COLLABORATIVE TELEPRESENCE USING MIXED MEDIUMS

by

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ABSTRACT

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Master of Digital Media, 2016

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Collaboration in telepresence helps reduce the cost of travel expenses and the time lost through commuting. Telepresence has taken many forms from 2D to 3D systems, from autonomous robots to augmented and virtual telepresence environments, all in an attempt to bring telepresence closer to a real life experience. With head mounted displays penetrating commercial markets, virtual telepresence systems provide new ways for collaboration. With the help of 3D scanning advancements, the exploration of integrating a hyper realistic replica of real people in a 3D environment has the opportunity to create life like avatars that function in virtual environments. This major research project presents a telepresence system that provides a virtual space for users to collaborate in real time. A user study was conducted with industry professionals to query the effectiveness of collaboration in virtual reality. Results show efficiency in simultaneous navigation and collaboration while using a virtual telepresence system.

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1.0 | INTRODUCTION

The goal of this project is to explore human behavior and virtual reality to provide a basic virtual telepresence environment and testing it through user studies to be able to provide effective features in the future to cater to creative agencies. Taking an advertising agency as an example, the need to collaborate on creative work on a daily basis is essential. Advertisers no longer build one campaign for a multinational brand and run it exactly the same everywhere around the world, instead agencies are relying more on collaboration across their global offices (Faulconbridge, 2011) and figuring out more ways to personalize experiences for their brands as well as the consumers of these brands. Through the mergence of diverse international talent, agencies can cater to global markets with the aid of online and digital solutions and can also communicate the tone of a brand with a more local appeal. Agencies will also gain insights of markets and consumer behavior on a global level.

An advertising agency has the advantage of separating their departments within a talent triangle amongst the creatives, account executives, and the strategists. The creative department being on the technical end of the triangle provides a full service on the execution of creative work. The strategists lead data aggregation, mining and categorization which provides the creative department with insights on creative work. The hub of this cycle are finally the account executives. They are the primary link to the clients but are also the communication representatives internally. This cycle is eternal and from it, the agency functions and achieves success stories to approach new businesses while learning more about their existing clients by the day, helping them bridge their business gaps and participating for awards through innovative ideas. Through this cycle, collaboration is in every corner.

Agencies in the Middle East seem to be doing things their own way and according to their markets' needs (Melewar, 2000). The headquarters of a multinational agency will only get involved in situations addressing the overall global image, however, they leave every office to cater to their own markets with minimal interference. This leads in less to no collaboration between offices in the Middle East and the offices in the West.

While traveling still dominates as the most effective means in which efficient one-on-one meetings can take place, some international agencies cannot afford that on a regular basis and so traveling is kept only for high level meetings or big award ceremonies. Telepresence systems are therefore the cost friendly tools for frequent collaboration amongst global offices. Although agencies already use software like Skype and Hangouts, they have a number of limitations such as losing the ability to multitask by changing through different files and being able to view the other user at the same time as well the minimal control a user has over the remote environment. This major research project (MRP) explores the use of virtual telepresence as a more effective means to support creative collaboration between remote sites, which would relate and appeal to an advertising agency's ambience. It is an exploration of digital and human behavior in a real world setting operating in a virtual environment.

2.0 | BACKGROUND AND RELATED WORK

Telepresence has been trending and in the eye of the tech industry for more than two decades (Fuchs, 2014); many other industries are constantly utilizing telepresence systems and are impatiently waiting for its breakthroughs. From popular apps like Skype and Hangouts to portable and autonomous robots, telepresence has taken many forms and will continue to do so in the coming years (Neustaedter, 2015). The aim is to still allow people located in two or more different locations to connect in one space with minimal distortions (Chen, 2000). In industry, the need for these telepresence systems has increased due to the cost per commute as well as the frequency of commuting needed (Edwards, 2011). Some commutes for bigger multinational corporations are overseas with hefty amounts spent on them. Entrepreneurs with startups that are required to travel in order to do business overseas can go through the same cash flow problem with a higher risk of loss. Live one-on-one meetings are essential in business regardless of the medium they are depicted in and according to McDougall (1994), "[The company] has to be over there to find out what the customers want." One-on-one meetings can occur daily in a business and in some industries like advertising, meetings become the forum for brainstorming and making business decisions on the go. With international agencies, the need for collaboration increases, and with costly air travel, telepresence shines as the prime solution.

Despites their use in business contexts, telepresence systems still have a number of limitations. 2D telepresence systems like Skype and Hangouts are often the most used in corporations. Their main limitation is that they restrict the user's feelings of being present by limiting the amount of control the user has in the remote environment (Fuchs, 2014; Neustaedter, 2015). With 3D telepresence using an avatar, the user can maneuver around a virtual environment giving them more control than 2D systems. They also limit the user's identity (Price, 2008). Both user ends are unable to see each other but rather see a fictional character which causes social disruptions during communication (Monahan, 2008). Telepresence robots on the other hand provide more control by allowing the user to navigate through a remote environment. Their limitation however, is the user's multitasking ability in navigating and interacting with people (Neustaedter, 2016; Kristoffersson, 2013). Most of the commercial robots do not have a collision prevention system and this pushes the user's focus more towards the navigation, losing the ability to interact comfortably (Neustaedter, 2016; Desai, 2011; Takayama, 2011). With projection telepresence, the ability to see a remote person in a local environment is more successful, however, the ability to collaborate isn't. Movements of the user distorts their projected image (Maimone, 2013; Fuchs, 2014). With virtual and augmented reality telepresence systems, the users can feel quite present at the space, but some argue that there is a social disruption caused by the lack in the ability to see the user's eyes (Beck, 2013). It is claimed that eyes play a vital role in communication (Chen, 2000). By 3D scanning a user and placing them into a virtual environment, the users can interact with each other without seeing headsets on each other (Newcombe, 2011; Tong, 2012). The goal of this MRP is to create a virtual reality telepresence environment that allows users to explore and share their feedback on what they have seen as well as what they would've liked to see in a virtual telepresence environment.

