VIA VR: A Technology Platform for Virtual Adventures for Healthcare and Well-Being

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Abstract— **To harness the potential of virtual reality (VR) in the healthcare sector, the expenditures for users such as clinics, doctors or health insurances, have to be reduced – a requirement the technology platform VIA VR (an acronym from "virtual reality adventures" and VR) promises to fulfill by combining several key technologies to allow specialists from the healthcare sector to create high-impact VR adventures without the need for a background in programming or the design of virtual worlds. This paper fleshes out the concept of VIA VR, its technological pillars and the planned R&D agenda.**

I. Introduction

Enriching serious games [1] with VR technology opens up entirely new opportunities for medical prevention and therapy, for example regarding cognitive capabilities, sensorimotor rehabilitation [2] or exposure therapy [3]. First-person VR experiences are often rather similar to adventure games whose potential for being used as serious games was discovered and documented early on [4]. In those games, the player slips into the role of a protagonist that solves various puzzles through combination of interactive elements and by engaging in dialogue with non-player characters (NPCs). In short, the adventure genre relies on the presence-generating narratives and interactions with the virtual environment. Such games can support a wide range of health-related topics – from use cases such as fear therapy and pain treatment to enhancing the emotional stability of immobile patients by the sensation of otherwise unreachable experiences.

Although creating complex virtual worlds becomes increasingly easy by the use of game engines that provide a high level of abstraction, generating viable VR content is still costly. A game has to be conceptualized and realized in terms of structure, form and content – from narrative elements via interactive puzzles to dialogues of distinct NPCs. Furthermore, a virtual environment has to be composed of adequate graphics, animations, ambient sounds and music. By providing an integrated infrastructure and high-level access to addressing these challenges, VIA VR aims at reducing these efforts and enable non-programmers to compose effective VR adventures.

II. State-of-the-Art

Plenty of softwares allow to compose VR videos, e.g. InstaVR, WondaVR, Learnbrite or CenarioVR which lack the means of interactions with the environment, hence yielding low immersion [5]. Yet, some interactive VR experiences can be realized without the need of programming skills [6], [7]. But they build on simple templates that only serve limited niches of application and cannot be adapted for other use cases. Amazon Sumerian, a web-based platform for the creation of general purpose VR content allows to import and compose prefabricated assets and scenes in a VR game. Its interactive elements like the behavior of NPCs can be defined by means of a visual programming language (VPL) which facilitates game development by the use of graphical elements representing concepts, relationships and constraints [8]. Due to the focus of Sumerian on entertainment, its lack of transparency and its questionable data policy, it is inappropriate for health-related serious games. VIA VR deploys the VPL toolkit articy:draft that has been available for several years and has an established client base.

In contrast, VIA VR supports healthcare professionals and practitioners by taking into account their medical and therapeutic points of view by providing templates for measurement methods, NPCs, interactions, environments, scenarios and whole use cases. To keep the users' efforts at a minimum, a recommender system (RS) makes context-sensitive suggestions based on background knowledge, enriched with situational data about behavior and interactions [9]. The RS' recommendations have to be generated and presented at the right moment and need to be precise, meaningful, effective, comprehensible and verifiable at any given time [9], [10]. Depending on the area of application, evolutionary algorithms might provide a suitable solution to generate custom-tailored game environments or rudimentary blueprints of game components [11]. Furthermore, clustering algorithms can be used to identify the most suitable solution from a range of alternatives, e.g. to provide a selection of assets that best fit a specific situation [12].

VIA VR supports a high degree of immersion providing realistic avatars by means of smart-device-based photogrammetry [13], [14] as well as player comfort and direct control over the course of the game [15]. Yet, the player might have to cope with potentially demanding therapeutic content that needs to be imparted effectively. Due to the high degrees of freedom within the virtual environment, relevant information has to be adequately highlighted, for example by using color contrasts or audible signals [16]. An essential objective of VIA VR is to meet the high international standards of data protection regulations which is realized by state-of-the-art data security technology [17].

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III. R&D CHALLENGES

The realization of the VIA VR poses an integrative and interdisciplinary challenge, i.e. to combine and extend the current state of research and technology in regards to asset generation, game design, user guidance and VR into a platform that makes the realization of health-related VIA accessible, secure and effective. These aspects yield R&D streams that are shown in Figure 1. They reach from generating, selecting and pre-processing media content and the planning of effective measurement methods (Assets) over their guided, meaningful composition in editors (Design) to providing a concrete, tangible experience manifested in a fully-fledged game product (Engine). The functionality of the platform is motivated by concrete use cases whose efficacy needs to be tested and evaluated. Furthermore, it must be ensured that social, legal and ethical requirements are fully met (User Centered Development). The underlying data structures of the aforementioned functional pillars converge into a (Meta-)Representation-Layer interlinking the different fields of activity.

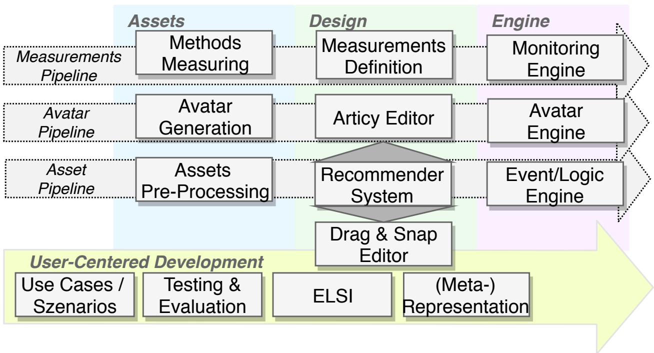

Fig. 1. Three process pipelines supporting the pillars of the VIA VR platform accompanied by comprehensive user-centered development tasks.

Access to VIA VR is provided by a desktop application that provides access to a variety of web services, e.g. to (non-)commercial databases for graphical and audio assets, as well as a dedicated online database of ready-to-use virtual objects or even whole game worlds. A personalized avatar of the user can be generated from a series of images taken by a smart mobile device. All assets can be imported into a VIA VR project and therein be composed using drag-and-drop functionality. In one editor, game elements like buildings, scene objects, furniture, NPCs can be dragged onto a world map that represents a tangible 3D game environment. Another editor defines the relationships and interactions between those elements. A game engine is responsible for processing user input and output, rendering graphics and audio as well as running the game logic.

IV. CONCLUSION

This paper motivated the development of VIA VR, an accessible platform for creating VR adventures for health-related applications, and provided an overview of R&D works that need to interface. The success of VIA VR fundamentally dependens on its acceptance by the target users, and, on the feedback and ongoing support from the research community on virtual worlds and serious games.

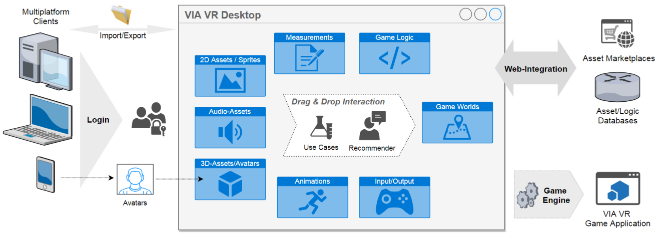

Fig. 2. Software modules and services of the VIA VR platform.

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