

RiSE: Reflectance Transformation Imaging in Spatial Augmented Reality for Exhibition of Cultural Heritage

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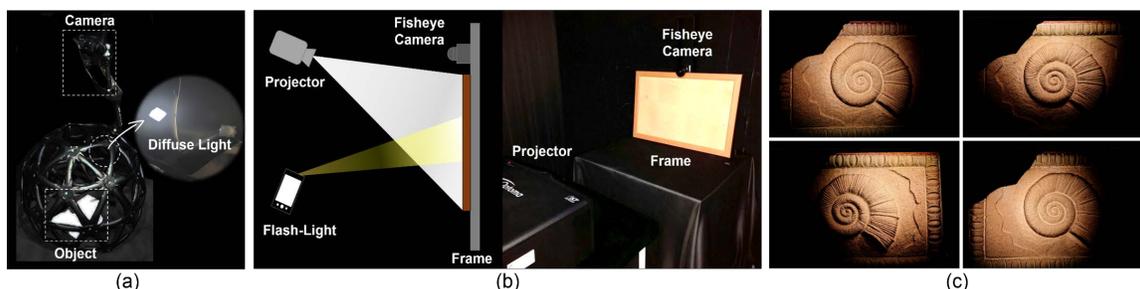


Figure 1: RTI in SAR for Exhibition: (a) the PTM measurement system, (b) configuration of the exhibition system, and (c) our results

Introduction

Traditional museums have shown interest in exhibiting a meaningful representation of cultural heritage. However, existing stereotypical exhibition fails to attract the visitors' interest continuously as it provides only static and non-interactive contents and transmits information unilaterally. Recently, high performance measurement techniques have rapidly developed to a degree that allows for the realistic digitization of cultural heritage. Based on this digitized cultural heritage, dynamic and interactive content, such as 3D video and augmented reality, have been made to improve the immersion of visitors. In spite of these attempts, the sense of artificiality is still a challenge because most existing methods demonstrate their content via screen displays.

In this paper, we present a new exhibition system that provides immersive experience and presents realistic digital cultural heritage to visitors. To this end, we measure the relief type cultural heritage based on polynomial texture mapping (PTM) which is one technique of reflectance transformation imaging (RTI). Reconstructed digital content can be exhibited using spatial augmented reality (SAR) technology that can produce immersive contents by overlapping virtual contents and real-world environment. In addition, we enable participation of the visitors by letting them interact to the system using flash light of their smart phones.

RTI in SAR System

To capture the appearance of the cultural heritage, we use the PTM proposed by [Malzbender et al. 2001]. The PTM is a method for modeling the mesostructure and texture of an object which changes according to the illumination condition by collecting multiple images and estimating the polynomial function of each pixel on the image. Our measurement system is shown in Fig. 1 (a). We acquire 40 sample images illuminated with different light directions

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on hemisphere. The Nikon D3 camera is mounted in the apex of the dome. Target object and a reflective ball are placed on the floor, and the light directions are estimated by using the reflective ball. For each pixel, the coefficients of polynomial function for intensity are estimated by a RANSAC-based least square approach to remove the effects of specular and shadow. Finally, we can create realistic textures of cultural heritage under arbitrary light directions. In order to showcase the digitized cultural heritage in an immersive manner, we project the PTM textures onto a physical surface based on SAR technology. The warping of the projected image can be defined as a parametric 2D Bezier patch by taking distortions of projection surface into account. As shown in Fig. 1 (b), a fish-eye lens is placed near a projection surface to estimate (u, v) coordinates of interactive light source, e.g. mobile flashlight, to interact with a user in real time. According to coordinates of a moving light source, the corresponding PTM images are rendered. A Gaussian blending mask is used to maximize the effects of visualization. Fig. 1 (c) shows our results of the PTM image projected onto a wooden frame. Projected images increase the perceived realism of surface structure by rendering a proper texture according to the user input.

Conclusion & Future Work

In this paper, we developed a novel exhibition system, based on SAR technology, that can provide an immersive experience to visitors by digitally showcasing cultural heritage measured through the PTM scheme. The proposed system is expected to become a new type of exhibition that will break free of the paradigm of the traditional museum. Our future work will be measuring outdoor cultural heritage on a large scale and augmenting it into an indoor exhibition space, so that we can overcome the spatial limitations of exhibitions and give people a new experience and way to explore.

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References

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