3.0 | APPLICATION CASE: ADVERTISING

Working in a multinational advertising agency, efficient collaboration is crucial especially while working on regional or even global campaigns. The problem with many offices collaborating efficiently is that the digital tools they use for communication lacks the creative freedom advertising creatives need in order to engage in effective brainstorming sessions while maintaining the ability to be at their local offices. For instance, overseas creative meetings are held on Skype or Hangouts as they are the fastest and most accessible tools for industry professionals. The reason for these meetings can be to brainstorm ideas for a creative brief. A major limitation is being able to see either the other remote user or a screenshare from their computer. This forces the users to look at one thing at a time instead of many. Sharing ideas and having different inspirational boards that can be showcased to everyone connected at the same time becomes more difficult.

Agencies still resort to air travel for commuting to meet in a designated location where effective collaboration can take place along with a hefty payment of expenses to cover the entire fleet of employees. Places like Dubai and Cannes are prepared to accommodate large amounts of employees where they can all experience face-to-face meetings and not through 2D telepresence software. Collaboration in telepresence is still limited in a sense that it still does not provide a user with abilities to multitask by sharing content, observing other content by other users, and working on an ideation board together while being able to see all users with no distortions. Virtual meetings can provide an efficient creative and collaborative playground (Duncan, 2012), where employees can still meet and engage with one another effectively. A creative agency will enjoy saving travel costs and can reallocate their money to a more needed venture such as initiatives for creative work or possible room for expansion.

The aim of advertising agencies is not only to bring about new clients but to get awards as well; the problem that multinational advertising agencies face is that collaboration between all their global offices is very minimal. Every office of a multinational advertising agency apart from the headquarter offices is limited in accessibility to the rest of the other offices with regional affiliations being an exception at times. International management meeting are the only exception to this barrier as all the offices are required to meet to talk about potential business and the headquarter's needs. However, projects that are worked on by a group of combined talent from around the world who all belong to one global advertising agency is unheard of. There are also no social platform to cater to all employees from all around the world that belong to one agency while maintaining exclusivity from the public.

4.0 | SYSTEM DESIGN

The telepresence system allows two or more users to collaborate in real time. Users are able to collaborate using different tools within the environment such as the ability to connect online and display a web browser as well as build a virtual building. The virtual building within the environment showcases an office setting where there are interactive lights, television screens, and public browsers. The outside area allows the users to collaborate and build primitive buildings. Every user's virtual representation is a simple robot avatar that is static and hovers around when the navigation tools are used. To start the experience one user has to host a session using the menu at the entrance of the main building while the other user has to join the session once it has been created (see Figure 1). When a successful connection is reached, both users will be teleported to their assigned location.

Figure 1: Session hosting widget.

4.1 | A USER SCENARIO

Within the virtual environment, there is a button to exit the virtual session and is located on the roof of the main building. Two users must find an area outside of the building and build their own primitive building to take them up to the roof in order to end the session (see Figure 2). One user starts inside the main building on the second floor by the staircase. The other user starts right outside of the main door building door and waits for the other user to make their way there. When the users have settled on where they want to build, they can toggle the building mode and start creating their primitive building together. Once both users are on the roof, one of them can toggle the User Interace Mode and end the session (see Figure 6).

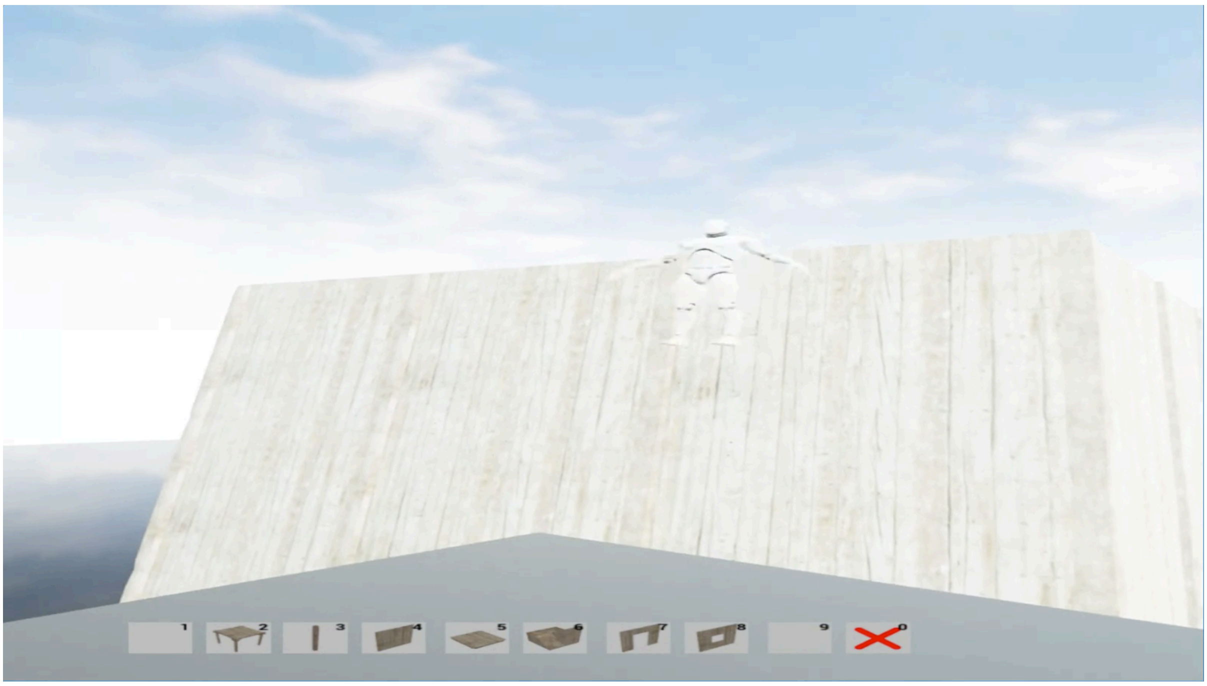


Figure 2: Participant jumping to the main building roof.

