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Use of Example Based Color Transfer to Suppress Corruptive Artifacts

Mukesh Bharsakle[1], Niraj Dengale[2], Vivek Deshmukh[3], Akash Manwani[4]

Abstract: **Sample based shading exchange is a discriminating operation in picture altering however effortlessly experiences some corruptive ancient rarities in the mapping procedure. In this paper, we propose a novel brought together shading exchange structure with corruptive antiquities concealment, which performs iterative probabilistic shading mapping with learning toward oneself separating plan and multi-scale point of interest control plot in minimizing the standardized Kullback-Leibler separation. Initially, an iterative probabilistic shading mapping is connected to develop the guiding relationship between the reference and target pictures. At that point, learning toward oneself separating plan is connected into the exchange procedure to keep from ancient rarities and concentrate subtle elements. The exchanged yield and the extricated multi-levels points of interest are coordinated by the measurement minimization to yield the last result. Our structure accomplishes sound grain concealment, shading loyalty and point of interest appearance flawlessly. For show, a progression of destination and subjective estimations are utilized to assess the quality in shading exchange. At last, a couple of stretched out applications are actualized to demonstrate the relevance of this system.**

Keywords: **Shade transfer, computational photograph, edge- preserving smoothing, Picture manipulation.**

I. INTRODUCTION

Color control is a standout amongst the most widely recognized assignments in picture altering. While craftsmen resort to photograph altering instruments to physically alter shading appearance, programmed shading appearance change is still of popularity, owing to the natural difficulties to handle complex structures universal in regular images. Seemingly, sample based shading exchange [1], which goes for replicating the shading appearance from an offered case to a target gray scale or shading picture, is the best approach to handle the issue. Fast advancement has been seen in the most recent decade in the field of shading exchange. Representative methodologies incorporate established histogram coordinating, statistical exchange [2], dimensional likelihood thickness capacity exchange [3], slope saving exchange [4], non-unbending thick correspondence exchange [5], dynamic exchange [6], to rundown a couple.

In spite of the fact that these methodologies are successful in exchanging the shading data, they would at times produce visual artirealities, owing fundamentally to the contradictive parts of shading distribution protection and picture content conveyance, because of the huge distinction in the force dispersion between the reference and the focus on, an unsatisfactory exchanged result was created, with exceptional relics as takes after and block diagram is shown in Fig. 1.

Shade distortion - A few disharmonious or surprising hues show up which are excluded in the reference picture.

Grain effect - A marvel shows up because of improving the clamor level of the picture under the extended mapping. Commonly, it would appear that a few commotions or unpredictable squares.

Loss of details - The fine-level points of interest in the target picture is missed after the shading exchange.

We take note of that it is not an exceptional case. In a perfect world, shading exchange between reference and target pictures ought to full-fill the accompanying objectives.

Shade fidelity - The shading appropriation of the target ought to be near to that of the reference picture.

Grain suppression - No visual relics (grain/blocky artitruths) ought to be produced in the target picture

Detail preservation - Details in the original target should be preserved after the transfer.

In this paper, we introduce a novel brought together system for sufficient based shading exchange, which plans to accomplish simultaneously grain concealment, shading devotion and point of interest safeguarding. The fundamental to our methodology is to fuse learning toward oneself filtering plan into the iterative probabilistic shading mapping with minimizing standardized K-L separation as convergency. Initially, a probabilistic mapping is iteratively connected to produce coarse shading mapping. Diminishing the N-dimensional likelihood distribution of both reference and focus to an one-dimensional probability circulation pair, it can coordinate the shading conveyance of the focus to the reference. Second, the learning toward oneself sifting is embedded around with into the method of shading mapping. By changing over the first focus into an uncorrelated space, the power channel is taken as the learning illustration into the separating, which is hide their connected to the mapped result. The K-levels subtle elements can be separated by the differential administrator between the first target and the set of exchanged yields. At last, the points of interest are recombined to the exchanged yield to create the outcome in a multilayer controllable.

