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ENVIRONMENT MAP CAPTURING USING MOBILE DEVICES

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Abstract- Mobile devices have been rapidly growing in power, capability and features of a mobile hardware devices is flexible tool for capture the environment maps to reconstruction of the real world. This captured environment maps later can be reused for rendering in virtual or augmented reality. This captured environment maps act as the source for the natural lighting and it is important part of rendering for virtual environment. This paper focus on new method for capturing, reconstruction of environment maps by a mobile devices. We capturing the natural light in high dynamic range (HDR). Moreover, additional feature is performed.
Keywords –Augmented Reality, HDR, LDR, GPU, Natural lighting.

I. INTRODUCTION

The environment maps are used to reconstruction of the real world. For this it needs the application that utilize real illumination. Then this captured environment map rendered to augmented reality. Augmented reality (AR) is a live direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPSdata [1]. This paper performed additional features for our method.
This paper focus on a new method for capturing and reconstruction of the environment map using customer mobile phones. This method does not require any additional application or hardware. We can also use the captured environment map for image-based lighting. Inertial measurement unit (IMU) of the mobile phone is used for project camera image properly to the environment map. Practical representation is the main advantage of our method.
Low Dynamic Range cannot store environment map, because it contains a broad range of intensities, for this we use high dynamic range (HDR) of environment light. In our method, the reconstruction of camera image is to HDR data via exposure mode or exposure time. The first step, we estimate the inverse camera response curves of particular camera in the calibration procedure to map the measured sensor response onto HDR radiance in an appropriate way[2]. Then this reconstructed HDR radiance values are accumulated into spherical environment map. Both camera projection to the environment map and HDR reconstruction run on the mobile GPU to produce attractive performance.

II.OTHER RELATED WORK

Environment map plays an important role in computer graphics for rendering with natural reflection. An environment map can be captured by taking a picture of reflective sphere[3][4]. We can combine the multiple pictures to obtain full 360 degree of incoming light. Another approach is to use an additional

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camera with a fish eye lens. This method needs only consumer mobile phone for to capture environment map.

Reconstruction of the HDR map is important to capture the high contrast of natural light. For reconstruction of HDR radiance from multiple images, several methods are presented. These methods calculate the HDR radiance as weighted sum of input images captured by the static camera with varying exposure times.

In the field of panorama capturing an important research has been done. Different panorama presentation have been presented including cylindrical (figure 1), spherical (figure 2) and others [5] and figure shows environment map. Panorama capturing can easily implement in mobile devices ,it is an advantage of it The previous methods for panorama capturing suffer from the limitation of low dynamic range data and therefore are not suitable for light capturing. Our method reconstructs the environment maps in HDR to accurately capture the real light.

Figure 1. Cylindrical Panorama Capture

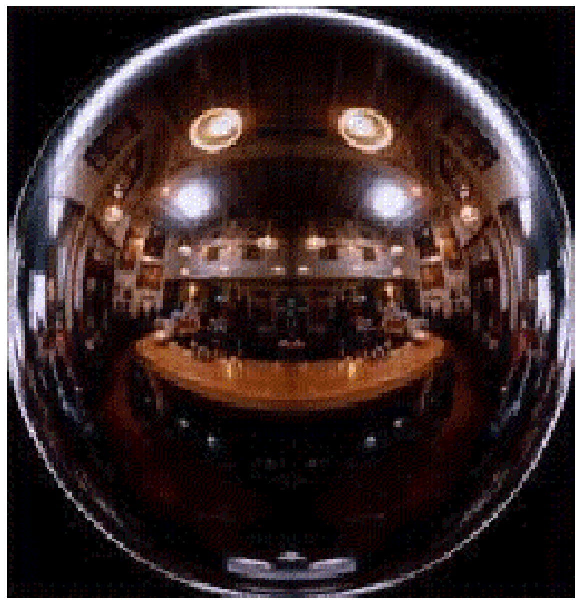

Figure 2.Sphereical Panorama Capture.