4.2 | SYSTEM FEATURES AND INTERACTIONS

Users in the environment have independent and collaborative features within the virtual environment. All users have a private static web browser that they can call using the button labeled ‘1’ on the mouse or on the keyboard. Other users will not be told when a user has a private browser active. There are two public web browsers located inside the dark room of the virtual building and can be shared between all users (see Figure 3). This feature was designed for users to use when researching online during a brainstorming session.

Figure 3: Participants exploring the public browser widget.

Another collaborative feature is the ability to create primitive buildings. To be able to use this feature, users have to be in the outside area around the main building. Both users are provided the same interface feedback in real time on where and what they can build. For instance, in an area where a user cannot build, a red mesh is displayed (see Figure 4). When a user is able to build, a green mesh will be displayed. Users can also activate videos displayed on television screens around the environment by navigating towards them. Once the user is within a specific distance, the video and audio will play.

Figure 4: Green and red mesh building logic.

5.0 | IMPLEMENTATION

The prototype telepresence system built is a virtual scene that two people can join in real time while using an Oculus CV1, Oculus Remote, and a mouse. The hardware build consists of at least one head mounted display and one computer running the executable file. The system also works with two or more head mounted displays, each running on a different computer. A user can also connect to the system in 3D by just using a computer screen without a head mounted display and can navigate around the environment using a keyboard and a mouse. The user with the Oculus CV1 can navigate through the environment by using the Oculus Remote held with their left hand and a computer mouse with their right hand used to function the tools.

5.1 | SOFTWARE BUILD

The system works with the Unreal Engine 4.11 and uses a blueprint node based system. Building base meshes were bought and designed to look like a creative office. To provide the participant access to the internet, the chromium based web browser widget was created. To run a webpage in virtual reality, the widget was designed and then placed within a null 3D widget where it could then be placed within the environment. A text box was created on top of the webpage to allow the user to change the URL. A button on the bottom was created to close the web browser. Web browsers that were in 3D space were surrounded by volume trigger boxes to track the user's gaze. A separate browser was created that could be operated by clicking the '1' button found on the left side of the mouse. This web browser is static and pops out whenever it is called.

TV screens were created by adding a media player component and attaching a video to them (see Figure 5). A null 3D widget was created and the media player was added to it in order to allow the video to be placed anywhere within the environment. A volume trigger box was added around the media player in the widget to allow the user to control the video. Once the user approached and was inside the trigger box, the video would play. The video would also close once the user stepped out of the box. The parameters of the volume trigger box were invisible to the user. Some of the lights within the environment were also surrounded by volume trigger boxes to light an area as the user walked by.

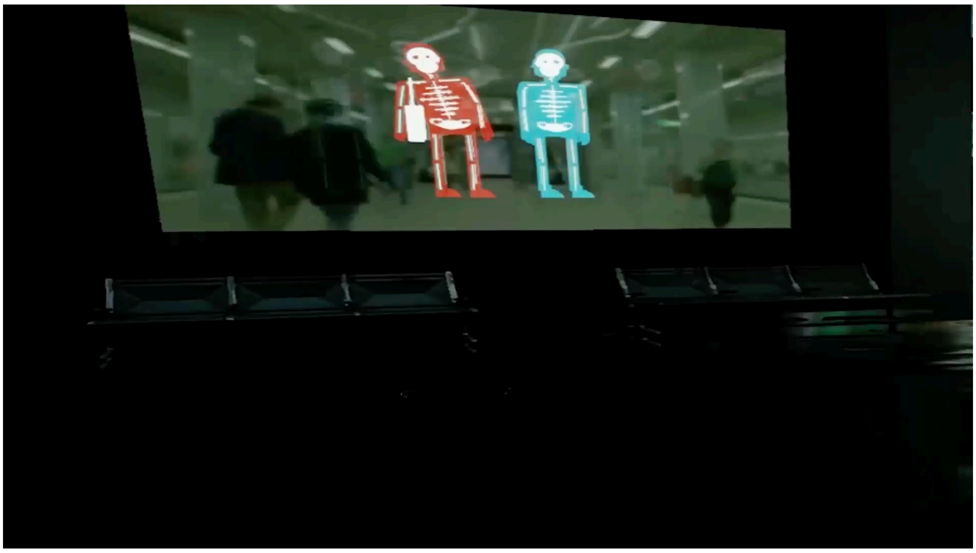


Figure 5: Main interactive TV screen.

For the active collaborative task, a building system was created to allow the user to create their own primitive buildings while they were in their virtual experience. These building tools were created by adding instances of meshes that would respawn whenever the user gazed through a trigger box. Each mesh had different restrictions and logic that would not allow the user from spawning them. The floor for instance, is the essential mesh required to be able to spawn any other mesh. Next a user had to spawn two poles before they could spawn any walls, doors, or roofs. Once there was a minimum of two floor meshes, a user could spawn a staircase. For the user interface, the mesh would turn green to signal a correct placement in the environment and would signal red if it cannot place the mesh. This system was built for multiplayer and uses a listen server so users would be able to collaborate and build at the same time.

