be in a shared space, he or she will need to move around in order to see everything that he/she can and for this reason the system must keep track of their position inside the VT environment.

2.3. System requirements

The system needs to be entertaining above all. Since the it is not something the user can use at home but instead has to use it in a specialized environment, the user has to have some motivation for getting out of his house and going to where the system can be used.

There are several factors that we need to consider to make the system useful to the user. The characteristics this system needs are:

- Easy to learn: The user will be unfamiliar with how the system works and will have no previous knowledge of VT. For this reason, our system must be simple and have the user interact with the minimum possible number of its elements.
- User freedom: When traveling, people are free to move and see things at their own pace so it follows that VT will allow the user to see things at their own pace too. Another important aspect is that the user should be able to move around the environment. If not, then the experience would be reduced to nothing more than watching pictures or a movie.
- Shareable Experience: The user must be able to use this system alongside other people.

Based on what we want to have the users experience and the factors we need to focus on, the system we propose will consist of three main components that interact between them to give the user the travel experience: the server, the head-tracking device, and the display.

The components interact between them as shown in Figure 1. The user interacts with two of the three components (head-tracking device and display). However, the user does not need any kind of technical knowledge to use them.

The user should have no need of pressing buttons in order to tell the system what to do and this will give him the freedom to focus on other parts of the experience so that he or she may enjoy it more.

The tool ill be used inside a dome – such as planetarium`s where a 360-degree projection of the location is displayed. To accomplish this we need an omnidirectional projector of some sort. Inside the dome, the user wears the head-tracking device on his/her head while holding the display in his/her hands. When the user moves his/her head around the tool tracks where they are looking at and as soon as the user is looking at an interest point the information on that interest point is shown on the display.

Inside the dome there will be space for more than one user at the same time, thus creating a good environment for a "shareable experience." The term "shareable experience" means that the user can have the experience alongside other people at the same time and that he or she may interact with the other people if he or she wants to. This is also the reason that we are not employing VR headsets like the Oculus Rift. Using a headset would prohibit the user of interacting with other people because of the isolation that comes with using it.

The head-tracking device will keep track of the user's position inside the dome and of the user's head orientation (attitude). The device then will transmit this information to the server. In the server this information is processed and the information that the user will receive (if any) is decided. After this the server communicates with the display and tells it to show the chosen information.

The head-tracking device needs a way to measure the user`s movements and there are many options for doing this. But there is a gadget that most people today have and that has the required sensors to work as a head-tracker: the smartphone. (69% of Americans [3] and 64.2% of Japanese own a smartphone [4])

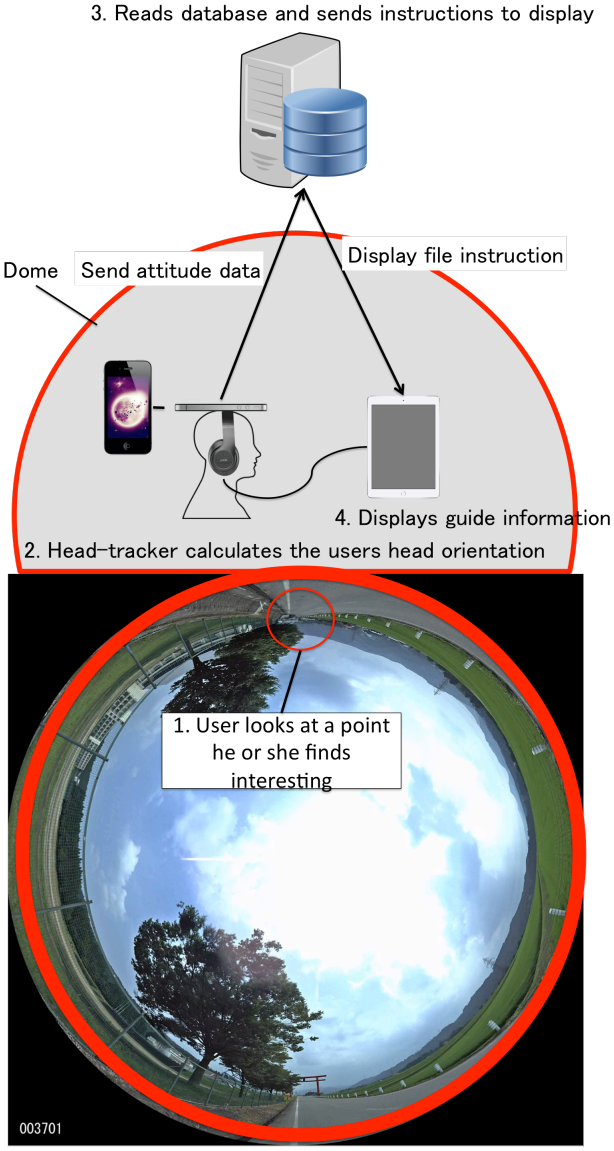

Figure 1. System Diagram

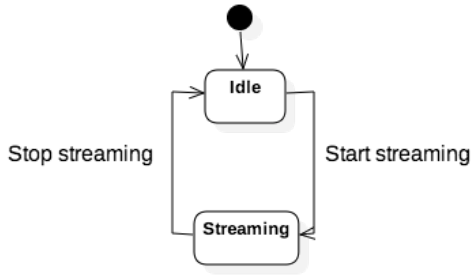

Figure 2. Head-tracking device`s state diagram

Using a smartphone will help the user get used to our system more easily because they already know how it works. On top of that, the smartphone`s sensors (gyroscope and accelerometer in this case) are quite powerful and can be used perfectly well as a head-tracking device.

