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Assessment of Efficient Deghosting Technique in High Dynamic Range Imaging

Khursheed Dar[1], Sumit Mittal[2,*]
[1 2] MM Institute of Computer Technology and Business Management
Maharishi Markandesh (Deemed To Be University) Mullana Ambala - 133207
*khurshid.azam@gmail.com; sumit.mittal@mmumullana.org

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Abstract:

High dynamic range (HDR) imaging innovation is widening up progressively prevalent as of late. A standard and most basic way to deal with acquire a HDRI is the numerous exposures combination technique that comprises of joining various images of a similar scene caught with various introduction times. This practice facilitates splendidly just on static scenes. In any case, if there is a movement in the scene amid the succession procurement, the resultant HDR image contains ghosting ancient rarities because of moving items in the caught scene. High dynamic range imaging approaches are relied upon to extend the dynamic range of pictures that can't be caught well by utilizing customary camera sensors. To create a HDR Image we have a technique of taking the stack of images with varying presentation level and then combining these images to get the final image having more details. However, we may get ghosting artifacts by slight dislocation of images brought by camera. A little work, over the past decade has been devoted to abstractly or objectively evaluating HDR de-ghosting results. In this paper, we have made comparative analysis upon the techniques employed in the prior researches. On the basis of performance evaluation we will conclude best approach and future work.

Keywords: *High dynamic range imaging, HDR de-ghosting, Taxonomy of HDR De-ghosting.*

I. Introduction

All Common Scenes regularly have a higher dynamic range illumination respect than those captured by current imaging sensors. Under various reasonable conditions, it is alluring to get HDR image in reality [1]. Numbers of HDR imaging techniques have been proposed during last decade. A typical methodology shared by them is to catch numerous images with various introduction levels of a similar scene and afterward remake a HDR image by changing the camera response function [2]. Through tone mapping technique, the dynamic range of the images is reduced, so that it can be displayed in gadgets having low dynamic range [3]. The technology of tone mapping has become widely popular in the modern age due to its applications in the digital world. There are a considerable number of tone mapping techniques that have been developed so far. In some cases, one method may be better than another, depending on the user's need [4]. Then again, MEF is considered as a successful option for HDR imaging. By accepting identical arrangements from information, MEF calculations essentially combine the LDR image, which is extra enlightened and comprehensible than any input image [4]. A prominent issue with most computational HDR

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imaging and MEF techniques is that minor deletions between images by camera or visual movement offset good conditions from the blend and cause the supposed ghost relics Fig. 1. As of late, a lot of exertion has been dedicated to HDR deghosting for dynamic scenes. With different HDR deghosting procedures being proposed, it is continually important to qualitatively and quantitatively review the visual considering deghosting results. The Human Visual System (HVS) is the ideal gatherer of visual information in many applications; Subjective appraisal is an effective method to comprehend human practices when taking a gander at dehhosted pictures. In spite of the fact that it is costly and tedious [5][6], emotional quality assessment has some advantages. In the first place, it gives useful information for thinking about human methods in assessing the explicit nature of deghosted images. Second, it provides a criterion for considering the implementation of work-performance for HDR deghosted calculations. Third, the adoption and viewing of existing and Future Target Image Quality Appraisal (IQA) models can assist in assessing the comprehension of deghosted images. In this way it gives some knowledge on creating compelling IQA methods for HDR deghosting [7].

Figure 1 (a) Supplied image sequence of Fabrizio Pece

(b) Pece10 (c) SPD-MEF

II. CAMERA AND DISPLAY DYNAMIC RANCE

The dynamic range of a camera sensor can change significantly, from a little more than 2log10 units in reduced advanced cameras, over 4log10 units for high-end computerized single-lens reflex (DSLR) cameras, and up to 5log10 units for expert HDR proficient cinematographic camcorders. Figure 1a outlines the dynamic range for a commonplace shopper level camera sensor. Luminances over the highest quantifiable incentive for the present introduction time can't be enrolled since the sensor has immersed. Data underneath the most minimal perceivable esteem is lost because of clamour and quantization. This implies the dynamic range can really reach out to a lower point on the luminance pivot, yet these qualities just contain commotion and don't convey any data. The distinction in dynamic range between sensors is for the most part because of the capacity to deal with clamor, where for example a substantial sensor with low goals can decrease the clamor level by incorporating over the bigger pixel regions. The clamor floor of a sensor can be estimated in various ways, and the numbers revealed by producers will, in general, be extremely idealistic. This implies the dynamic ranges indicated above, with up to 5 log10 units, can be hard to accomplish by and by. To catch a HDR image, a lot of various exposures can be joined into one image utilizing strategies for HDR reproduction. Figure 1d outlines how the dynamic range can be reached out along these lines. Another methodology for expanding the dynamic range is shown in Figure 2(b). It depends on just a single introduction, and the brilliant image regions are reproduced by methods for profound learning techniques. [8].