5.2 | HARDWARE BUILD

The virtual build runs through a computer with the Windows 10 operating system. The Oculus CV1 was the head mounted display used. The Oculus Remote was used to navigate around the environment. The Oculus Remote's main button was used to allow the user to jump. A programmable mouse was also used to allow users to control the tools within the environment. By moving the mouse around, a user could turn left or right allowing the user to have a seated experience. The mouse included 12 programmable buttons. The button labeled '1' was used to call a static web browser. Buttons numbered '2' to '10' were used to call different meshes of the building tool. Finally, the '12' button was used to toggle the Game mode and User Interface mode. Each of these modes activate different features in the environment.

The User Interface mode allows the user to interact with widgets, web browsers, and the building tools. The Game mode allows the user to navigate around the environment freely and will not lock or limit the head mounted display. The Oculus Sensor allows the user's head motion to be tracked which enables the user to stand up, walk around a very limited area, and come up close to objects in the environment to take a closer look.

Figure 6: Quitting a session using the User Interface Mode.

6.0 | USER EVALUATION

The purpose the initial user study was to collect feedback on the system prototype from potential users in order to inform future iterations of system design. This iterative process allows the system to be tailored to the needs of its future users.

6.1 | EXPERIMENTAL DESIGN

The design of the 3D space, objects in the space, and the types of collaboration tools all went through informal design critiques. Once the system was ready, it was tested on two groups of participants. The participants recruited for this study were industry professionals who work in Horizon FCB Kuwait, an advertising agency and are between the ages of 22 to 46. Four participants were above 35 and four were below 35. These volunteers were familiar with one another and are constantly present in a creative and professional environment where they are required to collaborate on a daily basis. The first group from this participant pool were four employees from the creative department with equal amounts of both genders aged between 23 and 45. and the second were four employees from the account servicing department. The participants of this user study have never had a virtual reality experience before. A non active participant was also recruited to participate and collaborate with users in the second scenario. The participants were asked to use online tools in the virtual space to go through two scenarios, the first was a navigation task, and the second was an active collaborative task with the non active participant. The experimenter observed the user interactions and took notes. The user interactions were also screen recorded. After the users were done with their collaborative experience, they were asked to complete a quick survey querying their experience. The time taken of each participant's virtual experience was also measured with a time limit of 10 minutes per session. The usage differences of the telepresence system between the groups were analyzed, their feedback was documented, and the results determined. The results are documented in this final paper and an additional video was submitted with this paper showcasing highlights from the user's screen recorded experience as well as an overview of the project.

6.2 | TASKS

The study included two separate tasks. Two users participated in the tasks at a time. For the user study's effectiveness, a non active user was oriented with the system and given instructions on the process of conducting the study. The same non active user conducted all the tasks with every active participant. All the participants first went through an orientation task as none of them have had a past virtual reality experience before. This task involved a walkthrough around the environment with the non active participant in order to orient the active participants. The second scenario was an active building task where both participants were asked to create a primitive building that would take them to the roof of the main building. This task did not relate to advertising itself and the reason behind this was to not restrict the participants and lead them to use features and determine what needs to be done to the features presented. Instead the participants were active in a building task and were asked to think of possible features they would want that would help them if they were to use such a system at work and what kind of things would they be using it for.

6.3 | TASK 1: ORIENTATION AROUND THE VIRTUAL SPACE

Each participant was guided through a designed path around the virtual area while maintaining a conversation. The environment provided all the possible user interactions through objects in the space such as sliding doors, and screens that showcase work as well as the ability for the user to connect online. The participants held a conversation about the work environment in an advertising agency and how the different areas within the virtual space caters to segments within the agency (see Figure 7). After the virtual experience was over, they reported their feedback through a survey. The purpose of this task was to identify if a user was able to navigate through the virtual environment while maintaining the ability to hold a conversation throughout half the experience as well as to orient them on using the system before an active task. Each participant had a maximum of 10 minutes to explore the environment. The participants were asked to complete a survey questioning their experience.