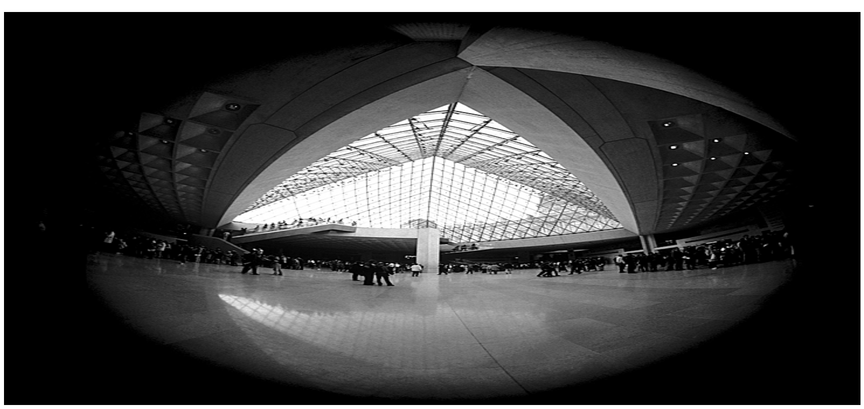

Figure 3.Environment map

III. ENVIRONMENT MAP CAPTURING

Environment mapping is an efficient image-based lighting technique for approximating the appearance of a reflective surface by means of a precomputed texture image. The texture is used to store the image of the distant environment surrounding the rendered object[6]. In our method projects the environment map capturing of each camera image in a spherical environment map and from accumulated image data reconstruct the HDR radiance. And the projection of the image is based on the current orientation of the mobile device. From data of built-in IMU this orientation is calculated. The camera image is converted to the radiances and it is stored as float values. The weighted radiance and weights from multiple images are accumulated into a spherical environment map. Finally, the accumulated data are divided by the accumulated weights to get the radiance.

III. HDR RECONSTRUCTION

High dynamic range of reconstructed radiance data is essential to accurately represent the high contrast of real light.

Therefore, low dynamic range data, captured by the image sensor, have to be converted to the HDR radiance. We use the approach presented by Peter kan. [7]. The inverse camera response function is reconstructed for each color channel in the calibration process. Then, we use these functions for the HDR reconstruction in the following procedure. A mobile camera is set to the auto-exposure mode to correctly adapt exposure time to the local portion of the scene where the camera is pointing. If two images overlap, they usually have slightly different exposure time due to the adapting auto-exposure. For i^{th} image, captured by the mobile camera, we know its exposure time t_i. Therefore, the radiance L_j can be calculated from the pixel values $y_{i\,j}$ as:

$$L_j \approx \frac{\sum_i w_{ij} t_i f^{-1}(y_{ij})}{\sum_i w_{ij} t_i^2}$$

$y_{i\,j}$is the pixel value from the ith image which is projected to the j^{th} pixel of the environment map. The radiance $L_j$corresponds to the jth pixel of the environment map. $f^{-1}()$ is the inverse camera response function. The weight w_ij is calculated according to [8]. The accumulation of the sum in the numerator of the fraction in above Equation is done for each color channel when a new image is captured and projected to the environment map. The denominator of this fraction is accumulated to the alpha value. Finally, each color channel is divided by the alpha value to obtain the reconstructed HDR radiance L_j. The HDR reconstruction runs onGPU and the environment map is accumulated to the floating point framebuffer to achieve interactive speed.

IV RESULTS

In this method to assess the capability of capturing the real illumination, we compare with real image and rendered image. To illuminate this image captured environment map is used. Light reflections on the rendered model are visually similar to the ones on the real model shows in figure 3. Due to HDR environment map brightness of reflection is correct. And shape and direction of the virtual shadows are similar to real ones. Nevertheless, the result is visually acceptable, particularly if the reconstructed map is used for image-based lighting.

Fig(a)

Fig (b)

Figure 2: Fig (a) The environment map of our method. Fig (b)(Bottom) The comparison of real (left) and rendered (right) model. The rendered model is illuminated by the captured environment map.

IV.CONCLUSION

This paper introduces a new method for HDR environment map capturing by a consumer mobile phones. This method does not require any additional hardware or application and therefore is very practical for capturing of any environment. Additionally, we reconstruct the HDR radiance from the captured and accumulated image data. Our approach is extended with image alignment method based on feature matching which corrects the orientation given by device sensors. The results show that the proposed method is beneficial for rendering with natural light. Our method can be valuable for many fields, particularly image-based lighting, material reconstruction and augmented reality.

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