Auto white balancing

A PROJECT REPORT

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18MIS1033 18MIS1035 18MIS1105 18MIS1038
Reg. No. nnMCAnnnn

in partial fulfillment for the award of the degree of

Master of Computer Applications

School of Computer Science and Engineering

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June - 2020

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DECLARATION

I hereby declare that the project entitled **Auto white balancing** submitted by me to the School of Computer Science and Engineering, Vellore Institute of Technology - Chennai Campus, 600 127 in partial fulfillment of the requirements of the award of the degree of **Master of Computer Applications** is a bona-fide record of the work carried out by me under the supervision of **Guide**. I further declare that the work reported in this project, has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma of this institute or of any other institute or University.

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CERTIFICATE

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(Reg. No. nnMCAnnnn) to Vellore Institute of Technology - Chennai Campus, in partial fulfillment of the requirement for the award of the degree of **Master of Computer Applications** is a bona-fide record carried out under my guidance. The project fulfills the requirements as per the regulations of this University and in my opinion meets the necessary standards for submission. The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma and the same is certified.

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Acknowledgement

Give your acknowledgement in the following hierarchy: Guide Project Co-ordinator Program Chair Dean and Others.

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Abstract

Auto White Balance (AWB) plays a key role during a camera system, and determines image quality to an outsized extent. Existing AWB algorithms don't seem to be completely reliable and sometimes produce inconsistent temporal estimates for consecutive frames, resulting in abrupt colour changes within the output video stream. This paper presents an efficient approach to stabilize AWB estimates in a picture by detecting scene and/or light changes and adaptively setting appropriate convergence times.

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Chapter 1

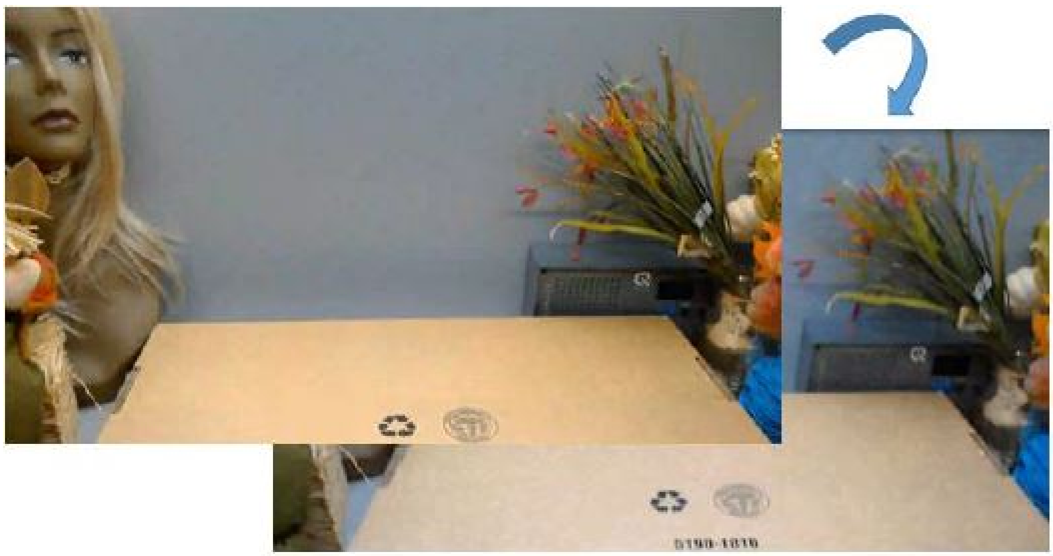
Introduction

Automatic white balancing (AWB) mimics the chromatic adaptation functionality of the human sensory system. It refers to the method of correcting the image for colour shifts attributed to the colour of a lightweight source. Thus, AWB methods have a crucial role in colour imaging devices, like digital cameras, aiming at a faithful representation of the visual scene in real time, without any manual adjustment from the user. In video or live-view (preview) modes, AWB estimates are usually produced for every frame of a continual video stream. Therefore, stabilizing AWB estimates is crucial to provide visually-pleasing video.

