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Immersive Journalism: Immersive Virtual Reality for the First-Person Experience of News

Abstract

This paper introduces the concept and discusses the implications of immersive journalism, which is the production of news in a form in which people can gain first-person experiences of the events or situation described in news stories. The fundamental idea of immersive journalism is to allow the participant, typically represented as a digital avatar, to actually enter a virtually recreated scenario representing the news story. The sense of presence obtained through an immersive system (whether a Cave or head-tracked head-mounted displays [HMD] and online virtual worlds, such as video games and online virtual worlds) affords the participant unprecedented access to the sights and sounds, and possibly feelings and emotions, that accompany the news. This paper surveys current approaches to immersive journalism and the theoretical background supporting claims regarding avatar experience in immersive systems. We also provide a specific demonstration: giving participants the experience of being in an interrogation room in an offshore prison. By both describing current approaches and demonstrating an immersive journalism experience, we open a new avenue for research into how presence can be utilized in the field of news and nonfiction.

I   Introduction

In this paper we introduce the concept of immersive journalism, which is the production of news in a form in which people can gain first-person experiences of the events or situation described in news stories. Well-crafted journalism always aims to elicit a connection between the audience and the news story. Creating that connection via different kinds of immersion has long been considered ideal. Describing her reporting during World War II, reporter Martha Gellhorn (Gellhorn, 1994) called it "The view from the ground." Writer George Plimpton (Plimpton, 2003) actually joined the Detroit Lions American football team in order to give his readers the most intimate sense of playing on this team. Television news correspondent Walter Cronkite made a series of documentaries recreating historical events where he would offer a brief introduction before an announcer would give the date and the event, proclaiming, "*You Are There!*" More recently, attempts to combine audio, video, and photographs on the Internet have created what some journalists call immersive

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storytelling. As technology editor at MSNBC, Jonathan Dube said that he believes this can bring the reader or viewer "closer to the truth" (Willis, 2003).

The fundamental idea of immersive journalism is to allow the participant to actually enter a virtually re-created scenario representing the news story. The participant will be typically represented in the form of a digital avatar, an animated 3D digital representation of the participant, and see the world from the first-person perspective of that avatar. In an immersive system such as a Cave (Cruz-Neira, Sandin, DeFanti, Kenyon, & Hart, 1992) the person would see his or her own real body, and the avatar only through shadows and reflections in virtual objects in the environment, though other online people could also see the avatar directly. In a system such as a head-tracked HMD, the person would see the avatar substituting his or her own body from a first-person point of view. Ideally, depending on the extent of body tracking, the movements of the virtual body will match those of the movements on the person's real body.

The participant can also enter the story in one of several forms: as oneself, a visitor gaining first-hand access to a virtual version of the location where the story is occurring, or through the perspective of a character depicted in the news story. Whether visiting the space as oneself or as a subject in the narrative, the participant is afforded unprecedented access to the sights and sounds, and possibly, the feelings and emotions that accompany the news.

In Section 2 we describe other extant digital approaches to the interactive presentation of news. In Section 3 we give the theoretical background supporting the claim that immersive virtual environments offer a unique possibility for providing people with first-person experiences of news stories. In Section 4 we describe in detail one particular application of this notion, which gives participants the experience of being in an interrogation room in a prison cell with their virtual body resembling a Guantánamo Bay detainee. Participants' responses to this experience are discussed in Section 5. This is followed by a discussion of the implications of our work in Section 6 and conclusions in Section 7.

2 Background—Interactive Journalism

The application of interactive digital media to journalistic practice spans a broad spectrum from illustration and infographics to 3D embodied experience in video games. One example of this is "news games," which are a subset of the serious games movement (Michael & Chen, 2005), and represent a collection of digital game designers applying game mechanics and engines to games involving educational or topical issues. Serious games as news fall into broad categories: editorial (most famously Gonzalo Frasca's "September 12th" (Frasca, 2001)), educational, expository, and advocacy/ activist. The latter three examples feature a degree of role-playing, or first-person involvement, as the player is motivated to take some sort of action within the world of the topic at hand. While role-playing demands direct interaction with the objects in the environment including possibly other players, "first person" does not necessarily mean that the player is the subject of the story. Educational games such as *Global Conflicts: Palestine* (Hanson, 2007) and exhibitions at the Newseum (Interactive News Museum in Washington, DC) tend to place the player in the role of a journalist—by exploring the environment and interviewing the populace, the player gains insight into the issue.

