Hybrid Campus Art: Bridging Two Realities through 3D Art

Minna Pakanen[1], Paula Alavesa[1], Hannu Kukka[1], Peetu Nuottajärvi[2], Zacharias Hellberg[2], Lari-Matias Orjala[2], Niko Kupari[2], and Timo Ojala[1]
Center for Ubiquitous Computing
P.O Box 4500, 90014 University of Oulu, Finland
[1] firstname.lastname@oulu.fi,
[2] firstname.lastname@student.oulu.fi

Abstract
We describe an interactive digital art application deployed at a university campus with the goal of investigating participants' initial experiences of bridging two realities through 3D artwork in a hybrid reality space. The underlying purpose of the installation is to bring liveliness and increased social interaction to both the virtual and the physical world. We used the HTC Vive and a 3D painting program (Google Tilt Brush) for the creation of the artwork. After creation, the artworks were transferred to an immersive virtual mirror world, in our case a version of our university campus, using an export tool. Results from an initial user study with 32 participants suggest that people found our system attractive, and there was only slight difference in how much they enjoyed seeing their work in the Tilt Brush view versus the virtual campus gallery view.

Author Keywords
Virtual reality; 3D painting; virtual gallery; digital art.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

Introduction
Artists have used computers to create art in a three-dimensional space since the 1950s. However, technical

limitations in both hardware and software have forced many great ideas to remain on a conceptual level until the last few years [10]. Historically, the first attempt in utilizing a 3D space in artwork was a virtual reality system by Ivan Sutherland in 1968, where users were able to view and manipulate a wireframe object from a head mounted display [16]. Later on, more sophisticated systems have been introduced for artists. These include, for example, a surface drawing system which enables creating organic 3D shapes with hand and tangible tools [13].

More recently, affordable off-the-shelf virtual reality equipment such as the HTC Vive [8], and 3D painting programs such as Google Tilt Brush [18] have made VR 3D painting more accessible to the general public. This technological development, together with increased accessibility, allows us to, for example, view paintings in animated 3D form in the way the famous painter saw his/her object and imagine what their intentions were while painting [11]. These new technologies have also made it possible for us to 'step inside' famous paintings, such as Vincent van Gogh's The Night Café, through a VR experience [17]. The history of digital 3D art shows how strong the human drive for creativity is. It is important to facilitate this creativity with current digital tools. Here, a fundamental design goal is to utilize the drive for creativity in making realistic 3D environments more attractive and inviting to users. Further, we aim to leverage the Campus Art system as a tool for self-expression and artistic communication inside the virtual campus environment.

Realistic 'mirror world' representations of real-world environments [5, 12] are readily available as 3D models to be used in various applications [1, 15]. Efficient use of these models requires embedding them into their context in a meaningful. In a university context, mirror worlds of campuses have been developed on top of Google Earth, for example at Northeastern University [1]. A 3D mirror world representation of the Shanghai University campus in the BaoShan district was created for a building an escape training simulation for staff training [15]. One of the most obvious use cases for mirror world -like virtual campuses are simulations and guidance applications. However, their potential in a more artistic context is still an open question.

In this work, we suggest user-generated 3D art as a tool for providing meaningful experiences and added value to users of such 'mirror worlds'. Farman describes the interplay of mirror-world-like representations of physical reality, being maps or 3D virtual environments, in mobile applications as "an experience of multiplicity", where layering and constant interplay bring the virtual and the physical worlds together, thus creating a pleasurable experience of virtuality [4] and collaboration by bringing people together [9]. This layering of realities is also known as *hybrid reality*.

De Souza e Silva [12] define hybrid reality as *the space that is created when one or more realities such as reality and virtuality are blended by the social interaction and communication across those realities*. Motivated by the potential for collaboration and experience in a hybrid reality context, we designed the *Hybrid Campus Art* system to be used in a social setting at a busy central hallway of our university campus. We describe an experimental setup (Figure 1), where the aim was to investigate participants' initial experiences in bridging two realities through 3D artwork. HTC Vive

