360TourGuiding: Towards Virtual Reality Training for Tour Guiding

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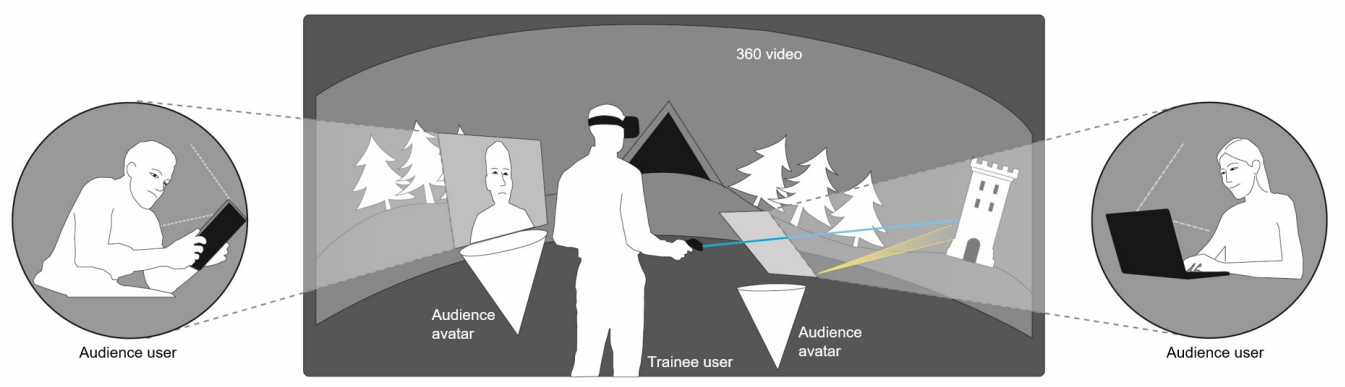

Figure 1: 360TourGuiding concept: a tour guiding trainee can view and practice tour guiding with 360 travel videos in VR. Other people can remotely join into the training session as audiences or acting tourist using their mobile device (e.g., tablet) or personal computer (e.g., laptop), which can capture their facial video streams using the built-in front facing camera. The audiences' facial video streams are displayed on corresponding 3D avatars in the VR environment

ABSTRACT

Tour guiding plays an important role in turning sightseeing tours into memorable experiences. Tour guides, especially inexperienced ones, must practice intensively to perfect their craft. It is key that guides acquire knowledge about sights, in-situ presentation skills, and perfection ability to interact with and engage tourists. Therefore, tour-guide education requires on-site training at the place of interest including live tourist audiences. However, for modest budgets, such setups are costly and tourism students have to practice tour guiding at home or in simulated class-room setups. It has become a challenge for students to adequately prepare themselves for jobs in terms of relevant knowledge and skills. To tackle this problem, we propose 360TourGuiding, a VR system enabling its users to practice tour guiding with 360 travel videos plus the attendance of remote audiences participating through their mobile and personal device. This paper reports on the concept, on our design, current implementation, and on a pilot study with the current 360TourGuiding prototype. Based on qualitative feedback gained through the pilot study, we discuss possible system improvements, future system updates, and plans for empirical evaluation.

CCS CONCEPTS

• **Human-centered computing → Interactive systems and tools**.

KEYWORDS

VR, mobile devices, 360 video, tour guiding, collaborative

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1 INTRODUCTION

Tour guiding is key for the success of touristic trips. When guiding tourists to a venue, tour guides often have to multitask. They need to both keep track of their current location and surroundings to identify candidate landmarks or artefacts that may be presented to the tourists. While presenting about the venue, they also need to monitor the tourists' behaviors and expressions to adapt their communication and interaction to keep the tour interesting. These skills requires a lot of prior repetitive training to help tour guides effectively perform their job. In addition to that, as there might be changes in the venues (e.g., new landmarks, installations, restaurants, stores, etc.), tour guides also need to keep their knowledge up-to-date and adapt their tour guiding to the changes. Therefore tour guiding needs to be frequently practiced by tourism professionals, either if they are experienced or inexperienced, like students.

In tour guiding training, trainees should be able to do field trips where they will be taken to the venue of interest with the presence of target tourists. Trainees can familiarize themselves with the actual environment of the venue while practicing their observation and improvisation skills. However, such a setup can be extremely costly, especially in oversea locations, thus could not be organized frequently. This is also problematic for students, who often have a tight budget for such field trips. The lack of training could lead to inexperienced and under-prepared tourism professionals.

