Things from Another World. VR, UI and UX through Run of Mydan

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ABSTRACT

When it comes to games in Virtual Reality (VR), User Interfaces (UI) require peculiar attention, since they imply different interactions and uses than games experienced on two dimensional screens. Through the examination of the case study *Run of Mydan*, a first person single-player and multiplayer flying VR shooter, we discuss and ruminate on VR UI, and its influence on players in terms of UX (user experience). Drawing specific attention on affordances, usability, discoverability and feedback, we analyse how the developers of this game dealt with the UI as embedded into the environment or displayed on the avatar's body. We focus on how a diegetic interface facilitates the player in effortlessly understanding the virtual world and reaching immersion. Based on the findings, we conclude that UX benefits from the intuitive diegetic solutions that the developers adopted, providing support for the "zero interface" approach in conveying information in virtual, three dimensional environments.

Author Keywords

Games; Virtual Reality; User Interface; User Experience; Immersion.

ACM Classification Keywords

K.8.0. Personal Computing: General – Games; H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Virtual reality (VR) is a system of principles, methods and techniques intended to give the player a more realistic way of perceiving and experiencing the surroundings by reproducing via modelling and simulation an artificial, three-dimensional space. Especially speaking of games, VR is now on the rise, benefitting from price cuts on VR headsets and some must-have contents (revenue up from 1.8 in 2016, to 2.2B in 2017, and it is estimated to grow to 4.5B in 2018 [23]). The main profile devices are PlayStation VR, Oculus Rift and HTC Vive.

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What changes – and what is also challenged – in comparison with the traditional way of playing video games, is the player sense of interaction and immersion. Experiencing VR games, players interact with their surroundings (artificial environment) through senses and limbs, and the information flow is bidirectional: through senses, it goes from the environment to players; through limbs, it goes backward. Conceptually, this way of interacting with the virtual world is more realistic than the mouse-and-keyboard (for pc games) or pad/joystick (for consoles and arcades games) mediated way: indeed, players use motor schemes that have been previously acquired in the naturalistic setting of the physical environment to perform everyday actions. On the contrary, traditional ways of mediating interaction involve acquiring motor patterns that are only loosely related with the resulting in-game meaning (as pressing the "w" key for moving the avatar forward) and often suffer from cross-modality interferences (as using buttons on the left to have the avatar perform actions on the right [13]). However, even by taking realism into account, there are recurrent perceptual UX problems. Ever since their conception in the 60's, VR via head-mounted systems has been involved firstly in visual and secondary auditory senses [24], revealing a quite persistent lack of coverage on other senses. In particular, the absence of haptic stimuli and of a physicality of the virtual world impacts on VR realism and immersion [15,16]. Although the use of wearable technology, physical props, and the possibility of having players walking while navigating VR environments (e.g.: [5]), the problem is still far from an easy solution. In fact, such approaches cannot fully nor smoothly recreate the experience of touching objects. That said, we are in front of haptic and proprioception issues, where the first refers to the sensory domain of touch, that have already been mentioned, while the second relates to those stimuli that are produced and perceived because of the position of our body in the environment/space and its locomotion. Indeed, our brain continuously checks the proprioceptive and visual consequences of motor commands (e.g.: [2]). In some cases, a mismatch occurs, such as when patients with an amputated limb try to move it. The majority of these patients experience the vivid presence of a “phantom limb” associated with extreme pain. Crucially, by restoring the visual feedback, the pain is also instantly reduced [19], suggesting that the sensorimotor mismatch may be interpreted by the brain as pain [18]. Similarly, when looking at virtual reality, the matching between what is being perceived via visual and non-visual channels may evoke bizarre experiences. One such experience is known as the *cybersickness* or *VR sickness*, a feeling that closely resembles motion sickness. Interestingly, while for motion sickness vestibular stimulation is necessary, with visual stimulation being a possible contributing factor, in VR sickness only the visual stimulation occurs [11]. In line with the phantom limb example, this suggests that the mismatch between the information flowing through the visual channel and that elaborated through another channel (in this case, proprioceptive information) is the triggering factor. This issue is still being dealt with.

In developing the first VR contents, multiple UX problems popped out concerning UI. To lessen its impact, answering the necessity of delivering complex information, a design solution can be embedding information into the environment, following the idea that the best interface is no interface [10] – trying not to expose it, and not even to refer to the way it is used in two dimensional games. A three-dimensional environment offers different affordances than a two-dimensional one, including those that refer to our innate perception-action patterns (since we live in a three dimensional space) [4,14,17]. Taking advantage of this, VR designers could approach UX problems simply demanding the interaction learning to already known patterns.