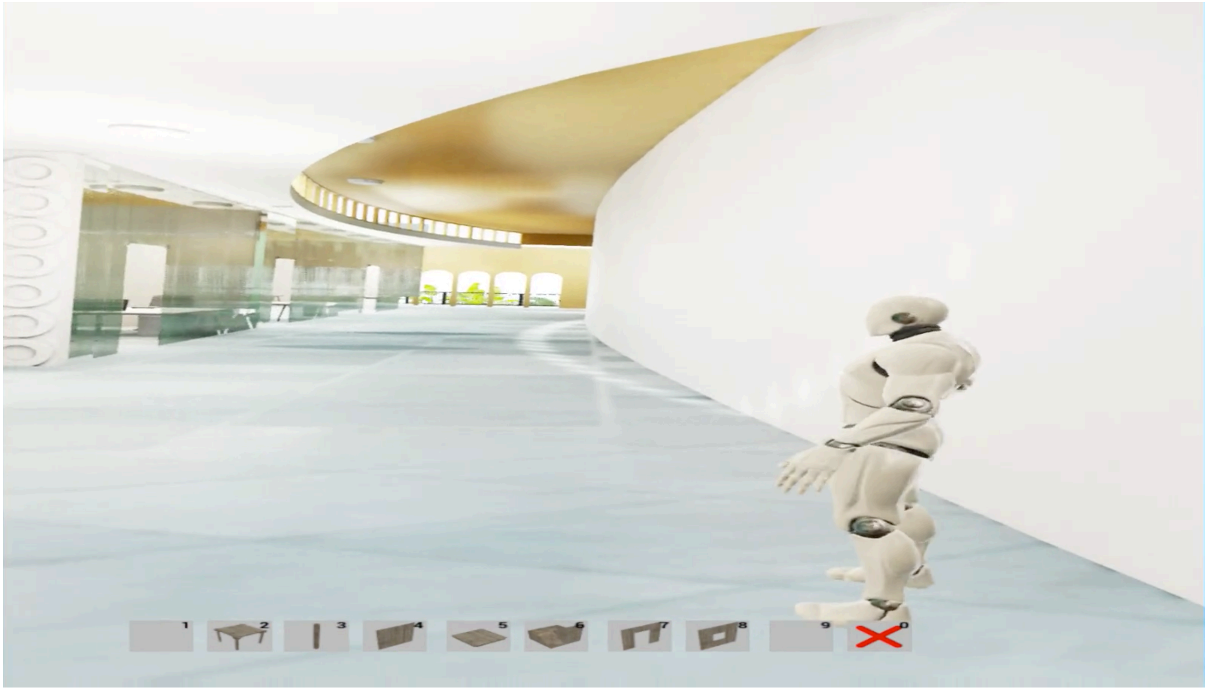


Figure 7: In the eyes of the participant during the walkthrough

6.4 | TASK 2: ACTIVE COLLABORATION THROUGH BUILDING

Participants also went through a collaborative task in the virtual space. For the purpose of the user study's effectiveness, the participants were limited to a space where the collaborative building tools are located (see Figure 8). The participants had to create a building that would take them to the roof of the main building (see Figure 9) using the tools operated through the programmed buttons on the mouse. They were given a maximum of 15 minutes to complete the task.

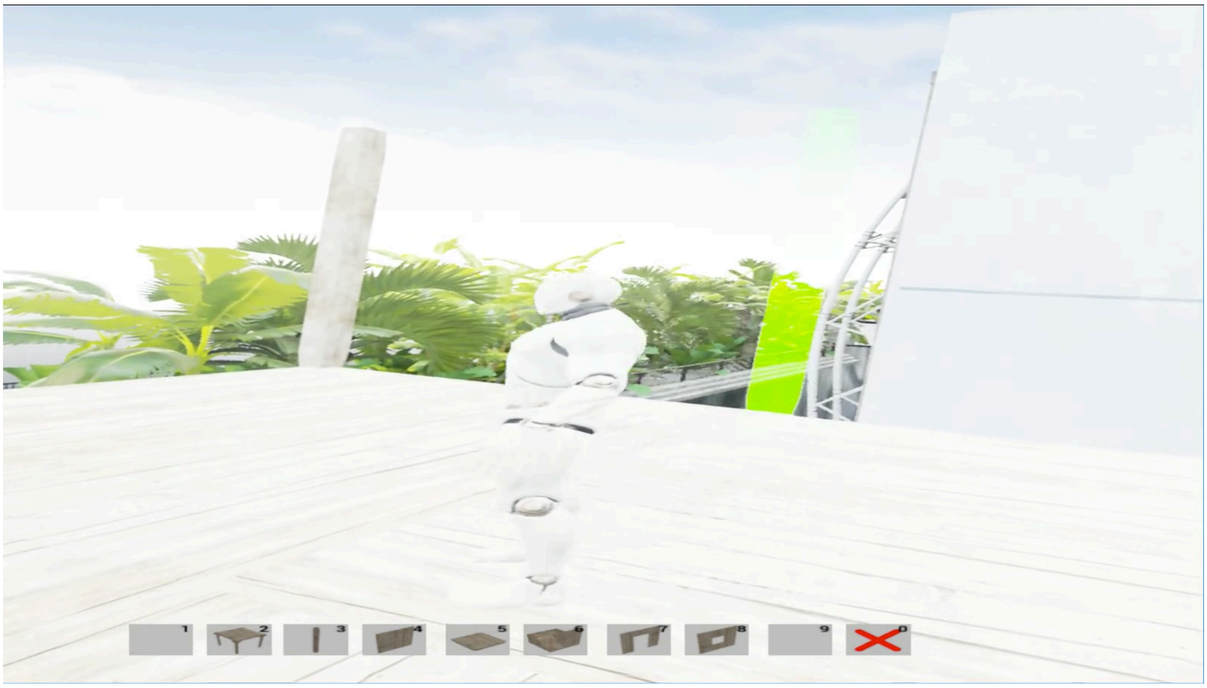


Figure 8: Participant building a pole mesh

The purpose of this task was to identify how participants collaborate in a virtual space, the effectiveness of virtual collaboration, and its failures. After the virtual experience was over, they reported their feedback through a survey where they were asked if collaboration would be more efficient if they were able to see a 3D interactive representation of themselves as well as others in the virtual environment.

Figure 9: Participant on the roof during the active task.

7.0 | FINDINGS

The majority of the participants found it easy navigating while collaborating in the environment. In the first session, most of the participants found it easy to get acquainted with the system's navigation devices they were operating as well as the tools they were using in the virtual space. After experiencing their second session, all of the participants found the tools a lot easier to use. Five of the participants managed to finish the collaborative task despite the fact that this was their first virtual reality experience.

7.1 | QUANTATIVE RESULTS

7.1.1 | TASK 1: ANALYSIS

In the first task, half of the participants felt like they were physically present in the virtual environment. All of the participants found it easy to discover the navigation tools provided. All of participants also found it easy to use these tools. 75% of the participants were not distracted by the virtual environment and were completely aware of their surroundings not losing the sense of where they were (see Figure 10). Seven out of the eight participants were able to communicate while navigating around the environment. 62% of the participants had a clear field of view. 75% of participants also found the overall experience pleasant. Three out of five of the younger participants did not feel like they were physically present in the virtual environment. All Participants under 35 were not distracted by the environment and had a clear sense of where they were.

The purpose of the first scenario was to identify if a user was able to navigate through the virtual environment while maintaining the ability to hold a conversation throughout at least half the experience without getting distracted. 75% of the participants which includes all the creatives, did not get distracted while navigating around the virtual environment and were completely aware of their surroundings without losing the sense of where they were. Half of the participants who were dominantly client servicing employees, felt like they were physically present in the virtual space.

