A Case for Play:
Immersive Storytelling of Rohingya Refugee Experience

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ABSTRACT

The displacement of refugees from their natural homes have caused violence and estrangement all over the world, as victims, perpetrators, and hosts jostle for territorial and resource control, to the detriment of victims who live in unbearable conditions outside their homelands. There's often misunderstanding amongst hosts and Western media that see refugees as parasites and destructive agents who hoard resources. Educating both sides of the refugee-host divide have led to programs like UNVR, which created immersive films following conventional 2D filmmaking approaches, portraying static scenes with western voices that attempt to put us inside the refugee camps to elicit empathy. Instead of relying on storytelling through voice as in conventional documentaries, we embarked on an audio-visual journey-based approach to show the daily lives of Rohingya refugees in Balukhali, Bangladesh using dynamic movements in VR space, spatial audio that surprises, and collaborative filmmaking that involves the participants as they empower themselves using 360 cameras as tools for exploration. Instead of investigating the hardships of refugees from a western perspective, we enabled a boy in the refugee camp and his family to collaboratively create a visual experience that represents their daily struggles the way they have become used to. The interactive VR film becomes an empowerment tool to enable self-expression in a corner of the world that has become used to being the observed as opposed to the observer, in turn taking advantage of VR as a medium for both immersion and capability to surprise in 4D.

INTRODUCTION

Documenting the truth often requires telling stories that faithfully represent the subjects in the way they are affected emotionally, not merely the cold reality. For example, showing only the physical destruction of 9-11 would not get at the truth of the way people were affected, both the perpetrators and the victims. Even showing the physical and verbal scenes without organization would not get at that most important element of what it means to us. Thus telling stories objectively can be closer to the truth than simply facts. But how do you tell stories objectively without an agenda? How do we represent subjects in their subjective states? How do we distinguish genuine stories from the

pretense of truth? Here we describe an approach that uses 360 media to empower refugees to tell their stories by collaboration with community members and visitors.

The medium of Virtual Reality (VR) promises a new way for journalists to show reality, by putting a 360 camera where events occur and assuming that it does not affect the natural state of its subjects. VR films such as Chris Milk's "Clouds Over Sidra" put audiences in a static scene in the middle of the refugee camp to evoke empathy for the plight of its subjects [1]. But VR fundamentally changes the responsibilities of the journalist filmmaker, as the producer and its sponsor quickly learn to produce material that evokes emotional responses for their own sake, making the viewer emotionally vulnerable due to the high level of fidelity [2]. Because the director steps away from a completely immersive but static scene, we forget that the entire experience is orchestrated to evoke a certain type of reaction under the impression of duplicating reality. Unlike traditional filmmaking in 2D, the entire set is part of the VR experience, so that all arrangements with subjects have to be done well beforehand, with mutual understanding.

In order to tell a story that is closer to the subject matter, rather than give the impression of truth, we aim to use VR in three specific ways that remind us of the limitations and ethics of the medium. 1. We aim *not* to hide the director filmmaker, but to make her a part of the truth-telling, for in making the documentary, we inserted ourselves into the sociology of the environment, so why should we disingenuously hide ourselves? 2. We invite the subjects to make the film, empower themselves to express what they would like, giving them direct access to the audience and allowing them to have agency about being the portraitist and not just the portrayed. 3. We use dynamic movements and spatial audio from surprising sources to rethink the VR medium, reminding audiences that VR is telling us a story (by way of an actor with agency moving her journey forward in time), and not just a static representation of reality.

Together, these techniques show the viewer genuine experiences that coalesce into stories framed and imaged collaboratively by the creator and her subjects, illustrating VR as a medium for expressive filmmaking rather than as an absolute description of reality. In turn, it opens up opportunities for the filmmaker and her subjects to play together, to involve both parties in the documentary process.