In the light of this reasoning, our research question regards how players grasp information from the VR environment, and hence understand how to interact with the game elements. Sense-making issues (as wayfinding or interaction with the environment), complications with actual navigation in real spaces, and interaction with the UI (techniques from handheld to full-body), are just some of the main problems. Recognizing their existence, as well as the inconsistencies and discrepancies that tag along, we propose to go through a case study for ruminating how hands-on experiences can serve to unpack some recurrent problem and overcome frequent usability issue. Then, based on our observations we discuss the game affordances as usability, discoverability, feedback, and what kind of information the UI convey to those who play.

METHODOLOGY

From a methodological perspective, the research conducted on the artifact is based on qualitative research on Virtew’s *Run of Mydan* (2017) as our case study. The analysis follows how the investigation of the game experience according to user-centered approach resulted into implications and implementations of the VR game, throughout its design process (from the first demo to the current version). We used variable methods: informal interviews, direct observation, participant observation via moderate participation in the design phase (impacting on the implementation of the game) and playing with the current version, collective discussions, and self-analysis. As a matter of fact, one of the authors of this paper has been the first playtester of the early access release, the first public version of the game. The benefits of conducting observation and interacting over an extend span of time (about 1 year, at the time of writing) lies in the collection of those reasonings that are not influenced by *a posteriori* fact, but rather progressive improvements, for example how discrepancies have been resolved.

According to Howell [7], we conducted the research: 1) Establishing encounters with the developer team before starting the study; 2) In the field, entering the community since the game was in a demo phase; 3) Recording observations and data via (a) field notes and (b) semi-structured interviews, being aware of possible subjective biases and prejudices [1,6,21]; 4) Analyzing data by (a) thematic and (b) narrative analysis.

RESULTS AND DISCUSSION

Run of Mydan is a first person single-player and multiplayer flying VR shooter. The two game modes differ not only in the number of players involved but also in the navigation mechanics. Thus, we go from describing common features to vetting into the main differences. Finally, we analyse the menu interface and its UI, as an element deliberately designed as separate from the game environment. The game can be played either with the HTC Vive VR system or with the Oculus Rift one, alongside a pair of controllers and turrets to track the player. In the following, we embrace a twofold perspective: the one of the player who experiences the game, and the one of the developers who took specific decisions in terms of interaction, aesthetics and so on.

General features

The entire gameplay is based on a singular assumption: the player’s avatar and the enemies can be damaged until they die. As such, the main goal of the player is to survive and kill enemies. In *Run of Mydan* players can perform the following actions: moving, attacking (with the currently selected weapon) or blocking (by generating and using a shield). Depending on the game mode, these actions have different effects in terms of gameplay, since can affect different game elements.

Acknowledging Lee and colleagues’ research on avatars’ spatial navigation of virtual environments [12], and relying on the concept of *peripersonal space* alongside the extrapersonal and personal ones, we draw our attention on its implication in terms of interactions between avatar, player, and environment. According to the authors, navigating the space with their avatar, players tend to ignore visual stimuli located “outside of the avatars’ peripersonal spaces in which the avatars cannot interact, thereby irrelevant informational space" [12]. To increase immersivity, the game uses no head-up display (HUD) to convey information, but it is either embeded it in the environment or embodied it in the three-dimensional elements themselves. Following the "zero interface" principle of the VR medium, the UI and its elements have been made contextual to the environment itself, therefore fluidly merged with the it or with the avatar, as explained below. In terms of affordances, embedded or embodied UIs have an impact on usability: they do not communicate their presence to players, but players get to intuitively know about their existence and function. *Run of Mydan* UI mainly relies on discoverability, as the degree of ease with which the player discovers the elements and features of the game system as far as they are first encountered, and on the game ability to contextually and timely provide understandable feedback of what is going on. For example, if the flying modes are grounded on quite intuitive and graspable interactions, especially because they rely on the well-known Ironman and Superman imaginary with equally clear affordances, the use of weapons is otherwise based on a different and "less natural" reasoning and affordances that require to start a learning process – as discussed below.