Stabilizing AWB is typically approached by calculating the ultimate AWB estimate for the present frame as a weighted average of temporal AWB estimates obtained for the present frame and several other prior frames. the number of prior frames to be considered is typically defined relative to a continuing convergence time assigned to AWB algorithm during tuning phase. AWB algorithms are not completely reliable and infrequently produce different or maybe incorrect temporal estimates for consecutive frames, leading to abrupt colour 4 changes within the output video stream. One solution is to increase the convergence time. However, having one large convergence time incorporates a drawback of manufacturing a lag when a quick AWB response is desired, as an example, in situations with the sunshine source and/or the scene changes.

There is a wealth of published literature on AWB algorithms for photography emphasizing the importance of the accurate estimate of white point on image quality [1, 2, 3, 4, 5, 7, 8,9, 10]. It allows for a white balance control with relevancy a white portion of an object within the field of view of the video camera. Similarly, proposes an approach to a neighbourhood automatic white balance algorithm. Also, proposes an algorithm that finds more proper white pixels to calculate the

averaged distortion and improve the precision of the estimated colour temperature. In addition, the add proposes an approach to compensate the colour differences by deciding whether the colour distortion of the scene is caused by a lightweight source or a chromatic object. However, the aforementioned works mainly target accurate AWB computation for any given frame independently. While is predicated on a multiple frame approach for white balancing of digital colour images, their main contribution is on modifying the exposure time independently for each colour component.
In this work, we propose a method on stabilizing AWB estimates for continuous video stream, while providing the flexibility of different convergence rates under various scene/light source changes for the end user.



The above picture (1) is an example of dramatic change in colour due to inconsistent AWB results. Frames shown are within a small window in a picture without abrupt changes in light source and scene. Best viewed in colour.

Chapter 2

APPROACH

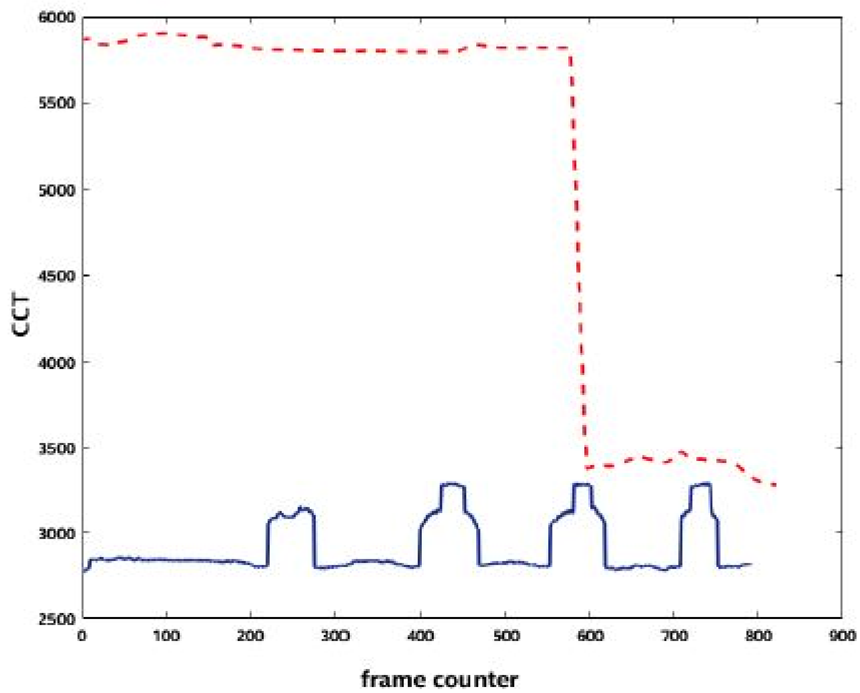
The proposed approach adaptively sets appropriate convergence times by detecting scene and lightweight source changes through analysis of temporal changes between video frames using several feature signals, like the correlated colour temperature, colour statistics, and high-frequency image information. The proposed method is effective, computationally efficient, and produces visually pleasing video.