BACKGROUND

Virtual Reality as Medium

Human empathy is what joins us together despite diverse backgrounds and expectations. Humans are uniquely able to empathize not only with other humans, but animals, fictional characters, and even machines. Virtual Reality (VR) transports humans to a story environment where they feel the character's emotions by virtue of seeing the same situation and interacting with the same people at a high degree of realism. This generates participatory empathy, which comes from our own experience of the subject, as opposed to affective empathy that comes as an emotional reaction to a different being's plight [3]. One study has shown that when viewers saw a girl living in a refugee camp via VR, they experienced greater engagement and empathy compared to viewing 2D

[1] Milk, Arora, and Pousman, *Clouds Over Sidra*.
[2] Kool, "The Ethics of Immersive Journalism."
[3] Torisu, "To What Extent Can Virtual Reality and Machines Stimulate Empathy?"

displays [4]. Further studies found greater empathic response to color blindness following a VR experience, meaning that VR facilitated the ability to take the perspective of a color-blind person [5].

VR may be designed to immerse ourselves in other perspectives, but does VR change people's actual behaviors? Namely, is VR capable of driving activism? In a study looking at charitable giving to local refugee aid organizations, VR experiences of a destroyed Middle Eastern city, and not flat monitor 360 video, led to greater number of givers and greater amount of donation per giver [6]. What's more, experiencing the VR documentation led to a significant increase of post-exposure-experience petition signing, up from 61% to 82% compared to the traditional 2D screen-based equivalent [7]. Others have found that dissemination of VR material led to both increases in both positive and negative emotional responses that call for behavioral and political change, highlighting the role of VR outside its purely immersive property [8].

The interaction of human emotion with VR experience is not as simple as one-directional influence, however. Personality traits are correlated with immersion in VR, suggesting that humans have pre-formed agendas when controlling their own VR experiences [9]. This bidirectional influence ushers in a VR landscape in which storytelling is no longer one-sided as in a traditional medium. Instead of storytelling from the point of view of a narrator informing her audience, as in novels and movies, VR presents an alternative, implicit storytelling perspective where the environment is set up and configured for self-exploration that leads to its own stories being told, as in gaming environments. Future immersive film practices will create spaces and social connections that form empathetic relations without an overt, direct narrative [10]. We leveraged this opportunity with VR to create a collaboratively empowering work that allows subjects to tell their own stories without deliberate narratives to guide the audience.

Historical Context

To investigate the 360-VR medium as collaborative play, we visited the Rohingya refugee camps in Southern Bangladesh to document a vulnerable community whose day-to-day activities are seldom known to the public. The Rohingya is a Muslim group previously living in the Buddhist Rakhine state in Myanmar, with a history of violence that cuts deep into the cultures of the respective communities [11]. During World War II, the Rohingya Muslims were aligned with the British while the Rakhine Buddhists supported the Japanese. After the war, the Rohingya were denied citizenship, and in 1978, the Myanmar government launched operations to clear the area of the Rohingya, leading to formation of militant groups such as the Rohingya Solidarity Organization (RSO), which used drastic means to attack the Myanmar borders with Bangladesh. After renewed attacks by the Arakan Rohingya Salvation Army (ARSA) in 2015, the Myanmar government began processes to systematically root hundreds of thousands of Rohingyas out of Myanmar using

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[4] Schutte and Stilinović, "Facilitating Empathy through Virtual Reality."
[5] Ahn, Le, and Bailenson, "The Effect of Embodied Experiences on Self-Other Merging, Attitude, and Helping Behavior."
[6] Gürerk and Kasulke, "Does Virtual Reality Increase Charitable Giving?"
[7] Herrera et al., "Building Long-Term Empathy: A Large-Scale Comparison of Traditional and Virtual Reality Perspective-Taking."
[8] Durnell, "Emotional Reaction of Experiencing Crisis in Virtual Reality (VR)/360°."
[9] Shin, "Empathy and Embodied Experience in Virtual Environment," 2.
[10] Jones and Dawkins, "Walking in Someone Else's Shoes."
[11] Ahsan Ullah, "Rohingya Crisis in Myanmar."

violence and humiliation tactics [12]. Over 700,000 refugees fled to neighboring Bangladesh, whose government is already dealing with a massive population, and is seeking to prevent further population explosion by means of forced sterilization and repatriation [13].

