Assessment On Quality Of Color Image Using Gamut Mapping And The Emboss Filter

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***Abstract*— Today is the world of digital processing and here everyone wants the image with better quality with high resolution. In the image processing lots of functions are used to increase the quality of color image. Previously CID (Color Image Difference) metric is used to remove the artifact and increase the color quality of image but still some artifact remains present in image. For removing visual artifact there is needed to do the modification in the objective function. After doing the modification in the CID metric new objective function is found named as ICID (Improved Color Image Difference). CID based enhancement is free from visual artifact and retain the contrast, structure and exceed the color quality of image to the great extent. The CID function is also used for different file format and different size of image. In this paper we compare the gamut mapping and the emboss filter by calculating the iCID metric. Emboss filter do the better work on edges and the lightness inversion of the visual data.**

***Index Terms*— Image difference, image quality, color, gamut mapping, emboss filter**

I. INTRODUCTION & MOTIVATION

Now a day's world of digital processing. Daily lots of digital image are uploaded on the different site. When that same images are work on different site and on different platform like mobile, computer or any other platform. At that time the quality of that image is not like the original image. Lots of noise and artifact is added in that image because different operation are perform on that images. These operation are performed by the user according to their convenience. To achieve the original quality, different algorithm and functions are applied on that images.

Previously CID (color image difference) metric is used as the objective function. Gamut mapping algorithm is used to calculate the metric. But some artifacts are remain as it is in image. To remove that artifact and to obtain better quality of the image there is need of some modificati

Doing the modification in the objective function named as iCID (improved colour image difference) it help to remove previously identified artifacts with retain structure and contrast. It also help to match the original quality of the image with the great extent.

The main goal of this gamut mapping is to achieve the better quality for any type of image. Remove the artifacts Related to the lightness inversion, chromatic ringing, chromatic edges and lightness banding.

In this paper we compare the gamut mapping with the emboss filter. This filter stamps and carves the active layer or selection, giving it relief with bumps and hollows brighter areas are raised and darked ones are covered. An emboss filter gives the 3D effect to the image. The experimental result shows which is good to achieve the better quality of the image. It also shows the which is more powerful to remove the artefact related to lightness inversion, chromatic ringing, chromatic edges and lightness banding.

Here we calculate CID metric and CID metric without chrome contrast and structure with and without CSF (Contrast Sensitive Function) filtering. The CID metric is evaluated when emboss filter is applied on images. And then doing comparison between these calculated CID metric

Our paper addresses these shortcoming .

- Doing the modification in CID metric to avoid artifacts.
- The iCID metric is applied on gamut mapping and visual dataset.
- We compare the iCID based gamut mapping with am boss filtering function.
- We introduced optimization intent to account for specific the application purpose

The remaining paper is organized as follows:

Section II is about previous works. Section III represents the methodology of gamut mapping algorithm. Shows how to remove the artifacts and improve the color quality of image. Section IV presents the assessment of Jens preiss et al. technique and our modification.

II. RELATED WORK

For removing the artifact from the image and improving the color quality of image many author work on different area. They uses the different algorithm and objective function to remove the artifact and increase the quality of color images, some are as follows

Lin Zhang et al. developed a novel feature similarity (FSIM). The image quality assessment is developed according to the human visual system that understands the image feature according to low level feature. For obtaining the right scale is on the based on image resolution and the viewing distance and that are not easily obtained [3].

Zheng youzhi et al. developed evaluations of fused images. They display a structural similarity metric that does not consider reference image for image evaluations. They form metric by using universal image quality index. Image evolution distinguishes between complimentary information and redundant information. For the better performance there is need to distinguish complimentary and redundant information properly [4].

Ingmar Lesser et al. developed image difference framework. They compare image normalization, feature extraction, feature combination. They create image difference and measure by choosing some implementation for every steps. There is a need for improvement in prediction of gamut mapping distortion [5].