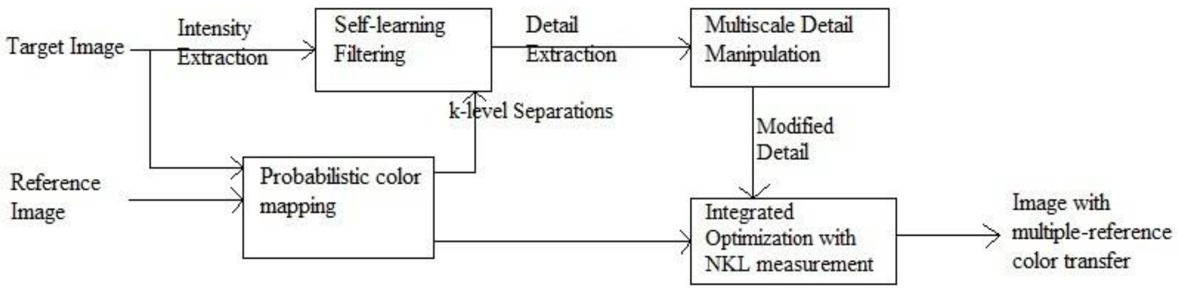

Fig. 1 Block Diagram of the System

• Propose a novel shading exchange system to accomplish an unified corruptive antiquities concealment, which is indicated in grain concealment, shading constancy and subtle element control Underline on the prevalence of the learning toward oneself sifting plan in shading exchange, instead of embracing post-professional cessing solutions for the antiquities.

• Design a kind of destination and subjective estimations for the quality assessment of shading exchange to exhibit the execution of our methodology Show our structure would be reached out to a few applications which is connected with shading altering.

II. RELATED WORK

In this area, we simply underline on the best in class automatic shading exchange approaches however not those of intuitive manipulations [6], and outline their preferences and imperfections. Likewise, the edge-protecting smoothing channels are presented, with the goal that we can examine them for grain impact concealment and detail safeguarding in the accompanying areas.

A. COLOR TRANSFER:

The histogram coordinating [7] has the capacity tag the state of the alluded histogram that we anticipate that the target picture will have. On the other hand, histogram coordinating can just process the shading parts of the shading picture freely. Since the relationship of the shading parts are divided, this approach would create the unsuitable look, e.g. grain impact, shading twisting. Reinhard et al. [2] firstly proposed an approach to match the methods and fluctuations between the target and the allude ence in the low associated shading space. This methodology was sufficiently effective, yet the basic means and changes coordinating were liable to deliver slight grain impact and genuine shading distortion. To keep from the grain impact, Chang et al. [4], proposed a shading class based methodology that classified every pixel as one of the essential classifications. At that point a curved frame was generated in shading space for every classification of the pixel set, and the shading change was connected with every pair of arched structure of the same class. For the shading mutilation, Tai et al. [3] proposed a changed EM calculation to section probabilistically the information pictures and develop Gaussian Mixture Models for them, and the relationship was developed by each Gaussian part combines between the target and the reference under Reinhard's methodology [2].

Abadpour et al. [3] proposed the misused central component investigation and made a low corresponded and independent scratch shading space to decrease the shading relationship, proposed a K-dimensional likelihood thickness capacity exchange way to decrease the high-dimensional PDF coordinating issue to the one-dimensional PDF coordinating by Radon Transtructure [7]. This operation can lessen the shading relationship and keep the shading appropriation of the exchanged result reliable with that of the reference. On the other hand, it would prompt the variance of picture substance as the pixel force changed. Therefore, the Poisson reproduction was acquainted with cure the outcome. Enlivened by the angle area strategy, proposed an inclination safeguarding model to change over the exchange preparing to a streamlining, and adjusted the shading distribution and the point of interest execution. Then again, worldwide ideal solution normally obliged huge computational expense.