Photographic images from both sides have appeared that seem to support different agendas. Myanmar officials claim one image supporting ARSA attacking its own village, but later investigation led to identification of Hindu arsonists [14]. Amidst all the rhetoric from both sides is a need for truthful, immersive documentation of the refugees' plight and stories of how these events came about. Photos can often be faked (Figure 1), and the narrative stories of the victims do not come across from official documentation. Meanwhile, refugees themselves do not have means of making films or immersive experiences that can tell their story, making misperceptions on the Bangladeshi side common place. The public perception in Bangladesh as perpetrated by the government-sponsored media is that Rohingya militants have been spreading in refugee camps, and that refugees are given no freedom of movement [15]. As a developing country with a burgeoning infrastructure, Bangladesh has been reluctant to absorb the over 1.3 million Rohingya in its country, but UN resolution with Myanmar has been a stalemate. The Bengladeshi authorities have portrayed the Rohingya as militant and self-serving outsiders who seek to benefit from using resources in Bangladesh. The result is seldom documented abominable conditions.

Virtual Reality as Journalism

Using VR as a medium for journalistic narratives promulgating sustainable peace has been at the forefront of development. Viewers are given a headset, headphones, and controller and allowed to roam in a virtual world whose environment can be created from photos or 360 videos. The UN's VR documentary *Clouds Over Sidra* (Figure 2) tells the story of a Syrian girl refugee living in Jordan [16]. Seeing the world from her perspective increases self-reported empathy and emotional responses, and facilitates behavioral changes such as the willingness to support humanitarian work [17]. Another VR film, *Waves of Grace*, explores the life of an Ebola survivor in Liberia who helps others heal through faith, and was shown at Sundance Film festival [18]. Amnesty International generated a 16% rise in donations when the organization began distributing a VR program that allowed viewers to experience the Syrian civil war immersively.

Immersive work with the Rohingya and other refugees are not limited to VR experiences. While Al Jazeera's ContrastVR project has filmed an immersive Rohingya experience focused on the camp life of a young girl [19], other projects have included using theatrical forms to express immersive experiences, such as a play that documents 14 Rohingya youths who discuss onstage their families' experiences during the escape from Myanmar's oppressive raids [20]. VR for storytelling of refugee experiences don't even have to be comprised of real footage, as in the example of Khaled Hosseini's immersive animation about the death of a 3-year-old refugee boy

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[12] Macmanus, Green, and de la Cour Venning, "Countdown to Annihilation."
[13] Milton et al., "Trapped in Statelessness."
[14] Ware and Laoutides, "Myanmar's 'Rohingya' Conflict."
[15] Rahman, "The Rohingya Refugee."
[16] Milk, Arora, and Pousman, *Clouds Over Sidra*.
[17] Durnell, "Emotional Reaction of Experiencing Crisis in Virtual Reality (VR)/360°."
[18] Arora and Milk, *Waves of Grace*.
[19] Mickute and Ghorbiah, *I Am Rohingya*.
[20] Zine, *I Am Rohingya*.

who drowned attempting to escape the camp [21]. Drawn in 360 video, it gives the feeling of the events surrounding the boy as told by his parents better than any real footage could.

While these previous 360 films utilize VR as an immersive medium, they tend to rely on static shots reminiscent of screen-based filmmaking. Sound is usually easily localized, and the camera has no action. This makes for a static set where the auteur filmmaker is completely absent from the theme, so that whatever is presented is proclaimed to be reality itself. This fails to recognize that behind the scenes, the director and staff have had to have numerous conversations with and issue directions to their subjects. These overt instructions may be to move freely in space, given to them prior to the shot, and hence wholly invisible to the VR viewer. These experiences tend to be slow and show sad or depressing scenes designed to evoke sympathy as opposed to empathy. The audience is exposed to a narratively framed dreary life that they should believe exists based on what the filmmakers have presented. Most of these films use dubbed voices and westernized music, making the experience puzzling. They tend to have beautiful renderings of nature scenes that contrast with the camp, emphasizing their decrepit state. Point of view of the camera almost never shifts, in order not to evoke dizziness in VR users, and even the equipment that the 360 camera sits on is painstakingly smudged out in post-production, again emphasizing the lack of intrusion into the scene by the filmmakers.