Raja Balasubramanian et. Al. developed a spatial gamut mapping technology to overcome shortcoming encounter with standard point wise gamut mapping algorithm. Problem with the point wise algorithm is that they do not consider importance of spatial neighborhood effect in account [6].

Ingmar Lisser et al. performed an analysis of various image processing problem of human color perception. The main aim was to identify color space property that are required for color image processing algorithms. Improve perception based image processing method. Color appearance model (CAM) and image appearance model (IAM) still are in research area and their prediction accuracy can be improved [7].

Ingmar Lissner et al. developed flexible image difference framework. Different type of image difference feature are extracted from input image. Using these feature they judging the image difference. Using different type of feature they optimize the relation between image difference and human assessment. These performance can improved by using non redundant image difference feature [8].

N. Bonnier et al. developed spatial gamut mapping algorithms (SGMAs) by a psychophysical experiment. The results of the experiments are then compared to image quality metrics (IQMs). After the investigation they think that there is not strong correlation with observers [10].
Ding Wenrui et al. developed an image and video quality assessment method. For describe image quality they use peak signal to noise ratio and the structure similarity index . For obtain the mapping function between the objective quality assessment and subjective quality assessment they used neural network.For getting the better assessment, more HVS characteristics should be analyzed to develop high performance quality assessment method [11].

III. METHODOLOGY

Different objective functions and algorithms are used to removing the artifacts from the distorted image and improving the color quality of color image.

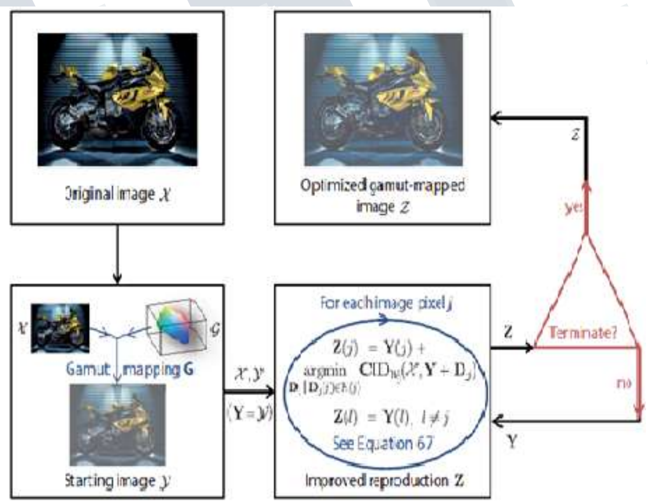

Fig. 1. Flow of Gamut Mapping Method [1].

A. *Steps of gamut mapping.*

- input is color gamut g and reference image x.
- Image y is valid in color gamut for iteration.
- Do the pixel wise gamut mapping.
- If the condition is not fulfilled then go to step 3.
- Terminate after the condition if fulfilled.
- Output is gamut mapped image.

Algorithm 1 Optimizing Gamut Mapping

```
INPUT: gamut G, reference image X
1. Y = G(X) ⊂ G
2. REPEAT
3.   FOR EACH i ∈ Ω
4.     Y(i) = Y(i) + argmin_{D_i(i)∈H(i)} CID_W(X, Y + D_i)
5.   END FOR
6. UNTIL TERMINATE
OUTPUT: Y
```

Fig. 2. ***Gamut Mapping Algorithm [1].***

Getting the original quality of the image or the better quality of the image, different type of the function and algorithm is appied on the distorted image. Objective function is used to remove the artifact trom distorted image.Previusly, CID metric is used as objective function CID metric is evaluated with gamut mapping. But some artifacts are remain as it is in the image. To remove that visual artifact, need to modify the CID metric. After diong the modification in the CID metric named as iCID metric. For the modification some comparison term like croma contrast and croma structure is added in CID metric. iCID metric is applied on the gamut mapping. When iCID metric is used as objective function, it remove the visual artifact retain the contrast, structure and exceed the color quality of the image.

