



VR and AR Technology on Cultural Communication

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Abstract. The theme of this platform is built around “the road of Hess”, which was initiated in the modern maritime Silk Road capital-Quanzhou, as the core of design and programming. The history of Silk Road will be presented with panorama technology, which is one of the network multimedia technology. In the form of Web APP, the real records and spread of the humanities and scenic sites of Quanzhou will be showed in 720° perspective. An immersive experience of 3D live virtual can be expected. The aim of this study is to simulate and realize the all-around real scene. In the paper, the tasks of the VR panorama fused construction include image acquisition, image registration, image smoothing, image modification by the algorithm and mathematical theory behind splicing fusion, the panoramic camera category and projection model, panoramic transformation and collection principle, the image registration of feature point and transform frequency domain. The product positioning of “maritime silk route culture” will be presented by 18 selected spots in Quanzhou. The study, with an overall design and an organization of connecting different scenes, is for the virtual scene roaming system, which is based on image.

Keywords: Maritime Silk Route · 3D virtual scene · Product design · VR panorama

1 Introduction

With the new-developing technology, virtual reality technology (VR) is applied in user scenarios more frequently and is becoming increasingly important in the computer application field. Through image and video we can realize the 720-degree immersive

panorama visual experience has been fulfilled by using the Virtual Tour System with 3D Real Scene, that need actual scene to generate [1]. Different from normal viewing angles, VR panoramic warping technology acquire better life-like viewing experience because it demands several steps including collecting all 360° photos, mending them all together and uploading the result on the mobile Internet. Users may feel like they are experiencing the situation themselves and learn new lessons while playing [2–4].

Three methods which distribute 3D life-like scene are described in this research, including the linear fusion algorithm, the future point based image saving algorithm and the gradually fading out algorithm. What makes this paper different from others is applying both the VR and AR on “Maritime Silk Route Culture.” [5–7].

2 Method

3D Panoramic Roaming Technology is an advanced virtual reality technology. It only needs some daily-accessible electric devices such as mobile phones or laptops to connect the virtual scene and network whereas VR demands more complex equipment to achieve its goal. Immersion experience can be achieved. It is based on settled spots that include panorama images generation and bring 720-degree full perspective effect [8–10].

The main concept of 3D Panoramic Roaming Technology [11] is how to produce panoramic image fusion. To ensure the quality of image fusion, it is important to pay attention to the panoramic images received. There are three method to achieve the goal, which combine panoramic head and ordinary camera, an panorama camera and applying graphics computing [12]. In this paper, the method is chosen to generate panoramic images with cost-effective equipment.

Therefore, several major contents will be successively analyzed in this paper – the panoramic image acquisition, feature point recognition on image registration task, and use smoothing algorithm on the image fusion process. The framework of image processing is shown in Fig. 1.



Fig. 1. The framework of image processing

2.1 Acquire Panorama Images

The rule of panoramic image acquisition is to collect more than 30% of the contents with overlapping areas, so that they can identify similar feature points and the later image fusion to generate three-dimensional panorama. Multiple lenses, integrating light and

shadow, head and tripod combined with the 360-degree camera are the key tools to fulfill the experiment.

The functions of ordinary camera transformation including translation, rotation, scaling in horizontal and vertical directions, are as shown in Fig. 2 and 3.

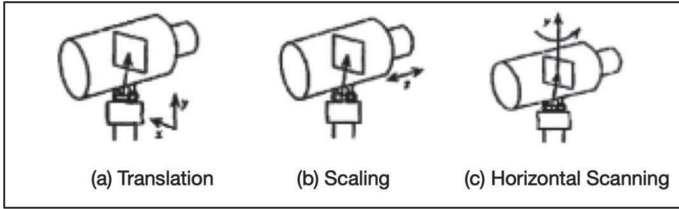


Fig. 2. Camera transformation of (a) (b) (c)

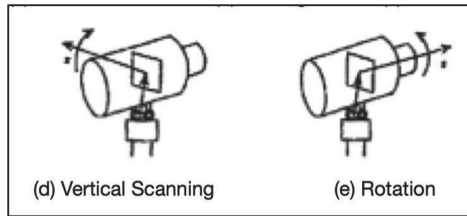


Fig. 3. Camera transformation of (d) (e)

However, in order to simulate the reduction of human fixed visual direction, the panoramic image transformation generated requires the camera in a fixed position and vertical direction without panning and zooming. The idea is to take the center of the camera as the eyes of human. The movement like the translation or rotation of the camera simulates the action of human head. For example, looking up and down, nodding the head and moving the head, these create all-round perspective experience of 720° for users. Figure 4 respectively simulates the rotation principle of the central axis point and plane.