However, the filmmakers *did* intrude into the camp, by the very existence of the crew and the directions given out. Making the 360 film was an agenda that blurred out the true state of the camp the way it was lived in. Instead of this packaged process, can we create a more participatory method which involves both subjects and filmmakers, so that the product is an organic representation of what the journey was: that of outsider journalists exploring homes of people they are curious about? Even with limited understanding, can we get refugees to play collaboratively with us, telling us a version of their own story?

METHODOLOGY

We stayed in Cox's Bazar in the month of Ramadan in late May, and visited the Balukhali Rohingya camps by way of a 4-5 hour drive every morning, because we were not allowed to stay close to the camps (Figure 3-4). We had no power, and had to leave before 3pm each day during Ramadan due to camp closure, so only refugees themselves can take videos in the evening. Upon arriving at the area, we climbed up the hills in block B56 to meet the Maji (leader) Salim. Working with the Program for Helpless and Lagged Societies (PHALS), Salim took us to Camp 8E, where we visited two families before deciding to work with the family of Ameena Khatun, who had 10 children (5 sons, 5 daughters) between them. Like most Burmese, the family doesn't have family names, so we refer to each of them by their unique first names. Sometimes even they can't remember everyones' names.

Ameena and Ehsan (her husband)'s family came from Patiya Para, Myanmar during the forced extradition (Figure 5). They walked through hills and forests for 16+ days in the heat of the burning sun and in the rain. The children became sick and they had to beg for rice from others on the way. The Myanmar military had burnt their houses down so there was no choice but to go forward.

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[21] Hosseini, *Sea Prayer*.

People were seen jumping into rivers and falling from hills, fleeing from the military. They cooked only once every four days, and had to rely on limited provisions during that time.

One daughter of the family, Shamima, died on the way to Bangladesh. She was vomiting and having diarrhea, with very little to eat, but the cause of death is unknown. Because there were so many family members, they had to leave her in the jungle and move on. No one has any mementos, souvenirs, photos, or clothing of hers, because they had no belongings from home. The only remnant of Shamima that Ameena Khatun has is in her memory. Ameena also can neither draw nor write, so Shamima's memory will be hard to pass on. The only thing she had wanted was her children's safety, so Ameena has difficulty dealing with this pain to this day. Currently they also lack provisions and clean water, but in Bangladesh at least they do not fear having the light on during Ramadan or fear practicing their religion.

To tell the story behind the truth of the Rohingya refugee experience of the family of Ameena Khatun, we needed to describe their lives from different perspectives, so that audiences can be immersed in the multi-dimensionality of the narratives. Thus we took a multi-disciplinary approach consisting of 1. A narrative film about how Ameena and the family deals with the death of Shamima, as a way to serve as the lasting memory that otherwise would be lost to posterity; 2. A documentary about empowering refugees to express themselves by teaching them video-making using a phone during evenings at Ramadan when we don't have access to them; 3. A VR experience that takes the audience inside camp life, narrated and guided by Mofizur Rahman, with camera work and playful initiative by Mofizur and his friends in the camp. For the rest of the paper we will discuss the VR experience. For the film and documentary, see http://www.raylc.org/rohingya/.

VR filming was done using a Ricoh Theta V 360 camera attached to a TA-1 3D spatial audio microphone, and stitched and converted daily offline. Refugee-handled camera work was hand-held, while tracking scenes following Mofizur during his journey were done by lifting a fully extended tripod above the head of the cinematographer. Mofizur and his companions were instructed only on how to hold the camera without obstruction, and allowed to roam freely around the house and to pass off the camera to others. Before recording the main interactions, subjects were given the camera to take short pieces of footage. That footage was converted from two-fisheye view into 360 video format on the computer and shown to the subjects, who could then interact with it by using the computer trackpad (Figure 6). We then loaded the 360 video into a Unity scene with a single sphere and inverted normal for display on the inside of the sphere. The result was exported to a Google Pixel XL phone for immediate viewing by the subjects as a quick prototype in VR. They were allowed to iterate as many times as desired before taking the main footage.

RESULTS AND OUTCOMES

Unleashing the Auteur

Previous VR films of refugee camps exhibit static scenes, passively viewed subjects in narration, and hidden evidence of directorship and cinematography. Our work with the Rohingya attempts to address these issues to produce a more active experience that shows collaboration between subject and director.

