“AR HOPE TOUR”
— Earthquake Reconstruction Experience/Disaster-prevention Education Tourism using Wearable-device Glasses —

1. Introduction

It is now six years since the Great East Japan Earthquake in 2011. Videos from the time being played repeatedly portray the raw power and menace of the tsunami that followed, overwhelming our imaginations. We all recall how we felt powerless, but even though those lessons were carved violently on our memories at the time, in these six years they will have started to fade.

To preserve the memory of the disaster in the affected areas, stories are being told and tours to promote disaster prevention are being given, but the conditions at the time are difficult to convey in words, and it is more and more difficult to experience the conditions at the time of the earthquake, as reconstruction in the region has progressed. Images and video from the time are being used to complement the experiences, but these 2D representations are limited.

We created a solution to this issue with a see-through wearable glasses device utilizing imaging devices and augmented reality (AR) technology. The solution we have developed displays photos of the tsunami damage right after the earthquake and computer graphic data over the real scenery in front of the viewer. Also in addition to providing an experience of the tsunami disaster site, our solution provides high quality advance training and can transform the journey to the site into part of the experience using various imaging devices.

This article describes this technology, demonstrations held in Miyagi Prefecture, and future prospects.

2. Development and sale of SmartEyeglass

In September 2014, Sony announced development of “SmartEyeglass,” a see-through wearable glasses device, and began sales in March 2015. It also began providing a software development kit (SDK), which is currently marketed by Sony Semiconductor Solutions Corp.

The device has many sensing functions; including a CMOS image sensor, accelerometers, gyroscope, electronic compass, light sensor, and microphone, as well as smartphone connectivity for obtaining location and other data. The device uses display overlays that allow data to be checked without looking away from the object being viewed. This enables information to be added to the real world, and information can be presented based on the user’s situation. The device uses a thin lens rather than a half mirror, which would obstruct the view. The lens is only 3.0 mm thick, has high transparency of 85%, and was made possible with Sony proprietary holographic optics technology. The display is monochrome rather than color to reduce power consumption, and has maximum brightness of 1,000 cd/m². The binocular display is able to display easy-to-read text that is highly visible in various environments. The device can exchange sensor, image and other data wirelessly with a smartphone, for use in a variety of scenarios depending on the smartphone application.[1] Sony has begun cultivating companies, developers and other creative partners who are considering solutions and businesses using SmartEyeglass.

3. Implementing the NATORI AR HOPE TOUR

The National High-School Sightseeing Plan Contest (also called Sightseeing Koshien) was held in August 2014, backed by MEXT and the Japan Tourism Agency. The grand prize was won by Miyagi Prefecture Agricultural High School with their concept, “Feel the Past! Experience the Present! Relate to the Future! Be Enchanted by All—A time-traveling disaster tour (or tsunami affected area tour)” which used AR.[2]

While the school was developing the concept with ASA Inc. (headquartered in Sendai City), ASA made a proposal to Sony to use SmartEyeglass in the project. The following year, during the 3rd UN world Conference on Disaster Risk Reduction held in Sendai City on March 15, 2015, they held disaster experience demonstrations in collaboration with the Natori City Tourism Association, with the title, “NATORI AR HOPE TOUR.” At each point along the tour, beacons (devices emitting a radio signal) sent signals which were received by smartphone apps, which would send corresponding image data to a SmartEyeglass device connected via Bluetooth. The devices would coordinate with sensor data to display AR images in front of the viewer, which would follow their line of sight. This produced a vivid display of Natori City in the past (before the earthquake), just after the earthquake, and today. Listening to the high-school student story-teller guides made the tour into an experience of hope for the youth who are rebuilding for the future rather than focusing on the tragedy.
5. AR HOPE TOUR in Sendai: March 12, 2016 (Sat) exhibit

Before experiencing the tsunami site using SmartEyeglass, an orientation was held using a 4K ultra-short-throw projector (VPL-GTZ1) provided by Sony Business Solutions Corp. The high-resolution 4K aerial photographs taken directly after the earthquake gave participants a spatial understanding of the earthquake site and threat of the tsunami and totally immersed them in the aftermath of the tsunami.

Participants then boarded a bus for the Sendai Arahama Elementary School, which was hit by the tsunami. On the bus, they experienced the disaster site through 360° whole-sky video collected by Tohoku University over the two weeks following the earthquake and shown using Xperia Z4 tablets from Sony Mobile Communications Inc.

Finally, they arrived at the disaster site, Arahama Elementary, 700 m from the sea shore. This area received the worst damage within Sendai City, and more than 180 people were lost. Arahama Elementary has been preserved in Sendai City as a reminder of the earthquake.

During this tour, the tour guide sent images from his smartphone to apps on the participants’ smartphones rather than using the beacon format as in the previous tour. This improved operation.