News games range from simple 2D animations to elaborate 3D game play. The *KUMA\WAR* episodic series of online games are an example of the expository genre of news games. While the game play is adapted from an existing military third-person shooter game engine, the scenes and missions are reenactments of battles from the war in Iraq and Afghanistan based on news accounts, interviews, and DOD reports. KUMA Reality Games positions itself as journalistic and their web banner proclaims: "REAL WAR NEWS, REAL WAR GAMES" (KUMA Reality Games, 2004). They evoke both the power of the medium as well as the story to impart empathy to the player:

At Kuma, we are very sensitive and respectful of American and coalition soldiers and the sacrifices they are making every day. We hope that by telling their stories with such a powerful medium that we enable

the American public to gain a better appreciation of the conflicts and the dangers they face.

http://www.kumawar.com/about.php

In the activist game *Darfur is Dying* (Ruiz, 2006), the player is a refugee from a Darfuri family and must evade the Janjaweed militia patrols on trips for water and firewood. The game is meant to increase empathy for victims of genocide by positioning the player within a game environment where the hazards refer to actual tragedy.

The advent of large-scale multiplayer games and environments such as Second Life[1] provide a further opportunity for the recreation of news. "Gone Gitmo," a virtual representation of Guantánamo Bay prison, experiments with avatar agency, spatial narrative, and the integration of documentary video within the computer graphics environment (de la Peña & Weil, 2007). The player is represented by an avatar that is eventually and unexpectedly yanked from passive involvement to active participation by being hooded, shackled, and transported in a C-17 transport plane to a cage in Camp X-Ray. Rising out of the cage, the participant is confronted with documentary footage of detainees while movement around the space triggers original video of Guantánamo Bay prison released by the U.S. Department of Defense. The integration of primary source material documenting the physical space within the virtual space validates the digital build as it reinforces the narrative and the sense of immersion.

Another novel use of Second Life focuses on carbon offset (de la Peña, 2009). It explores cap-and-trade markets by providing participants the ability to travel through an examination of the current financial system in which both individuals and corporations can allegedly offset their carbon pollution by paying into such projects as forest preserves or methane capture on farms. Participants start this journey in a Second Life site by selecting the component of their lives they intend to offset: annual carbon emissions produced from either their cars, a transcontinental plane flight or from heating their house for a year. These selections then bring

[1]http://www.secondlife.com

the participants to virtual replicas of actual projects where human-rights consequences, financial waste, and questionable practices provide a glimpse behind an opaque system. They are also followed by a personal carbon cloud to underscore individual responsibility inherent in the pollution problem.

The examples that we have discussed in this section would typically be called interactive journalism. The user enters a digitally represented world through a traditional computer interface. There is an element of choice, where the user can select actions among a set of possibilities, investigating different topics and aspects of the underlying news story. This offers both a method of navigation through a narrative, occasionally bringing the user to documents, photographs, or audiovisual footage of the actual story, and it also offers an experience. When the Second Life user's avatar is captured, this is something personal, something that is a part of the user over which he or she has lost control, offering perhaps the shadow of the type of feeling that might be associated with the real events.

This type of interactive journalism reflects basic elements of what we are calling immersive journalism. In the next sections, we discuss deep immersive journalism, where the participant can feel that his or her actual location has been transformed to the location of the news story, and more importantly that the participant's actual body has transformed, becoming a central part of the news story itself.