Both *Clouds Over Sidra* and *Waves of Grace* contained long, static views with the camera smudged out so that audiences cannot see the mechanisms of the filmmaking even when looking down in

VR. This technique is even more pronounced in "My Mother's Wing," a VR film about a mother's loss of her children in Gaza [22], which tends to narrate the experience like a traditional 2D film, with long voice-overs and subtitles. In one moment, even a car seat is emptied in order to accommodate the invisible but ever-present audience. One static scene follows another with English voice-overs and Western orchestral music. The director's involvement is hidden from view, as is the behind-the-scenes production that led to the naturalistic behaviors found in the film. Instead of showing the refugee experience in isolation, we recognized that any observational process is inherently transformative of the subject being studied [23]. The moment we arrived at the refugee camp, we were dealing with subject preconceptions of what should be shown and not shown to us. For example, are these filmmakers wanting to make a sad story? Should we show them our sad side? What do they expect refugees to be like? Shall I show them what they want to see? These preconceptions necessarily influence the documentary, so that the supposedly objective film with an invisible narrator is already subjectively placed upon first arranging such a visit.

Instead, we wanted to show the collaborative nature of such a visit. We were not the only ones observing, the refugees were observing us as well. Thus we should not be the only ones expressing ideas, the refugees have things they want to show as well. The first order of action was to show us not hidden from view but as part of the collaborative process. Instead of objective cameras planted on the ground, we held up the 360 camera with our hands and holding on to our tripods. We played in the football games they played, not hiding from it (Figure 7). We followed along during the tour, and participated in passing the camera to each other. In turn our camera exists in the scene, not apart from it. The story that emerges is not an impossible attempt to hide our presence, but rather to document how visiting refugee camps occur, and how we learn from each other.

Subject Empowerment

Current VR experiences rely on filmmakers to provide the context, both in terms of where the film takes place and who we can meet in it. In *The Displaced*, a VR film about three children from refugee camps, the audience gets to meet the protagonists, but never get to follow them [24]. We are ferried on a boat we cannot step away from and asked to read subtitles as the protagonists read their lines. Like other VR experiences, we are introduced to the protagonists but when we really want to see them face-to-face, we are confronted instead with desolate landscapes. What if instead of being a passive subject, we let protagonists take the camera where they wish to take us, and let them dictate the terms of the journey?

To empower the refugee subjects, we took four different approaches to making the VR experience, and incorporated them into the film: 1. We gave the family a Samsung phone capable only of taking video and photo, and asked them to document evening activities when we were not there, and used their content in our subsequent documentary and exhibition; 2. We showed them how VR filmmaking works from taking footage to importing, to stitching, to viewing the binocular result on a phone, then asked them to take the camera around the house and beyond to give us a tour as they pleased (Figure 8); 3. We also followed the subjects around as they moved about town, so that we, with the camera mounted high above us on a tripod, is the follower to the initiative of the subject; 4. We let the children learn about VR filmmaking via the demo and then let them pass the

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[22] Arora and Palitz, *My Mother's Wing*.
[23] Eberhardt and Thomas, "Designing Environmental Field Studies."
[24] Ismail and Soloman, *The Displaced*.

camera between themselves, allowing them to see what their presence and faces look like afterwards on the stitched video on the computer, then let them again play with passing the perspective amongst themselves and playing with the audiences' view and their own creative movements (Figure 9).

The result of this initiative-based filmmaking is an increase in the way the refugees promote their own stories. After learning initially about how their movements in space in the camera translated to a 360 degrees view that evolves in time on the computer and in binocular form in the phone, they began taking the camera to places we did not envision. Mofizur Rahman took the camera and put it on the cabinet, when the family began making semai (a food item that was also Shamima's favorite), in order to give us a better view. The children took turns playing with each other with the camera, giving it back and forth to each other without choreography. At the football field, following the person pursuing the ball led everyone to follow the camera, and to play with it as if it was part of the game that they were orchestrating. When we showed the family and children some of the footage they were helping to make, they flocked to the computer (Figure 6) and marveled at the technology and the way they had played with it.
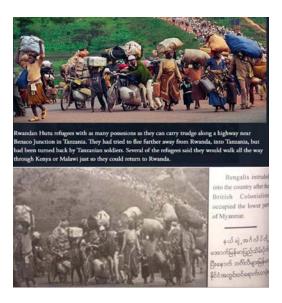
Dynamic Video and Audio

