Towards a Metaverse in Health Informatics: 3D Visualisation of Physical Activity from VR Gaming

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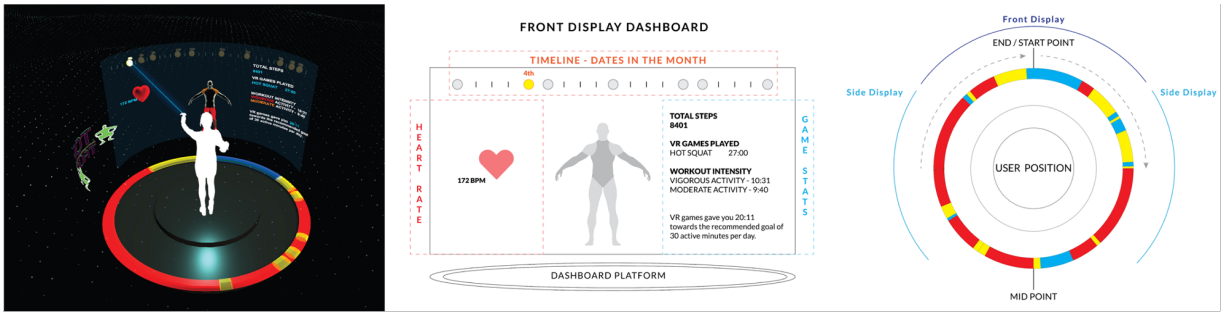

Figure 1: Immersive 3D dashboard in use (Left); Front Display (Centre); and the Workout Intensity Ring (Right)

Abstract

Playing VR games has potential for contributing towards a player's physical activity, while engaging them through a fully-immersive experience. However, limited work has focused on the player's physical health data from playing VR games and how it can be represented to make the player aware of their exertion to meet their goals and prevent over-exertion. We present the design of a long-term 3D dashboard that presents the exertion data from VR gameplay, while being accessible outside of VR.

Index Terms: Human-centered computing—Visualization—Visualization techniques—Treemaps; Human-centered computing—Visualization—Visualization design and evaluation methods

1 Introduction

Virtual reality (VR) games are a promising method of motivating people to exercise by making exercise fun and immersive [1, 3, 7]. VR exergaming has begun to emerge as a potential way to gain the benefits of exercise while having a highly immersive game experience as it allows players to move around a room-scale environment freely. Exergaming, combining physical interaction that provides exercise with video gaming, usually requires some external device to capture player's movement [2, 6]. These devices have typically included depth sensing cameras, dance mats, and hand-held controllers. Falling costs of VR hardware and the growth in immersive games that make use of virtual spatial environments provide more opportunities for players to obtain real exercise. Commercial head-mounted displays (HMD), including the HTC Vive [1], Oculus Quest [2], will be able to support exercise through VR exergaming. Due to the physical nature of the interaction during VR gameplay (i.e. engaging the whole body and moving around the room), players can achieve some physical exertion when playing VR games. This is the case even when the game was not designed specifically designed to provide exercise [8]. Research has also shown that individuals were able to gain valuable contributions to their overall level of physical activity through VR gaming [10].

A current limitation of these games is that the gaming environment does not provide feedback on the activity of the player after they have finished playing. Providing an information dashboard is important for helping people to plan and self-monitor their exercise levels, especially for the long-term player [4, 5]. Previous work has presented initial steps towards providing feedback on physical activity that is achieved through VR gaming. These have included a 2D dashboard [9] and heatmap of the body parts that are utilised during VR games [11]. We present a further contribution to these projects, by providing feedback to the user through an immersive 3D visualisation of the physical activity of games just played.

2 Immersive 3D Health Dashboard

In our work, we propose a 3D dashboard which provides feedback to the user through an immersive 3D visualisation of the physical activity gained from VR games (Figure 1, Left). The dashboard was designed based on data we collected during a 10-week user study (with 11 participants) which measured heart-rate and step data from VR gameplay, Kinect data for the body movement and video recording for the player's performance was also collected. The dashboard can be engaged with through VR and provides users with a holistic view of their long-term physical activity data gained from both VR gaming and other sources outside VR, such as walking and running. The dashboard consists of 3 main parts: (1) Front Display; (2) Side Display; and (3) Exertion Ring. The Front Display (Figure 1, Centre) provides the user an overview of their physical activity for the month. Based on the day chosen in the timeline, the panel displays the user's maximum heart-rate, muscle usage (visualised on a 3D human body - data can be sourced from a Kinect or smart clothing), total steps, VR games played with total times, and the workout intensity — displaying minutes of vigorous and moderate activity (linked with the Workout Intensity Ring). Figure 1 (Right) provides an overview of the displays and the Workout Intensity Ring. The Side Display contains video recordings of the user's best and worst gameplay performance. The Workout Intensity

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[1] https://www.vive.com
[2] https://www.oculus.com/quest/

Ring visualises the player's workout intensity experienced in the gameplay on a selected day. Blue represents light exercise (below 50% maximum heart-rate), yellow for moderate exercise (50% - 70%), and red for vigorous activity (70%+). The data by default is shown in a collapsed (combined) form, but can be expanded to visualise each intensity level in their own ring.

3 Conclusion

In this paper, we have introduced an interactive 3D visualisation that shows the long-term physical activity data from playing VR games. It illustrates the integration of sensor data from Microsoft Kinect and Polar H7 Heart-rate in a virtual environment that allows players to track their physical activity data from playing VR games. The dashboard takes advantage of the presence of the user in the virtual environment, rather than through a secondary interface.

We described the design, including the influences from our previous work [9,11]. This work is the first step towards a 3D visualisation for physical activity provided by exergames. In future work, this design can be tested with participants who contributed their data to the creation of the 3D visualisation dashboard. It may also integrate other sensors to give the feedback to the user on their physical activity through VR gaming in relation to their overall physical activity, such as daily step counts collected by activity tracking wristbands.

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