Dong et al. [5] proposed prevailing shading thought for shading exchange. At the point when the measure of prevailing shades of the target was steady with that of the reference, the shading of the reference would be exchanged to acquire a palatable result. Then again, when the measure of overwhelming hues was not adjusted, the un- palatable result would be delivered, enhanced Dong's methodology [5] and further proposed a conveyance mindful origination to consider the spatial shading dissemination in the allude ence picture. What's more Wang et al. [7], built up the learning- based shading exchange systems to prepare out the correct shading guiding relationship. As of late, HaCohen et al. [5] introduced the non-unbending thick correspondence and utilized it as a part of case based shading exchange. Notwithstanding, the relating prerequisites would confine the case determination, proposed a dynamic histogram reshaping system for pictures of arbitrary element range, which still experiences shading mutilation in some amazing cases. What's more, explored the evaluation of picture authenticity for the assessment of the picture recovery.

B. Edge Preserve Smoothing:

The grain impact can be dealt with as a unique sort of commotions [4], and it would be evacuated by straight smoothing. Despite the fact that the direct smoothing can evacuate the grains, the over-obscuring would wreck the first picture points of interest and bring down the sharpness of edges. Edge-protecting smoothing (EPS) channels [2] are proposed to defeat this issue. They can keep the edge smudging by straight sifting as indicated by their power or gradient-mindful properties. Be that as it may, the execution of unadulterated EPS channels is constrained [7], particularly if there exists the corresponding variant of the data picture.

Joint respective channel (JBF) [2], is the initially guided edge-protecting smoothing methodology. The JBF abuses the pixel power of the reference which is connected to the focus to enhance the sifting impact. On the other hand, in the same way as the two-sided channel (BLF), JBF can not evade the corona antiquity and angle inversion issue. Much the same as previously stated Bae's methodology [4], it requires the inclination adjustment to cure the reaction of BLF. He et al. [3] proposed the guided channel, which has the favourable circumstances of JBF yet conquers the deformities.

What's more, in light of the edge-safeguarding smoothing, the details can be extricated to control in a multi-scale manner [2], proposed an involved plan for subtle elements, however their receptive two-sided disintegration has surrenders as a fore mentioned, proposed two multi-scale plans which are less complex than Fattal's, in light of the fact that the WLS-based de-organization beats the imperfections of reciprocal deterioration. And afterward, Farbman et al. [4] presented the dispersion maps as a separation estimation to supplant the Euclidean separation in their weighted minimum square channel. As of late, explored the nearby Laplacian pyramid to yield the edge-safeguarding decay for fine-level subtle element control.

III. INTEGRATED SHADE MAPPING MODEL

As described in previously, the example-based shade transfer problem lies in seeking the reasonable mapping relationship between reference and target images, and a perfect shade transfer approach should satisfy three goals at the same time, including the shade fidelity, grain suppression and details preservation. Motivated by the probability-based mapping and edge-preserving decomposition, we present a novel unified transfer framework instead. The overview of our framework is as follows.

Shade mapping stage. A probabilistic shade mapping is applied to achieve the basic shade corresponding and a self-learning filtering is embedded to avoid the artifacts and separate the transferred target into K-levels.

A. Kullback-Leibler Distance for Shade Transfer:

The Kullback-Leibler separation (K-L) [6] can gauge the comparability between two totally decided likelihood circulations. Here, we apply it to gauge the distinction between the reference also, exchanged result in shading exchange.

The minimization of K-L separation implies the shading appearance of the target near to that of the reference. Let what's more, signify the disseminations of the reference picture and the exchanged picture, individually.

Taking the K-L distance as a measurement in an optimization procedure, to guarantee the convergence of minimization. The above K-L distance is a fundamental measurement in our framework. We first break our solution into two phases. One is the color mapping; the other is the detail manipulation.

B. Iterative Probabilistic Shade Mapping:

A short time later, a channel quantization with step is utilized to control the scale of information extent, which is parameterized by the pixel force then again client setting. This quantization can promise the scale consistence in diverse date scope of the turned channels. At that point, the relating 1-D likelihood thickness disseminations of both target and reference are yielded by the likelihood insights like the picture histogram and the algorithm is shown in Fig. 2.