Chapter 3

ALGORITHM DESCRIPTION

This work purposes a method that adaptively acts appropriate convergence times by detecting scene or light source changes. In particular, the proposed method aims at recognizing the following scenarios:

- Scene change and no light source change.
- Light source change and no scene change.
- Scene change and light source change.



The above graph (pic2) illustrates the process of CCT Values associated with set of continuous frames of a halfway carpet with negligible changes in light source (blue) and a picture of lab booth undergoing a light source change (dotted red).

Each one of the above situations is related with a particular convergence time, with the biggest being utilized in circumstances when no light source and no scene change are distinguished, and the littlest being utilized in circumstances with both light source and scene changes. This is accomplished by investigating fleeting changes in a few component signals, acquired for each edge of the information video stream. These highlight signals incorporate the associated shading temperature (CCT) values, shading measurements, and high-recurrence picture data.

The CCT esteem gives a proportion of light source shading show upance characterized by the nearness of the light source's chromaticity directions to the black-body locus. This worth can be evaluated by finding the nearest point to the light source's white point on the Planckian locus. Since most illuminants can be portrayed by the shading temperature of the light source and 7 different 3A (auto- introduction, auto white-parity, and auto-center (AF)) frameworks us partner yield some type of CCT data, breaking down worldly contrasts in CCT values gives a helpful data on potential light source changes. In this manner, the proposed strategy focuses on finding the casings with huge contrasts between their evaluated CCT values. In our tests, the change in CCT values is registered utilizing the supreme distinction between the CCT esteems related with outline I and casing j. This is summed up as following:

$$DCCT(I; j) = jCCTi\square CCT\ jj \quad \text{-- (1)}$$

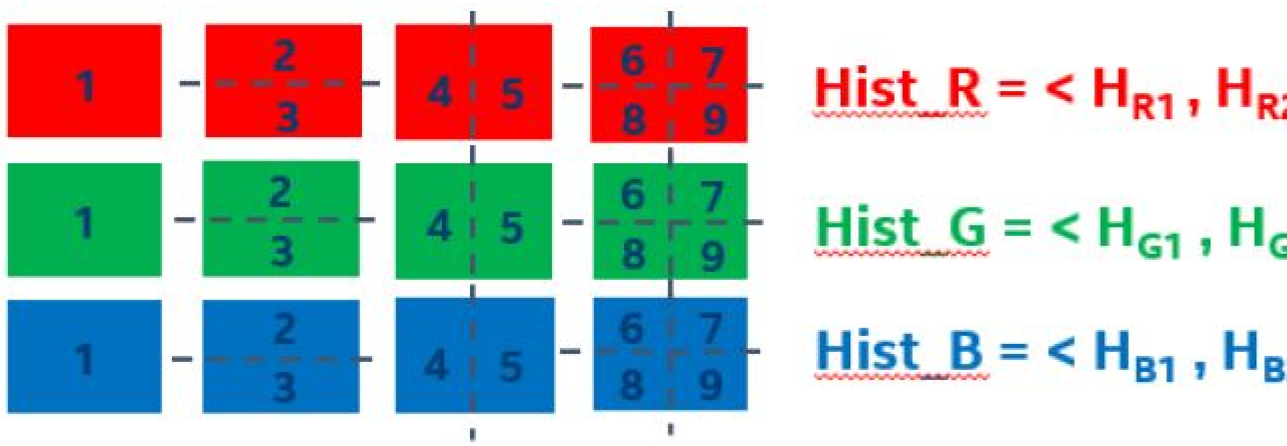
where CCTi denotes the CCT value at frame i. In addition, Figure 2 demonstrates how CCT values could be a useful indicator on light source change by illustrating sample CCT values associated with contiguous frames of a video undergoing a negligible light source change versus a dramatic light source change. It can be seen that the maximum DCCT between continuous frames is about 300 for the video with negligible light source change and is about 2500 for the video with drastic light source change.

