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Integrated Color Constancy Algorithm with Illumination Normalization for Deremoscopy Images

Neeraj Jasrotia
Research Scholar, SSCET Badhani
Punjab, India

Er. Satnam Singh
Asst. Prof., SSCET Badhani
Punjab, India

Er. Vikas Saini
Asst. Prof., SSCET Badhani
Punjab, India

Abstract: ***Color constancy has ability to restore the actual colors in given image by evaluating the effect of color light source. Many color constancy techniques has been proposed so far to enhance the color constancy accuracy rate further. But in existing literature no such a technique is found which behaves optimistically in every case. Although the dermoscopy image classification using color constancy has shown effective results over available techniques, but it still suffers from the issue of uneven illuminate, random noise and poor brightness. Therefore to handle this issue a new integrated dermoscopy image classification using color constancy approach is proposed in this paper. The new approach has used illuminate normalization and alpha trimmed median based image noise reduction as post processing of dermoscopy image classification using color constancy to reduce the effect of random noise and poor brightness.***

Key Words: COLOR CONSTANCY, DERMOSCOPY, ILLUMINATION, ALPHA TRIMMED MEDIAN FILTER.

I. INTRODUCTION

In the 1990s, light-based visual advances were received to increase theclinical analysis of melanoma. Dermoscopy is a noninvasive technique that permits in vivo assessment of hues and microstructures of the epidermis, the dermo-epidermal intersection, and the papillary dermis not noticeable to the bare eye. Amid a dermoscopy evaluation, the pigmented skin injury is secured with fluid (typically oil or liquor) and analyzed under a particular optical framework. Applying oil decreases the reflectivity of the skin and improves the straightforwardness of the stratum corneum. This permits representation of particular structures identified with the epidermis, the dermo-epidermal intersection, and the papillary dermis, and it additionally recommends the area and appropriation of melanin. In the most recent couple of years dermoscopes with LED light with polarization have been presented and by utilizing enraptured light, drenching fluid is no more important, and some of these instruments don't require direct skin contact. Non-enraptured versus energized light and contact versus non-contact dermoscopy gives to some degree distinctive appearance of the analyzed sores as to shading and representation of vessels. In a study by Benvenuto-Andrade et al. they report amazing assention for most dermoscopic hues, except for blue-white cover and pink (red) shading when looking at non-spellbound and enraptured light. They likewise reason that most dermoscopic structures had reasonable to immaculate assention, except for milia-like growths and comedo-like openings, which appear to be better pictured with non-captivated light and the enraptured light enhances the representation of red territories and vessels, particularly the last with non-contact dermoscopy [1]. These structures are particularly associated to histologic elements. The distinguishing proof of particular indicative examples identified with the conveyance of hues and dermoscopy structures can better propose a threatening or considerate pigmented skin injury [2]. The utilization of this procedure gives a valuableaid in diagnosing pigmented skin sores. Due to the many-sided quality included, this approach is held for experienced clinicians.

II. DIGITAL DERMOSCOPES

Advanced sorts are less demanding to take and store dermoscopy pictures, however simple sorts are all the more broadly utilized. There is a study in the writing that thinks about pictures of a dysplastic compound melanocytic nevus and a slight threatening melanoma under five diverse handheld dermoscopes. The amplification was indistinguishable in all dermoscopes. The creators demonstrate that in the more up to date dermoscopes, the picture quality as to shading and noticeable differential structures is particularly enhanced contrasted with the dermoscope with one and only light source. Three progressed dermoscopes will be explored quickly here [3].

2.1 DermLite II Pro

With new advances in innovation, dermoscopes have likewise developed. DermLite from 3Gen Co. is a dermoscope comprising of an amplifying lens surrounded by light-radiating diodes that can be balanced for polarization. This multi-ghostly dermoscope gives shading perception; running from whitelight epiluminescence, surface pigmentation utilizing blue light, shallow vascularity under yellowlight, and more profound pigmentation and vascularity with the more profound infiltrating red light recurrence. Another variant of the DermLite can be utilized for the assessment of pigmented sores and non-pigmented skin growths, scalp ailment, and vascular examples. The DermLite can be joined to a camera to record pictures and has a retractable faceplate for use with submersion oil.

As of late, the organization has given an iPhone pack that clients can snap the DermLite onto their iPhone cameras [4].

