Semiotic Virtual Reality Framework Validation

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Abstract
This paper presents a user study designed for validating the Semiotic VR Framework, a tool that allows to identify the best-suited Virtual Reality (VR) applications to get a specified communication objective, by adopting the appropriate techniques to implement visualization, interaction and modelling of the VR application.

Author Keywords
Virtual Reality; Semiotics; Communication; Validation; Usability; User Experience.

ACM Classification Keywords
H.5.1 Multimedia Information Systems: Artificial, augmented, and virtual realities.

Semiotic Virtual Reality Framework
The Semiotic Virtual Reality Framework [1] is the outcome of research in the field of semiotic analysis of Virtual Reality (VR) communication, focused on syntax, semantic, and pragmatics. We study the syntactic level as defined by the characteristics of the visual communication adopted in a VR application, the semantic level as related to the functional model chosen to design the application, and the pragmatic level as the one based on the

human-computer interaction that changes the user's role. This approach stems on both a study of literature review on theoretical research by Eco [3] and Greimas [4], paired with a long-time experience in VR research and development and in Human-Computer Interaction and Design in general.

The Semiotic VR Framework can be used to classify and describe different kinds of virtual reality applications and to better understand communication in VR. It represents both a tool for evaluating existing VR applications and for supporting designers of VR systems in their decision-making processes. To exploit the framework potentials, designers and developers have to select the appropriate level of detail and likeliness in visualization, interaction, and modelling, choosing the appropriate sensory stimulation systems, determining the necessary languages for performing a successful human-VR communication.

Using the framework, a VR application can be located in terms of parameters that allow to identify the expressive power of the communication solution provided by VR. The framework proposes a three-dimensional space (see Figure 1), where the three axes represent the range of variation of Structure (or syntax), Model (or semantic), and Interaction (or pragmatics representation) of the applications at hand. The Structure axis is relative to the syntactic level, which ranges from symbolic to highly realistic (better called likely). To identify a position in this axis, we need to consider the iconicity level and the likeliness level of Computer Graphics solution adopted as well: the iconicity level helps in locating the position, while the likeliness level suggests possible Computer Graphics solution to obtain the desired iconicity. The Model axis is relative to the semantic level; it ranges from mathematical to impressionistic. To identify a position in this axis, we will consider the detail level of the underlying mathematical, physical or chemical model that rule the evolution of the VR world, or the presence of symbolic or logical model of the evolution. The Interaction axis is relative to the pragmatic level; it ranges from abstract to concrete, considering also the narrative aspect of communication of the system. To identify a position in this axis, we consider the interaction approach and the interaction devices that exercise different sensory systems.

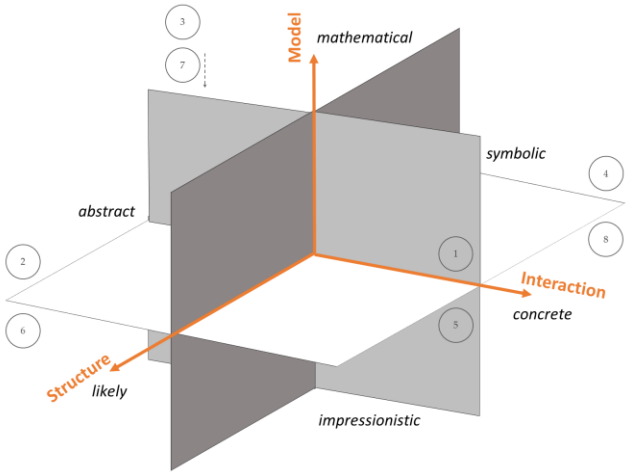

Figure 1: The Semiotic VR Framework is a three-dimensional space divided into octants.

Validation Process

To validate the framework, we designed a user test that applies a combination of semiotic and cognitive evaluation methods for measuring both usability and User eXperience (UX) of the use of eight VR applications on a Samsung Gear VR with a Samsung Galaxy S7 smartphone. Table 1 shows the octants of the framework and the application chosen for the validation process.

We are currently performing the individual user tests, involving 10 users aged from 18 to 30, both with and without experience in VR headsets like Samsung Gear VR. We pair cognitive and semiotics methods of usability and UX evaluation in the same user study.