The proposed technique additionally depends on shading measurements which are utilized to acquire both worldwide and limited data on each outline. In the previous case, one histogram for every shading channel is determined to gather the insights from the whole casing. In the last case, confined shading histograms are gotten for different spatial parcels of each casing. For example, the edge can be partitioned into equal parts (top and base, both ways), quadrants, and some other non-covering or covering squares dependent on a few foreordained measures. Histograms can be determined in RGB or some other appropriate shading space, for example, YUV, LAB, and so forth. Acquired worldwide and confined histograms are joined and standardized for each shading channel. So as to join the worldwide and restricted shading channel data related with each casing, one can either link these histograms, or register a weighted normal of them. Standardization can likewise be applied utilizing unique procedures, for example '1, '2, and '. Subsequent to finishing the standardization, each edge is spoken to by a vector that joins standardized histograms from all shading channels. The vectors acquired for various casings are broke down for transient changes. The distinction between these vectors can be registered utilizing Hellinger separation, Euclidean separation, Minkowski separation, or internal item. In our trials, the shading measurements are made by connecting the '1 standardized worldwide and neighborhood histograms related to each shading channel R, G, and B, trailed by another

'1 standardization. In this paper, we allude to these histograms as spatial pyramid of shading histograms or in short shading insights (CS) [13]. Moreover, we use Hellinger separation to gauge the distinctions between shading insights of casings I and j:

$$\Delta CS(i,j) = \sqrt{\sum_{k=0}^{K} (h_k^{(i)} - h_k^{(j)})^2} \tag{2}$$

with h(i) being the normalized spatial pyramid of color histogram associated to frame i, and K denoting the total number of bins in each histogram.
graphicx



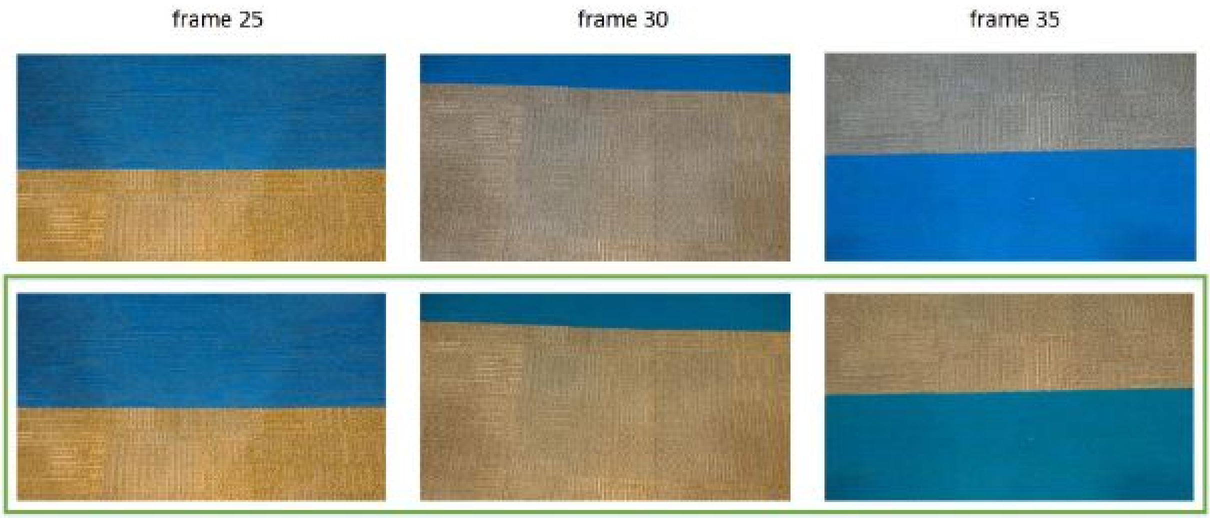
The above (Pic-3) illustrates the algorithm based on spatial pyramid of color histograms.