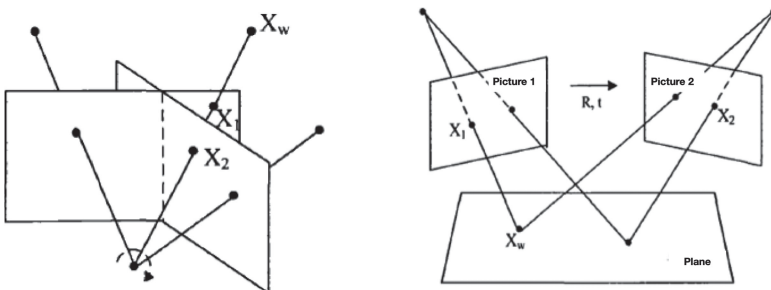


Fig. 4. Arbitrarily rotation with the core point and in the plane

2.2 Feature Point Recognition Methods on Image Registration Task

Firstly, among all methods of image processing, matching feature point is the most famous method. The principle is to label the feature points of the real panorama images with selected important attributes such as edges or lines. The main algorithms to match feature point are Harris and SIFT algorithms, which is shown in Fig. 5 and Fig. 6.

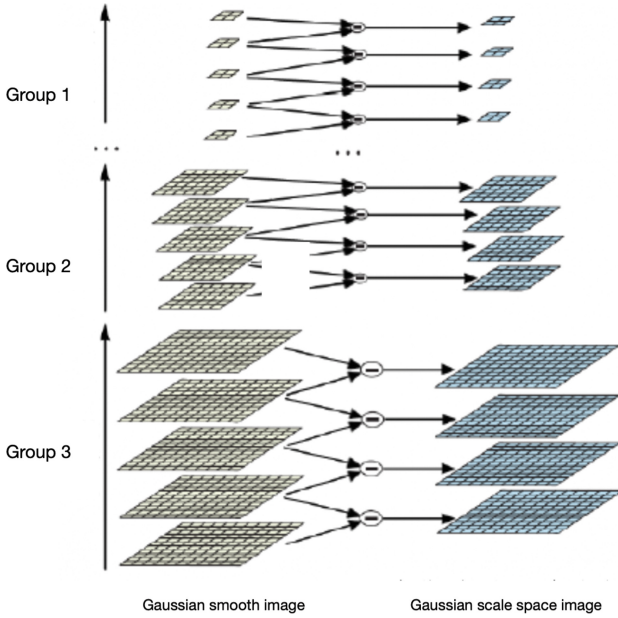


Fig. 5. DOG space image

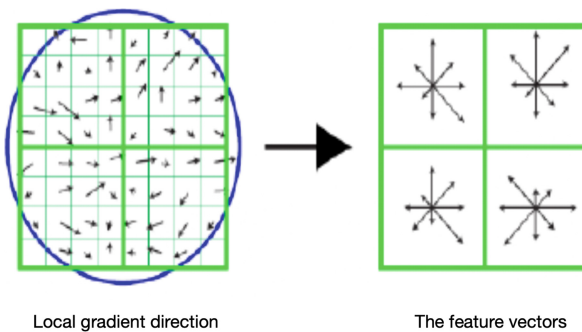


Fig. 6. SIFT generative feature description

Before the image registration being operated, the feature points must be read and calculate first. Feature point matching approach allows the feature point to expand in an easier and a more active way. Moreover, with lower sample size requirement and high

flexibility, rich image information and gray coefficient can be reserved to achieve accurate reading. However, the wrong image registration still forbids feature point matching approach its goal. As a result, to avoid image fusion failure, the RANSAC algorithm is needed to check and purify the lapses.

2.3 Use Smoothing Algorithm on Images Fusion Task

Before adjusting image color and linking all images, the images must be enrolled and adjusted. The image may not be able to save accurately if the coordinate pixels is shifted accidentally. Furthermore, more missteps including color fading, shapes and lines mangling, and objects dislocating may also show up while restoring the image.

Thus, how to apply the most suitable image synthesis algorithm to not only make the image more vivid but elevate the restoration degree and slash the vague objects. Linear fusion algorithm and fade-in and fade-out algorithm are on the top list of image synthesis algorithms we have known so far.