3 Immersive Virtual Reality and the Body

One of the most remarkable aspects of immersive virtual environments is that people tend to respond realistically to virtual situations and events even though they know that these are not real. Even more surprisingly, this response-as-if-real (RAIR) occurs even though the level of fidelity with respect to everyday physical reality is severely reduced—with respect to visual appearance, the realism of illumination of computer graphics rendered scenes, the realization of physics, and

above all the representation and behavior of virtual humans (Sanchez-Vives & Slater, 2005). Research has focused on the concept of presence—the sense of being in the place depicted by the virtual displays. Recently, this concept has been deconstructed into place illusion (the original meaning of the terms telepresence or presence)—the sensation of being and operating at a remote or virtual place; and plausibility—the illusion that what is happening is really happening (Slater, 2009). A third important strand is recent research in cognitive neuroscience in the field of body ownership, where it has been shown that the brain has a high degree of plasticity in the representation of the body, and that it is not difficult to induce illusions of body distortions, additional limbs, and even the sense of ownership of an entire virtual body (see Slater, Perez-Marcos, Ehrsson, & Sanchez-Vives, 2009 for a recent review). We next show how these three concepts—place illusion, plausibility, and virtual body ownership—can be harnessed to generate immersive journalism.

First we consider place illusion (PI). The original papers that introduced the concept of presence in virtual environments (Held & Durlach, 1992; Sheridan, 1992; Barfield & Weghorst, 1993; Slater & Wilbur, 1997) meant by presence the strong sensation of being in the space depicted by the virtual reality system. This is a qualia, a quality of our experience that is impossible to describe; it is specifically the illusion of being in the virtually rendered space *even though you know that you are not there*. In normal circumstances, this is not a sensation you can have in physical reality, since there is no disjunction between where you know yourself to be and where your senses tell you that you are. It was argued (Slater, 2009) that the critical factor leading to PI is the generation of sensorimotor contingencies (SC) by the virtual reality system similar to those of physical reality. SCs are the implicit rules of how to move our body in order to change perception—the knowledge, for example, that to look underneath something you bend your trunk forward while rotating your head upward. In order to see what is behind us, we know how to turn our head, shoulders, trunk, or entire body around in order to change our visual input. To grab hold of something that is beyond reach, we know how to propel our bodies forward, reach out a hand, and so on. When a virtual-reality system affords SCs that are

similar to those employed in physical reality, this endows the placeness to the virtual environment. This illustrates a profound difference between an immersive virtual reality experience such as can be achieved, for example, in a head-tracked head-mounted display with a wide field of view and looking at a standard computer monitor. In the HMD example, as you turn your head around 180° you are continually receiving at least visual sensations from the virtual reality. On a standard monitor, however large, as you turn your head, eventually images from physical reality will intrude into the visual field. There are many caveats to this approach, including the role of individual differences, discussed in the original paper by Sanchez-Vives and Slater (2005). The conclusion is that head and body tracking, and appropriate multisensory changes in correspondence with body moves (changes that follow rules of everyday sensorimotor contingencies) will tend to lead to PI.

Second, suppose that you are (in physical reality) parking your car illegally. Just as you pull up to the curb, you notice a police officer standing by the street corner. Your heart misses a beat and you are just about to pull away rapidly when you notice that there is no police officer at all but a dummy stationed there. The police dummy is a failure in plausibility—for a moment the dummy was for you what it appeared to be, a real police officer. Then the plausibility, the sensation that something is real, that it is actually what it is represented to be, was lost, and as a result your behavior changed (Slater et al., 2009). Plausibility (Psi) is an important component in relation to media experiences. Whereas PI is a static property of an experience (i.e., there may be nothing at all happening in the place that you are in) Psi is more concerned with the dynamics of events and the situation portrayed. Is it credible in relation to what would happen in reality? (Put another way, it is not credible that a police officer would be standing completely stationary, which may have been the cue that broke the plausibility.) Also, does the world respond to you—as you carry out actions, are there responses in the environment that respond to those actions (e.g., your car pulls up to the curb and the police officer at least looks in your direction). Third, are there events that specifically and personally relate to you?

The above describes a framework for the consideration of the circumstances under which RAIR may occur. PI means the sensation of being in the virtual place depicted, Psi is the illusion that the events there are what they seem to be (they are really happening). If you are there and the events are happening, then they are happening to you—and there are very many examples in the literature of people responding realistically to virtual situations and events.

