Either Give Me a Reason to Stand or an Opportunity to Sit in VR

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ABSTRACT

In this position paper, we want to point, with a little bit of provocation and maybe a pinch of fun, to some grievances of and also chances for today's pool of (consumer) VR applications concerning the chosen user posture. In our opinion, the user is considered standing or required to stand in too many cases, and transitions between postures are usually entirely unsupported.

1 ACT I - GIVE ME A REASON TO STAND...

Somewhere during the design process of a new VR application.

Alice *"Do we assume our users to sit or to stand?"*
Decider *"What posture are our existing hardware and room setting made for?"*
Alice *"Standing."*
Decider *"OK, then we do it standing."*
Alice *"But it is a Formula 1 racing simulation..."*
Decider *"...oh it is a sitting VR scenario? Hmmm.... don't mind, a chair would scratch the floor and we maybe would have to track it. So let's just stick to the standing posture."*

This little drama very likely never happened, because, even worse, the question about the most suitable posture is often not even actively asked but decided subconsciously.

While these statements, as well as the drama itself, are maybe a bit overdone, they highlight two things: The main drivers for the decision whether a VR application is used by the user being standing or sitting typically seems to be mainly determined by the available hardware and environment. At least that was our impression from experiencing a lot of commercial and academic VR games and applications, as there often seemed to be inappropriate assumptions about the users' posture, often leading to a mismatch between physical and simulated posture.

The second question in this dialog: Which is the corresponding posture in virtuality? (Here seated in a racing car) in the best case contributes to the decision as well. Thus, would application developers just have to be convinced to get better, to start asking for the corresponding posture first or rank it higher in priority, and everybody would be happy? Is it that easy? We do not think so. And here is why:

First, the two mentioned factors (hardware & environment, and virtual posture) are not per se a problem when deciding for the right physical user posture, but there is more to consider, such as comfort, engagement, and safety. However, discussing those is not the intention of this abstract. This is, usually, one of the major goals in VR is to create a convincing sensation of the activity that is virtually performed. The easiest way to achieve this is to mirror the virtual activity in reality. And there is the pitfall:

One of the most basic and common activities when designing VR experiences is (free) walking, and one essential prerequisite for walking is an upright posture. Thus the user is placed in an upright physical position by the designers. Unfortunately, free walking is a hard challenge in VR, and there is a large field of research working on enabling or substituting real walking [13, 14]. Nevertheless, the majority of available VR applications today are still either stationary, utilizes teleportation, or controller-based steering. None of these methods, performed in an upright body posture, is walking. At least some do allow for physical walking inside the tracking space. However, as soon as the available tracking space cannot include the virtual world completely, there is usually teleportation or steering added again[1], which in the end again might lead to the user not walking at all [3, 9]. Hence, we have a user in an upright posture not walking, and the danger now is not asking why, again. The reason was walking, and we have reasonable doubts that the named travel methods are closer to real walking than an embodied travel method that is performed in a seated position [7]. Going further down this road, we also would have to ask whether we want to give the user the sensation of actual walking or just the illusion of self-motion (vection), which is different but not discussed here.

As a consequence of the above, there are a lot of (consumer) applications that assume the user being standing, while not allowing for walking. What else are we doing in an upright, unsupported, and stationary position? The only things coming into my mind during the first minutes of thinking, are: waiting in a lane or at a traffic light, singing, archery, ... There will be more, but I think you got the point.

One of these applications led to the following real-life situation, where the actors have been anonymized:

2 ACT II - ...OR AN OPPORTUNITY TO SIT!

Alice went home, where Bob is sitting on their living-room's floor wearing a wireless consumer HMD.

Alice *"Bob, why are you sitting on the floor?"*
Bob *"That's a long story ..."*

20 minutes earlier...

Bob is looking at the VR home screen, browsing the store, and changing some settings. After a while, he is bored of standing, knowing that there is no seat in the tracking space, which would be hard to find now anyways. Thus he accepts the situation. After some additional time, he gets more and more annoyed about standing. Having to stand is also not supporting him with the point-and-click interaction he has to perform. Still remembering his orientation in the living room, he recognizes that their couch makes one border of the tracking space. *"Eureka, this is the solution!"*, Bob thinks, walks on, and sits down as soon as recognizing the couch at his legs. Too early, ...the screen gets black and notifies Bob to re-enter the tracking space because of security issues.