The static nature of video and audio in VR productions makes it seem as if it's part of the limitation of the genre. From *Clouds Over Sidra* to *I am Rohingya*, each film is reluctant to tire the audience, or to push the boundaries of movement that is possible when the camera is displaced in space and time. What encapsulates this best is *Meet the Soldier*, and *Refugees*, two VR films from Scopic [25]. In each case, a great amount of movement from soldiers running to refugees arriving at the harbor is portrayed in the experience without a jolt of movement of the 360 camera. With catastrophic events involving shooting and pushing happening all around the view, the audience is fixed to the ground (fixed to the stones of the beach in the case of the refugees) without a trace of movement. Does this portray the viewer in a 360 film not as part of the scene at all? Are we not a witness to this story but rather a God-like overseer? This approach has been taken by other VR refugee experiences, along with (mostly) Western-created music and sounds that often don't fit to the subjects but rather to the audience for whom the experience is intended. It is catering to the eye and ear that are used to Western cinema: the subtitles, the fixed camera, and the western music. But to document a more realistic refugee experience as opposed to the sad, drawn out view that is not part of their lives (which are often happy and playful in their own ways), we have to play with perspectives and surprises, to fit the medium to the view of the subject as opposed to our own.

To show dynamic interactions reminiscent of play, we traveled with the 360 camera either on a tripod that we moved, or by holding on top of our heads by hand. We also enabled static scenes where families were eating or making food, only to have Mofizur Rahman take the camera during the recording and go outside. Movements of the viewpoint also came from locomotion of the vehicles that took us to camp, from refugees taking the camera to places like football fields and kitchens, and from the cinematographer following the subjects while carrying the instrument (Figure 10). Interactions were unpredicted, such as when children interrupted us from behind, taking advantage of the VR medium to use all 360 degrees.

[25] Cherim, *Meet the Soldier*.

Audio of our VR experience was also dynamically enabled to surprise and play in 3D. Family members frequently interrupt our movement in following Mofizur Rahman with voices that occur behind us as we move forward, causing audiences to turn around, a feat that is unique to VR compared to 2D movies, and which is not taken advantage of by static-scene VR refugee films up until now. We also used only original voices of the refugees with subtitles placed at the location of their speaking to heighten the immersion with spatial audio (Figure 10). We used music improvised by Rohingya musician Takir, as recorded by the group Music in Exile, to give a genuine voice to Rohingya musical creative roots, as opposed to Western traditions. The resulting production is filled with Rohingya initiative, collaboration, and influence.

Lists, Figures, and Tables

Figure 1*. A 1996 photo of Hutu refugees of Rwanda (top) altered and described falsely as Bengalis who intruded into Myanmar after British occupation by Myanmar military's book on the Rohingya. (Source: Reuters, Poppy McPherson)*
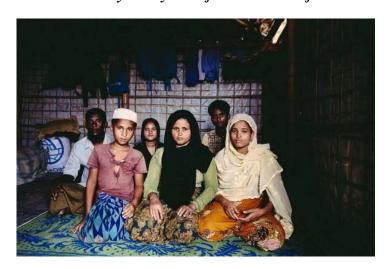

Figure 2*. Film still from Milk and Arora's VR film about the Za'atari Syrian refugee camp in Jordan following a 12-year-old girl around to school, cafeteria, computer lab, and other daily activities. (Source: Within from unvr.org)*

Figure 3*. Location of the Rohingya refugee camps in Balukhali, Bangladesh, a 3.5 hour drive away from the nearest town, Cox's Bazar. (Source: maps.google.com)*

Figure 4*. Rohingya camp at block B56 of Balukhali in Bangladesh. The central football field is surrounded by shanty in all four directions of the hills.*

Figure 5. Some members of the family of Ameena Khatun, including the father Ehsan (left), and the boy Mofizur Rahman (front left next to Ameena), who narrated the VR experience.

