Virtual Reality 360 Content Preservation for Disaster Relief

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***Abstract*—In this project, we are interested in providing and customizing a distributable workflow of virtual reality 360 (VR360) suitable for compassion relief operation. Recruiting volunteers for disaster operation can face a number of obstacles and issues, these include physically and mentally challenges for volunteers. Disaster workers are usually volunteers from across the country and across the world. Most operations involves logistics in terms of financial support, transportation, emergency response vehicles and provide the victims and communities shelter, food, clothing, relief supplies and even comfort to those in need. In an ideal situation, we are looking at setting up a manageable workflow which can be operated by workers of compassion relief organization in terms of simplified method and apparatus for acquiring and generating 360 virtual content. The content should be operated and produced by multiple small teams of minimum-trained taskforces which have the capability to obtain and processing these 360 content in digital media.**

Keywords—virtual reality; augmented reality; digital humanities; disaster relief; user experience; data conservation

I. INTRODUCTION

Human resources for disaster operations are key for compassion relief management. Recruiting professionals and a great number of volunteers can be arranged based different requirements of disasters [3]. The types of disasters can include tornadoes, storms, floods, wildfires, earthquakes, and drought.

There are several modern approach such as virtual and augmented reality that can provide location-based 360 visualizations. For instance, the technical consideration and high fidelity workflow of digital preservation has been explored by Fisher et al. [1] and Okura et al. [2]. However, some of these sophisticated techniques are usually developed by and made available for professional industries and scientific communities. The lack of standardized information and open source references about 360 content generation and distribution becomes a difficulty for untrained relief workers which did not have multimedia technical background.

The main contribution of this on-going work is that we intend to provide a simplified virtual reality 360 (VR360) spherical panorama digital workflow which can be transferable and adaptable for disaster relief operators which value 360 content preservation. These preserved content shall be optimized on the 360 user experiences which enhances the awareness in terms of conservation and assessment [7]. During the initial stage of this project, the 360 content can be used for volunteer recruitment of compassion relief operations.

II. BACKGROUND

In terms of training simulation and remote assessment for emergency relief operation, preparation is a key component of disaster relief operations in early stages [4]. Making virtual reality as a solution for disaster preparedness has becoming a practical interest [10][11]. Co-ordination and collaboration are usually the main requirements in preparation [12]. The 360 visual content either in static or video format can provide visual simulation available in mobile medium or head-mount-devices.

Inaccessibility is another issue for preparation [5], therefore it may be ideal for the multimedia taskforce that is capable of obtaining 360 data to be prepared for coping up with such issue which can be performed with sufficient equipment support. In an ideal situation, 360 visual content acquisition can be also used for site recovery and humanitarian activities monitoring. Hence, essential aspects of acquisition and handling of 360 data for disaster relief operations should emphasis on high level of convenience, transportable and ease-of-use.

Volunteer recruitment is a successful factor for human resources suitable for disaster relief supply chain [5]. Most multimedia data of the disaster sites are commonly being obtained by resourceful organizations and localized authorities. For instance, private non-profit organizations may have limited access to those data and it would be difficult for such organizations to coordinate sufficient preparation for relief

operations [6]. To our interest, it will be worthy to explore 360 visualizations which can be experienced using panorama images and videos acquired at the disaster sites during the process of volunteer recruitment.

III. Approach

The proposed approach involves four simplified technical procedures. These ideal procedures to be adapted for disaster relief operations shall be made deployable instantly at the relief site should a disaster occur, this allows 360 content to be acquired first hand based on the real situation from the beginning to recovery stage. Figure 1 shows the intended digital or workflow procedure as it begins with identifying the nature of disaster whether there is a safe ground for a group operator to setup a small camera with monopod/tripod. To illustrate, the size of a Samsung manufactured dual-lens spherical panorama camera can be seen in Figure 2.