The prevalence of 360-degree video (hereafter: 360 videos) and the recent rapid development of virtual reality (VR) might open the opportunity to mitigate the above problem. Travel 360 videos of places around the world recorded by tourists or locals can be now easily found on video sharing platforms like Youtube. They are rich sources not only for online traveling but also for tour guiding professionals to quickly acquire up-to-date knowledge about the places. Leveraging these technologies, we present the concept and the on-going development of 360TourGuiding, a VR system that allows users to practice tour guiding without having to travel to the place of interest. Conceptually, 360TourGuiding allows tourism guiding trainees to view 360 videos of the place while presenting about it to audiences, who are remotely joining into the training session using their mobile or personal device. The trainees can thus effectively familiarize themselves with the place through the real images presented in the 360 video while training their ability to maintain their awareness on tourists and adapt accordingly. We report the design requirement elicitation, the concept and the early development of 360TourGuiding. We also report a pilot study to explore the potential of an early prototype of 360TourGuiding in supporting tour guiding training. Based on the qualitative feedback from the pilot study, we outline our current progress in improving the system and our plan to evaluate its effectiveness.

2 RELATED WORK

2.1 VR training environments

360-degree video has been extensively employed in VR systems for training decision making in sports [4, 8], learning foreign languages [11], medical education [9], pedagogy [2]. VR systems presenting audiences in pre-recorded 360 videos were also shown to be an effective training tool for reducing anxiety in public speaking [12]. Tseng et al. [15] developed a web-based VR environment where users can view panoramic pictures of a sight while practicing their tour guiding presentation skill. However, in these systems, trainees can only view the pre-recorded videos. They cannot interact with the content or perceive behavioral responses from the target audiences. These feedback are important in tour guiding training. Trainees need to maintain their awareness on the responses of target audiences to adapt their presentation and their communication strategies. Conveying target audiences' behavioral responses will thus be vital to the the realism and effectiveness of training systems for this domain.

Instead of using 360 videos, other VR systems utilize 3D models to offer interactive training environments. Pittarello et al. [10] developed a VR environment where actors or actresses can interact with 3D models of stage objects and characters while practicing their acting. 3D-based VR has also been shown to be effective for public speaking training [7, 13]. Wang and Wang [16] developed a VR system allowing users to freely navigate in the 3D environment of a park to practice tour guiding. In general, compared to 360 videos, although 3D contents provide more navigation flexibility in VR, they have lower presentation realism and much higher cost for production and maintenance. Therefore, we opted to choose 360 videos as the medium to represent a place in 360TourGuiding where a trainee can view and interact while practicing tour guiding.

2.2 Collaborative interaction with VR

VR opened the opportunity for users to collaboratively view and interact with virtual contents either in collocated and remote settings. Maintaining social awareness among collaborators is essential in collaborative systems. A Facebook 360 demo illustrated the use of simplified 3D avatars representing collaborators co-viewing a 360 video [1]. However, simplified avatars are difficult to adequately express facial expressions of collaborators. Leveraging textured 3D meshes of body scan [5] can realistically convey collaborators' expressions but requires specialized capture hardware like depth-camera. CollaVR [6] highlights the collaborators' areas of interest on 360 videos to indicate their current attention and maintain awareness among them. 360-video VR collaboration was also explored in heterogeneous device settings. Henrikson et al. [3] supports collocated collaboration between a VR user and a user using a mobile tablet in creating and previewing storyboards of 360 videos. TransceiVR [14] also supports collaboration between a VR user and a mobile user in working on 3D virtual contents. In 360TourGuiding, we enable collaborative communication between the tour guide in VR and a number of spectators on mobile devices. For training realism, we leverage the commodity of webcam on mobile devices or personal computers to involve users into a tour guiding training session as audiences.

3 ELICITING DESIGN REQUIREMENTS

3.1 Method

To gain understandings on current practices in tour guiding training, we conducted interviews with two lecturers (both are male, around 30 years old) specialized in teaching courses related to tour guiding, and three students (1 male, 2 females, all 22 years old) majored in tourism. They are from tourism departments of different local universities. The lecturers respectively had 3 and 5 years working as professional tour guides prior to joining the universities. They have been teaching tour guiding for roughly 5 years. The interviews were semi-structured and carried out in an online setting using Zoom due to local Covid-19 restrictions at that time. Each interview took around one hour and was video-recorded with the interviewees' permission. Videos of interviews were first transcribed and thematically analyzed by two junior researchers in the team and the results were then discussed with other three senior researchers for refinement.