1) Color image difference metric: This is used as ojective function for gamut mapping. It contain the different term for computing like lightness difference l_L, lightness contrast c_L, lightness structure s_L, chroma difference l_C, and hue difference l_H. Where A is subset of Ω and it contain all pixel position. │A│= Number of index set. x_i, y_i are the pixel array on the i^{th} position.

$$\mathrm{CID}_A(X,Y) = 1 - \frac{1}{|A|}\sum_{i\in A}\left[l_L(\mathbf{x}_i,\mathbf{y}_i)\cdot c_L(\mathbf{x}_i,\mathbf{y}_i)\cdot s_L(\mathbf{x}_i,\mathbf{y}_i)\cdot l_C(\mathbf{x}_i,\mathbf{y}_i)\cdot l_H(\mathbf{x}_i,\mathbf{y}_i)\right],$$

…….(1)

2) Improving color image difference metric:Some artifacts are remain as it is when CID metric is used as the objective function. Therefore there is a need to modify the objective function.

B. Lightness inversion:

This artifact is identified when background is not looking properly. The CID metric identify the lightness inversion by the lightness difference comparison term. The artifact lightness inversion is avoided by employing an initial gamut mapping *G* that trasform lightness monotonically.

$$: Y = \mathcal{G}(X) : X_L(i) \le X_L(j) \Rightarrow Y_L(i) \le Y_L(j)$$

(2)

Where X_L, Y_L are the lightness component for images and i,j € Ω is the pixel position.

C. Cromatic ringing:

This artifact is identified by repeating the shape of edge in image. The CID metric identify the croma deviation with its croma difference term. To remove this artifact, we add the comparison term croma contrast c_C in the CID metric.

$$c_C(\mathbf{x},\mathbf{y}) = \frac{2\sigma_{\mathbf{x}}^C\sigma_{\mathbf{y}}^C + c_6}{\sigma_{\mathbf{x}}^{C^2} + \sigma_{\mathbf{y}}^{C^2} + c_6},$$

(3)

D. Cromatic edges:

This artifact is identified by the thin cromatic lines. To avoide thes artifact we add the croma structure term in CID metric.

$$s_C(x,y) = \frac{|\sigma_{\mathbf{xy}}^C| + c_7}{\sigma_{\mathbf{x}}^C\sigma_{\mathbf{y}}^C + c_7},$$

(4)

Where x and y is the pixel arrays.σ_{xy}^{C} is the is the gaussion weighted linear correlation of croma components between the pixl array σ_x^C and σ_y^C .

Weighted parameter C7 > 0.

E. Lightness bonding:

This artifact is in the elongated structure and it is not present in the reference image. The comparison term of lightness structure detect the lightness bonding. But it is too small to detect this artifact. Therefore α is introduse as the exponential parameter and it is greater than 1.

F. Improved CID metric:

To avoide this artifact, there is need of modification in the CID metric. We add the croma contrast comparison term *cC* and croma structure comparison term *cS* in the CID metric to achive the better quality of color image.

Xi and Yi are the pixel of the array.

A is the exponential parameter in the term of lightness structure.

$$\mathbf{iCID}_A(X,Y) = 1 - \frac{1}{|A|}\sum_{i\in A}\Big[l_L(\mathbf{x}_i,\mathbf{y}_i)\cdot c_L(\mathbf{x}_i,\mathbf{y}_i)\cdot s_L(\mathbf{x}_i,\mathbf{y}_i)^a\cdot l_C(\mathbf{x}_i,\mathbf{y}_i)\cdot l_H(\mathbf{x}_i,\mathbf{y}_i)\cdot c_C(\mathbf{x}_i,\mathbf{y}_i)\cdot s_C(\mathbf{x}_i,\mathbf{y}_i)\Big]$$

(5)

IV. EXPERIMENT

A. *Data Source*

The experiments are conducted on the datasets to perform the experiments of base paper, the data sets are requested from Colorlab, Wikimedia, Fotopedia.We use the TID 2013(Tempere image database 2013). This dataset contain 25 reference image and comprising 3000 conventionally distorted image are generated from the reference image.
We also perform the experiment on images which are taken from Wikimedia and from Fotopedia with different format with variation in size.