With this design the system will comply with the factors described above. The system will be easy to learn, will allow the user freedom to move around the environment and take his/her time, and it will let the user share the experience in real time with real people around him or her.

3. System development

3.1. Head-tracking Device

For this system, the head-tracking device we used as an iPod Touch because its gyroscope and accelerometer are good enough to track the movement and it is small enough to be put on the users head without causing much discomfort.

The device uses the gyroscope to measure the attitude (or orientation of the head) of the user in Euler Angles (roll, pitch, and yaw, measured in radians) and the accelerometer to measure the acceleration among axes *x, y,* and *z* in meters per second squared.

The head-tracking device uses the User Datagram Protocol (UDP) to send information packages called datagrams to the server. Each of these datagrams contains the attitude and acceleration of the device at that moment. We use an application called Sensor Data developed by Wavefront Labs [5] to measure and send the gyroscope and accelerometer's data.

The device has two different states as seen in Figure 2.

3.2. Server and Display

The server receives the datagrams from the head-tracking device and unpacks them. Then it compares the attitude received at that moment with a database where “points of interest”, that is, locations that have information on them available, are stored. If they coincide then the server sends the display instructions on what content to display using the UDP protocol.

The display receives the instructions from the server, which consist of the ID of the content it needs to display, and then the content is displayed.

The states of the server and the display are shown on figures 3 and 4.

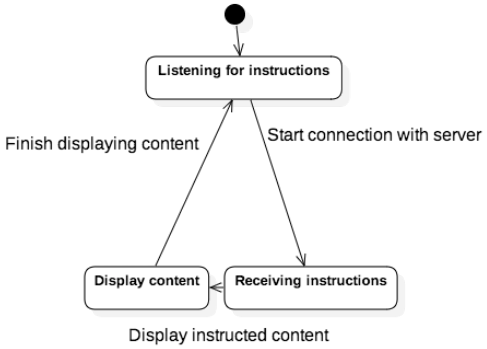

Figure 3. Display`s state diagram

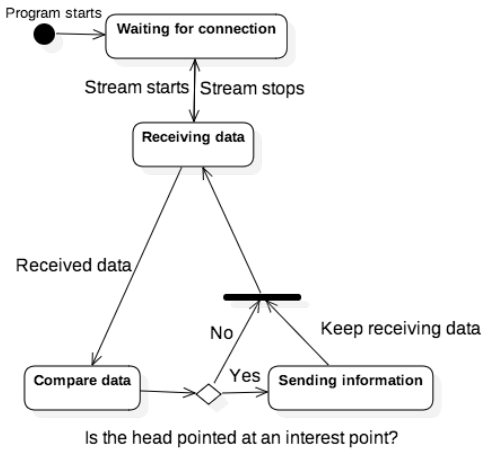

Figure 4. Server`s state diagram

4. Social impact

There are 3 different aspects that influence a person`s travel experience. The first is pre-experience which can be defined as "what the person hears before doing any actual travelling". The second one is the actual experience; seeing the sights, enjoying the food, doing recreational activities, etc. The last one is the post-experience; the memories, talking with your friends about your experience. [6]

Tourism agencies may adopt VT in general and this tool in particular to promote actual travel destinations so that people can see what`s in store for them should they choose to travel there. By doing this, agencies would take the opportunity to improve on the first aspect of a satisfying experience.

Promotion of travel destinations through this means may increase the number of people willing to travel and improve the tourism economy. The ability to experience travel without having to go very far may even open a previously untapped market: the elderly and people with disabilities.

These people want to travel as much as anyone else but they don't do so as much because a lot of places are simply inaccessible to them. VT can allow them to "visit" these previously inaccessible places and experience traveling.

5. Conclusions and future works

This system was created with the intention of allowing people to experience Virtual Travel and share those experiences with other people.

This tool could be used in museums and similar places as a learning tool, allowing all kinds of people to visit places that would be difficult or even impossible for a regular person to go.

Travel agencies can also use this tool to give their clients a "sneak peak" of places they can go. That way the clients can get interested in the place and be more motivated to hire the agency. It is an opportunity to allow clients to briefly experience a foreign environment and its highlights.

Another possible use for this tool could be in simulations for activities that could place the user in harm's way.

This tool could also be useful in research involving cognition. Proper testing should be conducted, but this tool may prove a useful and cheaper alternative to the more expensive eye-tracking tools already in the market.

In order to increase the degree of satisfaction of the user, collaborating with researchers on adaptive text in order to ensure each user can get personalized information is a possibility.

6. Acknowledgements:

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