Virtual Reality to Improve Human Computer Interaction for Art

Fayez Chris Lteif[1,*], Karl Daher[1], Leonardo Angelini[1], Elena Mugellini[1],
Omar Abou Khaled[1] and Hayssam El Hajj[1]

[1] Lebanese International University, Saloumi Street, Lebanon
christlteif@hotmail.com, hayssam.hajj@liu.edu.lb
HES-SO University of Applied Sciences and Arts Western Switzerland
{karl.daher, leonardo.angelini, omar.aboukhaled, elena.mugellini}@hes-co.ch

Abstract. The integration of technology, namely virtual reality, with arts is implemented in this paper. An observational study is performed by replicating an actual museum by a Swiss-Lebanese artist and having user experience it in a virtual immersive environment. Data is then collected to monitor the user experience and its effects on his emotional and psychological state. This information is used to reflect on future developments and enhancements to elevate the user experience and potentially upgrade it with further advanced technologies.

Keywords: Technology · Virtual Reality · Art · Immersive environment

1 Introduction

Art, "something that is created with imagination and skill and that is beautiful", according to the Merriam Webster dictionary, always referred to a classic practice that evolved with mankind. However; when technology erupted to become an essential tool for humanity with the benefits it offers, art needed to embrace the change and become technology oriented. Consequently, Virtual Reality (VR), another emerging technology found a great influence onto several sectors such as tourism, where Beck J. displays its growth and impact on tourism with a comprehensive state of the art study on VR systems and their potential capabilities [1]. Additionally, healthcare has also been a primary point of focus according to Brenda Kay Wiederhold [2], as she investigates the notion of Virtual Medical Centers to improve human performance through careful physiological monitoring during VR therapy and training to eventually reflect the results onto the real world. Far from limitations, Virtual Reality has also been embraced in industrial fields, such as Autonomous vehicles [3] to help avoid risks of physical setups where people could be injured. Virtual Reality (VR) is the use of computer technology to create a simulated environment [4]. It is mainly simulated using a specific platform consisting of a head mounted display (HMD) and hand controllers connected

to a computer. Upon use the user finds himself fully immersed in a new virtual world and in this paper's context, an immersive museum.

In this paper, the idea of human to machine interaction is tested in an observational study in the field of arts. A VR headset provided the user with an art gallery experience with several interactions and decisions to make. This was displayed and tested in Swiss-Lebanese artist's exhibition Hafiz Bertschinger in Belfaux, Switzerland. The idea behind the experiment was to extract a preliminary sense of how humans react to artistic virtual expositions, and its impact on their psychological state, such as emotions. In section 2, a state of the art is discussed regarding previous uses of virtual reality to enhance the human to machine interaction and development, in addition to previous attempts to integrate Art into VR. Furthermore; In section 3, the project is thoroughly discussed and broken down into several subsections, its fundamental principles, technologies used and hardware, software implementation, testing phase and finally the results. In Section 4, the results are displayed, and future work is discussed based on what benefits the initial testing phase mounted to.

2   State of The Art

As Virtual Reality became viral in recent years, its use was not just limited for entertainment purposes but rather into enhancing the life of individuals. A state-of-the-art study was conducted and broken down to two essential fields, virtual reality to develop the human computer interaction and virtual reality to promote art.

2.1   Virtual Reality to develop the human computer interaction

Telekinetic object movement, a concept rather demonstrated in movies only, was never considered a reality, However, with the help of Virtual Reality simulations this became possible. This means integrating neuroscience with technology to enrich human life. This is done by studying physiological signals to further develop a better understanding of human conditions using neurotherapy feedbacks. On another hand, neurable [5], a software company founded in 2015, was able to facilitate the use of Virtual Reality to monitor the human brain. The technology is powered by breakthrough Brain Computer Interface (BCI) research and signal processing techniques. It enables the delivery on the promise of truly useful BCI tools for enterprise and consumer applications. Their software was able to reflect a real time insight of the human brain signals and use them in various domains such as human insights and simulation training. The human insights category was used in optimizing marketing and advertising by analyzing emotions rather than questionnaires. Additionally, simulation training which Measures stress in VR simulation training to improve outcomes and Conduct user-user, user-expert, and user-cohort analysis with objective biometrics. Another use of Virtual Reality was in pain reduction. In an **IEEE Pulse** research, patients who were distracted by the VR immersiveness showed reduction in pain scores [6]. Some pain directed VR products were already being implemented such as SnowWorld, an immersive VR experience designed to reduce the pain of burnt patients during their treatment. Moreover, this technology was not only limited to burn pain, it was also implemented for dealing with chronic

pain. A VR application called GLOW was developed. GLOW is geared primarily toward alleviating chronic pain and promoting relaxation and mindfulness [6]. The application was accompanied by a heart rate monitor that can help users control their respiration and lower their anxiety levels. This is achieved by introducing the patient in a calm environment that takes away the pain to an extent. Additionally, virtual reality was implemented as "Immersive mirror for pain control and treatment", [7] that uses virtual and augmented reality for the treatment of phantom limb pain and stroke rehabilitation. Regardless of pain treatment, VR has also been used for training young adults with intellectual disabilities [8]. A study adopted by the University of Fribourg, that simulated real life scenarios specifically a public transport bus to help individuals train for different situations be it riding the correct bus, getting out of the bus and interacting with strangers. As a result, this will help eliminate the dangers of the real world by engaging in a confined and controlled virtual environment.