Yes, there are absolutely worse situations than sitting on the floor, and yes, there would have been workarounds for Bob, such as raising the headset or grabbing a chair and placing it in the tracking space (see Section 3). However, contradictory to the first act, this one is no fiction and an example of an application design that is not user-centered. This situation is unfortunately not unique or constructed. In fact, there are many situations like this, and you might have experienced some yourself.

Sitting clearly generates less fatigue than standing [5]. Moreover, fatigue in leg and lower back muscles was also shown to be higher in a pure standing condition, which pretty well translates to a user in VR that is standing for no reason, and without anything to do, than compared to a dynamic standing posture [2], which incidentally also better

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[1] Funnily, some available applications do not care for the problem at all. In consequence, you either just cannot reach a well-served tennis ball or decide to run into your dining table. Let's hope it is actually a decision.

supports an active and involved user, e.g., playing a sports game or walking around. This may also reflect our own experiences that standing around waiting feels much more exhausting than walking, even though the total whole-body energy consumption might be lower.

So should we just seat all the users and everybody is happy? No, that is not the full answer either. Many applications are placing the user in an upright position for a good reason. However, many applications also do not have to. Does the application really mimic a standing scenario? Then do standing! There is free walking provided in the application? Then do standing! I cannot walk, and I do not get more involved when standing? Then let me sit down!

Now, to be really honest, instead of placing the user either in a seated or upright position, the real goal should be to allow for both.

3 Act III - Build my world, but let me decide how to explore it!

`In the meanwhile, Bob got a chair into his tracking space, he is heavily involved in getting out of a virtual escape-room, while Alice is helping him with instructions from the outside. Time is running out, and as nothing holds Bob onto his chair any longer, he jumps up and nervously walks around, simultaneously trying to solve the puzzle in his hands. He re-positions the virtual room to avoid the virtual table, and suddenly time is over, they lost. However, they made more progress than ever before. Highly motivated, they want to start again, and Bob wants to sit down, but wait... where was the chair?`

The title of this section is provoking and heavily generalized, and thus we want to clarify that this is not suggesting to stop authorization of content and experience design and only create open worlds instead. The last episode of the little drama much more tries to show that the ultimate goal should be to neither design for a standing nor a sitting posture exclusively. Designers should create worlds that are consistent, no matter how the users want to explore them or how they want to behave, in a frame still given by the author/designer. In reality, we usually do not care about the posture of an activity; it is just given, and when it is not, we choose, and our choices can also change. Thus VR applications should be designed to empower the user to choose by themselves. And even when an application seems to have a definite posture associated with, one should not forget that there might be transitions from or to other applications and activities that look different.

Seamless transitions between standing and sitting, every time and everywhere are difficult to archive in VR today; thus, it is usually [4] not possible to dynamically create or remove a seat in the tracking space. However, some things can be done: In the described case it might have helped to switch Bob's HMD to see-through mode after the level, or blend in the chair [6]. A better solution would avoid a re-positioning of the virtual to the real world such that Bob's chair could be tracked and included or substituted into the virtual experience [11,15]. Sometimes it might be even feasible to procedurally generate the complete virtual world based on the real one [12]. Other options include utilizing redirected walking [10], subliminal re-positioning [8], or haptic retargeting [1] to either help align reality and virtuality after a re-positioning, or making re-positioning unnecessary in the first place. In some cases (see Act II), it might already be helpful if users could define areas in their rooms that allow for sitting, e.g., chairs and couches, such as we are already used to draw and define our walkable tracking spaces. In sum, there is an increasing amount of potential solutions already proposed (at least in the research community) that could be incorporated by VR developers, although sometimes usability and user experience would need to be enhanced before wide-spread adoption.

4 Guidelines

The positions made in this paper can be summed up in the following guidelines:

1. Do not confuse standing with walking when deciding about the users' real-world posture. If walking is not feasible, consider a seated posture instead, especially for longer experiences.
2. If asking users to stand, give them a good reason for standing. The users do not want to stand for no reason, so get them involved, use methods utilizing their lower body parts, or tasks that utilize their extended reach and mobility.
3. When there are potential downtimes or at least a few seated activities, allow for seamless, understandable, safe, and bidirectional transition between sitting and standing.
4. Consider that the users might come out of another context, e.g., a home screen requiring another posture, into your application. How can you provide a suitable transition?
5. Wherever possible, design independently of the posture or at least for both postures, and let the users decide. Users might have reasons to choose one over the other that we cannot anticipate - including physical ability, prior activities, or simply preference.

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