Figure 6. Subjects and members of the refugee camp in the 360 VR production interacting with the short footage they themselves took after using the 360 camera to record some movement associated with navigation using the camera.

Figure 7. Involvement of the creators in 360 videos for VR. A scene where the journalists are working with documentation of the family while the Mofizur Rahman enters with the camera (left). A scene where the director plays football together with the Rohingya children (right). (VR screenshot)
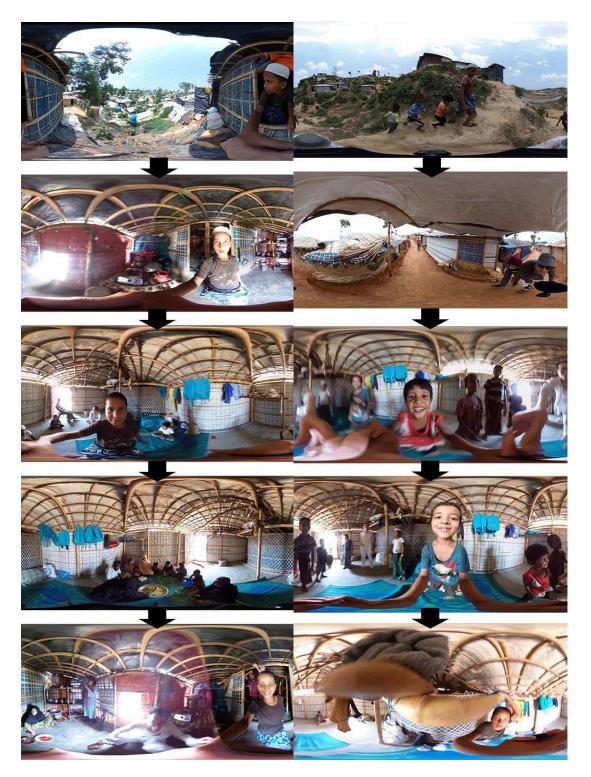
Figure 8. Empowering refugee subjects in creating their own voice. Providing a phone and instructions on use to a family member so that they can be free to document their evenings during Ramadan (left). Mofizur Rahman giving a tour of his home using a 360 camera as perspective (right).

Figure 9. Empowering refugee subjects in expressing their own voice. Following the trek laid out by Mofizur Rahman as he takes his friends and us around the camp, showing us his favorite places (left). The children passing the 360 camera around amongst themselves, playing with perspective (right). (VR screenshot)

Figure 10: Audio and spatial dynamism in VR film. Following a protagonist with a 360 camera during play while he chases after the ball, as if the audience is also chasing the ball (above). Subtitle coupled to place in the environment where voice should emanate or point towards (below). (VR screenshot)

Figure 11: Storyboard of VR experience as Mofizur Rahman gives a tour of his home (left). Scenes 4-5 contain interactive elements (people to talk to, items that conjure up memories). Scenes 1-3 are 360 videos by Mofizur. Storyboard of children playing a game of handing off

the camera to each other (right). Conclusion of the VR experience consists of the camera eventually being passed to Mofizur Rahman, and he puts it inside a blanket.

ACKNOWLEDGEMENTS

APPENDIX

Here we will describe the audience VR experience in our production. The audience first arrives in Balukhali on a jeep vehicle and immediately realizes that it's an immersive experience unlike anything else static she has seen, because she is in a moving vehicle throughout the experience. She is transported to the family's hut, where the son Mofizur Rahman introduces himself after he pokes his head in from the window, and gives them a tour of the hut. The footage is shot by Mofizur himself holding the 360 camera after previous training where we let him take the camera with the recording on, and then upon his return, we stitched the video together and showed him how 360 content works. The tour he gives actually begins outside the window overlooking the landscape (where Mofizur holds the camera) and brings the audience into the humid but comfortable shack where his family lives. We have the music of Rohingya by Mohammed Alom playing in the background, as recorded by the group Music in Exile. Mofizur wings it a bit, going fast at times and slow at others, making the experience spontaneous for the viewer, who feels as if her hands are led by the young boy. The tour ends in the living room, where the viewer is given control of the experience and allowed to roam in the main room where the family gathers as Mofizur enters.