Fig. 2 (a) Typical camera sensor

(b) HDR reconstruction from a single exposure

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III. DEGHOSTING

After the worldwide arrangement step, the 2-3 close-by edges at various introduction esteem are all-inclusive adjusted. On the off chance that we recreate a HDR outline out of these casings, we may acquire a few apparitions; i.e., moving parts of the scene which grows dim. To clarify this issue, the authors have tried different things with various deghosting mechanisms for tranquil images [9]. From these examinations, the authors have discovered that the Pece and Kautz's BMD strategy [10] typically gives sensible quality outcomes and it is computation time is less to process, check Figure 3 The devised strategy depends on MTB, and the method yields for every pixel weight outline every introduction, where a high load is given to solid pixels (i.e., no development) in that outline. Note that this calculation requires two limits to be set; i,e., the sizes of a widening and a disintegration channels. In our investigations, we discovered that choosing worldwide limits per scene cut produces acceptable outcomes. In any case, a transiently changing programmed limit could deliver ideal outcomes. We additionally tried different calculations, for example, Gallo et al. [11], which can likewise accomplish comparative quality outcomes. We picked to keep the BMD calculation in our work since it doesn't require a camera reaction capacity, and it is progressively clear to actualize [12].

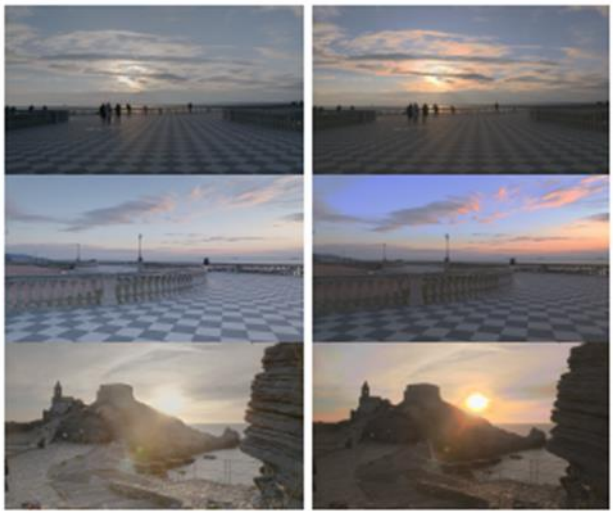

Figure 3: Visual comparisons between Ezgi Ackora et al., (left) and Mangiat and Gibson's algorithm (right).

IV. TAXONOMY OF HDR DEGHOSTING

In order to compose and highlight similarity and contrasts between existing deghosting calculations, here we present a classification of approximately 50 methods, depending on how we approach the deghosting issue. Worldwide introduction enrolment techniques mean to adjust singular exposures all-inclusive. Moving article expulsion strategies intend to expel the movement by assessing a static foundation. Moving Article Choice Strategies detect manipulations in informational pixel forces and are influenced by movement and expel ghost antiques by using a locally isolated source image or by joining various sources that are stable. Move the Item Enrichment Techniques Center around retrieving or re-creating phantom pixels by searching for the best coordinate district in different exposures or impacts. Coordination areas are used to exchange data to a hazardous locale. These calculations may discover pixel or fix based thick correspondences. Video deghosting techniques are custom-made to evacuate the potential ghosting antiques in HDR recordings. In this method, they are used when making fleeting data of recordings. Point-to-point taxonomy goes with the instructions in Figure 1.4. Although this classification is significant in most cases, it should be noted that there are some crossover approaches that are difficult to have a place with an isolated class. Such calculations are based on their prevailing characteristics.

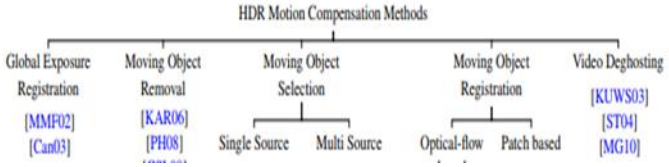

Figure 4 Taxonomy of HDR motion compensation methods [13].

