Real Time Relighting for an Arbitrary Shaped Object using an RGB-D Camera

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Abstract

Usually, relighting techniques require knowledge about the shape of a target object and the lighting environment. The quality of the relighting is highly dependent on the normals accuracy of the object since they are used for the computation of the illumination. We propose a new relighting approach for arbitrary shaped objects using an RGB-D camera such as the Microsoft's Kinect. The generated depth map is useful to estimate the normals of the object, but can be inaccurate because of the noise such as discrete depth values or missing data. An accurate segmentation of the target region for relighting is also an open issue since the boundaries in the depth map does not always match color's ones. We focus on the depth map modification to segment the object region, and normal estimation for an accurate relighting. Our implementation of the method achieves a relighting at 15fps.

Key words: Relighting, RGB-D camera, GPU

1 Demonstration Description

We propose a relighting approach from a single RGB-D camera such as Kinect and implemented it on GPU. A depth sensor can obtain the scene's geometry in real time. For relighting, the segmentation of the object region and the normal estimation is very important. In our strategy, the object region is segmented using a depth thresholding. However, the boundaries in the depth map do not always match color's ones because of the noise in the depth map. Therefore, we define an invalid depth region around the object boundaries and resolve these invalid depths by using the valid depth values from the neighborhood. At this time, other invalid depth values of the object region are filled with an interpolation of nearest valid depths from the same object. The result is shown in Figure 1 (c). Compared with the raw depth map (Figure 1 (b)) the object boundaries are improved by using this process. After that, the object region is segmented and the normal map is estimated by using the integral image technique [1] (Figure 1 (d) and (e)).

In the relighting part, we need to estimate the light environment of the input and target scenes using a mirrored sphere. After that, the relighting result is obtained by computing the rate of these light environments [2]. Relighting results are shown in Figure 2.

In our demonstration, we present this real time relighting of an arbitrary shaped object for any kind of input and target scenes if we can capture their lighting environment.

Demo requirements:

- One table (2×1 m)
- Some space (2×3 m) in front of the camera and with uniform color background
- Three power outlets for laptop, RGB-D camera and display
- Reasonably good (not too dark) lighting conditions

Our equipments:

- One laptop
- One RGB-D camera with a tripod
- One mirrored sphere for obtaining the light environment

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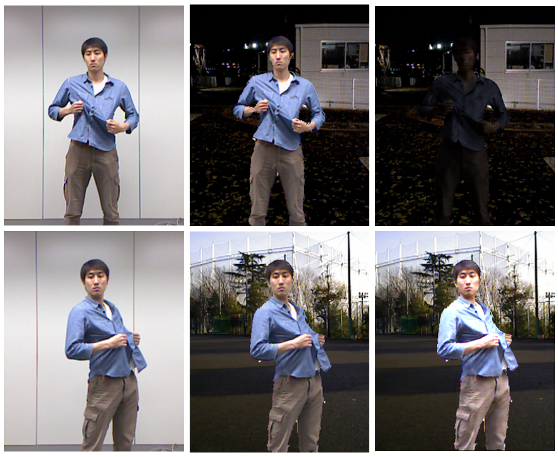
(a) (b) (c) (d) (e)

Figure 1: Depth enhancement and normal estimation. (a) and (b) are raw color and depth images captured by an RGB-D camera. (c) is depth modification result and (d) is segmentation result by using (c). (e) is normal map represented in color space.



(a) (b) (c)

Figure 2: Relighting results. Column (a) shows the input image. (b) is the composite image without relighting. (c) is the composite image with our relighting method. The above and bottom shows result relighted in *Night* and *Ground* scenes respectively. Note that the object shading is changed according to the light source position.

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