2.2 Dino-Lite Pro USB Dermoscope with Polarizer

The DinoLite is a conservative advanced magnifying instrument with USB - PC network. Amplification ranges from 10X to 200X (movable single lens) to 500X with white spellbound LED lights. The LED's light is around the 400 nm range. The polarization highlight permits the client to lessen the impact of reflections and glare when taking a gander at profoundly intelligent surfaces. Conformity of the polarization highlight is performed by method for a pivoting neckline, permitting the client to look at articles with differing levels of polarization. Handyscope can be utilized for tele-dermatology, joining most recent correspondence innovation of iPhone with a device for skin disease screening. Dermoscopy pictures brought with iPhone camera and the dermoscope connection can be messaged to different masters for a brief moment sentiment. Versatile dermoscopes can give a decent portability to specialists while they are associated with servers through wireless associations with give a coordinated dermoscopy station [5].

III. IMAGE ACQUISITION AND IMAGE PRE-PROCESSING

While working with advanced pictures of any sort, the image obtaining is dependably the initial step of picture investigation process. Picture obtaining is a phase, at which pictures are gathered keeping in mind the end goal to make certain information set, which is later investigated to check whether any of the assembled pictures offer comparative elements or contain any of the predefined components, or meet already characterized supposition.

3.1 Image Acquisition

Dermoscopic pictures are fundamentally computerized photos/pictures of amplified skin injury, brought with traditional camera outfitted with exceptional lens augmentation. The lens joined to the dermatoscope demonstrations like a magnifying lens magnifier with its own light source that enlightens the skin surface equally. There are different sorts of dermoscopy gear, however every one of them utilize the same standard and permit enrolling skin pictures with x10 amplification or more. Because of light source coordinated into dermatoscope lens, there happens to be issue with skin reflections. To neutralize this issue, a fluid is utilized as a medium layer between the lens and the skin. In current dermatoscope the fluid is redundant, as a result of the energized light source that expels the reflection issue. Advanced pictures obtained utilizing photograph dermatoscope are adequately high determination to take into consideration exact examination as far as differential structures appearance.

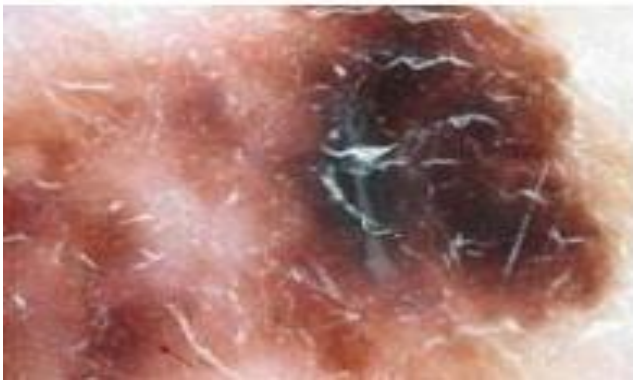

Figure 1: Skin lesion as viewed by Dermoscope

Dermatologist can make precise documentation of accumulated pictures, opening a way for PC examination, where pictures are prepared keeping in mind the end goal to concentrate data that can later be utilized to characterize those image

3.2 Image Pre-processing

Before investigation of any picture set can occur, preprocessing ought to be performed on every one of the pictures. This procedure is connected with a specific end goal to ensure that every one of the pictures are reliable in sought trademark. At the point when working with dermatoscopic pictures, preprocessing can cover number of components like: picture enlightenment leveling, shading range standardization, picture scale fitting, or picture determination standardization. This can be subject to characterized essentials and strategies connected in post handling.

A case of rudimentary operation, for example, picture standardization is the determination coordinating. Expecting that the picture size in pixels is given, and all pictures are in the same Proportion, it is anything but difficult to discover the pictures of littlest determination and after that scale the bigger pictures to coordinate the measure of the littlest one. This operation permits figuring the elements like injury measurements, sore outskirt length and sores range scope. It is conceivable to standardize alternate parameters like shading palette standardization, shading immersion standardization, standardization of shading segments, et cetera. Exceptionally regular operation in preprocessing is shading segments standardization, known as the histogram evening out. Picture histogram is the circulation of hues qualities in the middle of amazing hues utilized as a part of the palette.