Linear fusion algorithm demands the user to analyze the pixel value of the images and check if there is any mistake in the saved images and lastly to confirm which side does the pixel overlap appears. If the overlap is on the right side, the image registration task of the left side is assumed to be failed, the right side will obtains full measurement weight. The superposition However, if the overlap is neither on right side or left side, by applying the following 2-1 formula, the measurement index can be found out.

$$P(x) = 0.5 \times P_1(x) + 0.5 \times P_2(x) \quad (2-1)$$

When images are very distinct from others, the linear fusion algorithm can be applied though edges might be the same. The algorithm allows images to transmit clearly and accurately and decline the lapse showing up from the image.

3 Conclusion

As China has grown into a more significant role on the globe, “One Belt and One Road” has become a popular topic. However, none of the studies has combined this issue with new digital technology. This research is the first to combine the most recognized Web App version of virtual reality panorama with the 3D panoramic roaming system of Marine Silk Road Culture which is at Quanshou. The unique culture is waiting to be explored and documented by applying the 720-degree lifelike panoramic visual experience. Advocating the Marine Silk Road Culture, which may bring more investment to the “One Belt and One Road” tourist cities, to people’s acknowledgement is the main focus of this research.

By acquiring the panoramic image, registering image with future-based recognition, mixing the image with suitable algorithm has made this research to be the first one to present the panoramic images successfully. The following step is importing the immersive experience providing technology, 3D panoramic roaming system, on the panoramic images

One limitation of this study is that the sharpness of panoramic technology still has room to be improved. Therefore, as future research, it should pay attention to steps of obtaining panorama such as shooting, registering and fusion.

References

1. Dempsey, P.: VR in movies: hollywood has fully embraced the dawn of the VR age. *Eng. Technol.* **11**(3), 31 (2016)
2. Glowacki, B.R., Freire R., Thomas, L.M., O'Connor, M., Jamieson-Binnie, A., Glowacki, D.R. : An open source Etextile VR glove for real-time manipulation of molecular simulations (2019)
3. Lee, J.H., Shvetsova, O.A.: The impact of VR application on student's competency development: a comparative study of regular and VR engineering classes with similar competency scopes. *Sustainability* **11**, 2221 (2019)
4. Manuel Sanchez-Garcia, J., Toledo-Morales, P.: Converging technologies for teaching: augmented reality, BYOD, flipped classroom. *Red-Revista De Educacion a Distancia* **55**, 22–34 (2017)
5. Mahmood, Z., Ali, T., Muhammad, N., Bibi, N., Shahzad, I., Azmat, S.: EAR: enhanced augmented reality system for sports entertainment applications. *KSII Trans. Internet Inf. Syst.* **11**(12), 6069–6091 (2017)
6. Ramirez, E.J., LaBarge, S.: Real moral problems in the use of virtual reality. *Ethics Inf. Technol.* **20**(4), 249–263 (2018). <https://doi.org/10.1007/s10676-018-9473-5>
7. Bieniek-Tobasco, A., McCormick, S., Rimal, R.N., Harrington, C.B., Shafer, M., Shaikh, H.: Communicating climate change through documentary film: imagery, emotion, and efficacy. *Clim. Change* **154**(12), 1–18 (2019)
8. Castle, J.J., Stepp, K.: Silver screen sorting: social identity and selective exposure in popular film viewing. *Soc. Sci. J.* **55**(4), 487–499 (2018)
9. Timplalex, E.: Shakespeare in digital games and virtual worlds. *Multicultural Shakespeare-Transl. Appropriation Perform.* **18**(1), 129–144 (2018)
10. Gao, H., et al.: Super-fast refresh holographic display based on liquid crystal films doped with silver nanoparticles. *IEEE Photonics J.* **11**(3), 1–7 (2019)
11. Van der Ham, I.J.M.: Elapsed time estimates in virtual reality and the physical World: the role of arousal and emotional valence (2019). http://apps.webofknowledge.com/full_record.do?product=UA&search_mode=GeneralSearch&qid=2&SID=8A4hHbvUdc9IuSCQL4b&page=1&doc=1. Accessed 26 Oct 2019
12. Kim, P.W., Lee, S.: Audience real-time bio-signal-processing-based computational intelligence model for narrative scene editing. *Multimedia Tools Appl.* **76**(23), 24833–24845 (2016). <https://doi.org/10.1007/s11042-016-4144-1>