Multiplayer mode(s)

The multiplayer mode features a 3D, gravity free environment in which player's avatar floats and moves. Such environment is a finished world, and its extension is signaled by an invisible wall that appears once encountered: when a player reaches such border, a visual effect that could be described as a disintegrating net of floating orange-stroked triangles appears. If the avatar does not touch such fringe, nothing signals its existence neither its proximity: matter-of-factly players are allowed to see the rest of the world through such net, but they cannot reach/explore it. This brings to a situation that provides situated information just when it is needed, and in the meanwhile it is providing enhancing player's feeling of being in a full world rather than in a mere portion.

Then, focusing on in-game locomotion, players can perform 360 movements to navigate the environment. Movements can be performed in two modalities, selected in the settings. Selecting the Ironman mode, for moving players need to point the controllers at the direction that they want to be *pushed from* (i.e., pointing in front of myself to be propelled backwards); in the Superman mode, players point at the direction they want to be *pulled in* (i.e., pointing in front of myself to go forward). In the early design phases, the Ironman mode was the only modality. However, tests ran users showed that such modality of fly was not easily grasped and handled by all those who played it. In answer to such issue, the "superman" mode has been introduced.

That said, we switch from the interaction with the environment to the one with other online players. Players can enter several configurations (1 on 1 deathmatch, team vs team deathmatch, dominion, etc), however while such configurations are irrelevant to the current rumination, what concerns us is that in the multiplayer mode, the interaction with others consists of fights and occurs just through weapons – not barehanded harm can be provided. When damage is received, the avatar health decreases proportionally to the hits; recovery starts few seconds after the last hit. When the avatar dies, it respawns with full health, and a point is given to the opposing enemy/team.

Single-player mode

The single-player mode differs from the multiplayer mode mainly because it does not allow "free flight" movement: the avatar is indeed enchained to a floating platform. As such, the movement system previously seen for the multiplayer mode only moves the platform slightly on the left or right or makes it accelerate or slow down; the platform follows an invisible path (a sort of rail) over which the player has little control. However, the player can move across the two-dimensional plane of the platform, corresponding to about 2.5x2.5 meters. By walking around the tracked area, the movement, centered on the avatar, is recreated in the VR space. Because of some chains, which are a simple, narrative-based and very effective visual stratagem to communicate the game affordances, the player is led to know that the platform is the only walkable space. As such, the player is informed that by being on the platform s/he can move as if s/he was affected by gravity (even if the platform is not, since it moves floating along an invisible rail). This aspect alongside the properties of some environmental elements and enemies are a source of ambiguity, since some elements are inexplicably subject to gravity or not. This is certainly an unresolved issue that produces a cognitive dissonance, due to the environmental physics; however, the chain expedient provides a diegetic reason to the player who cognitively matches what s/he sees to what s/he understands of the world: in-game position and locomotion, as well as the feeling of gravity itself.

Focusing on the interaction with the world, the player simultaneously needs to 1) defend from environmental perils and assaults/offences by standard enemies as well as giant end-level bosses, through the use of shields and flying skills, and 2) attack such enemies or dangerous environmental elements using the available weapons. In certain occasions, players also need to use an appropriate combination of attack, defense and movement. In this mode, enemies do not recover from damage, but the player's avatar does. Then, when the avatar dies, it respawns in a previous checkpoint, full health. However, checkpoints presence and position are not communicated, and players are not aware of their existence, until the avatar dies and respawns. This choice undermines the player' sense of consistency of actions, since s/he is not informed about a mechanic that is available in the game.

Menu UI and player UX

The menu on which the player selects the game mode, configures settings, customizes avatars and so on is located in a separate space from the one in which the the gameplay occurs. By entering this space (fig. 1), the player leaves the game environment and a new nightly environment appears, with a menu consisting of a set of three-dimensional buttons and writings spanning 180° of the visual field and being centered on the player (fig. 1). The menu appears in the peripersonal space [12], so that buttons are reachable by extending the hand with no need for additional movements such as steps. However, by not having physicality nor haptic feedback, the virtual hand can use the same space occupied by the button. The interaction with the buttons requires to have the virtual index finger "inside" the virtual button, where the status of "being pressed" is signaled by a rather unexpected reaction: the button becomes partially transparent. This interaction results counterintuitive and unrealistic, and produces a certain ambiguity.

Figure 1. The menu and its UI.

