Comparative Study: Detection of Shadow and Its Removal

Neha Hial*, Somesh Dewangan**

*(Research Scholar, Department of Computer Science, Disha Institute of management & technology, Raipur (C.G)

** (Reader, Department of Computer Science, Disha Institute of management & technology, Raipur (C.G)

ABSTRACT

The presence of shadows has been dependable for reducing the trustworthiness of many computer vision algorithms, including segmentation, object detection, scene analysis, tracking, etc. Therefore, shadow detection and removal is a significant pre-processing for improving performance of such vision tasks. This work performs comparative study for three representative works of shadow detection methods each one selected from different category: the first one based on to derive a 1-d illumination invariant shadow-free image, the second one based on a hypothesis test to detect shadows from the images and then energy function concept is used to remove the shadow from the image. In this paper, we use the transformation of the gradient field for edge suppression which will result into the removal of the shadow from an image.

***Keywords* –** Cross -Projection tensors, Energy Function, Gradient field transformation, illuminant in- variance, Shadow Removal.

I. INTRODUCTION

In order to attain the affine transformation of the gradient fields the technique Cross-Projection Tensors has been introduced, which is an operation for suppressing the edges on images. This approach can also be used to remove complex scene structures such as reflection layers due to glass. While photographing through glass, flash images (images under flash illumination) usually have undesirable reflections of objects in front of the glass. We show how to recover such reflection layers and projected a gradient projection technique to remove reflections by taking the projection of the flash image intensity gradient onto the ambient image intensity gradient. We demonstrate that the gradient projection algorithm is a particular case of our approach, and commences color artifacts which can be removed by our method. Other methods for reflection removal include changing polarization and Independent Component Analysis. In this paper our aim is to design edge-suppressing operations on images. Construction of images depends on shape and reflectance of the objects in the scene and the illumination of the scene. Scene examination involves, factoring the image to recover the reflectance or illumination map. In techniques that use local per-pixel operations, a common approach is to preserve (or Suppress) image gradients at known locations so that in the recovered map, Edge suppression under varying illumination using affine transformation of gradient fields. Two images of a scene captured under different illumination, but with one having a foreground object. instance, the Retinex algorithm by Land and McCann assumes reflectance to be piece-wise constant (Mondrian scenes) and illumination to be even Horn proposed to manipulate the image gradient field under these assumptions, by setting large derivatives corresponding to the reflectance edges to zero using thresholds. By integrating the modified gradient field, one can recover the illumination map. However, a single threshold for the entire image cannot account for illumination and reflectance variations across the image. In this paper, we propose a new method for manipulating image gradient fields based on affine transformation using projection tensors. Our approach provides a principle way of removing scene texture edges from images as compared to thresholding (or zeroing the corresponding gradients). We make no assumptions on ambient lighting, smoothness of the reflectance or the illumination map and do not use explicit shadow masks.