The physical importance of could be translated as takes after. The projection of 1-D likelihood thickness is acquired by homography change, and the K-th mapping result is calculated. At that point, the distinction in the middle of prior and then afterward mapping is assessed by, The opposite change is used to restore the 2D picture. At long last, the middle of the road is upgraded and a cycle of emphasis is finished.

C. Self-Learning filtering Scheme:

On the other hand, there still exists an imperfection in the arrangement, that is, it is prone to deliver the grain impacts periodically. To address this testing issue, we exhibit learning toward oneself separating plan and consolidate it into the previously stated iterative probabilistic shading mapping.

Firstly, expect the exchanged result furthermore, its sifted yield is isolated into 9X9 a progression of patches, and every patch-pair has 1-to-1 comparing relationship. At that point, we further expect that g also, g' have the accompanying straight learning relationship in the patch p_k.

Generally, the learning toward oneself separating is an edge-saving smoothing operation iteration under direct relapse with reference picture.

Algorithm 1: Integrated Color Mapping Model

Input: t: target image, r: reference image, k: iterative times, ε: regularization factor, λ: detail factor

Output: g: transferred result

$g^0 = t, i = 0, \delta = D_{\mathrm{NKL}}(t, r)$ % Initialization
while $i < k$ **do**
while $\delta^i = D_{\mathrm{NKL}}(g, r) \geq \delta^{\max}$ **do**
$\mathcal{H} = [I, \mathcal{R}] * orth(rand(Q_n))$ % Homography Transformation
$G = \mathcal{H}^{\mathbf{T}} g^i,\ R = \mathcal{H}^{\mathbf{T}} r$
$S_{\min} = \min(G, R),\ S_{\max} = \max(G, R)$
$S = (S_{\max} - S_{\min})/q$ % q steps of quantization for $G\&R$
$\rho(g^i) = \mathrm{Hist}(S, G),\ \rho(r) = \mathrm{Hist}(S, R)$
$\tau = \mathrm{HistMatch}(\rho(g^i), \rho(r))$ % 1D distribution matching
$g^{i+1} = g^i + \mathcal{H}[\tau(G) - G]$ % Iterative update
$\alpha = (\frac{1}{|p|} \sum t(g^{i+1}) - \mu \overline{g^{i+1}})/(\sigma^2 + \varepsilon)$
$\beta = \overline{g^{i+1}} - \alpha\mu$
$\hat{g} = \alpha * g^{i+1} + \beta$ % Apply self-learning filtering
$d = t - \hat{g}$
$g^{i+1} = \hat{g} + M(d, \lambda)$ % Detail manipulation
end while δ
end while k
return

Fig. 2 Algorithm for Integrated Color Mapping Model

D. Multi-scale Detail Manipulation Scheme:

As described previously, details in the original target should be saved after the exchange. Really, points of interest regularly correspond to the style appearance, and this trademark is huge to the shading related applications. Since we have consolidated the learning toward oneself separating plan into the shading mapping, we can adventure its property of edge-safeguarding deterioration to concentrate, the subtle elements while repaying or improving them in the exchanged output. In our system, K-levels points of interest are acquired by iteratively applying the learning toward oneself sifting plan. The sigmoid capacity is further conveyed to stay away from the hard cutting that would happen when the subtle element levels a resignificantly supported.

E. Integrated Optimization Techniques:

We exhibited the K-L separation can be utilized to assess the likeness between the shading appropriation of the reference picture and that of the exchanged picture. With this united structure, we achieve our beforehand expressed targets reliably, checking grain covering, shading faithfulness and purpose of investment safeguarding.