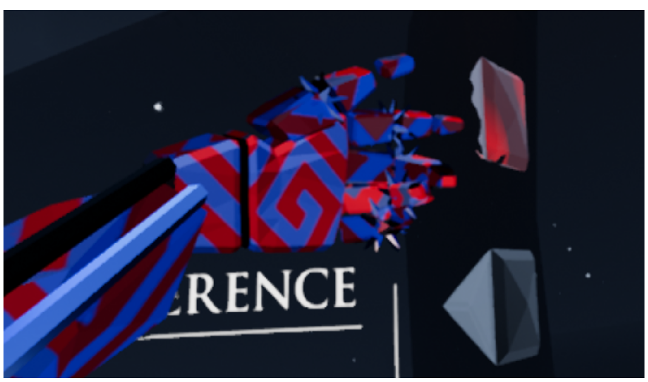

Figure 2. The button getting transparent when being presses.

Moreover, to perform every choice here mediated by these three-dimensional buttons (fig. 2), the player has to push the trigger on the controller with the index finger. In so doing, we obtain a sensorimotor mismatch: even if the player is pressing the button on the controller, the virtual hand does not move, and the button does not look as "being pressed". According to our experience, this mismatch is perceived as a friction with the interaction, resulting into a fracture of the immersion [3,15].

UI embedded in the gameplay

The UI has been designed and implemented to let the player's experience be as immersive as possible by facilitating the path from engagement to engrossment and total immersion [3]. In fact, all the information regarding in-game meaningful statuses are embedded with appropriately diegetic representations [8]. Recognizing the central role of immersion, in the following we expand some of the concepts that contribute to it (and its maintenance). The first point regards information overload, possibly due to an excessive amount of informative elements that could affect in a negative way the player decision-making process. In fact, dealing with a virtual representation, we undergo a peculiar contradiction that stands "between our impression of virtually unlimited perceptual content and the existence of severe attentional limitations" [22]. To reduce the information overload and smoot as much as possible the play experience, the game developers firstly developed an effective navigation system for both the single and multiplayer modes, fitting the game general coherence and timely providing answers to the task to accomplish in the game space. Then the 3D environment has been designed for balancing (and ameliorating) how information is provided. Aptly, the way in which the game system shows visual information should regard only the items needed to accomplish a task (at hand), coherently and timely, instead of forming an extended, detailed representation of the full variety of objects in the surrounding environment [20]. The UI should enable to handle multiple and dynamic information, also exploiting our spatial cognition capabilities. Just the player's damage information is traditionally provided, responding to the very habits of players: when the player is repeatedly hit and damaged, the vision of the world turns red with a contrast that gets stronger the more serious the damage is. When life is recovered the colour returns to normal and the life bar on the forearm fills up. That said, during the gameplay, the player is provided with some information that rather than being overlaid on the screen, are wisely situated into the virtual space. This allows players to bypass them by "walking across the information themselves", providing the conceptual, and cognitive, implication that they are part of the VR world. According to our direct experience, the way in which the UI has been embedded in the avatar's body as well as in the environment itself contributes to increase immersivity rather than producing a sort of detachment due overlay of information. Indeed, recognizing the potentialities of the avatar's body in being a diegetic element that can be used for providing supplementary information, basic information as health and weapon readiness states are displayed on the arm of the avatar (in line with how it has been done in *Dead Space 2*, a solution already discussed in [9], [8] and [25]).

On the contrary, more advanced information is conveyed by means of several intuitive affordances. For example, the avatar status is represented on the arm and the line of fire can be inferred by aligning a set of three-dimensional floating triangles resembling the behaviours of aiming with a shotgun (fig. 3). From an UX point of view, these UI design choices result as consistent as meaningful, in addition to be diegetic. They allow players to behave in a natural way, and simply check their arm for information about their health and weapon recharge states, or point their weapon using triangles to aim, rather than adding layers of information in the environment – as a non-diegetic life bar or aiming cross in the middle of the field of view.

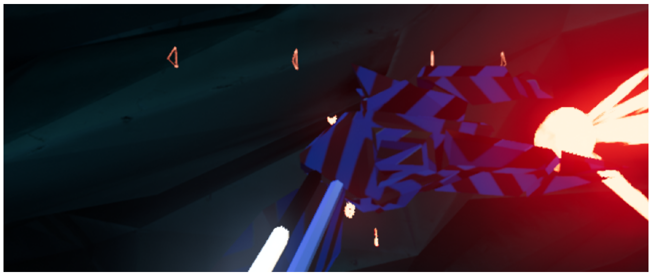

Figure 3. The avatar arm with the health and weapon readiness state, and the weapon pointing system.