The tests are organized into several steps: Initial demographic questionnaire; Task-based user test of a first set of four applications (think-aloud protocol); Four usability questionnaires (one per application); Task-based user test of a second set of four applications (think-aloud protocol); Four usability questionnaires (one per application); Final UX questionnaire.

The entire user test is recorded (audio and interaction) and the Communicability Evaluation Method (CEM) [7], a Semiotic Engineering method for evaluating the communicability of an application, is applied. The usability questionnaires are 26 likert-scale questions -- a combination of SUS [2] and CSUQ [6] questionnaires. The UX questionnaire is based on the UEQ Questionnaire [5].

In particular, we are expecting to collect significant information by using the tagging feature of CEM to highlight the communication breakdowns that might take place during the user tests.

Future Steps

Our plan is to conclude the user study (user tests and data analysis) before the end of August 2017 and to propose the presentation of the results of this research in a poster at the CHItaly 2017 conference.

The future development of this work is the design of one further user study using an Oculus Rift device, to test a more sophisticated VR experience, and to proceed with the definition of an evaluation methodology that includes other existing methods of user experience and usability evaluation for VR applications.

References

1. Barbara. R. Barricelli, Davide Gadia, Alessandro Rizzi, and & Daniele L. R. Marini. 2016. Semiotics of virtual reality as a communication process. *Behaviour & Information Technology* 35, 11, 879-896. http://dx.doi.org/10.1080/0144929X.2016.1212092
2. John Brooke. 1996. SUS: A Quick and Dirty Usability Scale. In: P.W. Jordan, B. Thomas, B.A. Weerdmeester & I.L. McClelland (Eds.), *Usability Evaluation in Industry*. ISBN 9780748404605
3. Umberto Eco. 1976. *A Theory of Semiotics*. University Press.
4. Algirdas J. Greimas. 1983. *Du Sens II: Essais Sémiotiques*. Seuil.

5. Bettina Laugwitz, Theo Held, and Martin Schrepp. 2008. Construction and Evaluation of a User Experience Questionnaire. In *USAB 2008*, LNCS 5298, 63-76. http://dx.doi.org/10.1007/978-3-540-89350-9_6

6. James R. Lewis. 1995. IBM Computer Usability Satisfaction Questionnaires: Psychometric Evaluation and Instructions for Use. *International Journal of Human-Computer Interaction* 7, 1, 57-78. http://dx.doi.org/10.1080/10447319509526110

7. Clarisse Sieckenius de Souza, Carla F. Leitao. 2009. Semiotic Engineering Methods for Scientific Research in HCI. Morgan and Claypool Publishers. https://doi.org/10.2200/S00173ED1V01Y200901HCI002

Octants	Interaction	Structure	Model	Apps
1	Concrete	Likely	Mathematical	In Car Racing VR[1]
2	Abstract	Likely	Mathematical	In Mind[2]
3	Abstract	Symbolic	Mathematical	Human Anatomy VR[3]
4	Concrete	Symbolic	Mathematical	Star Tracker VR[4]
5	Concrete	Likely	Impressionistic	Bandit Six: Salvo[5]
6	Abstract	Likely	Impressionistic	A Night Sky[6]
7	Abstract	Symbolic	Impressionistic	VISO Places[7]
8	Concrete	Symbolic	Impressionistic	PAINT VR[8]

Table 1: The eight octants, their values in terms of Interaction, Structure, and Model, and the Apps used for the user study.

[1] https://www.oculus.com/experiences/gear-vr/1409977735730829/

[2] https://www.oculus.com/experiences/gear-vr/742896805825051/

[3] https://www.oculus.com/experiences/gear-vr/1658650407494367/

[4] https://www.oculus.com/experiences/gear-vr/1438854922813902/

[5] https://www.oculus.com/experiences/gear-vr/1009334549088838/

[6] https://www.oculus.com/experiences/gear-vr/1613977911951627/

[7] https://www.oculus.com/experiences/gear-vr/943598329068595/

[8] https://www.oculus.com/experiences/gear-vr/1123989124339476/