II. LITERATURE SURVEY

In [1], it is analyzed to derive a 1-d illumination invariant shadow-free image. Then the use of the invariant image together with the original image to establish shadow edges. By setting these shadow edges to zero in an edge representation of the original image, and by consequently re-integrating this edge representation by a method paralleling lightness recovery, They are able to arrive at their sought after full color, shadow free image. A requirement for the application of the method is that they must have a calibrated camera. It has been analyzed that a good calibration can be achieved simply by recording a sequence of images of a fixed outdoor scene over the course of a day. After calibration, only a single image is required for shadow removal. It is shown that the resulting calibration is close to those achievable using measurements of the camera's sensitivity functions. Illumination conditions can confound many algorithms in vision. Like, changes in the color or intensity of the illumination in a scene can cause problems for algorithms which intend to segment the image, or recognize, objects in the scene. One illumination effect which can cause particular problems for these algorithms is that of shadows. The disambiguation of edges due to shadows and those due to material changes is a complicated problem and has a long history in computer vision research In addition; the exploration of shadows as cues for image understanding has an even older lineage. Recently, the significance of understanding shadows has come to the fore in digital photography applications including color correction and dynamic range compression. One possible solution to the confounding problems of shadows is to originate images which are shadow free: that is to process images such that the shadows are removed whilst retaining all other salient information within the image. Recently, a study aimed at lightness computation set out a clever method to attenuate the consequence of shadows in an image. Unfortunately however, this method requires not just a single image, but rather a sequence of images, captured with a stationary camera over a period of time such that the illumination in the scene (specially the position of the shadows) changes noticeably The example used by the author was a sequence of grey-scale images of a fixed outdoor scene, captured over the course of a day. Assuming that material changes are constant in the scene and that shadows move as the day progresses, it follows that the median edge map (for the sequence) can be used to determine material edges (shadow edges since they move are transitory and so do not affect the median). Given the material edge-map it is possible to create an intrinsic image that depends only on reflectance. This reflectance map might then be compared against the original sequence and an intrinsic illuminant map for each image recovered. While this method works well a major limitation of the approach is that the illumination independent (and shadow free) image can only be derived from a sequence of time varying images. In this paper a method has been proposed for removing shadows from images which in contrast to this previous work requires only a single image. The approach is founded on an application of a recently developed method for eliminating from an image the color and intensity of the prevailing illumination. The method works by finding a single scalar function of image an RGB that is invariant to changes in light color and intensity i.e. it is a 1-dimensional invariant image that depends only on reflectance. Because a shadow edge is evidence of a change in only the color and intensity of the incident light, shadows are removed in the invariant image. Importantly, and in contrast to antecedent invariant calculations, the scalar function operates at a pixel and so is not confounded by features such as occluding edges which can affect invariants calculated over a region of an image. As in [2]. This has provided a hypothesis test to detect shadows from the images and then the concept of energy function is used to remove the shadow from the image. The algorithm used to remove the shadow. The first step is to load image with shadow, which have probably same texture throughout. By applying contra harmonic filter pepper and salt noise is removed. Effect of shadow in each of the three dimensions of color is determined. And then average frame is computed in order to remove the shadow properly So the colors in shadow regions have superior value than the average, while colors in non-shadow regions have smaller value than the average values. Images are represented by varying degrees of red, green, and blue (RGB). Red, green, and blue backgrounds are selected because these are the colors whose intensities, relative and absolute, are represented by positive integers up to 255. Then, construct a threshold piecewise function to extract shadow regions. The results of the threshold function is a binary bitmap where the pixel has a value of zero if the corresponding pixel is in the shadow region and it has a value of one if the corresponding pixel is in the nonshadow region.

III. DESCRIPTION OF THREE METHODS

A. To obtain the 1-d illumination invariant shadow free image: An experimental calibration has two main advantages over a calibration based on known spectral sensitivities. First, RGBs in camera are often gamma corrected (R, G and B are raised to some power) prior to storage. In- deed most images viewed on a computer monitor are (roughly) the square root of the linear signal. This is because monitors have a squared transfer function and so the squaring of the monitor cancels the square root of the camera resulting in the required linear signal. However, for the calibration set forth above, the gamma is simply an unknown multiplier in the recovered parameter and does not change the direction of the lighting direction. For considering the effect of a gamma correction on the invariant image calculation, they simply deduce a different vector ek and ep than that would have calculated using linear signals; but the effect on images is the same: e? produces an invariant image. The second advantage of an experimental calibration is that the camera sensitivity may change as a function of time and temperature. A continuous adaptive calibration would support shadow removal even if the current state of the camera differed from manufacturer specifications.
B. To obtain the shadow free image by using energy function. The effects of shadow on different combinations of colors are represented. The shadow pixels that belong to a corresponding color are isolated and removed. In this work first preprocessing of image is done by filtering the image using contra harmonic filter where pepper noise is removed. Then, average color values of red, green¸ blue (primary)

components in image are obtained which are considered dark pixels as of shadow regions. Then hypothesis test is used to detect the shadow and shadows are detected by comparing average R, G and B values with original R, G and B values of image. After shadows are detected then shadow removal is done by using energy function. After the shadows are detected, the next task is to define an energy function to remove shadows. There are two different methods to produce light for the shadow region. In the first method, it is assumed that the required light is a constant multiple of white light. In the second method, it is assumed that the required light is a constant, not necessarily a multiple of white light. However, both the above methods emphasized the third assumption i.e. the illumination is close of being constant inside the shadow regions. Moreover for both the methods, there is a need to compute the average value for each colour (light) inside and outside shadow regions. Since shadows occur because of lack in light in certain region, shadows are removed by supplying more light to the shadows regions only. An effective noise reduction method for this type of noise involves the usage of a contra harmonic filter. The salt and pepper noise is also known as data drop out noise, speckle or intensity spikes.

C. Proposed Methodology: Edge suppression by using Gradient field transformation. This approach can also be used to remove multifarious scene structures such as reflection layers due to glass. While photographing through glass, flash images (images under flash illumination) usually have adverse reflections of objects in front of the glass. It can be used to illustrate how to recover such reflection layers. A gradient projection technique has been projected to remove reflections by taking the projection of the flash image intensity gradient onto the ambient image intensity gradient. The gradient projection algorithm is a unique case of this approach, and introduces color artifacts which can be removed by our method. Other methods for reflection removal include changing polarization or focus and Independent Component Analysis (ICA). Background subtraction is used to segment moving regions in image sequences taken from a static camera [11, 12]. There exists vast literature on background modeling using adaptive/non-adaptive Gaussian mixture models and its variants. See review by Piccardi [13] and references therein. Layer separation in presence of motion has been discussed in [14, 15]. We show how mutual edge-suppression can be effectively used for foreground extraction of opaque layers. Here gradient-based approach relies on local structure rather than absolute intensities and can handle significant illumination variations across images. Local structure tensors and diffusion tensors derived from them have been used for spatio-temporal image processing and optical flow.

