

[DC] Quality, Presence, and Emotions in Virtual Reality Communications

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ABSTRACT

This doctoral thesis looks for the identification and evaluation of the factors that allow to improve the QoE of a remote client in telepresence and virtual reality scenarios. Specifically, quality and socioemotional concepts such as social and spatial presence, empathy, and emotions of being in a completely different place, as well as communicate and interact with people who are in that place. The main goals of my research are the analysis of the methodologies to evaluate video quality and socioemotional concepts, the implementation of additional tools using ML techniques to improve the QoE, and finally, experiments in real use cases.

Index Terms: Virtual Reality—Presence—Empathy—Quality Telepresence—Emotions—Quality of Experience

1 INTRODUCTION & MOTIVATION

Technological advances in Virtual Reality (VR) have allowed users to live immersive experiences, creating an inclusive, extensive, surrounding, and vivid illusion of virtual environment to a user [9]. For that, VR represents an abrupt change in remote communications and telepresence. Users are able to establish a remote communication more similar to a face-to-face conversation thanks to the capture and transmission of richer sensory information. However, VR technology is still awaiting full-spread implementation and standardization. The main challenges are related to video quality and interactive experiences that require more advanced technological devices and networks, and methodologies to consider socioemotional concepts that VR technology provides [10].

Regarding video quality, there are great challenges still to be solved to guarantee an acceptable Quality of Experience (QoE). There exist several works in the literature on the use of video quality metrics for omnidirectional contents [5]. Furthermore, as with traditional contents, the objective metrics are validated carrying out subjective tests to obtain more correlated results with human perception. The main problem in VR is that the standards used so far do not consider the specific characteristics of this kind of content.

With respect to socioemotional concepts, the research is mainly focused on presence, defined as a state of consciousness that may be concomitant with immersion, and is related to a sense of being in a place [9]. Also, there exist several works in the literature referring to the benefits of visualizing videos with Head Mounted Display (HMD) in terms of attention, narrative engagement, spatial and social presence, attitude, and enjoyment [1, 2, 4]. Additionally, VR adds a new phenomenon in relation to the apprehension that others might be having rewarding experiences from which one is absent, called Fear of Missing Out (FoMO) [8]. Passmore et al. [7] present that FoMO can affect users positively helping them to concentrate on the scene. The effectiveness of VR technology depends mainly on this kind of socioemotional concepts. However, the main problem in VR communications is that these concepts are evaluated without taking into account technical specifications and real use cases.

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2 APPROACH

We are interested in analyzing the main factors that influence a telepresence or remote conference experience in a VR environment with acceptable QoE. VR holds the potential to provide to the user skills that improve socioemotional aspects such as empathy, attention, attitude, and behavior in telepresence applications. In this sense, we are interested in implementing additional tools from the analysis of the scene, facilitating interactive communications and thus, improving the QoE. Finally, we propose to validate the results of this research with real experiences from use cases. As a summary, in this doctoral thesis scenario, we tackle the following challenges:

- Stage 1: **Analysis of the methodologies to evaluate video quality and socioemotional concepts.**
- Stage 2: **Implementation of additional tools using ML techniques to improve the QoE.**
- Stage 3: **Experiments in real use cases.**

The first stage of this research is a turning point to VR technology. So far, omnidirectional video quality works have been carried out following highly tested procedures. Following our pilot studies, these methodologies work correctly in VR environments [6]. However, the key value that this technology brings to society is not determined primarily by the offered video quality. For that, it is necessary to work on the extension of the current methodology to support the specific characteristics and demonstrate its additional value.

The second stage of this research is focused on ML techniques applied to omnidirectional content. The main objectives are expression recognition and event detection to provide additional information to the remote client. The output of the first stage will be a tool to assess the implementations carried out in this stage.

The third stage of this research is focused on experiments in real use cases to validate the methodology and implemented tools. This kind of implementation is useful in several applications. For example: in education, you can take advantage of the FoMO sense to improve the attention degree of the students and measure it. In entertainment applications, you can use the game to change the attitude and improve the empathy making the user make complex decisions. In assistive applications, you can detect events that can be dangerous to the assisted person.