We mentioned earlier that, for example, in order to grab something, you reach out your hand toward it, employing a rule of SCs that you have known since infancy. In virtual reality, suppose you do not see your hand moving as you move it. When you wear an HMD, for example, you do not see your own body. By default, you will be invisible. As you move your body, nothing will change in the environment itself. This is a failure of both the SCs that support PI and one of the rules for Psi (that the environment responds to your actions). A body representation is necessary for a completion of both PI and Psi.

In recent years, it has been shown that body representation is malleable. With appropriate multisensory correlations, it is possible to give people the illusion that alien objects (such as a rubber hand) are part of their body (Botvinick & Cohen, 1998), or induce out of body experiences (Ehrsson, 2007; Lenggenhager, Tadi, Metzinger, & Blanke, 2007), or give people a sense of ownership over a virtual body, as if the virtual body had become their own (Petkova & Ehrsson, 2008; Slater, Spanlang, Sanchez-Vives, & Blanke, 2010).

A virtual reality system that offers PI, Psi, and a virtual body provides the means therefore to transform not only people's sensation of place and reality but also themselves (to the extent that their selves are bound up with their body image). In the next section we describe how we exploited these ideas in an example of immersive journalism.

4 A First-Person Experience of a Stress Position in Virtual Reality

4.1 Background to the Scenario

An immersive journalism experience was designed to parallel the multiple news stories of detainees being held for extended periods in stress positions,[2] and where these detainees were often subjected to what was termed harsh interrogation (Bazelon, Carter, & Lithwick, 2005). We decided to integrate information provided in FOIA obtained transcripts documenting an actual interrogation, and what the U.S. Department of Defense considered torture, of Detainee 063, Mohammed Al Qahtani, at Guantánamo Bay Prison throughout 2002 and 2003 (DOD, 2003; Woodward, 2009). This immersive journalism experience used the ideas of body representation discussed above to allow a participant to undergo an illusionary transformation of his or her physical body perceptually entering the body of a detainee. The over-arching intention was to apply best practices of journalism and reportage to this unique 3D space to intensify the participant's involvement with the events.

The design focus consisted of two major components. The first was the scenario within a virtual cell where the participant's avatar would be confined in the type of stress position documented in reports by various NGO agencies (i.e., the International Red Cross) in images depicting detainee treatment at Abu Ghraib (ICRC, 2007)[3] and in other news stories. The second component was an audio track that implied that an interrogation was taking place in a cell adjacent to where the participant was experiencing the illusion of being in a stress position. The audio was produced using a binaural recording of actors reading from the actual U.S. Department of Defense logs of the Al Qahtani interrogation, and processed to match the acoustics depicted in the virtual space (see Figure 1).

The script was created by altering the passive tense of the logs to allow actors to read lines in an active voice. For example, "SGT R makes the detainee stand up and sit down 3 times," was altered to "Sit down! Stand up!" repeated three times. Also, the reference to a Christina Aguilera song in the logs did not specifically name which title, therefore the actual piece played in the au-

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[2]See http://www.slate.com/features/whatistorture/Taxonomy .html, citing link to CIA Manual http://www.gwu.edu/~nsarchiv/ NSAEBB/NSAEBB27/01-02.htm

[3]See also www.cbsnews.com/elements/2004/05/06/iraq/ photoessay615914_1_2_photo.shtml?tag=page
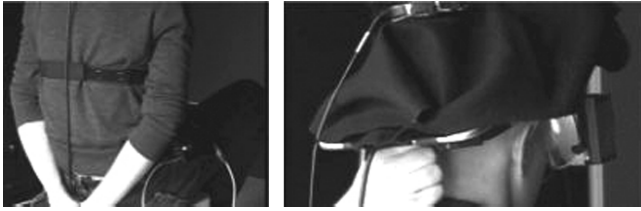
Figure 1. *The participant wore an HMD and a chest strap to monitor breathing. (a) Left: The participants sat upright with hands clasped behind their back. (b) Right: They wore an HMD, covered with black cloth to minimize light from the outside.*

dio was chosen arbitrarily. No additional changes or invented language was used in the script.