IV. CONCLUSION

We had analyzed the two techniques for removal of the shadow and one proposed methodology for the implementation. Among the two techniques the first technique described about obtaining the 1-d illumination invariant shadow free image, the second technique specifies about obtaining the shadow free image by using the energy function and the third proposed methodology describes about an approach for edge-suppressing operations on an image, based on affine transformation of gradient fields using cross projection tensor derived from another image. Here the approach is local and requires no global analysis. In recovering the illumination map, we make the usual assumption that the scene texture edges do not coincide with the illumination edges. Hence, all such illumination edges cannot be recovered. Similarly, while extracting foreground layer, edges of the foreground object which exactly align with the background edges cannot be recovered. This may be handled by incorporating additional global information in designing the cross projection tensors, which remains an area of future work.

REFERENCES

[1] G.D. Finlayson and S.D. Hordley. Color constancy at a pixel. J. Opt. Soc. Am. A, 18(2):253{264, Feb. 2001. Also, UK Patent application no. 0000682.5. Under review, British Patent Office.

[2] R. Gershon, A.D. Jepson, and J.K. Tsotsos. Ambient illumination and the de-termination of material changes. J. Opt. Soc. Am. A, 3:1700{1707, 1986. 3. D. L.Waltz. Understanding line drawings of scenes with shadows. In P.H. Winston, editor, The Psychology of Computer Vision, pages19-91.McGraw-Hil1 1975

[3] C. Fredembach, G. Finlayson,: Simple shadow removal", In Proceedings of International Conference on Pattern Recognition, (ICPR), pp. 832–835, 2006

[4] J.M. Wang, Y.C. Chung, C.L. Chang, S.W. Chen, "Shadow Detection and Removal for Traffic Images", Proc. IEEE International Conference on Networking, Sensing and Control, volume 1, pp. 649 – 654, 2004. [3] T. Chen, W. Yin, X.S. Zhou, D. Comaniciu, and T.S. Huang, "Illumination Normalization for Face Recognition and Uneven Background Correction Using Total Variation Based Image Models", Proceedings CVPR, volume 2, pp. 532-539, 2005.

[5] Y. Adini, Y. Moses, and S. Ullman, "Face recognition: The problem of compensating for changes in illumination direction", IEEE Transacations Pattern Analaysis Machine

5.Intelligence, volume 19, no. 7, pp. 721–732, 1997.

[6] G. Funka-Lea, “The visual recognition of shadows by an active observer”, PhD thesis, Department of computer and information science, university of pennsylania, 1994.

[7] A. Agrawal, R. Raskar, S. Nayar, and Y. Li. Removing photography artifacts using gradient projection and flashexposure sampling. ACM Trans. Graph., 24(3):828–835, 2005.

[8] G. Aubert and P. Kornprobst. Mathematical Problems in Im- age Processing: Partial Differential Equations and the Cal- culus of Variations, volume 147 of Applied Mathematical Sciences. Springer-Verlag, 2002.

[9] H. Barrow and J. Tenenbaum. Recovering intrinsic scene characteristics from images. In Computer Vision Systems.

[10] H. Chen, P. Belhumeur, and D. Jacobs. In search of illumination invariants. In Proc. Conf. Computer Vision and PatternRecognition,pages254–261,2000

[11] A. Elgammal, D. Harwood, and L. Davis. Non-parametric model for background subtraction. In Proc. European Conf. Computer Vision, pages 751–767, 2000.

[12] C. Stauffer and W. Grimson. Adaptive background mixture models for real-time tracking. In Proc. Conf. Computer Vi- sion and Pattern Recognition, volume 2, page 252, 1999.

[13] M. Piccardi. Background subtraction techniques: a review. In Proc. IEEE SMC Intl. Conf. Systems, Man and Cybernet- ics, Oct. 2004.

[14] B. Sarel and M. Irani. Separating transparent layers through layer information exchange. In ECCV (4), pages 328–341, 2004.

[15] R. Szeliski, S. Avidan, and P. Anandan. Layer extraction from multiple images containing reflections and transparency. In Proc. Conf. Computer Vision and Pattern Recog- nition, pages 246–243, June 2000.