B. *Ours Improvement*

In the base paper we calculate the iCID metric with gamut mapping. In modification we calcutate the iCID metric with emboss filtered images with visual data. Then we compare both iCID metric and show the result.

1) Using iCID function

Table1. Result on TID 2013

	CID	iCID*	iCID
None	0.496	0.616	0.502
None+	0.601	0.654	0.522
CSF	0.628	0.766	0.684
CSF+	0.646	0.829	0.741

* = without croma contrast and structure term.
\+ = automatic downsampling.

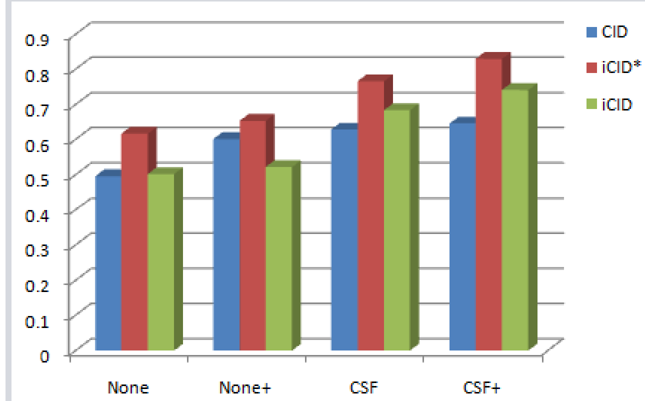

Fig 3. Bar plot to show the result for TID 2013

Table 1 shows the result for the TID database for the iCID function. When the downsampled iCID metric is used with CSF filtering it shows the better performance(second column with fourth row in Table 1).

Table 2. Result on gamut database

	CID	iCID*	iCID
None	0.614	0.580	0.580
CSF	0.637	0.704	0.697

* = without croma contrast and structure term.

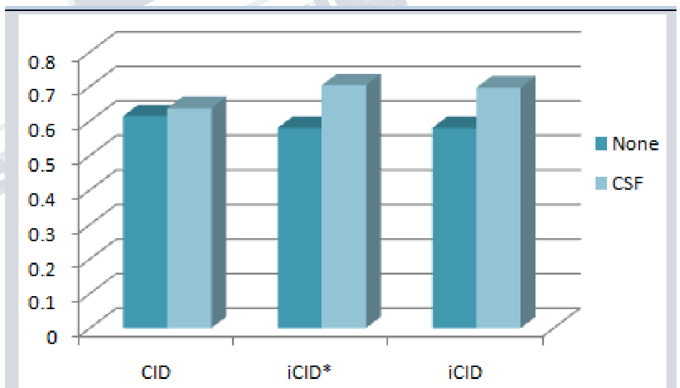

Fig 4. Bar plot to show the result for gamut database.

According to the table 2. gamut database shows better result, down sampled iCID metric with CSF filtering (second column with second row) But there is some negative impact occur with down sampled iCID when CSF filtering is not applied. It shows better result with CID metric (first column with first row in the Table 2)

2) Using emboss filter

Table 3. Result on TID 2013

	CID	iCID*	iCID
None	0.585	0.64	0.523
None+	0.606	0.667	0.535
CSF	0.631	0.772	0.689
CSF+	0.654	0.837	0.746

* = without comma contrast and structure term.
\+ = automatic down sampling.

When the emboss filter is applied on TID 2013 database it shows better result than the down sampled iCID metric with CSF filtering (second column with fourth row in Table 3).