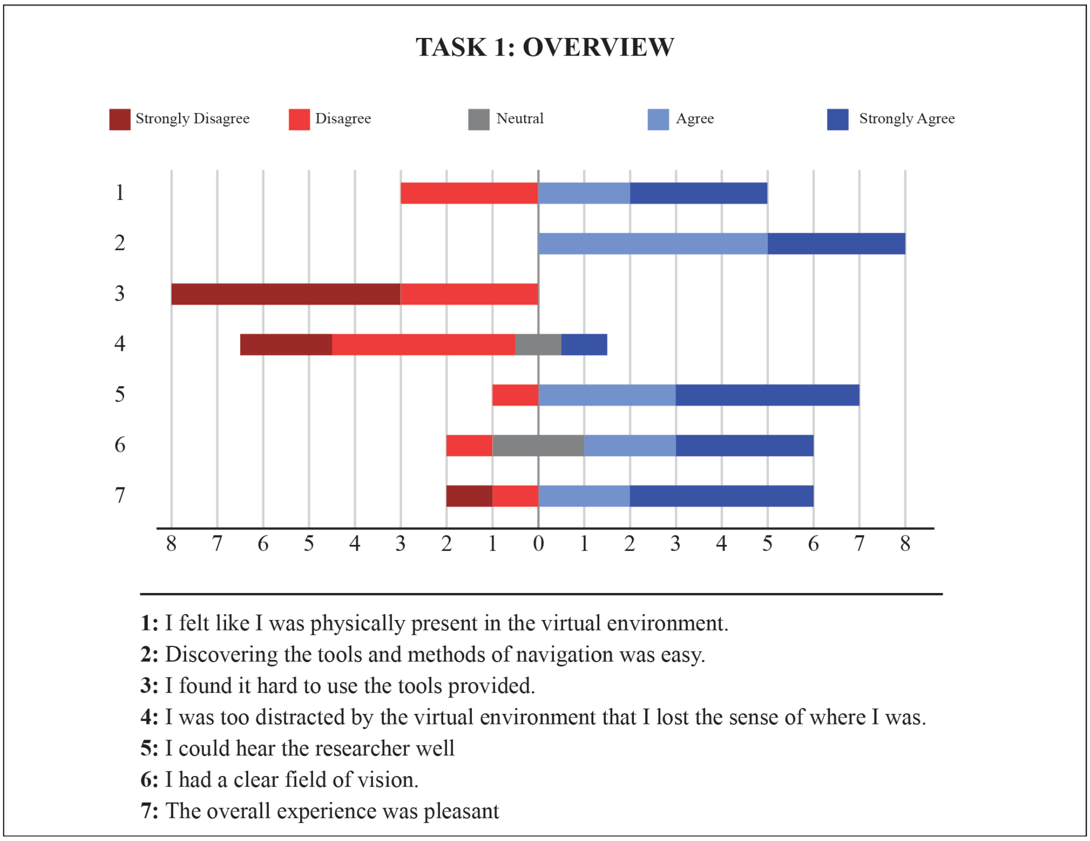
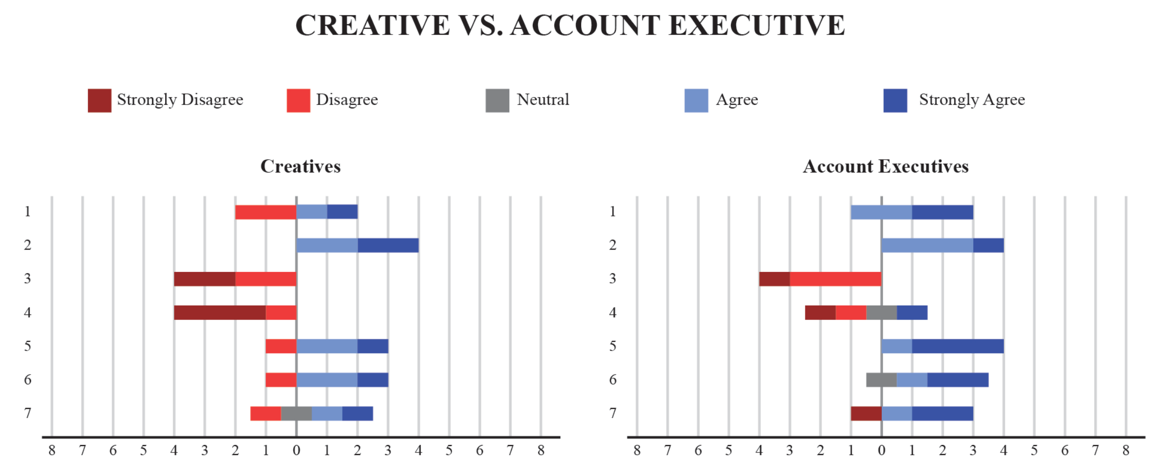


Figure 10: Survey results highlighting the user's ease of using the tools presented and the minimumdistractions they faced.

All the participants found it easy to use the tools provided. Seven out of eight participants were able to communicate while navigating around the environment. The account servicing employees felt more present in the space than the creatives (see Figure 11). Participants above the age of 35 found the experience much more real and pleasant, participants under 35 years of age thought the space needed more interactivity.