2.1 Prototyping

The scenario in which we are going to work on this research consists of a system that allows the communication between the place where the conference or lesson is carried out, called provider, to the remote client. On the provider side, 360VR video and audio are captured and transmitted in real-time. Likewise, from the client's end, the system allows to capture the audio and transmit additional information that the user is interested in share with the provider. It is carried out applying Augmented VR technologies, providing an immersive experience that facilitates him/her to interact naturally and fluently. The experiment scenario is shown in Figure 1.

3 FIRST STEPS

Here, the first steps and uncertainties of the doctoral thesis research are presented and discussed. In this stage, the interactive session will be simulated. It means that observers of the subjective assessments will be remote clients.

3.1 Research Questions

The four Research Questions (RQs) we are interested in are:

- **RQ1:** Can we evaluate quality and socioemotional concepts in the same experiment?
- **RQ2:** How does the actor's perspective affect in terms of socioemotional concepts?
- **RQ3:** Does the duration of the test affect socioemotional concepts perception?
- **RQ4:** What factors affect the QoE taking into account the goals of the VR application?

3.2 Test Material

We will need to consider videos with a duration of 5 minutes each one approximately. All sources should match the experiment requirements in terms of specific topics, with actor and observer perspective acquisitions, with people talking in the first person to the camera, and with some educational information. These requirements will help the evaluation of empathy, attitude and behavior changes before and after the test session. In addition, we will need to select varied contents in terms of scene characteristics to facilitate the evaluation of the quality. Since currently it is not possible to find large databases with that characteristics, we will acquire, edit and prepare the test material to guarantee stable results in the analysis. In this way, we will avoid sequences with poor stitching or unbearable effects that could disturb subjects and affect their evaluations.

3.3 Methodology

No standardized methodology to simultaneously evaluate video quality and socioemotional concepts is available nowadays. Thus, we will consider the following procedure. Observers will fill pre-questionnaires related to personal information, and the level of dispositional empathy [3] before the test session, where they will evaluate the video quality. Finally, the evaluation of the socioemotional concepts will be conducted from the post-questionnaires. In the experimental design, the selection of a representative sample of the population and the randomization of the evaluated concepts will be crucial to guarantee reliable hypothesis contrast and conclusions.

3.4 Uncertainties

In our pilot studies, we have observed that users perfectly discern between evaluating quality and presence. However, the evaluation of presence is more dependent on factors such as the duration of the test or interest in the content of the videos. Thus, it is difficult to cover a wide variety of content to obtain a robust evaluation of quality. Furthermore, contents of longer duration are required to achieve higher engagement. Here, we present the main uncertainty: "Is it possible to evaluate presence and quality in the same subjective assessment in terms of variety of content and duration?" Also, the scales and questionnaires are adapted for the context experiment. "How different scales designed to evaluate the performance of a VR application can be compared?"

4 NEXT STEPS & OPEN QUESTIONS

As previously mentioned, in the first stage of the doctoral thesis plan we are focused on client perception, simulating the interaction. As future work, we contemplate the following open question: how to apply this type of evaluation to telepresence applications where bidirectional communication is provided? Additionally, the second stage focuses on the analysis of the omnidirectional scene to detect events and transmit it to the provider to help the remote client to improve empathy and therefore, improve the QoE. Here, we consider several questions: based on the objective, what elements of the scene are more convenient to detect? How to show them to the provider? How about the FoMO perception in a more realistic scenario? And finally, how about the main use cases?

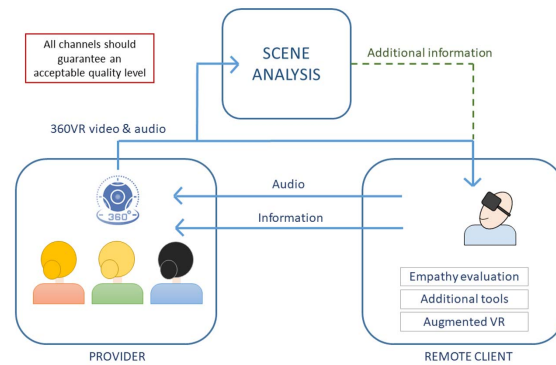


Figure 1: Experiment scenario.

5 CONCLUSION

The research will help to find the factors that will make users want to use VR applications. First, we will propose some guidelines to measure the impact in terms of quality and socioemotional concepts. Second, we will propose some extra tools that can help the user to work his/her empathy, improving the social skills and telepresence experiences. Finally, we will validate the research with specific use cases such as education or remote meetings, where VR technology is expected to achieve a high impact.

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