

Overview of the development process of a virtual reality application

Visão geral do processo de desenvolvimento de uma aplicação de realidade virtual

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Virtual Reality (VR) technologies have been proven valuable in various application fields, ranging from entertainment to more serious purposes such as education and training. However, proposing, developing, and delivering a VR application is complex, and many variables must be considered. At the proposal stage, it is crucial to consider the goals of the VR application and the target audience and propose requirements for the application that match the purposes for which they are developed. When developing the application, it is vital to understand the context of usage of the application so the targeted hardware is adequate for its usage: for instance, if the application is to be used in a VR station of a museum, there is complete control over the machine that is running the VR application and performance is granted. However, if the application is meant to be used in a domestic setting, there is no control over the VR hardware, so developers must assume that there are different and complex computational limitations, and the development of the VR application shall be optimized to account for that.

Once developed, the VR application is ready to be delivered and used by anyone. Nevertheless, before releasing the application to the public, it is important to ensure that it is working as expected and has no significant issues that can compromise the whole user experience. The evaluation of VR applications is typically divided into two stages: functional

evaluation and user experience evaluation. The development team makes the functional evaluation while developing the VR application. The process consists of starting with a simple prototype of the intended application and working in iterative cycles where new features and refinements are added at each iteration. At this stage, the development team also considers performance metrics such as latency and frames-per-second to ensure a smooth user experience when the application is being used by an end-user.

The user experience evaluation is a later stage of evaluation, typically the last before releasing the application to the public. This evaluation is achieved mainly by running user studies where users are asked to try the VR application. The evaluators collect data and feedback regarding the application usage to identify possible bugs and suggestions for improvements. For this purpose, evaluators can adopt objective or subjective metrics or consider both.

The most popular objective metrics for evaluating VR applications are psychophysiological measures that consist in analysing physiological processes such as cardiovascular responses, ocular measurements, or brain activity to assess variables such as stress, focus, fatigue, and the excitement or frustration of the user during the use of the VR application. Alternatively, to physiological measurements, behavior analysis such as facial expressions,

postural responses, or social responses can be evaluated to determine the effectiveness of a VR application. The principle is that the more credible the VR application is, the more natural the user responses to the virtual stimuli are when compared to how the user would react in a similar situation in the real world.

Subjective metrics for evaluating VR applications can be adopted mainly via questionnaires or post-experience interviews. The most popular variables used to assess VR applications via questionnaires are Presence (e.g., Slater-Usoh-Steed (Slater, Usoh & Steed, 1991), Presence Questionnaire (Witmer & Singer, 1998), Group Presence Questionnaire (Schubert, Friedmann & Regenbrecht, 2001)), Cybersickness (e.g., Simulator Sickness Questionnaire (Kennedy et al., 2013)), User Experience (e.g., Game User Experience Satisfaction Scale (Phan, Keeble & Chaparro, 2016) or Game Experience Questionnaire (Johnson, Gardner, & Perry, 2018)), Embodiment (e.g., Embodiment Questionnaire (Gonzalez-Franco & Peck, 2018)), Usability (e.g., System Usability Scale (Brooke, 1996)), and Satisfaction (e.g., After-scenario Questionnaire (Lewis, 1991)). Despite the existence of a set of questionnaires, evaluators are always free to build customized questionnaires to address specific questions regarding their particular needs regarding the evaluation of a VR application.

Despite the potential of VR across many application fields, simply delivering a VR application is not enough. The success of a VR application starts at a conceptual stage where the application requirements shall be appropriately defined and implemented. After that stage, there is another critical stage which is the proper evaluation of the VR application, and there are different approaches that can be adopted for such evaluation.

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