The virtual reality scene depicted a cell in which there was a male virtual human, who was standing in a crouched position on an apparently wooden box, with a virtual mirror to the side. The participant would experience the environment for a brief time from a third-person perspective, seeing the virtual character in front, before the scene would switch to the first-person position of the virtual character (see below).

4.2 Implementation

The scenario consisted of a room of size $7 \times 5 \times 7 \text{ m}^3$ with a box on which the avatar stood, a door, and a virtual mirror. The virtual room was modeled in Google Sketchup and 3D Studio Max. The virtual character was modeled in Character Studio and 3D Studio Max and exported to the Cal3D file format. The clothing of the avatar was chosen to look like Guantánamo prison clothing, and it was set in a pose similar to the reports on stress positions of detainees (ICRC, 2007).

The audio was recorded offline with actors in two independent sessions. Once the two recordings were completed, the sound was edited and rerecorded through another room using a Zoom H4 Recording system. The reason for the rerecording was to better simulate the sensation of being in a nearby room. The final recording was edited using Steinberg Media's WaveLab 6 audio editing software to improve the sound characteristics. The final audio was reproduced

through a Creative Soundblaster soundcard and 7+1 loudspeakers.

The environment was displayed via a Fakespace Labs Wide5 HMD, which has a field of view of $150° \times 88°$ with an estimated 1600×1200 resolution. The software environment was XVR (Carrozzino, Tecchia, Bacinelli, Cappelletti, & Bergamasco, 2005), and the virtual character was displayed using a hardware-accelerated avatar library (HALCA; Gillies & Spanlang, 2010). Head rotations of the participant were tracked by an Intersense PCTrack IS 900 system. Tracking data was streamed to the VR system via VRPN (Taylor, Hudson, Seeger, Weber, & Juliano, 2001) and used to turn the avatar's head and to adapt the viewpoint in the virtual environment according to the participant's head orientation.

A Nexus 4 (MindMedia) device was used to monitor the breathing of participants. The breathing data was also streamed via VRPN to HALCA to animate the virtual character's breathing in synchrony with the participant's breathing. The transitions in the camera position and in the audio spatialization were triggered manually.

4.3 Management of the Experience

It is important to note that the scenario we are describing was neither designed nor used for a formal experiment. Rather, it was a way of depicting a news story, and people could ask to experience it. We advertised the possibility to take part in this experience by word of mouth, and anyone interested was warned that the material might be experienced as unpleasant, and that they should stop whenever they felt the need. However, they were not told that this had anything to do with the Guantánamo Bay prison news stories. There was no data that we gathered other than talking to participants afterward to understand their experiences. After agreeing to try this immersive journalism experience, participants were asked to sit upright in a chair with their arms clasped comfortably behind their back, and their feet resting on the chair's footrails (see Figure 1). They were assisted in putting on the HMD, and initially the environment was displayed without the depiction of the avatar. This was designed to give them a few mo-

Figure 2. *The virtual scene. (a) Top left: The participants at first saw the avatar from a third-person perspective. (b) Top right: After entering into the avatar perspective, they may turn their head to the right and see a reflection in a virtual mirror. (c) Bottom left: As they moved their head, the view would change, and the head of the avatar would move in synchrony. (d) Bottom right: When they looked down at themselves, they would see the virtual knees and feet corresponding to a crouched position.*

ments of adjustment, and also for us to check that the belt they wore was correctly sampling their respiration. It was explained that they should move their head freely in all directions but that they must keep their body still. They were also told that they were about to be left alone in the room and that the story was that they were there in that room against their will. At that point, the experience began, with audio accompanying the introduction of the visuals (see Figure 2).