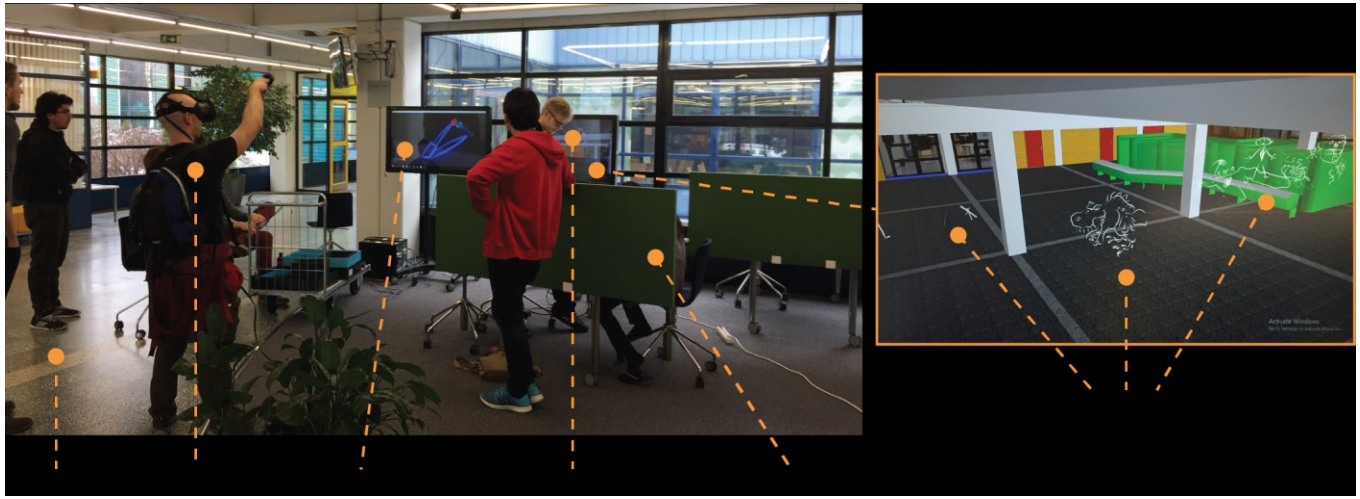

Figure 1. Campus Art in action: Tilt Brush in use at the pilot site and the resulting art work displayed in virtual campus. Drawings appear in the virtual campus as 3D line art drawings.

and Google Tilt Brush were used for the creation of the artwork, which could then be viewed on-site in a virtual campus gallery. The goal of the setup was to bring liveliness and social interaction to both realities

Hybrid Campus Art

The Hybrid Campus Art system comprises of the HTC Vive and Google Tilt Brush as input tools, and large displays for the audience to view the artwork inside the virtual campus. The social setting for the installation is important, as the ability to view the resulted work inside the virtual campus "gallery" is what separates our installation from more traditional digital drawing tools.

Once completed, the 3D artworks are exported automatically from Tilt Brush to the virtual campus. The campus model used in this study is created with three.js [3], and requires an additional export tool for the Tilt Brush data. Currently, the tool can only export the mesh structure of the drawings, but future versions should also be able to handle additional detail such as materials, textures, and dynamic effects. Due to this limitation, users creating artwork were instructed to use Tilt Brush features which create an exportable 3D mesh and not utilize *e.g.* particle effects when creating their drawings.

Experimental Setup

We conducted a field study of the Hybrid Campus Art system at the university campus over two days in April 2017. The system was set up in a public place, next to a busy central hallway where people could both observe the process of using the system, or participate by trying it out (Figure 1). We had 32 participants with an average age of 24 (SD=3,4), of which 23 were male, 7 female, and 2 other. Most of the participants (12/32) were computer science majors. 15 out of 32 had previous experience with VR systems, 13 out of 32 practiced visual arts to some extent, and 3 out of 32 had tried out one of the commercially available VR systems before. All participants were given a brief introduction on how to use the HTC Vive controllers and the Tilt Brush application, after which they were allowed to immerse themselves into drawing with the tool at their own pace.

All participants were issued a questionnaire directly after experiencing our system. First part of the questionnaire enquired the participants' age, gender, and previous experience on visual arts and VR systems. The second part consisted of 12 AttrakDiff [6, 7] word pairs to assess the attractiveness of our system. This part of the questionnaire had also questions on how satisfied participants were with the art they created in Tilt Brush, and the outcome that appeared in virtual campus. The questionnaire closed with open-ended questions on the possible use cases for an artistic hybrid reality system.

Results

The AttrakDiff questionnaire consisted of 12 word pairs in four categories (Figure 2): pragmatic quality (PQ), attraction (ATT), hedonic quality for identity (HQ-I), and hedonic quality for stimulation (HQ-S). The word pairs were selected to fit our particular evaluation setting from the full pool of words.

