Correction of Over and Under Exposure Images Using Multiple Lighting System

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ABSTRACT

When images are acquired in bright condition, it can cause a loss of highlight details (over exposure) in bright area and a loss of shadow details (under exposure) in dark area. Over and under exposure causes a big problem when people investigate dangerous place like Fukushima nuclear plant through the camera attached remote control robot. In this paper, we propose a method to correct the over and under exposure image to solve the problem. In order to compensate over and under exposure images, multiple images are acquired in different lighting conditions. In our method, two images are acquired by turning on and off multiple illuminations which set in different positions. The image processing is as follows. The first acquired image set to base image. Next, we extract over and under exposure area from the base image, and interpolate extracted area with other images. The results show that the over and under exposure is removed from the image by our proposed method.

KEYWORDS

Image processing, High dynamic range image, Image correction, Over and under exposure, Multiple lighting system

1. Introduction

It is necessary to use remote control robots when people investigate dangerous place where they cannot enter. Especially, it is necessary to use some lightings which are attached to the robot in dark area without external lighting in order to obtain the information of surrounding as shown in Fig. 1. In this case, the problem is that a portion of the image is unclear because of over and under exposure. In order to solve this problem, we propose the method of correction over and under exposure using multiple lighting system. This method is based on high dynamic range imaging[1][2] which is a technique for obtaining one high dynamic range image by combining a plurality of images with different exposure level.

2. Proposed method

Our method consists of image acquisition, extraction of over and under exposure areas and interpolation of over and under exposure areas. The proposed method is shown in Fig. 2.

2.1. Image acquisition

In this process, multiple photographs that over and under exposure appeared in different location are captured by changing lighting condition at the same background (Fig. 3(a)). The first acquired image set to base image $\boldsymbol{I}_0^{\text{base}}$ (Fig. 3(b)) and the other image set to $\boldsymbol{I}_0^{\text{other}}$ (Fig. 3(c)).

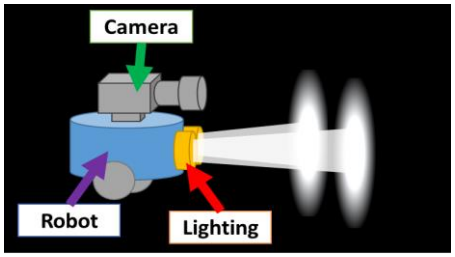

Fig. 1. Investigation using robot with attached lightings

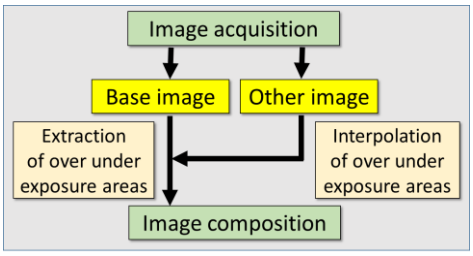

Fig. 2. Proposed method

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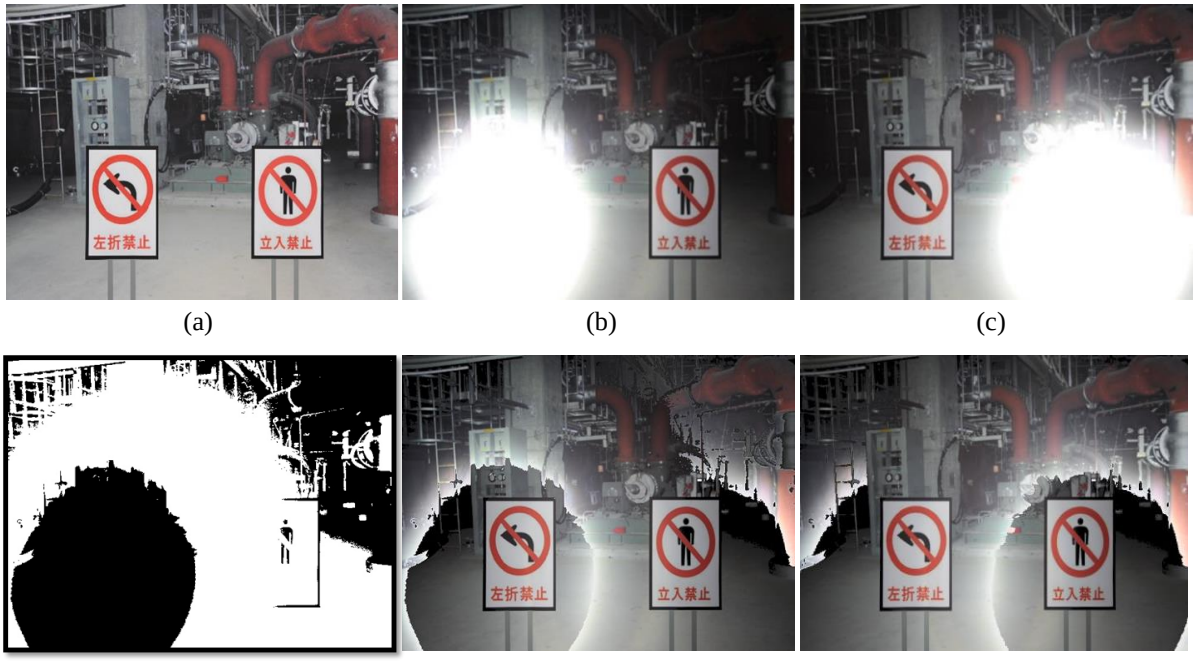

(a) (b) (c)

(d) (e) (f)

Fig. 3. Experimental result : (a)Background image, (b)Base image, (c)Other image, (d)Determination image (e)Combined image based on Fig. 2(b), (f) Combined image based on Fig. 2(c)

2.2. Extraction of over and under exposure areas

This process extracts the over and under exposure areas in the base image in order to get rid of these areas. Two threshold values are used for the extraction. If the pixel value of the base image coordinates (i,j) is included between τ_H and τ_L, the output values is 1. Otherwise the output value is 0. As a result, the obtained image is defined as a determination image D (Fig. 3(d)).

2.3. Interpolation of over and under exposure areas

In this process, we combine multiple images into one image. The areas of D=1 output $\boldsymbol{I}_0^{\text{base}}$ and the areas of D=0 are interpolated by $\boldsymbol{I}_0^{\text{other}}$. As a result of this process, the over and under exposure-corrected image $\boldsymbol{I}_f$ is obtained (Fig. 3(e), (f)).

3. Conclusion

In this paper, we proposed the method of correction the over and under exposure images using multiple lighting system. The experimental results show the effectiveness of our proposed method. For future work, we plan to apply our method to real situation like Fukushima nuclear plant.

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References

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