3.2 Findings

According to the lecturers, good tour guides need to have in-depth knowledge about the place, ability to correctly and compellingly present about it using speech and suitable body language (e.g., pointing, hand gestures, etc.), and good awareness of tourists' behaviors to appropriate their communication to maintain audiences' attention and engagement. Our analyses reveal that both professional tour guides and students majored in tour guiding need to intensively practice their guiding skills in order to be prepared and proficient in their job. Ideally, these skills would be practiced in field trips where trainees can physically visit the place of interest. However, today it is challenging for them, especially students to have the opportunity to practice on-site tour guiding due to financial issues. This is even impossible for far-off places like places in another continent. In many universities, tourism students usually have only two or three field trips with no more than one abroad trip in their four-year study. Therefore, in many courses, students had to practice or take exam of tour guiding in classrooms, where they would imagine their classmates as tourists or audiences and put images of the sights on PowerPoint slides, pretending to be on site. Sometimes, some students showed 360 images of the place they found on the internet in their presentation slides to provide audiences with richer visual information. However, the lecturers and students reported that viewing photos or even 360 images on presentation slides did not allow trainees to realistically perceive the touristic places due to lack of spatial immersion. Also, during Covid-19, such training sessions were performed online using video conferencing tools where trainees and audiences were distributed in different locations, thus significantly reducing the training's realism. Additionally, the students reported that besides training sessions on the class, they also needed to frequently practice by themselves at home, imagining there were tourists around them. Nevertheless, they found this extremely difficult because they could not see the actual sight, thus being unsure about the accuracy of their presentation. Furthermore, not being able to perceive responses from audiences made it difficult for them to practice their observation, communication and adaptation skills. For example, a student said that sometimes he wanted to try making a joke or telling a fun story while presenting about a place. However, without seeing actual responses from audiences, he was not sure if the way he joked or told the story could make them laugh. The lecturers also reported that they often shared photos of touristic places, that they collected from their trips or being shared by their colleagues, with their students to help them have the most up-to-date knowledge about the places. This suggested that 360 voyage videos frequently recorded and publicly shared by travellers or locals would be highly useful materials for learning and training in tourism as they provide quite holistic and update-to-date information about the places.

3.3 Design requirements

Based on insights from the analysing the interviews, we derived the following design requirements (DR) for a system aiming to effectively support training tour guiding skills to a professional level .

DR1: The system needs to allow trainee users (i.e., tourism professionals who use the system to practice their tour guiding) to perceive touristic places as realistic as possible to familiarize themselves with the places.

DR2: Besides the trainee user, the system also needs to allow other users to join into training sessions as audiences to help the trainee user practice their public presentation skill.

DR3: The system should allow trainees user to perceive attention, expressions and behaviors of audiences as much as possible to help them develop their observation, communication and contextual adaptation skills.

DR4: The system should allow trainee users to interact with the sight, especially via hand gestures while presenting similarly as they would do in the reality.

DR5: The system should leverage widely available media types to present touristic places, allowing users to easily and inexpensively find various contents for practicing.

4 360TourGuiding SYSTEM

4.1 Concept

Conceptually, 360TourGuiding leverages the immersion of VR to provide trainee users sense of being at the touristic place of interest. Trainee users can view the scenery of the place through a VR headset while presenting about it (Fig.1). To represent touristic places in VR, we had two reasons to use 360 videos instead of 3D models: First, 360 videos capture real images of the surrounding environments, thus providing trainee users a more realistic perception about the place (DR1) than 3D contents which are artificially crafted. Second, today, voyage 360 videos can be easily and quickly produced using off-the-shelf 360 cameras and are massively available on video sharing platforms, providing a diverse, inexpensive, up-to-date and easy-to-access material for tour guides to experience and use them for training purposes (DR5). In contrast, 3D models require much higher costs to produce, making this media not only expensive but also rarely up-to-date with the actual correspondence in the reality.