The visual experience started from a third-person perspective before moving to first person. The participants saw the avatar in front of them (Figure 2[a]), standing in a stress position on a platform. After 30 s, the visual scene temporarily dissolved, giving the impression of movement, and when it settled down again, the participant would be seeing through the eyes of the virtual character that had previously been seen from the third-person perspective, standing on the box in a crouched stress position. By looking to the right, a virtual mirror came into view (Figure 2[b, c]), reflecting the virtual body, the avatar, of the participant. The head movements of the avatar were synchronized with those of the participant, including synchronous breathing as con-

veyed through the chest strap, enhancing the sense that the participant had taken on the virtual body previously seen standing on the wooden box. By looking down, the participant would see that his virtual body was crouching in the stress position and he would see his knees and feet below him standing on the box (Figure 2[d]). Throughout, muffled audio of an apparent interrogation played in the next cell in order to create an atmosphere of being kept in a very uncomfortable position while an unpleasant scene played out in a nearby room. The complete video experience is available online at http://www.immersivejournalism.com/StressPosition. mov.

5 A Deep Immersive Journalism Experience

As mentioned, we have not attempted to carry out an experiment with this setup. However, we have recorded interviews with three participants after their experiences, and also several more who were not recorded. Our predictions were as follows: The head-tracked HMD provides a degree of sensorimotor contingencies similar to those of physical reality—as the participant looked around the visual field, the direction of the sound source would change accordingly. Therefore, participants would have the illusion of being in that place. There were actions that they carried out (turning their head) that had consequences in the virtual reality—in the mirror they would see the head of the virtual character turn similarly. Moreover, the situation as a whole had a certain credibility—the sounds coming from the apparently neighboring cell were based on a real interrogation, and the types of things said and the types of sounds heard (e.g., a sound that might correlate with an episode of water boarding torture) would be things known by the participants from their normal acquaintance with important news stories. Overall the being there and the plausibility would lead to response as if real, that is, participants would be induced to feel personally nervous about the situation that they were in.

Their first-person perspective within the virtual body, plus the correlated head movements and the correlated

breathing, might lead to a sense of ownership over the virtual body. Such a sense of ownership would lead to feelings of physical discomfort, even when the participant's body was sitting in a straight position. If this is *their internalized* body and that body is in the stress position then the discomfort from the stress position should be felt. Thus, the participant could even have the feeling of being in a crouched position, with some of the concomitant sensations.

The following are comments by these three of the participants relating to the points above.

1. Being there and plausibility lead to a realistic response.
"I was nervous because I felt I was kidnapped or something, you don't know what is happening."
"I was definitely expecting the attention to turn to me at some point which was itself somewhat unpleasant . . . I was expecting something unpleasant to happen to me, definitely."
"It was quite realistic . . . I felt pretty much the environment, the sounds, the perspective."
"I thought that there was going to be some bizarre scene like hitting or punching or something."
"You see a face sometimes in front of you sometimes by your side and you think—is that me? I'm in a room, alone? . . . And I hear people around, and they don't seem friendly . . . you cannot control things . . . you're helpless."
"I would be the next one in the interrogation room or something."

2. The influence of the virtual body came up in several responses.
"When I looked downwards I could see my legs, so I was on top of the box." "I might have been imitating his posture . . . I don't know, I remember feeling uncomfortable."
"I felt mostly forward [he bends forward]; sometimes I got tired and I [he straightens his back] but I was mostly forward."
"I was all flexed [he bends forward] and in an uncomfortable position."
"You know where are your legs and your hands

but at the same time you see the other guy, the guy that is supposed to be you, and you look at him, and . . . OK I'm really flexed, I'm in an uncomfortable position, so you start to believe that you are him."

Finally one participant, without previously knowing our intention regarding the idea of immersive journalism, made the following comment:

"During the experience I was kind of reminded of the news that I heard about the Guantánamo prisoners and how they feel and I really felt like if I were a prisoner in Iraq or some . . . war place and I was being interrogated . . . I felt how does a prisoner feel like."

6 Discussion

The overwhelming amount of audio-visual information available on media outlets today has led to the concern that the audience becomes indifferent to topics involving human suffering (Kinnick, Krugman, & Cameron, 1996; O'Neill & Nicholson-Cole, 2009). An important role of immersive journalism could be to reinstitute the audience's emotional involvement in current events. We have identified three major factors in virtual reality that could contribute to immersive journalism that may potentially lead to greater audience involvement: PI, being in the place, Psi, taking events as real, and most crucially the transformation of the self, in terms of their body representation into a first-person participant in those events.