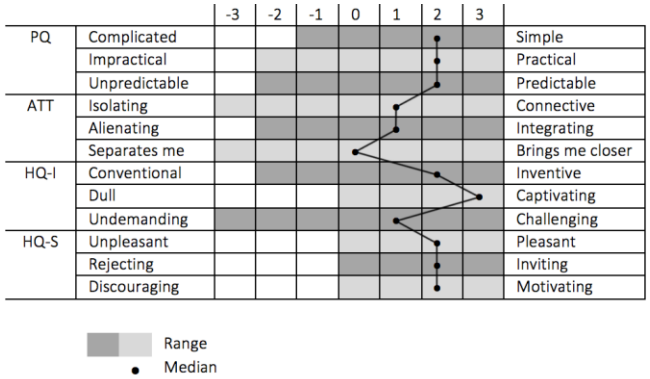

Figure 2. The hedonic and pragmatic qualities of Campus Art system.

As the current system cannot export all the textures and other details in the drawings from Tilt Brush, we also enquired how satisfied the users were with their drawings *i)* seen in Tilt Brush view; and *ii)* the final outcome shown in the virtual campus gallery (Figure 3). Results show that participants considered the attractiveness of both to be on the high end of the scale. However, the role of the provided virtual reality gear and the Tilt Brush was significant in the setup, and the response might in some parts be affected by the novelty of experiencing immersive VR for the first time (only three out of 32 participants had previous experience with immersive VR gear).

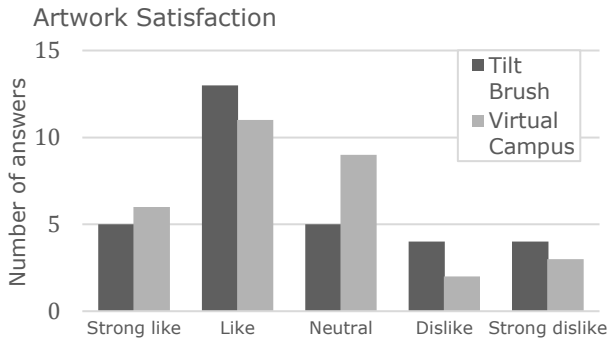

Figure 3. Satisfaction into the created and seen art both in Tilt Brush and in the virtual campus gallery.

As seen in Figure 3, participants liked both the Tilt Brush 3D model they created, and the wire mesh exported into the virtual campus model with similar results. We expected to see more of a distinction in opinion due to the reduced details of the exported models, but apparently, the lack of detail did not play a major role in user satisfaction. 24 out of 32 participants reported liking their artwork as it was presented in the virtual campus gallery. A large majority (29/32) also wanted to see works from other people in the gallery as well.

Other User Feedback

We asked the participants for their opinions on potential use cases for a hybrid reality art application such as Hybrid Campus Art. Drawing, design, and architectural planning, as well as art creation were the most dominant answers. As one participants stated: "*It might be more interesting for artists. It gives them more motivation for creation."* (#23/F). However, the participants suggested also that it could be used for education, therapy, and entertainment contexts such as games. Another interesting use case that came up was hybrid reality self-expression: "*Art installations for public self-expression, an alternative for public speaking, or writing.*" (#32/F).

Conclusion

We have described a digital hybrid reality art installation and the subsequent field evaluation on a university campus with 32 participants. The aim of the installation was to investigate participants' initial experiences on the idea of bridging the physical and the virtual worlds through the use of 3D artwork. The study was conducted at a university campus using HTC Vive and 3D painting program Google Tilt Brush for creation of the artwork. The created artworks were transferred to immersive virtual mirror world version of the campus. Results from the field study show that participants found the artwork created through the application attractive, and there was only a slight difference in how much they liked seeing their work in the Tilt Brush view versus the virtual campus gallery despite the reduced graphical quality of the virtual campus gallery art.

We acknowledge the limitations of our initial study. The questionnaires were issued right after the experiment, but we would have liked to record the immediate reactions of the participants when their work appeared at the virtual campus. Perhaps this would have given us insight on the significance of displaying the contents in a mirror world VE with spatial similarity to the physical site. Also, observation and interviews would have given better understanding of participants' and audiences' experiences during the installation. In future, we are planning a longer deployment with a more in-depth

focus on peoples' behavior by using a more qualitative research approach.

Acknowledgments

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