The scene changes from a 360 video to a full 3D dynamic model scene where the viewer can move around and interact with objects, unlike the 360 video where they are led to places. When the viewer gets close to a member of the family she triggers additional conversations (Figure 11). Each member of the family has her own real recorded voice in Rohingya language from the actual interview, with subtitles in English. The statements give her clues about what the family's life is like in Bangladesh away from their native homes, and how it relates to Shamima when they were back in Myanmar. They are triggered by colliders in the scene when the audience encounters the subject. In the eye-tracker version, a gaze toward the subject that has a fixation longer than 1.5 seconds also triggers the conversation. For example, when you approach Ehsan the father, he says "during Ramadan whenever I sit to pray, I pray for my daughter, for her soul; I couldn't give her water when she died." After talking to at least three family members or when a predetermined significant amount of time has passed, the scene moves to the kitchen, where Ameena is making preparations for Ramadan's fast-breaking iftar.

Here, items in the kitchen can be interacted with to bring up a closeup photo, much like a souvenir that was missing from the family's life when Shamima was left behind. When the item is the subject of the user's gaze or collided with, Ameena narrates what the item means to her and Shamima as a representation of lost memory. For example, when you touch the pot, it pops up an image of a food item called semai, while Ameena says in her own voice in Rohingya "when we left Myanmar we could only bring our pot with us, it's ancestral memory; inside is Shamima's favorite food semai that we made together." After interacting with at least three items, the scene shifts to Mofizur Rahman again, who takes the viewer out of the house into the village to show the viewer around his current home in Bangladesh.

As the viewer looks from above the scene following him, Mofizur talks about how each location relates to his home in Myanmar where he and Shamima played. As he exits the home to wander, he tells us in his own words how his current village reminds him of Patiya Para, Myanmar. When the viewer's gaze hits certain landmarks during the tour, Mofizur elaborates more on how they remind him of his home in general, and his sister in particular. For example, when the viewer just reaches the football field, Mofizur is reminded of her sister's love of kicking the ball around and how they would tease her by passing the ball around.

Triggered by this memory, the scene switches to a more dynamic environment, where friends now arrive and play chasing the ball with Mofizur. The audience runs after the child chasing the ball as others pass the ball around (for the dynamism of this, see http://www.raylc.org/rohingya/). The viewer realizes that Mofizur is actually emulating his sister chasing after the ball, because he would chant her name. He is feeling the time when she herself was the one ball-chasing, and his empathetic character has taken over. After five or more passes, he finally gets a foot on the ball to kick it away. The scene switches again when the children are finished playing (after some determined time). Mofizur takes us, the viewers, back by a different way across a bridge, this time with children (and us) following him. As we walk beside the children, we can talk to them one by one when our gaze is directed to them. They each know Shamima in their own way, and talk about what she did back home, and what home means for them, as we follow along.

When back in the home children pass the camera around as the viewer gets a closeup of each family member exchanging hugs and kisses with the viewpoint that shows their affection for Shamima (Figure 11). At this point the audience realizes she is now representing Shamima to the family because they are all hugging the audience with salutations reminiscent of what they said to Shamima. The audience has gathered what's known about Shamima in this journey, and has come to represent her in a way to the family. The scene is shot collaboratively so that children can give and take the camera the way they desire, moving the camera in the direction they deem personal to them. After the hugs, Mofizur gets the last kiss. He takes the camera that is the audience and, once the room clears, puts the camera away. It is as if he is putting Shamima away as well. The camera (and thus the audience) is put inside the blankets and the VR scene closes like a curtain to black, just as the Rohingya music finishes. SHAMIMA as a memory has been kept in this VR experience and it's now time to let her go back.

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RAY LC practices at the boundary of spatial interactions and neuroscience for building empathic bonds. Residencies: BankArt, 1_Wall_Tokyo, LMCC, NYSCI, Saari, Kyoto Tech. Exhibitions: Kiyoshi Saito, Macy Gallery, Java Studios, Elektra Montreal, ArtLab Lahore, Ars Electronica, NeON, New Museum, CICA Museum, NYCSDFF, Burning Man. Awards: JSPS, NSF, NIH, Imagine Cup.

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