While video games experienced on desktops can be a great tool for conveying cognitive information, they typically do not constitute a replacement of a physical world experience in terms of emotional and visceral responses. Our experience with highly-immersive virtual reality (VR) such as Caves and HMDs has convinced us that such environments can potentially induce experiences that are qualitatively different from those experiences through traditional desktop computing and console gaming. Such technologies are not available to the general public, but with the proliferation of large dis-

plays and body-centered interaction devices (e.g., Nintendo Wii, project Kinect[4]), it is not unlikely that the near future will allow for larger portions of the public to experience highly-immersive experiences at home or in their work environment.

A major concern in journalism is the extent to which reporting complies with reality. The term "reality" itself raises a series of problems. Postmodern writers such as Baudrilliard (1995) have come up with elaborate descriptions of how the duplication made possible by media becomes the truth by itself, a hyperreality. A possible objection to immersive journalism may be that it may strain the credibility of journalistic integrity, undermining the ability to bring the true facts to the public.

In this paper we claim that, perhaps unintuitively, the opposite may be true. Immersive journalism does not aim solely to present the facts, but rather the opportunity to experience the facts. We stress that the distinction between conventional documentary content, such as video and audio recordings, and synthetic content, such as 3D models and animation, is blurring. While we are accustomed to viewing video, images, and audio recordings as faithful duplicates of reality, we know that in many instances they are not. It has now become relatively simple to fake photographic images and even video footage using free software that can be obtained online. Such fakes have been distributed and sometimes even generated by leading media outlets. One example was Reuters presenting a digitally manipulated image of a bombing in Beirut as authentic.[5]

Furthermore, audio-visual content is only a sampling of the physical world, and this sampling can convey incorrect information, whether deliberately or not. Digital manipulation is constantly applied to video and images, for example, under categories such as image correction and image enhancements. Conversely, 3D models and animation today are not only becoming increasingly photorealistic, but they are often generated from samples of data obtained from the physical world, using various techniques such as 3D reconstruction, image-based rendering, and motion capture. For example, note that

[4]http://en.wikipedia.org/wiki/Kinect
[5]http://en.wikipedia.org/wiki/Adnan_Hajj_photographs_controversy

immersive journalism may be based on 3D video rather than on 3D synthetic modeling and animation. While the limitations we mention for natural content still apply to such 3D audio-video experiences, they are certainly not less real than video.

Finally, we claim that this sampling and presentation to the audience of audiovisual material, typically on two-dimensional screens with low field of view, is by itself misleading: while observing a human disaster in another part of the world by TV, the viewers may be misled to infer that they understand the human suffering involved. However, the fact is that they are only viewing and hearing a low resolution, sampled, duplicate of reality that does not cater to all senses. In this sense, traditional media can be claimed to depreciate and underrepresent reality.

We thus claim that immersive journalism, by allowing for more immersive experiences, if generated according to the principles advocated here and using ethical, best journalistic practices, constitutes a much more faithful duplication of real events.

In other words, we suggest that RAIR should be considered as part of the criteria for well-crafted journalism.

7   Conclusions

In this paper we have presented the concept of immersive journalism, and argued that virtual reality systems are uniquely fitted to deliver first-person experiences of stories that appear in the news; and that immersive journalism offers the opportunity of a uniquely different level of understanding contrasted to reading the printed page or passively watching audiovisual material. We have distinguished between what might be called interactive journalism or low-level immersive journalism, which supplies information in novel forms such as computer games, online communities such as Second Life, and which can give people some level of experience of a situation as well as providing a means to navigate through the vast amount of digital information that may be available on a particular topic. By deep immersive journalism, on the contrary, we mean transferring people's sensa-

tion of place to a space where a credible action is taking place that they perceive as really happening, and where, most importantly, it is their very body involved in this action. We believe that immersive journalism offers a profoundly different way to experience the news, and therefore ultimately to understand it in a way that is otherwise impossible, without really being there.

Acknowledgments

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