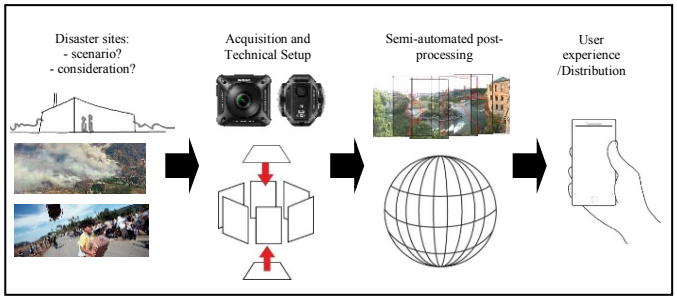

Fig. 1. Potential proposed workflow and training to be provided for relief workers /organizations.

Fig. 2. The size of compact 360 spherical panorama camera.

Such spherical camera being selected into the proposed digital workflow is ideal to be a palm-size configuration and should have a "one-button recording" feature which can be operated quick and easy even with untrained operator in the field. As shown in the Figure 1, the post-processing can be managed after an operator as successfully captured 360 raw footage stored in the memory of the 360 camera and has returned to his disaster location resource base. Post-processing method chosen essentially can be performed semi-automatically so that VR360 final content can be made ready for online distribution using a URL. In such a scenario Figure 3 shows a preset digital program provided by "KRpano" processing ten 360 samples for virtual reality environment in a few minutes. Figure 4 shows more than ten spherical panorama in 360 display being processed. These samples could be immediately viewable in platforms such as a personal computer, mobile devices and head-mount-devices (HMD).

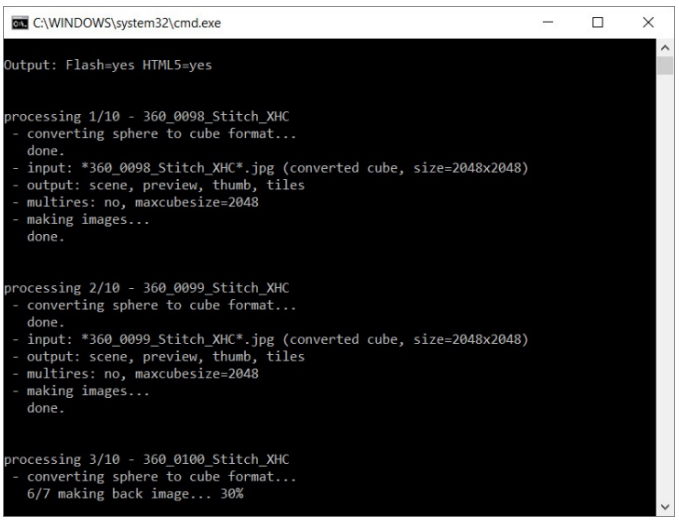

Fig. 3. Back-end automation using "KRpano" without needing complicated post-processing training.

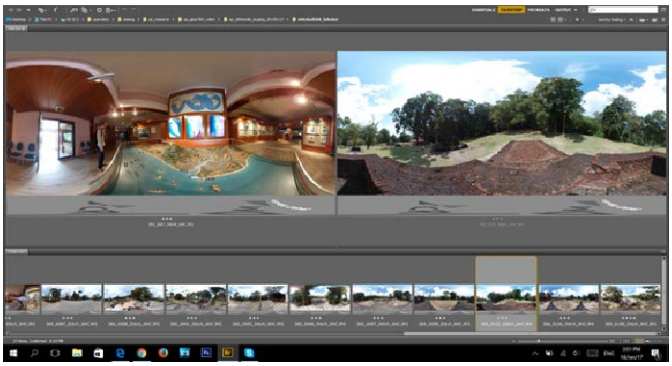

Fig. 4. A large number of spherical panorama fast and batch post-processing.

PC, mobile and tablet users can take advantage of WebVR which is widely compatible with most default web browsers of devices. WebVR approach allows target users to have flexibility to choose their preferred viewing platforms either in mobile or personal computers. The example shown in Figure 5 demonstrated VR360 content being view in stereo mode which is compatible to a head-mount-device (HMD) operated on a palm-sized mobile phone.