Like navigation, also the interaction with the environment occurs through movements of the upper part of the body: pushing the controller buttons, or orienting them as an extension of the player' arms in the space to fly or shoot, avoiding complications due to composite actions. The weapon selection currently involves the use of a dedicated button on the controller that can be pressed with each thumb to change the selected weapon on the corresponding virtual hand. The selected weapon is communicated by an icon on the back of the corresponding hand of the avatar, becoming in turn an embedded information. While no visual feedback in the VR space corresponds to the thumb movement, this design solution solves a number of issues that were detected during the playtest sections. The first iteration to select the weapon was a swipe on the controller pad, that provided no feedback, but the appearance of the selected weapon in the avatar hand in a following moment than the selection itself. The second iteration involved the appearance of a semi-transparent fan-like panel presenting the possible choices on the back of the hand on which the weapon was being selected. In this case, the player had to reach the back of that hand with the opposing hand, and act on it with a complex manipulation involving a *spline* generated on the wrist that needed to be connected with the weapon icon. Then, after performing such a complex manipulation with the opposing hand, the weapon was selected for the hand that was not manipulating. Playtesters reported this solution as very counterintuitive. The third iteration of the weapon-choice interface involved less manipulation by the opposing hand. The panel of choices was placed on the back of the shield: in so doing, to change the weapon on one hand the player had to press the controller shield button (a thumb press) with that hand. However, the problem remained, as the hand performing the selection still wasn't the one being affected by it. The second and third iterations did not solve the issue, since they produced expectations later disappointed. The last and current iteration simplifies the problem by limiting the overall manipulation. Reducing the number of choices to a maximum of three weapons to be selected among all those present in the game while in the the menu space, the cognitive load is relatively low and the manipulation happening directly on the interested hand keeps the selection intuitive. This iteration certainly took into consideration the principle of *discoverability*, while the second and third ones could not be described as user-friendly, even if we recognise the attempt to maintain a diegetic coherence. In *Run of Mydan*, the first playtests highlighted troublesome interactions, showing a persistent discrepancy between *perceived affordances* and unexpected results. To obtain a coherence between *perceived* and *real affordances*, the developers modified certain interactions (as the weapon selection one) and introduced specific *feedback* that are consistent throughout the gameplay [4], but also meaningful in narrative terms.

Finally, to convey further information they introduced the haptic feedback. Controllers vibrate when a player uses a weapon to shoot, but also when some weapons are ready or, conversely, when some other weapons are fully discharged. Additionally, vibration occurs also in one instance in which the shield is broken. In our experience, while vibration feels like a nice feature of these few actions, the coherence with which it is implemented conveys little meaning.

CONCLUSION

We analysed the use of UI in a three dimensional, virtual environment in the game *Run of Mydan*, in which the developer's attempt was to adopt the diegetic approach to facilitate both players' immersion and their understanding of the game world. While the resulting product reaches this goal in many aspects, some issues are still left to be satisfyingly solved. In fact, the diegetic informative elements embedded in the environment/body are coherent with both the design and psychological guidelines that suggest to use intuitive patterns and affordances. These, in turn, trigger already known motor patterns and facilitate the learning process, while rendering the gameplay more intuitive and the immersion deeper. Along with these benefits, the sensorimotor matching and the cognitive match between the bodily feelings and the visual stimulation are taken into account and exploited with diegetic solutions. The result is a game in which most of the information is conveyed in an intuitive and straightforward manner, and players can quickly grasp it and effortlessly interact with the world. However, a number of issues remain open: non-diegetic elements present various degrees of interference with total immersion. A great deal of work has been devoted to the weapon-selection interface, but the "non-diegetic button press" solution still leaves the cognitive load low while representing the current status in a diegetic way. On the opposite, the menu interface is by definition non-diegetic, in that the game needs to be paused to access it. However, in this space the UI is represented in a three dimensional space with convenient affordances. In a sense, while the menu space is separate from the game space, both have their own diegetic, but incompatible, meanings. Unfortunately, the interaction with the menu breaks the immersion, forcing the player to use body movements with no in-game reconstruction and based on the counterintuitive assumption that two objects may occupy the same spatial position. This analysis suggests that the diegetic, *no interface is the best interface* approach [10] is useful in providing a barrier-less path to total immersion in VR. However, while single case studies are useful in exploring state-of-the-art solutions, whereas evidence-based directions for UI and UX design are required the topic needs further quantitative-methods explorations.

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