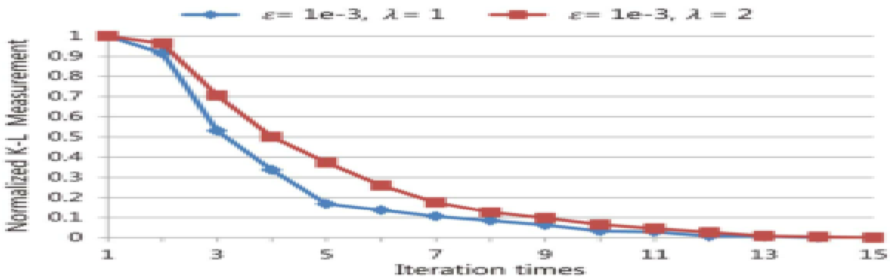

Fig. 3 Joining investigation. The blue line is the ordinary exchange without point of interest upgrade. Furthermore, the red line is relating to the upgrade . With the cycle expanding, the estimations of K-L separation are diminishing. That implies the shading dissemination of the exchanged result draws near to that of the reference dynamically.

IV. EXPERIMENTAL ANALYSIS

In this segment, we firstly examine the parameter settings and the meeting in our system. At that point, we think about our structure with the best in class approaches in the visual impacts and dissemination visualization. To further exhibit the adequacy, we outline a client examination to support the investigation. Finally, the runtime execution is displayed. All the investigations were tried on PC with Intel i7 2480M 2.7 GHz CPU, RADEON 450M, 8 GB DDR3 Ram, and MATLAB R2012a.

A. Parameter Setting and Convergence Analysis:

Our system alludes to 4 balanced parameters, including the span r of patch p_k in self -learning separating, the regularization element to remunerate the mistake created by the substitution, the emphasis and the point of interest improvement component. We will investigation the execution by changing these parameters. The proposed learning toward oneself separating plan is utilized to keep the mistake aggregation of grain impact or shading bending with the cycle expanding in shading exchange. The impact of learning toward oneself shifting plan is utilized to keep the mistake gathering of grain impact or shading mutilation with the emphasis expanding in shading exchange. The impact of learning toward oneself shifting is dictated by the sweep of patch also, the regularization variable. The previous confines the activity extension and influences the quality of the smoothing; the recent is utilized to adjust the edge/subtle element conservation and the picture smoothing. To be simplified, we altered the range in the majority of our investigations exactly.

Our system misuses the standardized Kullback-Leibler separation to quantify the likeness of shading appropriation between the exchanged yield and the reference picture as shown in Fig. 3, and guarantees the union amid the iterative method.

B. Shade Distribution Comparisons and Measurement:

In spite of the fact that we can assess the outcomes by visual watching specifically, the geometric circulation of the hues in the picture would not generally be exhibited as the district gather however conceivable scattering. As of now, it is difficult to assess the nature of the exchanged results by visual watching only. As we would see it, changing over the picture to 1-D shading histogram and 2-D shading disperse chart, we can watch the states of shading conveyance to assess the quality instinctively. we exhibited two gatherings of examined results.

From the top line brings about , some new hues show up in the exchanged result , which are not contained in the reference. By differentiation, our outcome is dedicated to the shading appearance of the reference. In the base column, take note of the most left side in 1-D shading histogram, the outcomes in have clear shading bending. Be that as it may, our outcome has the most closeness to the shading circulation of the reference. Through these visualization approaches, we can further quantify the nature of exchanged results dispassionately.

Here, we planned a measurable slope dispersion to assess our methodology. The slope circulation of the first target. Our outcomes with distinctive parameter settings. Through these examinations, we can show the angle dispersions of our outcomes are comparable to that of the first target.

Our standardized K -L estimation would be stretched out to assess the nature of the exchanged results which are delivered by diverse methodologies. We quantified the outcomes, and recorded their K- L values in Table I. Note the information, histogram coordinating [6] has a loathsome execution, and the K-L qualities are far over the estimations of different methodologies. From the visual perception, the consequences of histogram coordinating are not satisfactory. The Reinhard's methodology [2] is prone to deliver the shading bending, so its K-L qualities are high now and again. The dimensional PDF [1] and GradPrev [4] have satisfactory K-L values. For our outcomes, the recorded exhibitions are superior to those of past methodologies.

