Collaborative Software Modeling in Virtual Reality

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Abstract: This work has been published as a full paper at the MODELS'21 conference [Yi21]. Through collaborative modeling, end-users and experts can create a shared understanding of a system representation. While the Unified Modeling Language (UML) is one of the major conceptual modeling languages in object-oriented software engineering, more and more concerns arise from the modeling quality of UML and its tool-support. Among them, the limitation of the two-dimensional presentation of its notations and lack of natural collaborative modeling tools are reported to be significant. In this paper, we explore the potential of using Virtual Reality (VR) technology for collaborative UML software design by comparing it with classical collaborative software design using conventional devices (Desktop PC / Laptop). For this purpose, we have developed a VR modeling environment that offers a natural collaborative modeling experience for UML Class Diagrams. Based on a user study with 24 participants, we have compared collaborative VR modeling with conventional modeling with regard to efficiency, effectiveness, and user satisfaction. Results show that the use of VR has some disadvantages concerning efficiency and effectiveness, but the user's fun, the feeling of being in the same room with a remote collaborator, and the naturalness of collaboration were increased.

Keywords: Collaborative Modeling; Virtual Reality; UML

1   Introduction

While the Unified Modeling Language (UML) is one of the major conceptual modeling languages for software engineers, more and more concerns arise from the modeling quality of UML and its tool-support. Among them, the limitation of the two-dimensional presentation of its notations and lack of natural collaborative modeling tools are reported to be significant. In this work, we have explored the potential of using Virtual Reality (VR) technology for collaborative UML software design by comparing it with classical collaborative software design using conventional devices (Desktop PC / Laptop). For this purpose, we have developed a VR modeling environment, called *VmodlR*, that offers a natural collaborative modeling experience for UML Class Diagrams. Based on a user study with 24 participants, we have compared collaborative VR modeling with a conventional web modeling tool with regard to efficiency, effectiveness, and user satisfaction.

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2 Main Findings

Based on previous research and the participants' familiarity with conventional web modeling tools, we expected one downside of VR to be that users' task executions are slower and more error-prone in VR. The data from our study shows that this was indeed the case. These measures could have been influenced by the universal familiarity of participants with existing web modeling tools. It is therefore possible that speed and error rates in VR improve as users get more experience with a specific VR UML tool. The results of the System Usability Scale (SUS) evaluation additionally showed that our VR implementation is already quite usable even though it still lacks many features that users expect from such an application like automatic aligning of model elements and copy & paste functionalities. The various data points gathered about the naturalness of different aspects of the application gave a clearer insight on what concrete advantages such a VR application can have compared to traditional tools: On average, users found the interactions and especially the collaboration related aspects of the VR application significantly more natural than in the web application. This is especially important with respect to this work's focus on remote collaboration settings as the study showed that the feelings of being together and collaborating face to face with a co-worker were much higher in VR compared to the traditional PC alternative. Another aspect that we expected VR to be beneficial for is the motivation and fun users are having while using it. Our study shows that it is indeed true that users were a lot more motivated and had a lot more fun using the VR application compared to the web application. It is important to note that this could be influenced by the fact that VR is a relatively new and therefore possibly more interesting technology, so these values might align more over time when a user regularly uses a VR application for modeling. Summarizing, it can be said that VR can offer a more natural collaborative modeling experience compared to PC-based tools but that both techniques have certain advantages and drawbacks. These make the use of both tool-types, depending on the concrete situation, most sensible instead of using only one of them exclusively.

3 Data Availability

The code repository of our developed collaborative VR-based UML modeling tool VmodlR as well as details about the user study and corresponding evaluation data can be found at IRB Git[5].

Literaturverzeichnis

[Yi21] Yigitbas, Enes; Gorissen, Simon; Weidmann, Nils; Engels, Gregor: Collaborative Software Modeling in Virtual Reality. In: 24th International Conference on Model Driven Engineering Languages and Systems, MODELS 2021, Fukuoka, Japan, October 10-15, 2021. IEEE, S. 261–272, 2021.

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[5] https://git.cs.uni-paderborn.de/scg/vmodlr