2.2   Virtual Reality to promote Art

Art wise, Virtual Reality found a path through many applications that motivated this project and helped improve its development towards the right goal. The VR Museum [9] of Fine Art is a VR application on steam. The application offers an art gallery with an initial release of 15 high-fidelity sculptures, and famous paintings scanned and rendered in crisp detail. It allows the free movement around the museum and the ability to get close to every sculpture. One of its disadvantages that should be enhanced is the ability to properly interact with every sculpture as in rotating and touching. Lifeliqe VR Museum [10] is also a VR application for Vive. The app presents an unmatched volume of 1000+ interactive 3D models and 20 VR experiences to help students and teachers to learn and understand complex science concepts and make the learning process of STEM subjects more effective. Lifeliqe museum was created as an extension for the Lifeliqe curriculum program. Finally, Amaryllis VR [11] is a room scale VR installation created by the Danish-Armenian artist Miriam Zakarian. It was created in 2016 and had its first completed scene named "Ocean" exhibited to the public in August 2017. It is composed of several surreal worlds inspired by concepts related to what makes humans different from sophisticated machines: spirituality, mortality, the subconscious and complex emotions.

Hence art never truly stops to develop as several projects have already attempted its integration with technology, each in their own methods relative to their objectives, be it education, games and even philosophical designs. In this project we tried to study the emotional effect of the digitalized art while being presented in virtual reality. We compared the real-life exposition to the one presented in virtual reality.

3   Project Implementation and Testing Results

This whole concept of human to machine interaction, reflects itself in the human psych. How humans react to such behavior and how emotions develop towards such interaction. To fulfill this purpose, a virtual museum was created and presented during a real exposition. The virtual museum included artwork that was displayed in the real exposition. The project is in collaboration with the Swiss Lebanese artist Hafiz Berschtinger,

the experiment took place during one of his exhibitions in 2019. The idea was to recreate the artwork displayed in the museum into the virtual environment and analyze the interaction, experience, emotional state of various users.

The development of this project required several procedures on several levels in order to connect the pieces successfully, this required the incorporation of several software and hardware equipment to function all together as one unit. The main components with their functions are the following:

1. The first stage was to capture high quality 3D images and convert them into digital replicas of the statues, sculptures and paintings.
2. Then we introduced it into the Unity Game Engine on PC platform. The unity software will allow us to create the VR environment with all its assets and objects in addition to all its properties.
3. Then the coding was done using C# programming language.
4. After the creation of the complete application, it was tested on the VR headset, the HTC VIVE PRO for an immersive experience with the help of its motion tracking technology, directional audio system and HD touch feedback that offers realistic movement in the virtual world.
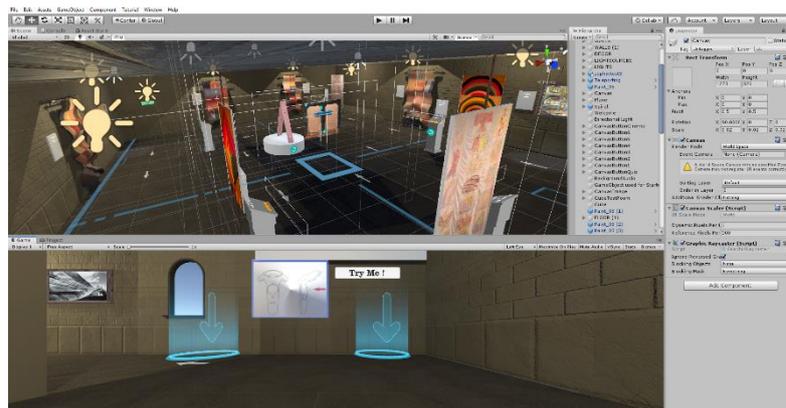

Fig. 1. Unity Game Engine Interface

Fig. 2. Statue 3D digital replica

2.3   Hardware/Software

The computer desktop is used to load the software responsible for the Museum application and integrate it through its peripherals to the VR headset. The computer requires high end specifications, the VR headset is latest generation, and the ones adopted are the following:

1) Intel Core I7-7700k Computer processing unit (CPU)
2) 32GB of Ram (min. required 8GB)
3) NVidia GTX 1080ti Graphics Processing Unit (GPU), (min. required GTX 1060 or equivalent).
4) HTC VIVE PRO virtual reality headset

The HTC VIVE PRO virtual reality headset allows the user to engage in the virtual world using its head mounted display, motion detecting sensors, G-sensor, gyroscope, proximity sensors. Additional hardware required was a computer screen running at all times to help view what the user is experiencing.