Wearing the SmartEyeglass in front of the Arahama Elementary school building, participants could see AR images...
of the mountains of debris at that location immediately following
the earthquake, overlaid on the current scenery, which provided a
realistic experience of the untouched remains after the earthquake.
The height of the tsunami was also shown in AR, using a bar
over the school building. This gave a sense of the height that
was difficult to get from the ground surface. Sighs and surprised
exclamations were heard all around as the participants recognized
the terror of the tsunami.

Later, they took a walk to the sea shore. Using AR to compare
images just after the earthquake with the current scene showed
how the tsunami erased a village of some 800 houses in an instant.
Even five years later, it was unchanged, with only the foundations
remaining.

Participants completed their AR experience of the tsunami site,
returned to the bus and moved to the Shichigo Community
Center. Lastly, they had an opportunity to hear from actual
victims of the disaster in the Arahama area, who are actively
telling their stories today. They had a chance to seriously
reconsider for themselves, what they should do if an earthquake
occurs. That concluded the tour.

6. AR HOPE TOUR in Tagajo: March 26 2016 Exhibit

A tour was also held in Tagajo City to experience the tsunami in an urban environment.

In contrast to the Sendai City experience, Tagajo was based on a “City Walk” format. The arrival of the tsunami was not visible among buildings and the complexity of the onslaught was terrifying. The experience raised participants’ awareness of disaster prevention.

Participants first experienced 360° whole-sky video of Tagajo City two weeks after the earthquake in an air-dome theatre provided by Wakayama University. The air dome video simulated an experience of being in the site just after the earthquake. One city staff person said that seeing the debris along the rail lines brought tears to her eyes as the memories came back.

Participants from Miyagi Prefecture Agricultural High School, who originally proposed the 2015 “NATORI AR HOPE TOUR”, also participated. They were very impressed with the wonderful upgraded experience. They were both delighted and happy to see their original idea developed further.

Next, participants went by bus to the Sony Sendai Technology Center (Sony Sendai Tech) to begin their “City Walk.”

The gyro-sensor in the SmartEyeglass enables it to know its position and orientation. Participants learned about the complex
characteristics of the “Urban tsunami disaster”[3], with buildings and flat geography making it impossible to see the arrival of the tsunami. Getting a sense of the relative positions of the ocean and rivers, helped to understand how the tsunami flowed directly from the Port of Sendai and also up the Sunaoshi River and over the broken levees, following the railroad tracks from two directions in complicated patterns.

The end of the City Walk was at “Sue no Matsuyama”. This place, famous in Tagajo City, is also featured in the Hyakunin Isshu ancient collection of Japanese poems[4]. It is high ground, so even today, the tradition is passed on that it is a good place to seek refuge from a large tsunami. In fact, the tsunami did not reach it after the Great East Japan Earthquake either, and it was a refuge for many.

After the tour, the participants returned to the starting point and participated in a workshop on disaster reduction. They were divided into several teams to discuss any measures, no matter how small, to mitigate the disaster, and characteristics of the “Urban tsunami” learned from their experience in the tour. They also presented their results. It was an opportunity for participants to think seriously about what they could do in the future to mitigate disaster.

7. Future developments

The “AR HOPE TOUR in Sendai/Tagajo” was covered in television, newspapers and on the Web and other media and was very highly rated by the participants.

Of the ten-year reconstruction period defined in the Great East Japan Earthquake Reconstruction Basic Law, the initial five-year “Concentrated Reconstruction Period” has ended, and the subsequent five-year “Reconstruction and Revitalization Period” has begun [5].

The AR HOPE TOUR project promoted by Sony, ASA, and Tohoku University, is contributing to earthquake experience and disaster prevention education as well as reconstruction and revitalization through a series of demonstrations, and is encouraging collaboration between the tourism industry and government to build businesses in Tohoku disaster prevention education and sightseeing tourism.

The project is also advancing to the next stage, as Kinki Nippon Tourist Co. Ltd. has recently joined. Our goal for the summer of 2017 is to start an “AR HOPE TOUR” in Sendai City as an on-site package tour with these same companies.

In the future, we hope to produce even higher quality earthquake experiences and disaster prevention education through collaboration with various industries and organizations and with Sony technologies and products such as SmartEyeglass, and to contribute to reconstruction and revitalization in Tohoku and to disaster prevention and mitigation around the world.

References

[2] From the site of the National High School Sightseeing Planning Contest
[3] From the “Tagajo Kenbunoku” Web site
[4] From the Tagajo City Tourism Association Web site
[5] From “Great East Japan Earthquake Recovery Policy” (Decided by the Great East Japan Earthquake Recovery Headquarters, Aug. 11, 2011) and Great East Japan Earthquake Reconstruction Basic Policy in “Reconstruction and Revitalization Periods” (March 11 2016 Cabinet decision)