The last element signal caries the high-recurrence information related with each casing, putting a specific accentuation on edges and corners. As in the past, the component signal extricated for various edges is broke down for worldly changes. The high-recurrence data can be extricated utilizing highlight detectors, for example, Scale-Invariant-Feature-Transforms (SIFT) [11] or Speeded-Up-Robust-Features (SURF) [12], and the level of incomparability between the edges is estimated by the reverse of the number of coordinating focal points. Moreover, the element sign can be gotten through high-pass sifting of person outlines, for example, utilizing the Sobel, Canny, Laplacian or a few other edge administrators. This is trailed by assessing the fleeting contrasts in high-recurrence substance utilizing Manhattan separation, be that as it may, other separation measurements, for example, Euclidean separation can be utilized also. This procedure can be applied to the dark scale adaptation of the RGB picture or the luminance channel when the caught image is changed to YUV, YCbCr, LAB, LUV, HSV, or a few other reasonable shading spaces which isolates the luminance from other shading qualities, for example, chrominance, tint, and immersion. It is likewise conceivable to process each shading channel independently and at that point consolidate the middle outcomes. On the other hand, the high- recurrence picture data can be separated such that takes favorable position of shading connections; for example, utilizing vector edge administrators. In this paper, the high recurrence data is computed by high-pass separating the individual edges in dark scale utilizing Sobel administrator and estimating the ’1 separation between the edge vectors of successive casings. The proposed strategy in its substance or any of its plan elements (i.e., transient change recognition dependent on CCT, shading states spasms, and high-recurrence picture data), can be applied to full-goals video outlines or their subsampled (scaled back) or in any case prepared (e.g., commotion decrease) renditions. Notwithstanding of such pre-preparing, there are a few different ways how the proposed strategy can be applied by and by. For example, one can pick to assess the contrasts between the two sequential edges, or on the other hand characterize a fixed advance capacity to choose the casings that are com- pared with one another. Also, one can choose a versatile venture to assess the contrasts between the present casing and the last casing with a distinguished scene as well as light source change. In any of these preparing modes, an enormous contrast between CCT values for two considered casings is deciphered as a light source change. Littler CCT contrasts can likewise recommend a light source change, yet just if shading histograms for two thought about edges change essentially while the related high-recurrence substance stay comparative. In the event that neither of these two cases happens, the proposed technique checks for a potential scene change; this circumstance is us partner related with enormous contrasts in both shading histograms and high-recurrence content. In every single other case, changes between the two casings are viewed as insignificant.

Chapter 4

EVALUATION

The real assessment of whether the distinctions in CCT values, shading measurements, and high-recurrence picture data between the two casings are sufficiently enormous to demonstrate a light source change as well as a scene change is finished utilizing to unable parameters. On the off chance that any of these occasions happens, the underlying AWB intermingling time can be supplanted with some shorter worth. In one model, the briefest combination time is utilized when a light source change is recognized, while some more drawn out intermingling time is utilized when a scene change is recognized. In another model, the most limited intermingling time is utilized when the CCT contrast surpasses a predefined high CCT limit, some more extended union time is utilized when the CCT contrast surpasses a predefined low CCT limit and simultaneously the shading measurement (CS) distinction surpasses a predefined CS limit while the high-recurrence content (HFC) contrast is littler than a predefined HFC limit, and much longer convergence time, yet at the same time littler than the underlying AWB union time, is utilized when the CS contrast surpasses the CS limit what's more, at the same time the HFC distinction surpasses the HFC sift old. In one more model, the last union time is preventing mined utilizing an element of at least one of the CCT, CS and HFC contrasts. For example, the last assembly time can be adaptively determined as a mix (i.e., weighted normal) of the two predefined assembly times, where the loads can be inversely corresponding to the distinction esteems. Then again, the loads can be determined utilizing the exponential capacity or a few other reasonable capacities.