C. User Investigation:

To further show the viability of our system, we plan a client examination with subjective analyses. We outlined 4 sorts of significant deserts in shading exchange, including grain impact, shading bending, smearing, and appropriation grating. In the factual sense, we gave 80 gatherings of trial information, and recorded the outcomes which were delivered by histogram coordinating [9], Reinhard's [2], k -dimensional PDF with Poisson altering [1], Xiao's inclination safeguarding methodology [4] and our own. We welcomed five guys and five females to take part, including 2 expert planners, 5 experts and 3 instructors. As delineated, the suppositions of every individual are recorded and introduced in visualization. With all the researched results, we can assess the measurable results as shown in Fig. 4. histogram coordinating has genuine grain impact and shading bending in real cases. Reinhard's methodology has a higher rate in shading mutilation also. Also, the methodologies are prone to deliver the obscuring. By complexity, our structure has a superior execution than the past methodologies in the previously stated 4 viewpoints. The examination results are predictable with the above goal and subjective results.

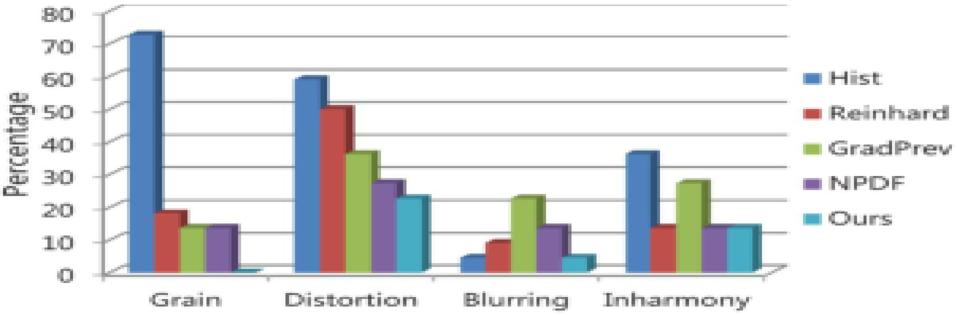

Fig. 4 80 examples are recorded and 10 persons took an interest in the examination. The top figure is a record in our examinations. Grain impact (G), shading contortion (D), obscuring (B) and dissonance (I) are assessed by clients' visual recognition. The base figure is a measurable investigation for our examination. The lower rate implies the better visual execution.

D. Time Performance:

We adopted the experimental runtime to measure our approach, and compared it with other approaches. We selected 5 sizes as the tested samples. The runtimes with various parameter settings were recorded, histogram matching [6] and Reinhard’s approach [2] had an efficient runtime response. However, as mentioned above, both of them were hard to obtain a satisfactory visual performance. gradient-preserving approach [4] and N-dimensional PDF approach [4] required

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too much time, because both of them needed to solve a large -scale optimization equation. Especially, if the size was over large, these two approaches would break down. By contrast, our approach had a sound time reaction and was superior to past methodologies in convenience.

V. EXPERIMENTAL ANALYSIS

In this segment, we extend our structure to some picture applications, including numerous reference shading exchange, high-dynamic- reach shading exchange and style exchange. Through these expanded applications, we further exhibit the material ness of our system.

Multiple-reference shade transfer obliges the exchange characteristically mixing the hues from numerous references. Nonetheless, as outlined, the fundamental contrast exist among the references. Albeit both of the references are the daylight subject, they have a huge distinction in the shading appearance. This distinction would effectively prompt the grain impact in the outcome. As represented the Reinhard's outcome has a genuine grain impact. The methodology receives the angle revision to stifle the grain, yet it doesn't keep the shading bending. Our methodology manages the grain impact and contortion in every step, along these lines, we can accomplish a visual acceptable result.