To help trainee users practice their ability to observe and communicate with tourists, 360TourGuiding enables other users to remotely participate in a training session as audiences using their mobile devices (e.g., tablets) or personal computers (e.g., laptops)

(DR2). Video streams of audiences captured by the front-facing camera built in their device will be displayed in the VR environment, enabling the trainee user to see their facial expressions and behaviors while practicing guiding (DR3) (Fig.1). We chose to leverage the use of mobile devices or person computers for these users due to two reasons. First, mobile devices and personal computers are widely prevalent, allowing anyone to become an audience for the trainee user anywhere at anytime. For example, if 360TourGuiding is deployed in a classroom, classmates of the trainee user can use their device to participate into the session. In another scenario when the trainee user is alone at home and needs to practice, he/she can ask some friends, who are not necessarily in the same place, to remotely join into the session to help him/her as audiences. Second, the built-in facing camera of those devices can capture real images of the audiences, which can allow the trainee user to realistically perceive the audiences' expressions and behaviors (DR3).

While presenting and guiding in 360TourGuiding, the trainee user can perform hand gestures conveyed through touch controllers accompanied with the VR headset (DR4). For example, the trainee user can point to or highlight certain objects in the 360 video of the place to attract the audiences' attention similarly the way he/she would do when tour guiding in the real world. Consequentially, the audiences can view the same 360 video on their mobile device as well as pointing or highlighting performed by the trainee user. Their current view on the 360 video will also be reflected in the VR environment to inform the trainee user about their current attention (DR3). In addition to that, the audiences should be able to perform certain gestures like pointing via the application running on their device to indicate certain things while communicating with the trainee user (e.g., asking the trainee user about something) (Fig.1).

4.2 Current design and implementation

In the VR environment for the trainee user to practice, we display 360 videos on a 3D spherical skybox with a radius of 30 meters (Fig. 2a). The tour guide is positioned at the center of the sphere and not supported to move around the environment. This is because the video is displayed on a planar surface, thus the content can be seen and easily interacted with, e.g., through distal pointing, from the center of the skybox. The video stream of each audience is displayed on a vertical 100cm x 100cm rectangular plane with a 3D cone underneath representing its body. Through informal testing during the prototyping process we found that this simplified presentation symbolic enough for viewers to understand it representing an audience while not causing non-canny valley issues. The avatars of the audiences can move around the VR environment according to the audiences' navigation on their mobile or personal device. The audience's video stream can perform 6-DoF rotation depending on the current view of the audience on the 360 video, visually indicating the audience's current attention. To avoid the audiences' avatars appearing as floating inside the skybox, we created a ground plane for the VR environment by mapping the bottom spherical half of the 360 video onto a horizontal plane placed at the middle of the skybox. Thanks to the presence of this ground plane, the audiences' avatars will cast shadow on it, thus mitigating the floating-in-the-air effect.

When the trainee user presents, he/she can use a handheld touch controller to point onto the 360 video, emitting a beam starting from the virtual representation of the controller towards the target. The trainee user can press the trigger on the controller to pin a holo marker at a location on the 360 video to attract the audiences' attention to a subject. The pinned holo marker will automatically fade way after 5 seconds. 360TourGuiding provides a control panel consisting three buttons to allow the trainee user to pause and temporally navigate the video backward or forward. The trainee user can pause the video when he/she wants to have time to present about particular places or things at a time in the video. This is similar to tour guiding in the reality when the tour guide often gathers tourists in front of a certain place when he/she wants to specially talk more details about it. The forward feature supports the trainee user to quickly skip certain parts of the videos where there are no interesting things to talk about in order to reduce training time. Each time the trainee user presses the button to trigger this feature, the video will seek to the next 5 seconds. The backward feature enables the trainee user to move backward to a time in the video where the trainee user was not satisfied with his/her guiding and wants to rehearse or improve it. We added this feature because 360TourGuiding is a platform for practicing, not a virtual guiding platform, thus the users should be able to repeatedly rehearse for higher perfection.

The application running on the audience's device (hereafter: audience application) supports the user to view the same 360 video being displayed in the trainee user's VR application. The audience can freely navigate on the ground plane of the VR environment to observe the 360 video from different views. The application also provides visual cues to keep the audience aware of where the trainee user is looking or pointing. Apart from that, the audience can also point at a certain location on the 360 video via touch (on mobile devices) or cursor interaction (on personal computers) while communicating with the trainee user, which will be also visualized in the VR environment.