The above (Pic-4) is a picture with negligible scenes and light source changes. It shows a carpet taken in a halfway under stable illumination. From Left to Right, it displays images corresponds to frames. Using Shooter AWB convergence times results in significant colour changes.
Using lower AWB convergence times keeps colour information more uniform between the frames. The proposed method correctly recognizes that neither scene changes nor light source change occurred and thus adapts longer convergence times.
Since we will probably execute the proposed strategy in an efficient and versatile route on different objective stages, the last design decisions exploit accessible assets and computationally straightforward methodologies however much as could be expected. In particular, the master presented strategy reuses both the low-goals outline shading states spasms and the CCT esteems that are ordinarily utilized/delivered by camera control calculations, rather than ascertaining the CCT esteems, histograms, and high-recurrence substance from the full-goals outlines. It is important that to acquire worldwide and limited shading histograms, nine histograms with eight canisters are characterized for every one of the RGB shading channels. These histograms compare to entire casing and its top half, base half, left half, right half, what's more, four quadrants, separately. This is represented in Figure 3. The nine histograms related with each shading channel are con- catenated and '1 standardized.The three standardized histograms (one for every shading channel) are then additionally linked, coming about in an element vector with 216 components. The contrasts between the standardized element

vectors acquired for various casings are evaluated utilizing the Hellinger separation. To figure the high recurrence data related with each casing, the luminance channel (gotten from the Bayer shading channel cluster information) of low-goals outlines is dependent upon high-pass separating. The level of dissimilarity in high recurrence substance between the two edges is computed utilizing Manhattan separation. The last intermingling time is set to its most brief permitted esteem when the outright CCT contrast surpasses a predefined high CCT edge, while in some other situation the last union time is identical to a weighted combi country of the most limited and longest permitted intermingling times. The weight related with the briefest permitted assembly time is set as the distinction between the greatest conceivable HFC variance esteem and the genuine HFC distinction esteem scaled by a pre decided HFC factor. The weight related with the longest permitted intermingling time is gotten by taking away the other weight (for the briefest assembly time) from one.

The above (Pic-5) is a picture with significant light source changes. The picture is captured in the lab booth by enforcing sudden light source changes. From left to right, displayed images correspond to frames. Using longer AWB convergence time shows a slow response to illumination changes. (Top) Using shorter AWB convergence time produces desired results. The proposed method correctly detects a light source change and thus adapts shorter convergence times.

Chapter 5

EXPERIMENTAL RESULTS

The effectiveness of the proposed method was tested with different scene complexity and illumination. Here, we show the recording of a hallway carpet under stable illumination (Figure 4) as well because the recording of a laboratory scene with some abrupt illumination changes (Figure 5). More specifically, Figure 4- a shows how small camera motion may result or end in abrupt color changes caused by the utilization of short convergence times in AWB, even when both the scene and illumination remain practically constant. As demonstrated in Figure 4-b, this issue will be alleviated by choosing larger convergence. On the opposite hand, Figure 5-a shows how long convergence times have a drawback of producing a lag, when a fast AWB response is desired within the situations with a lightweight source change. during this case, acceptable results will be produced using shorter convergence times, as illustrated in Figure 5-b. As suggested by these examples, the proposed method adjusts the AWB convergence time in each scenario and produces high-quality results by setting longer convergence times when no significant change is detected and adapting shorter convergence times when a change is detected.

Chapter 6

CONCLUSION

This work presents a strong and computationally efficient method for handling inconsistencies in AWB estimates associated with individual frames of live-view (preview) or capture video streams. We proposed a way on stabilizing AWB estimates and providing the pliability of various convergence rates under various scene/light source changes for the tip user. The proposed work can benefit any camera, cell-phone, tablet, and ISP manufacturer since digital video preview and video capture are must-to-have features in such products, and producing stable and consistent AWB estimates in digital video is crucial for good user experience.

Chapter 7

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