An example of 8k resolution panorama images which can be produced using the proposed simplified workflow can be seen in Figure 6, this was a 360 sample being obtained from the Bujang Valley historical site, Kedah in Malaysia [8]. The acquisition process requires less than 10 seconds from placing the camera on a stabilized monopod on the site to capture surround imagery.

Fig. 5. WebVR stereo viewing mode adaptable for HMD.

Fig. 6. 360 sample being obtained from the Bujang Valley historical site.

However, some drawbacks in terms of imagery quality can be observed in visual abnormalities. Figure 7 shows parallax error during stitching of imageries from the dual-lens compact 360 camera and insufficient dynamic range in terms of luminance

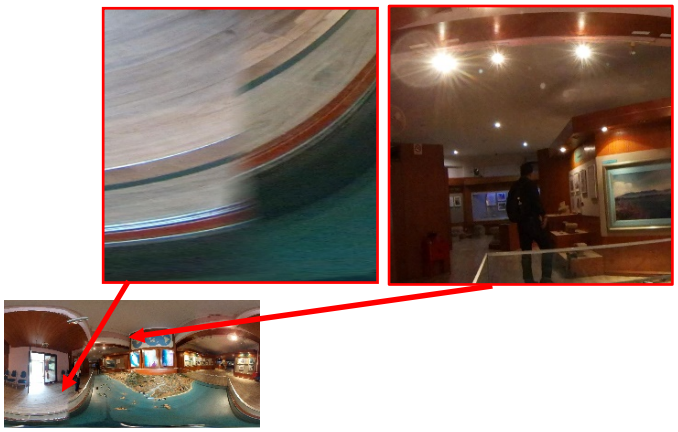

Fig. 7. Visual abnormalities observed in 8k resolution content reproduced with simplified workflow.

On the other hand, Figure 8 shows a near-perfect captured 360 content using different experimental system [9], 16k resolution high fidelity content can be reproduced but it requires an extremely complicated process. This example was a 360 spherical panorama image of a reconstructed disaster site (Great Hanshin earthquake in 1995) of the main street of Kobe, Japan. Such sophisticated system [9] produces minimum visual abnormalities and extended dynamic range, however it requires qualified personnel to provide technical support which may be unavailable on-site while managing disaster relief work.

Fig. 8. 16k screen resolution high fidelity content preservation.

There is vast amount of difficulties which requires to be solved for improving the practicality of VR360 content creation. Solving these difficulties shall provide improved immersion in terms of user experience in virtual reality applications. Such obstacles for spherical panorama reproduction may include:

- Parallax error (resulting stitching error)
- Limited dynamic range (in shadow and highlight)
- Ghosting effect (if HDRI using multiple exposures)
- Inconsistent white balance (for multiple angles)
- Inconsistent lighting distribution (for multiple angles)
- Nadir difficulty (due to tripod base)
- Time management (subject to camera configuration)
- Resolution (due to camera limitation)
- Camera or hand-shake (unstable mounting)

IV. Discussion

This work is to find ways of conserving scalable data from disaster relief events to mentor and coordinate from the transfer of data to the next event. At this conference, we expect to discuss further about issues of VR, smart technologies, and multimedia to interact and coach volunteer workers. Developing our digital and sustainable conservation methods could have an on a range of environmental and cultural applications.

In an ideal situation, virtual reality 360 content perseveration should provide extended data visualization of those disaster relief sites without increasing major workload to existing human resources. Figure 9 shows 360 content being experienced in a generic HMD using a mobile device as a computing module. The level of use-of-use and usefulness using the proposed approach for preserving, processing, interpreting and distributing VR360 content should be considered as the key challenge of introducing and implementing such system.

Fig. 9. Users experience on 360 content based on actual location using their mobile device.

V. Conclusion

In summary, in the aspect of preserving 360 information for the future in the digital space, we hope that this innovative practice is easily and conveniently adaptable for disaster relief operators. The procedure can be conserved as data which can be used future disaster relief and training. Therefore, each time, this can be used as a model of VR360 data and content creation for relief operators in scalable preservation subject to different size and nature of disasters. In future we wish to examine usability mixing of VR360 and augmented reality systems and which can provide greater level of visual communication details for disaster relief operations.

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