As for the software, several programs were needed to complete the project and also run it afterwards:

1) Windows 10 running on the computer.
2) Steam which allows the use of the SteamVR that helps run the application on the VR headset.
3) Unity software which is used to create the application.
4) Zephyr 3DF to capture the 3D models.
5) Inkscape vector graphics editor.
6) GIMP raster graphics editor.
7) Autodesk Fusion 360 to help create 3D models manually.

2.4   Tests and Results

The final step beyond the initial implementation, was to actually test the final product on actual subjects and record their experience. To fulfill the project objective, the product was displayed at a Museum in Belfaux, Switzerland, 2019. During the exposition of the Artist Mr. Hafiz Berschtinger. Since the product reproduces the museum artifacts, the users had to navigate the actual museum and then finally experience the virtual environment. After experiencing the virtual world, a questionnaire containing several observational questions was filled. The questions were oriented towards user experience. 20 participants have visited the virtual museum and took part in the study. 6 of those filled our questionnaire that helped further understand the participant's perception of the immersive experience.

The main points covered in the observation targeted the users' first impressions, thoughts on the environment and improvements they saw fit to enhance the whole experience, all while recording the emotional impulse.

Some of the questions are listed below as follows:

- *"How realistic did the sculptures/paintings feel?"*
- *"Was it easy to walk around the museum and interact with the environment?"*
- *"Rate your virtual experience?"*

Following the data collection, results were noted and revealed a relatively successful first attempt for the project design and implementation. The results were distributed as shown in Fig. **3**
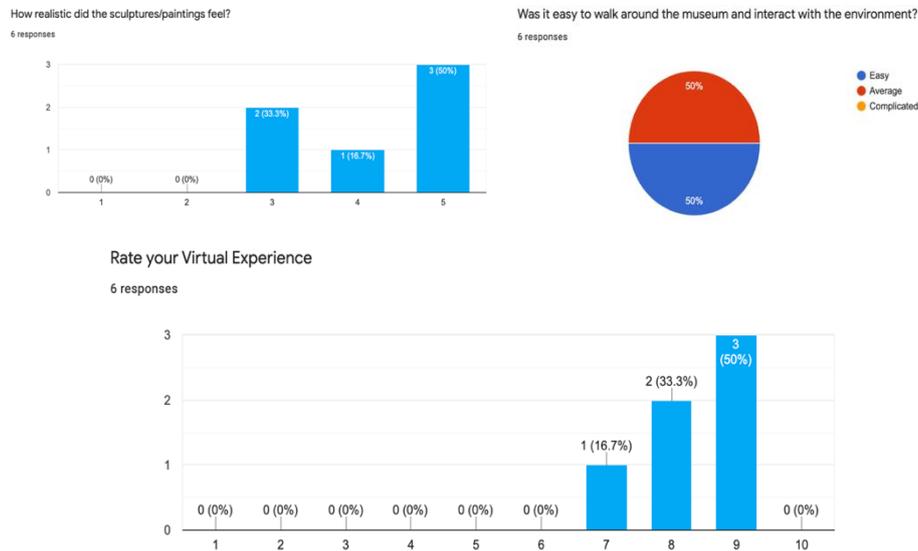

Fig. 3. Questionnaire Statistical results

Further results were also extracted based on user preferences. Some recorded the need for better overall lighting, using the device while standing rather than seated, and even reported some difficulties navigating certain aspects.

Aside from the museum review, the main goal was the observational study behind the physical and emotional reactions. Most users have recorded emotions of joy and excitement upon engaging the museum while others more acquainted with technology navigated naturally and displayed interest and enthusiasm to follow up on later updates.

4   Future Work and Discussion

Art as known to humanity, would be impossible without mankind's historical cache of technological development that helped enable its various new forms. Virtual Reality, in modern day, proved itself to be a valuable asset towards this understanding. Little could be added on the importance of this new emerging concept of virtual reality, but much could be said on what this technology has to offer in its future releases to advance the work of many artists and help them get the exposure needed to deliver their thoughts and concepts in a very unique and exceptional manner. What this project offered was a world with no limits for artists to become creative, interactive and reflect their art onto people's emotions in real and virtual expositions. The future potential is immense, the study for this project will continue to help improve the interaction methods to ameliorate the overall immersive experience. Examples reveal the integration of other technologies altogether, such as hologram assistants within the museum environment, voice command controls, and a possibility for improved emotional and psychological studies resulting from these experiences.

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