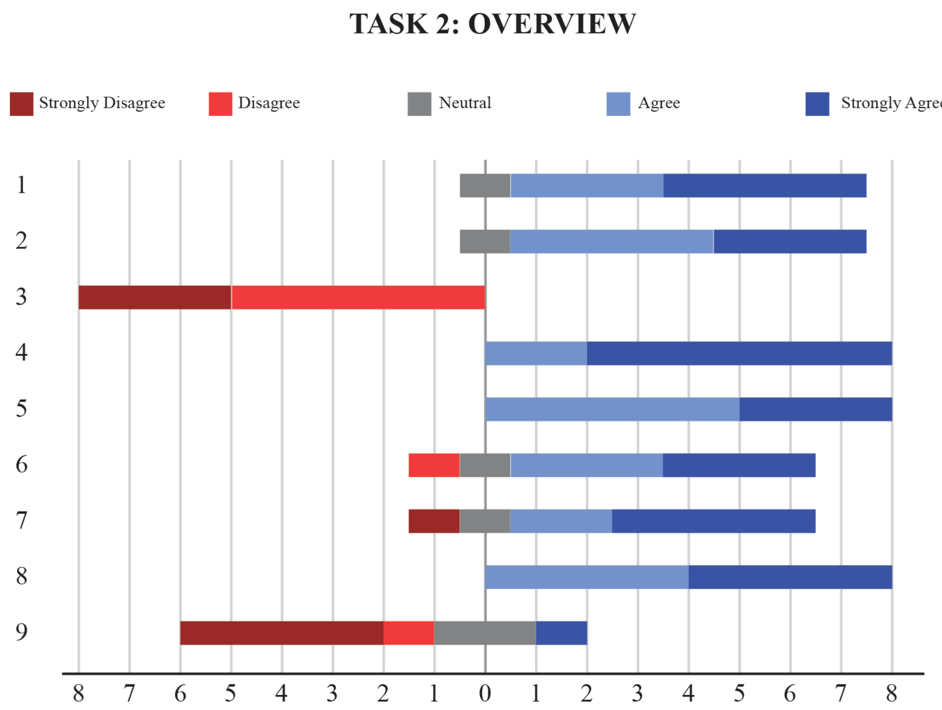


1: I felt like I was physically present in the virtual environment.
2: Discovering the tools and methods of navigation was easy.
3: I found it hard to use the tools provided.
4: I was too distracted by the virtual environment that I lost the sense of where I was.
5: I could hear the researcher well
6: I had a clear field of vision.
7: The overall experience was pleasant

Figure 11: Creative employee vs. Client Executive - first task comparison.

7.1.2 | TASK 2: ANALYSIS

In the second task, Seven out of the eight participants felt like they were now physically present in the virtual environment. All of the participants found that navigation was easy while communicating and collaborating with the other user in the virtual environment. All of participants also found it easy to use the building tools provided. All participants agreed that collaboration with the non active user was easy. Six out of eight participants had a clear field of view. 75% of participants also found the overall experience pleasant. Five out of the eight users did not find diffuclty in the task, two users were unsure (see Figure 12).



1: I felt like I was physically present in the virtual environment.

2: Navigating was easy while communicating and collaborating with someone while being in the virtual environment.

3: I found it hard to use the tools provided.

4: I could easily collaborate.

5: I found the navigation around the environment natural.

6: I had a clear field of vision.

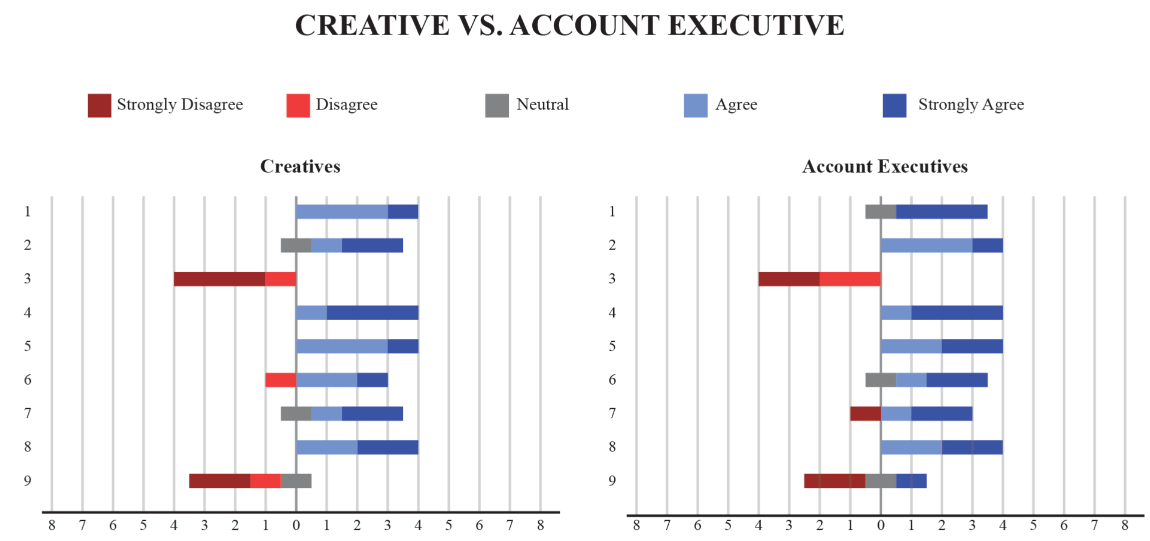
7: The overall experience was pleasant

8: I found it easy to navigate around the environment.

9: I found the task quite difficult.

Figure 12: Survey results of the second scenario on all eight participants.

The purpose of the second scenario was to identify how participants collaborate in a virtual space, the effectiveness of virtual collaboration, and its failures. In this session only one client servicing participant felt like they were not present in the virtual environment. The majority of participants also agreed that navigating was easy while communicating and collaborating; one creative employee wasn’t sure (see Figure 13).



1: I felt like I was physically present in the virtual environment.
2: Navigating was easy while communicating and collaborating with someone while being in the virtual environment.
3: I found it hard to use the tools provided.
4: I could easily collaborate.
5: I found the navigation around the environment natural.
6: I had a clear field of vision.
7: The overall experience was pleasant
8: I found it easy to navigate around the environment.
9: I found the task quite difficult.

Figure 13: Creative employee vs. Client Executive – second task comparison.

All the participants felt that the tools were easy to use. They also felt like navigating around the environment felt more natural than the previous session's attempt. They could also easily collaborate and work on the task with the non active participant. Half of the participants found the task easy with one client servicing employee that wasn't sure and another who did find the collaborative task difficult.

