College of Engineering Chengannur
Department of Computer Engineering
M. Tech. Computer Science (Image Processing)
03CS6901 Seminar I
Abstract of Proposed Seminar Topic

Local Neighbourhood Image Properties for Exposure Region Determination Method in Nonuniform Illumination Images

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Abstract

During image acquisition, non-uniform illumination regions are produced due to several factors, such as improper environment lighting and inappropriate capturing device setting. Applying contrast enhancement methods with the same enhancement concept to the whole image can over enhance or under enhance non-uniform illumination image. Thus, different and specific enhancement concepts should be applied to different regions in non-uniform illumination image. This concept requires identification of those different regions. Almost all existing methods that introduced the region determination process can only detect two different regions, namely, dark and bright, which inadequately represent the real exposure condition because the methods only consider intensity criteria to determine the regions. For this problem, a new method used for the accurate detection of non-uniform illumination regions is proposed. Different illumination levels affect not only the intensity but also the details in an image. Thus, three image attributes, namely, intensity, entropy and contrast, which are evaluated locally in detecting the regions, must be considered. For the detection to be on par with that in humans, the three attributes are combined with a rule based method for the identification of illumination regions.This proposed method qualitatively detects different illumination regions (i.e., over-exposed, well-exposed and under-exposed) in a nonuniform illumination image more accurate than the state-of-the-art methods.

Generally, different lightness values in a non-uniform illumination image can be categorised into three regions, namely, under-exposed, over-exposed and well-exposed regions. The under-exposed region is normally presented as a darker region relative to the average luminance of the entire image, whereas the over-exposed region appears brighter. The details in both regions cannot be seen or disappear in a non-uniform illumination image. The low dynamic range of intensities in under-exposed and over-exposed regions produces low contrast areas.A segmentation process that is solely based on intensity value inaccurately segments the ROI into background regions. Therefore, enhancement should be applied to an acquired image, and the contrast and brightness of the images must be improved. However, existing contrast enhancement methods simultaneously enhance the contrast of the dark (under-exposed) and bright regions (overexposed) with the same enhancement rate, thereby over enhancing the bright regions. As a result, the details in the bright regions often disappear. This problem occurs because of the illumination conditions or the exposure levels in the image are not determined before enhancement. To avoid this problem, different enhancement techniques with varying enhancement rates can be applied after various regions types are determined

Most of the existing local contrast enhancement techniques do not focus on determining exposure levels or regions in images. These techniques consider only intensity when determining the exposure regions.This method focus on the local intensity, contrast and entropy of the image as the properties that contribute to the different exposure levels in a non-uniform illumination image.

1)**Intensity** is the first image attribute included in determining illumination region. A colour image A with non-uniform illumination image of size R × C, where R and C are the number of rows and columns in the image, respectively, is first converted into Hue, Saturation, and Value (HSV) color model. The Value or intensity,V is then considered in determining the local intensity of the region in which the average intensity of the entire image,

$$V_a = \frac{1}{R*C}\sum_{i=1}^{R}\sum_{j=1}^{C} V(i,j)$$

and the standard deviation intensity of the entire image,

$$V_d = \sqrt{\frac{1}{R*C}\sum_{i=1}^{R}\sum_{j=1}^{C}(V(i,j)-V_a)^2}$$

are calculated. The upper and lower threshold points are calculated by

$$U_t = V_a + V_d$$
$$L_t = V_a - V_d$$

Then intensity, I will then be categorised into three different levels,

$$I = \begin{cases} I_{low} & if I < L_t \\ I_{middle} & if L_t \leq I \leq U_t \\ I_{high} & if I > U_t \end{cases} \tag{1}$$

All currently using methods use intensity value to determine the exposure region. However, the intensity-based classification of regions does not reflect the luminance of the regions because intensity only considers the brightness level of an image. A region can be possibly detected correctly by using the details of the region, especially for a well-exposed scene.Thus, those previous region determination methods failed to correctly identify well-exposed region.Therefore, in this work, entropy and contrast are proposed to be integrated with the intensity as these two attributes are known to best indicate the presence of details in a given space.

2)So, this method introduced **Entropy** as the second image attribute. Entropy is a measure of image information content and is widely used in many image processing applications.. The Shannon's entropy, E for a discrete random variable X, which represents an image with k grey levels x1, x2, . . . , xk , is defined as

$$E = -\sum_{i=1}^{k} P_i log_2 P_i$$

where pi represents the probability of grey level xi.. In image processing, discrete entropy refers as a measure of the number of bits required to encode image data. A high entropy value indicates a high amount of information contained and vice versa. Therefore, the amount of information relates with the details in an image, in which a high entropy value indicates more details exist in a region. This concept is adopted in proposed method for detecting the well-exposed region which must exhibit the richness in details.

3)**Contrast** of an image is considered as the third parameter in determining the exposure regions.. In image processing, contrast indicates the division of grey levels in a region.

Overall Region Determination : The final stage is conducted to categorise all blocks into one of the three previously defined regions based on the three previously determined properties.Region is determined by passing image through the rule based algorithm.Effectiveness of the proposed method is determined by comparing the region detection results obtained by the proposed method with currently using region determination methods.According to the survey results, experts agree and support that the proposed method is better than the current methods in terms of its region determination capability.

References

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