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Luminance Measurement of Night View based on a Smart Device

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Abstract. As economy has developed, a design of illumination for night view has been gaining a lot of attention. However, it causes not only energy waste but also light pollution from unnecessary night lighting, which effects on traffic safety as well. In this paper, we propose a new method based on a smart phone to calculate luminance which is one of the useful information in designing the illumination for night scenes. Our approach has high portability and compatibility, and also has advantages in terms of price, range of use, easiness in update and addition of new functions.

Keywords: Night View, Luminance, Smart Devices

1 Introduction

Modernization of cities has been going on for high-quality life in many countries. A city itself is doing its endeavor to build beautiful night views to attract tourists from many places. For this reason, a city's night view has been drawing a lot of attention, but it causes not only energy waste but also light pollution from unnecessary night lighting, which effects on traffic safety as well [1].

'A project for construction and maintenance of night views' is included in a landscape planning of according to the provision of Article 13 of a law for scenery, and development companies of lighting fixtures and research institutes of the design of lighting devices are considering a measure to enhance scenery and raise consciousness for it.

2 Related Works

It is recommended that Local Planning Authorities specify the following four environmental zones for exterior lighting control within their Development Plans: E1(areas with intrinsically dark landscapes) for national parks, areas of outstanding natural beauty, E2(areas of low district brightness) for rural, small village, or

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relatively dark urban location, E3(areas of medium district brightness) for small town centers or urban locations, E4(areas of high district brightness) for town/city centers with high levels of night-time activity [1].

Most luminance meters to check this brightness and environmental zones use lens as an important part of the metering system. The lens focus the light reflected or emitted from objects into a luminance meter through a small hole called aperture during a timed exposure to measure the value of luminance of a scene.

A method to measure luminance value using a digital camera was proposed to improve the defect of an optical instrument, in which a photo is taken to create an image, process the image with image processing techniques, and extract the related data including the value of luminance, a color coordinate, a luminance pattern, and etc.

After loading the images taken with a camera into a PC, a luminance analysis algorithm is applied to the images and a measurement scope is set. Then, the average value of luminance, the value of maximum and minimum, and etc. are calculated and analyzed at the defined scope after calculating the value of luminance [2, 3, 4, 5].

3 Bright Measurement using a Smart Phone

A smart phone has high portability and compatibility, and also has advantages in terms of price, range of use, easiness in update and addition of new functions, collection and analysis of data, and etc. Luminance information can be applied to various applications and areas by implementing photographing of night scenery, luminance measurement, information acquisition, level analysis based on a smart phone.

In this research, the value of luminance is calculated by using the method of digital camera measurement and new analysis algorithm to measure luminance values, and the location information of a smart phone for a scene is utilized, as well. Firstly, we figure out principles of luminance measurement by analyzing the internal structure of an existing luminance meter, analyze the sequence to calculate, and implement our proposed algorithm to measure luminance based on a smart phone.

Secondly, we implement the luminance measurement algorithm for a night scene taken using a smart phone camera, and analyze the relationship between the two algorithms for the images taken by a DSLR camera and ours. At the same time, some points are found out to supplement mutually between the two measurements methods in the overall processing procedure.

Thirdly, other necessary information is processed in addition to luminance and brightness. That is, the other information related to photos, for example, GPS, compass should be input manually in case of using a luminance meter or DSLR camera. Finally, the luminance algorithm is implemented based on the previous steps to effectively utilize sensors or functions on a smart phone camera.

4 Conclusion and Future Work

In this paper, we proposed a new method to measure luminance by using a smart phone. After analyzing weak points in measurement of night lighting based on luminance meters and / or DSLR cameras, we presented how to improve the drawbacks with a smart phone. The proposed method shows that portability is higher than existing devices and related information can be effectively acquired from the sensors embedded in a smart phone. Even though the performance of a camera in a smart phone can be lower, we can take those advantages by implementing relatively lighter luminance measurement algorithm. For our future research, we are going to research to minimize the error between two luminance values calculated by luminance meter and our new approach, and raise the accuracy of our approach.

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