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V. RELATED WORK

Tae-Hyun Ohet et al., [2015][14] Proposed an algorithm on HDR imaging that used rank minimization. The LDR images taken by different exposure time to display direct reliance and create a rank-1 framework while combining the power of each respective pixel, while expecting a direct camera reaction to visual illumination. Moving elements, immersions and image swings can disrupt the construction of LDR rank-1 images when practicing false settings brought about by a moving camera. To address these issues, they presented a rank minimization algorithm, while adjusting LDR images and identifying exceptions to the hearty HDR image. They evaluated the performance of their algorithm for efficient use of prepared models and subjectively separated their results and results from best-class HDR algorithms using test validation models.

Okan Tarhan Tursun [2016][15] Rejoing of high dynamic range (HDR) images of an unpredictable scene including moving articles and vibrant foundations was inclined to ancient rarities. Countless mechanisms had been recommended to endeavor to lighten these antiques, known as HDR Image deghosting algos. Right now, the nature of devised algorithms was determined by abstract evaluations which lead to and are not immediately obsolete as new algorithms were drafted quickly. The target metric was proposed, which means the approach was disassembled. The authors measured method takes input a pile of exposure images and deghosting result and creates a lot of ancient rarity maps for various sorts of relics. These relic outcomes can be consolidated to provide a solitary eminenent score.

Okan Tarhan Tursun *et al.* [14] have proposed an objective target metric analysis which intends to simplify the process of removing the artifacts. Their measurement works on pile of information exposures and deghosting output results and creates a lot of ancient rarity maps for various kinds of antiques. These ancient rarity maps can be consolidated to yield a solitary quality score. They played out an emotional analysis including 52 subjects and 16 distinct scenes to approve the assertion of their quality scores with abstract decisions and watched a concordance of practically 80%. Their measurement additionally empowers a new application and called it hybrid deghosting, in that the yields of various deghosting algorithms were joined to acquire an unrivaled deghosting output.

Kanita Karaduzovic Hadziabdic [2013] [16] have propose that HDRI could be produced by catching a succession of (LDR) low dynamic range images of a similar pose with various exposures and afterward combining those images to make a HDR image. Amid catching of LDR images, any adjustments in the pose or scarcest camera development outcomes in phantom curios resultant HDR images. In recent years numerous algorithms were projected to create apparition HDR images of dynamic poses. The proposed examination, suggested emotional psychophysical observations to assess four different algorithms for evacuating phantom curios in the last HDR image. According to their information, no assessment on deghosting algorithms for HDR images had been distributed. Along these lines, the point of this article isn't just to assess diverse phantom expulsion algorithms yet in addition to acquaint a philosophy with assess these different algorithms to exhibit a portion on the difficulties that incur in assessing apparition evacuation algorithms in HDRI. Visual stream algorithms devised appeared to deliver victories in adjusting input images previously consolidating them into a HDR image. Subsequently, one of the cutting edge deghosting algorithms for HDR image arrangement depends on the optical stream. For the test breaking points of the assessed deghosting algorithms the scenes utilized in their experiments were chosen subsequent the criterion projected which was well thought-out as de facto norm for assessing optical stream systems. The scenes utilized in the observations provide to give difficulties that should be managed by algorithms dependent on optical stream procedures as well as by other phantom evacuation algorithms for HDR

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imaging. The outcomes uncover that poses for the assessed algorithms come up short and may fill in as a guide for future research around there. The scenes utilized in the experiments serve to give difficulties that should be managed by algorithms dependent on optical stream procedures as well as by other phantom evacuation algorithms for HDR imaging.

Banterle et al., [17] have executed emotional psychophysical obsevations to assess four algorithms, expelling ghost relics in the last HDR image. As per their best learning, no assessment of deghosting algorithms for High Dynamic Range imaging had been distributed. Along these lines, the point of the article isn't just to assess distinctive ghost elimination algorithms, yet in addition to acquaint a strategy which assesses these algorithms to display a portion of difficulties existed on assessing ghost elimination algorithms in HDR images. Visual stream algorithms had been appeared to create victories in adjusting input images previously consolidating them into a HDR image. Thus one of the cutting edge deghosting algorithms for HDR image arrangement depended on optical stream. To examine the cutoff points of the assessed deghosting algorithms the scenes utilized in their observation were chosen subsequent the criterion, that was considered as true standard for assessing visual stream philosophies. The poses utilized in the observations give out to give difficulties that should be managed by algorithms dependent on visual stream philosophies as well as by other phantom evacuation algorithms for HDR imaging.