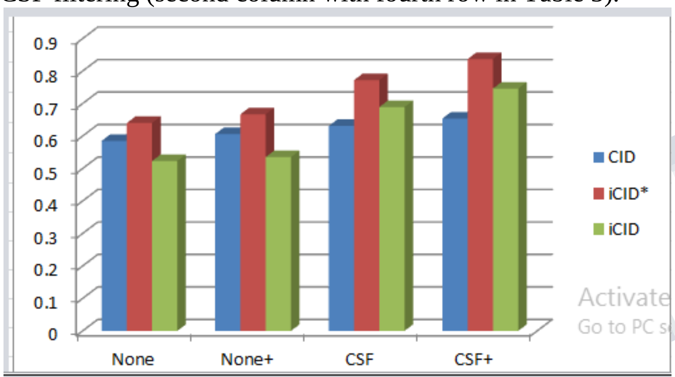

Fig 5. Bar plot to show the result for TID 2013.

Table 4. Result of gamut database

	CID	iCID*	iCID
None	0.615	0.718	0.59
CSF	0.638	0.713	0.698

* = without croma contrast and structure term.

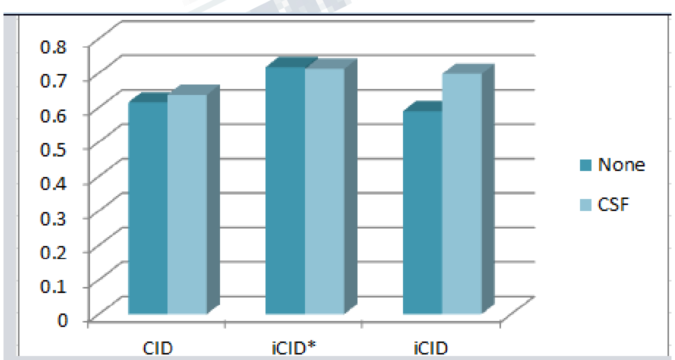

Fig 6. Bar plot to show the result for gamut database.

When the emboss filter is applied on the gamut database it shows better result than the down sampled iCID function with CSF filtering (second column with second row in Table 4).

3) Same image with variation in size

Table 5. Same image with variation in size

Size (Type :jpeg)	Metrics					
	NONE			CSF		
	CID	iCID*	iCID	CID	iCID*	iCID
25 KB	0.635	0.434	0.31	0.839	0.618	0.501
39.1 KB	0.635	0.824	0.7	0.838	0.812	0.695
55.5 KB	0.635	0.924	0.8	0.836	0.861	0.744
148 KB	0.635	0.1	0.1	0.835	0.960	0.844
367 KB	0.632	0.724	0.600	0.832	0.759	0.642
554 KB	0.631	0.724	0.600	0.832	0.759	0.643

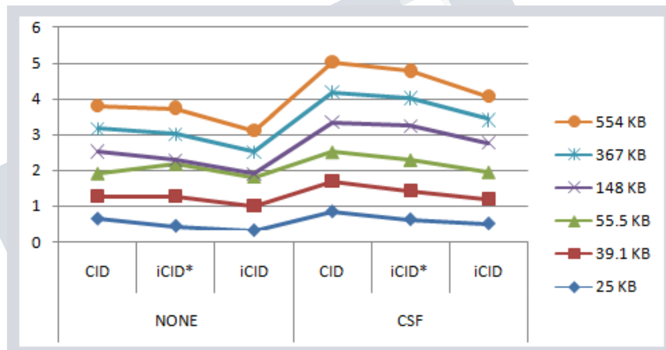

Fig 7. Representation for same image with variation in size.

We done the analysis on the same image with variation in size in jpg format. That image is taken from net. We analyzed that CID with CSF filtering is more supportive than the down sampled iCID with CSF filtering

V. CONCLUSIONS

When the users see the same image on the different platform they are not getting the image with original quality or with better quality. The iCID metric gives better color quality, retain the contrast and structure by using gamut mapping of the original image. In the existing paper we applied gamut mapping to calculate iCID metric over the different file format with variation in size. We also calculate the metric value by using the emboss filter. We show the comparison of gamut mapping with emboss filter. Hence emboss filter shows the better result on the chromatic edges. In the emboss filter the edges looking more sharp and clear with lightness inversion. Our experimental result with emboss filter shows better iCID metric than the existing.

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