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A REVIEW ON ILLUMINATION COMPENSATION AND ILLUMINATION INVARIANT TRACKING METHODS

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Abstract: Video surveillance is an active and most demanding area in computer vision. Tracking the visual targets is difficult in surveillance and activity analysis. Object tracking is challenging when target undergoes change in illumination. To deal with illumination variation in object tracking this paper gives an overview of several illumination compensation and normalization methods and also presents a review on illumination invariant object tracking approach.

Keywords: Discrete cosine transform, Illumination, Illumination compensation, Normalization, Object tracking, Visual target, Mean shift, Illumination variation

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INTRODUCTION

As one of the most important tasks of the computer vision, object tracking is widely used for many applications such as traffic monitoring, vehicle navigation, human computer interaction. Because of uncontrollable lighting condition object tracking is very challenging. For example illumination of outside environment changes because of many kinds of lighting conditions i.e. day, night, lamps, weather. Illumination change usually results in challenging problems for many computer vision applications such as recognition, tracking and motion analysis. A majority of technology have focused on enhancement of grey-level images in spatial domain. Later approaches for enhancing the color images taken into account chromatic information.

Nowadays images are represented in compressed form. To avoid the computational complexity compressed domain enhancement is invented.

Particularly processing in DCT domain has attracted significant attention of researchers.

This paper focuses on the variable illumination problem occurring in visual target analysis. For this it is intended to enhance images or frames by using illumination compensation methods.

The remaining part of the paper is arranged as follows. Section II presents detail description of illumination normalization and compensation methods. In Section III illumination invariant object tracking approach is given. And finally conclusion is presented in section IV.

ILLUMINATION COMPENSATION METHODS

Enhancement of images/videos basically improves the representation of information perceived. This is for providing better input to the automated image/video processing techniques. The objective of illumination compensation methods is to make image suitable for given task. In the last years various ways have been projected to work out illumination variation problem. They are as follows.

A. Pre-processing

Image pre-processing algorithms are put to use to make illumination stable[1]. General purpose image pre-processing algorithms such as Histogram Equalization, Gamma correction and Log transforms have also been used to normalize the illumination[2].

However using these general purpose techniques it is difficult to deal with non uniform illumination variation. Adaptive histogram equalization (AHE), Region based histogram equalization (RHE) and block based histogram equalization (BHE) have also been used to

manage with nonuniform illumination variation. Gamma Intensity Correction (GIC) and Quotient illumination relighting (QIR) have also been used for normalization of illumination [3] .GIC and QIR methods were used for changing illumination condition. GIC-Gamma intensity correction is used to normalize overall image intensity. But it fails when side lighting effects exist. QIR-Quotient illumination relighting method is used to remove side lighting effects. But it works only when the lighting modes i.e. light source direction, predefined canonical lighting condition are known.

B. Invariant Feature Extraction

The illumination invariant features are separated to make recognition process easy. Due to changes in illumination condition, variations in the images are produced. But study shows that representations like edge maps, derivatives of gray level and Gabor filter which are illumination invariant cannot overcome image variations.

Very recently the illumination normalization approach was proposed, in this approach DCT is employed for compensating illumination variation. The advantages of DCT domain is that it is possible to enhance features by modifying DC and/or AC coefficients[1]. Different algorithms have been used for grey and color images in block DCT domain. There are some new approaches investigated on the basis of scaling of DCT coefficients for illumination compensation. The key idea of one of the new approaches [4] for illumination compensation is that illuminations variations can be considerably minimized by deleting low-frequency discrete cosine transform (DCT) coefficients. Illumination variation mainly lie in low frequency band, we can find them using DCT. If DCT is applied to logarithmic image and DCT coefficients are discarded then it will adjust the illumination. Hence DCT is applied in logarithmic domain. But directly discarding the low frequency DCT coefficients cause loss of information. Another way [2] for compensation is that first the full input image is contrast stretched using histogram equalization and then DCT is applied to reduce variation in illumination. The illumination information is present in low frequency DC coefficients .A new way is used to subdue low frequency coefficients. The value of first DC coefficient is kept high for achieving contrast enhancement. In this way illumination is compensated.

Another new approach used to handle the illumination uses the algorithm based on DCT. This algorithm treats only DC coefficient, not all low frequency coefficients [5]. Here a group of particular number of frames is selected and algorithm is applied to modify DC coefficient value. If required then DC values are further modified by maximum Eigen value. In this way illumination is corrected.

TRACKING METHODS

Video surveillance is a process of analyzing video sequences. Object detection and object tracking are two steps in video analysis. Moving object detection is the basic step for further analysis of video. Different methods have been used for detection are background subtraction methods, statistical methods, temporal differencing, Eigen background subtraction etc. Until now a general purpose visual target tracker which can be applied to any real world data has not been come out.

The factors which affect the working of visual tracker are illumination effects or drastic changes in lighting conditions, clutter and sudden change in velocity. In this paper our focus is on illumination variation and the method which is invariant to illumination change so that it will track better through lighting effects.

A. Based on visual features

The basic tracker is mean shift tracker. It is suggested by Comaniciu et al. [6].For non-rigid object tracking mean shift is used. Mean shift means shifting the mean. Prototype of this method is proposed by Fukunaga and Hosteler. This algorithm is based on visual features like color and/ or texture. First it identify the object, find the probability density function and measuring the similarity detects most probable target position. Other related research based on visual features like color target tracking and tracking via graph cuts.

B. Based on Multiscale phase method

For tracking target under changes in illumination another approach used is based on multiscale phase. Here monogenic scale space representation is used to extract feature information in every video frame. With this multiscale phase information is captured which is invariant to illumination change. It is used to match points between frames. Experimentally it is shown that this method works only when illumination is not dark [7].

C. Based on Corrected Background- Weighted Histogram (CBWH) Method

The basic tracking method is improved as it considers only foreground features of target and candidate. Here target model is now represented by background weighted histogram (BWH). Because some target features may present in background and also difficult to represent target and candidate as they might contain background features. Background features are expressed by BWH. It reduces the occurrence of background in target formulation. The new more efficient approach [8] is corrected background weighted histogram (CBWH). BWH transforms both

target and candidate but CBWH transforms only target model. It effectively reduces the background interference than BWH. This technique can deal with minor changes in illumination but fails when illumination is dark.

CONCLUSION

Illumination of the surveillance video is critical to predict. It depends upon the real life factors like time, place, weather condition, lighting effects etc. where the video is taken. One of the major issues in visual target tracking is variation in illumination. The purpose of this work was to look into the problem of illumination variation. For this the study of several illumination compensation methods and illumination invariant object tracking approaches has been carried out. For best results use mean shift tracking approach in unison with proper illumination compensation method.

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