HEO *et al.* [18], proposed that even however abstract techniques for assessment give solid methods for examining, those were regularly bulky and should be rehashed for every novel projected strategy or yet its trivial adjustment. Therefore, there was a requirement for target excellence measurements that will give programmed methods for assessment on HDR deghosting algorithms. In the article, they investigated a few calculated methodologies of quantitative assessment of multiexposure HDR deghosting algorithms and showed their outcomes on five cutting edge algorithms. So as to play out a far reaching assessment, another dataset comprising of 36 poses were made, where every scene gives an alternate test for deghosting algorithm. The nature of HDR images created with deghosting technique was estimated in an emotional analysis and after that assessed utilizing target measurements. The article was an augmentation of their gathering article, they included one increasingly target quality measurement, UDQM, an extra measurement in the assessment. Besides, investigation of target and emotional observation was calculated and clarified all efforts more broadly. By checking connection among target metric and abstract quantity and the outcomes demonstrated out of the tried measurements, that (HDR-VDP-2) was the most dependable measurement for assessing HDR deghosting algorithms. The outcomes additionally demonstrated that for the vast majority of tried poses, Sen et al's proposed deghosting strategy outflanks other assessed deghosting strategies. The perceptions dependent on the acquired outcomes can be utilized as an essential point in the improvement of novel HDRI deghosting algorithms that could be strong to an assortment of scenes and would deliver best quality outcomes.

Kuang et al., [19] the results produced by high dynamic range (HDR) multi-exposure merging algorithm, was that to handle motion relics. Inside this study, they presented the criteria for the assessment of these algorithms. So as to play out a far reaching assessment of proposed dataset sorted into various kinds of scenes, each secene representing a test for the assessed algorithm. For the investigation, they select and tweak a tone-mapping administrator (TMO), which limits an opportunity for TMO antiquities and enabled them to examine coming about HDR images on a regular RGB display. They demonstrated the consequences of five cutting edge algorithms assessed dependent on the proposed criteria by performing master assessment examination and reach a determination for every one of these algorithms.

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Yuming Fang et al., [20] number of HDR deghosting algorithms had been proposed, over the years, however littlework had been devoted to assess HDR deghosting results either subjectively or objectively. In the article, they presented a far reaching emotional investigation for HDR deghosting. In particular, they make a database that contained 20 dynamic image groupings and their relating deghosting results by 9 deghosting algorithms. An emotional client examine was then completed to assess the perceptual nature of deghosted images. The exploratory outcomes exhibit the execution and confinements of existing HDR deghosting algorithm just as no-reference image quality evaluation models. They make the database generally available to the public.

Simon Silk et al., [2012][21] proposed an algotithm of HDR images of genuine scenes and they experience the ill effects of ghosting relics brought about by the movement in the scenes. Previous solutions were computationally very expensive and ususlly address specific types of ghosts. They demonstrated their technique LDR images as well as on HDR images. Extra requirements dependent on the earlier information of the changing exposures apply to HDR images. Additional limitations apply to High Dynamic Range images dependent on first facts of dynamic exposures. They enhanced the permanence of their approach by using recent super pixel partitioning techniques to improve change detection. Their elucidation was a new approach to areas where movement was seen throughout the abstraction. e.g., the leaves were blowing in the air. They exhibited the accomplishment of our methodology on the test the apparition scenes and their outcomes were equivalent to those of the current ones refined systems for giving computational savings in these techniques.

Pradeep Sen et al., [2016][22] suggested that Modern computerized cameras had a very restricted dynamic range, which makes them helpless to catch the full range of brightening in common scenes. Since this keeps them from precisely shooting unmistakable detail, scientists have gone through the most recent two decades creating algorithms for high-dynamic-range (HDR) imaging which can catch a more extensive range of brightening and along these lines enabled them to reproduce more extravagant images of normal scenes. The most common sense of these techniques were stack-based methodologies that took a lot of images at various presentation levels and afterward consolidate them to frame the last HDR result. Be that as it may, these algorithms delivered phantom-like curios when the scene had motion or the camera isn't consummately static. In the article, they presented a diagram of cutting edge deghosting algorithms for stack-based HDR imaging and talk about a portion of the tradeoffs of each.