7.2 | QUALITATIVE RESULTS

7.2.1 | MORE INTERACTIVITY

Some participants and dominantly the ones below the age of 35 felt like the environment needed a bit more interaction. They suggesting having a whiteboard where users can sketch on to brainstorm. One of the creative department participants also suggested having a modeling sandbox and for meetings to have a world generator feature where users can meet in different places every single time.

7.2.2 | LESS SPACE AND FASTER TRAVEL

Participants also expressed the fact that the space was too large and took time to get around in 10 minutes. They wanted a teleport like feature that would take them to other places around the environment faster. They also were curious about what else was going on in the virtual environment that they were not aware of. Some participants spoke about having a navigation bar that signals when other events are taking place in the environment and where.

7.2.3 | USER FEEDBACK

Participants expressed several concerns regarding the user interface feedback loop. Some participants wanted an indicator or mini map to allow them to identify where they were within the environment; way finding systems were also mentioned. Some users wanted to be able to see the crosshair of the mouse when activating the web browser instead of just having UI gaze based.

8.0 | DISCUSSION

From the participant pool there seemed to be a fair interest in having a virtual telepresence system. The creative department employees expressed interest only if creative tools existed that people can collaborate with. The account servicing department employees were interested in seeing tools that would guide them to organize campaigns as well as use this system as a medium to showcase campaigns to their clients. The system in this project was created with tools at a minimal level to be able to ask future users to evaluate them and share their feedback on the other types of tools they might need as well. The future work of this system will mainly revolve around upgrading the existing tools such as the web browser and implementing a dynamic one as well as functional ones around the environment. More upgrades to user controls will take place with the next generation of motion controllers. Databasing of data will be explored with a user interface that allows easy navigation. 3D user scanning will also be explored to allow a further study on a users' sense of presence in the environment.

8.1 | USER CONTROLS

Due to the Oculus Motion Controllers not being available in market, the system used an alternative route to control the user navigation and the user interface. Some participants expressed difficulty using the Oculus Remote and the mouse at the same time and wished they would be able to see their hands. By using the Oculus Touch, users will be able to have new features like being able to use their hands to aid in the interactions available within the environment such as holding, pushing, and pressing gestures. Users would also be able to toggle light switches and computer screens through hand motion as well as button controls in virtual reality. Future research can work around pushing the limits of user interface by having haptic feedback through motion controllers as well as the ability handle physical tangible objects that have virtual representations within the environment.

8.2 | API INTEGRATION AND HTTP REQUESTS

Some participants of the study requested tools that would allow them to view the same material at the same time and share and edit work. Some also requested databases of the previously done work so it could be showcased when needed and on different screens around the environment. There are tools available in the Epic Games Marketplace that can be purchased to aid in HTTP requests within the unreal engine coded in C++. By having such a tool, future research can focus on integrating dynamic data from social platforms by using their API's or to create a variety of databases where you can call them through HTTP requests.

8.3 | 3D USER SCANNING

To add more of a feeling of being present in the virtual environment, participants would've like to see a 3D representation of themselves as well as other people. A tool created by Bodylabs (http://www.bodysnapapp.com) helps scan a 3D mesh of a body using one Kinect sensor (Bogo, 2015; Loper, 2015). After 25 minutes from scanning the body, a 3D rigged model can be retrieved from BodyHub (https://www.bodyhub.com). The 3D model can then be placed into the virtual scene created in the Unreal engine. Bodylabs currently limits their services commercially.

8.4 | SECURITY CONTROLS WITHIN THE SYSTEM

With the participants wanting a database of their work that is accessible in the virtual environment comes more security risks. Access rights to areas in the environment and databases need to be implemented to guarantee privacy and confidentiality of information and data. For instance, the Managing Director might have access to be able to view everything happening within the environment and be granted access to all areas. A graphic designer would not be allowed access to different parts of the environment such as the board room. They proposed having doors that would be interactive depending on the user as well as having a code to access areas and documents.

8.5 | USER FEEDBACK LOOP

Some participants expressed that the map was too big and that in some moments during their experience, they lost the sense of where they were. One participant shared an idea of having a mini map to the environment to allow users to establish a sense of location as well as have the ability to fast travel to other further locations instead of navigating manually there. Signs around the environment will also be added as a way finding system of locating different areas of interest.

8.6 | UI AND MAIN MENU BUILD

Participants wanted to be able to get to places within the environment and fast but also be able to know where other users are within the environment. A main menu widget will be implemented and will provide the user with features such as a teleportation option to move users around the environment quicker. Sharing data with the user will also be explored in terms of information they would like to see about other users within the environment such as their name, location, and purpose of meeting. A 3D cross hair will also be added to the environment to assist the users' interaction with menu and web browser widgets.

9.0 | CONCLUSION AND FUTURE WORK

This project involved the creation of a prototype virtual telepresence system that was created and tested on future users to determine if such a system would be of interest, if virtual reality as a medium should be explored in the telepresence and business worlds, and if it was, then what is expected of such a system.

The results aggregated determined that there is an interest for industry professionals to use such a system. A user study was created and feedback by the participants was provided on what type of features they would like to see. Collaboration in virtual reality was also proven to be efficient as the participants of this user study have never had a past virtual reality experience before but still managed to navigate, communicate, and participate in an active task simultaneously.

Feedback from the participants in the user study highlighted essential features that the virtual reality telepresence system should have as well as problems that need to be tackled such as the user feedback loop and the security of data and information databased by the system.

Future work will include 3D scanning of users to create a well defined mesh to represent themselves in the virtual environment. With the help of new and upcoming motion controllers, virtual telepresence systems will get the benefit of exploring a new dimension of features that will bring the virtual experience closer to a real life one making a future user feel even more present within the environment.

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