In the current prototype, 360TourGuiding has only the trainee user's VR environment implemented using Unity. The audience application has not been implemented yet but we plan to implement this application both for Android mobile devices and Windows personal computers using Unity.

5 PILOT STUDY

We conducted a pilot study with the current state of the prototype to obtain early qualitative insights on the potential of the 360TourGuiding concept in supporting tour guiding training as well as to shed light on the next implementation of the system. We would like to explore if the combination of 360 video and audiences' facial videos displayed as 3D avatars in VR could be an immersive solution for effectively practicing tour guiding. We conducted the pilot study with two students (1 male, 1 female) majored in tourism from a local university. The students were at the third year of their four-year study and recruited through the introduction of our acquaintance.

The prototype of 360TourGuiding used in this pilot study only had the trainee user's VR system, but not the audience application. To display audiences in the VR environment, we recruited 10 volunteers who were students in our department to self-record videos

Figure 2: (a) Audience avatars in the 360 video skybox: the video stream showing the audiences' behaviors and expressions and the avatar's orientation conveying the audiences' attention. (b) Holo marker pinned at a location to highlight a point of interest and audience avatars are looking at it. (c) The video control panel with 3 buttons: backward, pause, and forward

of their own face performing six expressions: neutral, concentrate, surprised, distracted, bored and laughing. These expressions were brainstormed and distilled by the research team based on the need-finding interview data. These recorded videos were displayed on audience avatars to create the impression there were audiences attending the tour guiding training session. To improve their realism, the audience avatars randomly moved around in the VR environment and some also turned towards the pointing location of the trainee user on the 360 video. Each participant had around 10 minutes to get familiar with the system. When they felt ready, they started the study where they performed a 10-minute tour guiding with a 360 travel video of the local city. The participants were given a sample script presenting about most interesting landmarks in the video 3 days prior to the study. The script was composed by the research team and the participants were told that they just needed to remember the main contents associated to certain times in the video, not word by word. To improve the sense of realism, the participants were told that some of the avatars in the VR environments were real audiences remotely joining into the session. After the tour guiding, the participants were interviewed for around 20 minutes to gather their feedback on the system.

Overall, the participants also confirmed that the 360 videos provided more realistic and immersive perception about geographical places than using photos on slides. The participants also reported that performing tour guiding using 360TourGuiding caused more pressure and stress to them compared to practicing alone, although still less than actual tour guiding in collocated settings. They could see the values of the audience avatars as they could perceive the behaviors and expressions of the audiences, which can be helpful for tour guiding trainees to practice their observation and adaptation skills. The female participant even remembered she saw one audience laugh when she was presenting about a location, which kind of affected her presentation flow at that time. However, the participants said the avatars did not provide full interactions with them as in the reality where tourists often pointed at things in the place and asked them. Although this was not supported in the early prototype in the pilot study, it was in line with the 360TourGuiding concept and our implementation plan for the system. Regarding the system's features, although the pin marker for highlighting a certain location was perceived useful, participants believed that the pin marker should automatically attach to the pointed object while the video plays. Similarly, the participants suggested that the forward feature can be improved by allowing to quickly move to the next destination rather than jumping every 5 seconds. Together with this, the participants also suggested to be able to preview the tour itinerary in VR. In the reality, tour guides, specially inexperienced ones, having a tour itinerary, typically in the forms of a notebook or a piece of paper, is essential to keep track of the tour progress and prepare themselves for the next destination in the itinerary. Therefore, we plan to integrate a feature that allows the trainee user to view the itinerary associated with the video in VR and a mechanism to quickly fast forward the video to the next destination in the itinerary.

6 FURTHER IMPROVEMENTS AND FUTURE WORK

Based on feedback gathered in the pilot study, we recently improved the pin marker feature for highlighting to make it attach to the selected object when the video plays. More particularly, when the trainee user pins the marker at certain object on the 360 video, the system will extract key points in a peripheral area centered at the selected point and then apply optical flow to track the moments of these key points in the following video frames until the differences of the key points' movement vectors exceed a certain threshold. We will add the itinerary and improve the fast forward feature of the VR application, as well as implement the audience application. Finally, we will conduct a final user study with the fully developed prototype of 360TourGuiding, comparing it with conventional remote tour guiding training using video conferencing and presentation slides to more thoroughly understand the effect of the proposed solution.

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