High-dynamic-range (HDR) shade transfer obliges considering the picture substance devotion and the shading appearance. The low-element reach picture is delivered by the HDR devices in Photoshop CS5. The aftereffects of histogram coordinating and Reinhard's, respetively. Note the outcomes, histogram coordinating can't show the entire substance viably; and the Reinhard's methodology shows evident shading distortion. exploit their way to deal with make a delicate yet-sharp interpretation which is a convincing estimate of the impact created by a delicate centre lens. Their exertion would deliver a slight smudging. Be that as it may, obscuring is not generally expected in shading exchange. By our methodology, we can get an unmistakable yield, in which the substance and the points of interest are shown with a sound visual execution.

Style transfer is a fundamental necessity in craftsmanship outline. Heaps of picture styles can be reflected by the shading appearance, e.g. the antiquated, frosty and rainbow styles. We showed our methodology can successfully safeguard the style of the reference**.**

VI. DISCUSSIONS AND CONCLUSIONS

Step by step instructions to exchange the shades of the offered reference to the target adequately is a testing issue and is huge in shading exchange. Due to the unpredictability of the shading dissemination, it is hard to stay away from the corruptive antiques, for example, shading contortion, grain impact or loss of points of interest in the consequence of shading exchange glossary shown in Fig. 5. At the point when these issues show up, the conventional path is to apply some post-handling operations to cure them. Tragically, the post-handling operations are not generally viable and would result in different curios here and there.

GLOSSARY OF MAIN TERMS

Symbol	Description
r	the reference image
t	the target image
g	the transferred goal image
k	iteration times
τ	the mapping relationship
$\mathcal{H}$	the decorrelation operator for color image
Δq	the step for channel quantization
$\bar{g}$	the output of self-learning filtering
$\alpha_\kappa, \beta_\kappa$	the linear coefficients of filtering in the patch p_κ
$\mu_\kappa, \sigma_\kappa^2$	the mean and variance of g in p_κ
ε	smooth factor for filtering
d^k	k-levels details
λ	the adjustment factor for detail manipulation
$\rho(\cdot)$	probability distribution function for images
$C(\cdot)$	cumulative distribution function for images
$S(\cdot)$	the self-learning filtering operator
$M(\cdot)$	the detail manipulation operator
$D_{NKL}(\cdot)$	normalized K-L measurement function

Fig. 5 Glossary of Main Terms

In this paper, we proposed a novel shading exchange system to manage these corruptive antiquities by coordinated a self - learning sifting plan into the iterative probabilistic shading mapping model. Our structure not just keeps the shading mutilation and grain impact during the time spent exchange, additionally attains to the impact of subtle element safeguarding or improving. Also, to assess the nature of shading exchange, we proposed a progression of target and subjective estimations, including meeting investigation, shape examination of shading appropriation, visual correlation and client examination. By the test investigations in the goal and subjective information, we found that our system had a superior execution than the condition of- the-craftsmanship approaches, particularly in managing the grain impact, shading contortion, and loss of subtle elements. Notwithstanding the coordinated exchange, our structure was stretched out to the various reference shading exchange, HDR shading exchange and style exchange to exhibit its adaptability.

Quality and constraints. Our structure can attain to the shading constancy, keep the grain impact and save the point of interest flawlessly. Without unraveling the vast scale streamlining comparison, our structure has a sound runtime reaction. Our system exhibits the comfort in managing the entangled hues, owing to that it just requires to give the normal references however no other helper communications.

In any case, our structure still has a few impediments. On the off chance that the measure of the alluded hues is restricted, it is prone to create two noteworthy issues. One is the shrillness of shading appearance; the other is the shading dying like artifacts. The indicated reference is given, and the conspicuous shading discordance shows up in the entire picture and the dying like impact shows up on the slope.

Later on, we will extend our structure to feature altering. A trouble in feature shading exchange is the shading steady issues in the ceaseless edges, because of that the pixel hues would have a slight balanced if the substance change in the feature groupings. Furthermore, how to be mindful of the areas of the hues is likewise a basic issue. Moreover, to conquer the above restrictions in our way to deal with upgrade the style appearance needs our nonstop endeavors.

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