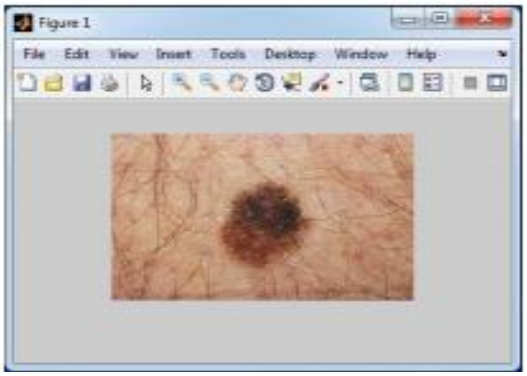

Figure 2: Original Image with Hair

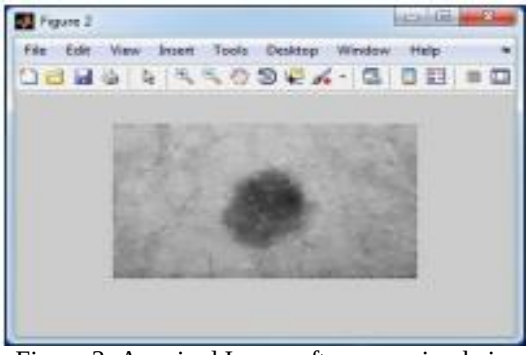

Figure 3: Acquired Image after removing hair

Expecting the circumstance where the brightest purposes of the grayscale picture are not white and the darkest focuses are not dark, performing histogram leveling will redistribute every one of the shades of the picture in a way that brightest spot of the handled picture will be shading and the darkest locales of the picture will get to be dark. Standardized picture is portrayed by better shine, sharpness and shading profundity, in this way permitting simpler detachment the sore zone from the foundation (skin shading). Applying histogram balance operation takes into account better separation of picture point of interest, and along these lines enhances the proficiency of components extraction. Histogram evening out can be performed for each of the shading segments independently, or on the greater part of the segments without a moment's delay.

3.3 Image Pre-processing & Restoration

Image Restoration Restoration is characterized as the strategy to recuperate the corrupted picture from an obscured and uproarious one [25].It can reestablish the debased pictures in various ways. The picture debasement can happen by different deserts, for example, blemish of imaging framework, awful centering, movement and so forth which make a picture typically boisterous or obscure [25]. Since the ruined pictures lead to blame recognition, thus, it is crucial to think about clamors present in a picture to choose the most suitable de-noising calculation. The picture clamors can be separated into four gatherings of Gaussian, Salt and Pepper, Poisson and Speckle [26]

A. Restoration from different noise

Image de-noising is a key stride in preprocessing of a picture. It is to a great degree hard to apply a powerful de-noising calculation for various sorts of boisterous pictures. The fundamental property of a decent picture de-noising strategy is to stifle the commotion and in addition protecting the edges.

B. Restoration from blur

As specified before, obscure is a sort of picture debasement which owe to the defective arrangement procedure of a picture. It happens by awful centering or movement between unique picture and camera. There exist distinctive strategies for de-obscuring, for example, Lucy-Richardson calculation strategy, Inverse channel, Wiener channel deblurring procedure, and Neural system Approach. In therapeutic applications, Wiener channel has been connected as a standout amongst the most effective and normal de-obscuring strategy which expel the commotion also.

IV. LITERATURE SURVEY

Catarina Barata et. al. (2015) [1] Heartiness is a standout amongst the most critical attributes of Computer Aided Diagnosis frameworks intended for dermoscopy pictures. Be that as it may, it is hard to guarantee this trademark if the frameworks work with multi-source pictures, gained under various setups. Changes in the enlightenment and obtaining gadgets adjust the shade of pictures and regularly decrease the execution of the frameworks. In this way, it is imperative to standardize the shades of dermoscopy pictures before preparing and testing any framework. In this work we explore four shading consistency calculations: Gray World, max-RGB, Shades of Gray and General Gray World. Their outcomes

demonstrate that shading steadiness enhances the grouping of multi-source pictures, expanding the affectability of a Bag-of-Features framework.

Omar abuzaghleh et al (2015) [2] proposed a novel constant mechanized picture examination procedure for early location of melanoma in the skin. It contains two models. The primary model is a constant ready framework whichaide the client to recognize the skin copy brought about by the sun rays.It utilizes 'time to skin copy' (TTSB) novel condition to infer the copy recurrence level and UV radiation list level. The second model is a mechanized dermoscopy picture examination framework. In this framework, firstly the RGB skin picture (shading picture) is changed over to a dark scale picture. So as to reject the hair from the picture, it is gone through 2-D Gaussian channel. After the picture is sifted, the skin sore is sectioned utilizing Otsu thresholding technique. The yield picture after division has sporadic edges in the picture. The edges are smoothened by outspread decay utilizing intermittent lines. At that point the component extraction of the picture is finished.