Kanita Karaduzovic-Hadziabdic et al., [2017][23] suggested that abstract techniques for assessment give solid methods for examining, and were regularly bulky and should be rehashed for every novel devised strategy or even its small adjustment. Therefore, there was a requirement for target quality measurements that will give programmed methods for the assessment of HDR deghosting techniques. They examine some of the computational methods of quantitative estimation on multi-exposure HDR deghosting methods and show their results on 5 cutting-edge algorithms. To assess foresight, another dataset consisting of 36 sequences was prepared, where each sequence gives an alternative test to the deghosting algorithm. The nature of HDR images generated with the deghosting technique was assessed in an emotional analysis and then utilized by objective measurements. Since the article was the growth of their collection article, they have an increasing objective quality measure, UDQM, as an additional measure in assessment. Moreover, the investigation of objective and emotional experimentation was underway and will be more widely clarified in this work. The outcomes demonstrate that HDR-VDP-2 was the most consistent measure for the evaluation of HDR decoding algorithms, by testing the connection between the target metric and the abstract score. The

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results additionally account for the majority of the attempted scenarios, Sen et al. The Degosting Strategy outperforms other predictive Degosting strategies. Insights depending on earned consequences could be beneficial as an important show off in the improvement of novel HDRI decoding algorithms, which were robust to sequence assays and can produce high-quality results.

K. Karaduzovic-Hadziabdic et al., [2014][24] Proposed an algorithm that breaks the results obtained by high dynamic range (HDR) multi-presentation consolidating algorithms that handle motion artifacts. They demonstrated the criteria for the evaluation of these algorithms. To evaluate foresight, they proposed a dataset, that was sorted into different scenarios, each representing a test for the predicted algorithm. For investigation, they selected and adjust the Tone-Mapping operator, which limits the opportunity for TMO antiques and enabled them to examine what was to come about HDR images on a regular RGB display. They demonstrated the consequences of the five most advanced algorithms based on the proposed criteria by master assessment and arrive at a conclusion for each of these algorithms.

VI. COMPARATIVE STUDY

In comparative study we are considering two previous researches regarding image deghosting. As far as our survey is considered very less researches has been carried out for image deghosting. We are citing research works below considering for comparison purpose.

Fang *et al*., [2017][25], had presented a comprehensive subjective study for HDR deghosting. Specifically, they created a database that contains 20 dynamic image sequences and their corresponding deghosting results by 9 deghosting algorithms. A subjective user study was then carried out to evaluate the perceptual quality of deghosted images.

The results produced by previously proposed algorithm had been studied using preference matrix. Several algorithm has been finally catagorised by considering the parameter RMSE (Root mean square error), PLCC (Pearson linear correlation coefficient), and (SRCC) Spearman rank-order correlation coefficient. The results showed poor performance in terms of parameter values but deghosting had been removed from the HDR images in the research. The contribution of the researchers had made foundation for the deghosting of HDR images.

M M Khan [2019][26], proposed deghosting technique that relied over (spectral angle mapper) SAM. Benefits of implementing SAM was, it was intensity self-governing and emphasis on only enlighting the spectral—i.e., color—resemblance among 2 images. In devised system emphasis is on eliminating dynamic stuff on increasing the dynamic range of still stuff spectral angle mapper (SAM) identified ghost pixels and replaced ghosted pixels by means of a suggested image through middling exposure settings.

A subjective comparison of the proposed deghosting algorithm were performed, they visually inspected output of HDR images (N, T, K, S, C and P) using tone mapping provided in MATLAB. The same tone mapping method was used to remove any inconsistencies that may be caused by using different tone mapping operators.

VII. CONCLUSION

Techniques for high dynamic range (HDR) imaging make it conceivable to catch and store an expanded range of luminance and hues when contrasted with what can be accomplished with a customary camera. This high measure of image data can be utilized in a wide range of utilizations, for example, HDR displays, image-based lighting, tone-mapping, PC vision, and post-handling activities. HDR imaging has been an imperative idea in innovative work for a long time. Inside the most recent few years, it has likewise achieved the shopper showcase, for

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example with TV displays that are fit for recreating an expanded dynamic range and pinnacle luminance.

As far as the study of discussed research articles is concerned. We can claim that SAM technique has performed well and further researches can be carried out with the reference of same work. On the basis of SAM technique, in our future work we will try to implement an optimization algorithm with the same concept to enhance the throughput.

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