Chen Lu et. al. (2015) [3] presents another strategy for epidermal zone division in skin entire Side picture (WSI). To accomplish powerful division, the monochromatic shading ought to be resolved first. Subsequently, the red channel of the first RGB picture is resolved. To begin with, this technique performs beginning division by Otsu thresholding and dispose of undesirable locale utilizing shape investigation on the parallel picture. At that point, the Template coordinating (TM) technique is completed relying on the result consequence of beginning division. A programmed circle shape format is made for TM technique. This format is connected to the red channel to build the sign on the melanocytic epidermal district .This strategy gives a reaction esteem picture where the melanocytic locale is spoken to by higher reaction esteem and different areas by lower esteem reaction. At long last, Probability Density Function (PDF) investigation is finished by computing the edge esteem for compelling epidermal division.

Aswin et. al. (2014) [4] presents another framework for identifying the skin growth at an early stage. In this calculation, the initial step is to evacuate the commotion and refine the outskirt of the dermoscopic image.The expulsion of hair is finished by Dull Razor programming and the clamor is sifted utilizing a mean separating strategy. In the wake of sifting, Otsu edge division is done on the picture keeping in mind the end goal to detach the pigmented sore territory of the skin for next procedure. Presently to distinguish the kind of sore, the component extraction is done through Gray Local Co-event Matrix (GLCM) and Normalized Red, Blue, Green strategies. Threatening melanoma is recognized by high complexity quality and variety of blend red, blue, green hues as kindhearted melanoma has low differentiation and uniform shading .at long last the separated element is ordered to disease injury or non-malignancy sore. The grouping is finished by Artificial Neural Network (ANN) through Hybrid Genetic Algorithm (HGA).HGA gives an exact and enhanced quality.

Mariam Ahmed et. al. (2014) [5] have outlined another robotized framework for diagnosing pigmented skin injuries. Both clinical picture (standard camera) and dermoscopic picture (Dermascope) can be utilized as a part of this framework. The picture is resized to 470 × 640 pixels and improves the fringe of the injury. The Image Enhancement is finished by two stages commotion filtration (middle channel) and after that change of RGB picture to Gray Scale Image. Next stride, contrast conformity and division, where the picture is differentiated and the sore is segregated from the skin foundation by Otsu limit strategy. For removing the components from the pigmented skin sore two capabilities geometric elements (Shape) and chromatic element (shading) are utilized to separate the element. Separated elements were ascertained by two unique sorts of Feature choice t-test and Fisher Score to locate the noteworthy one .The chose highlight is ordered by two classifiers-Artificial Neural Network and Support Vector Machine (SVM). Hence, the outlined framework was prepared with 320 pigmented skin injury pictures for clinical and dermoscopic pictures.

Mohammad Khalad et. al. (2014) [6] presents presents a novel Computer Aided Diagnostic (CAD) framework for the melanocytic skin division in the histopathalogical image.at the pre- handling stage, the picture is resized, edited and sifted by three channels wiener, Gabor and versatile middle channel. Before division, histogram adjustment is done to upgrade the picture contrast. At that point, this picture is divided by Edge Detection technique. The framework utilizes SFS (Sequential forward determination) to decrease the element parameter and improve the execution for SVM (Support Vector Machine) arrangement.

Emre Celebi et. al. (2014) [7] proposed a mechanized framework for dermoscopic pictures taking into account clinically noteworthy hues. In this method, the dermoscopic pictures which have N hues are diminished to few hues by K-implies bunching calculation. The estimation of K acquired from grouping calculation lies between 2 to 16.These qualities are independently figured by five bunch legitimacy criteria. After assessment done by group legitimacy, the quality procured from it is examined on an arrangement of 617 pictures by Symbolic Regression Algorithm. At long last, the Regression Algorithm gives a numerical condition which arranging the skin cancer(benign or malignant).If the yield quality is lesser than 0.5 it is generous generally harmful.

Jeffery et. al. (2014) [8] build up a novel division technique in view of the surface of the skin of the photographic pigmented skin injury picture At pre-handling step , the splendid spots and other clamor brought on by variety of brightening in the photographic picture is evacuated by Multistage light displaying (MSIM).This yield picture is portioned by Texture Distinctiveness Lesion Segmentation (TDLS) strategy. Initial step, an arrangement of typical skin and sore skin surface are dissected on the premise of scanty composition. In the event that TD metric quality is little, it's a typical skin or else it's a skin sore. In the second step, characterizing the ordinary and sore skin in view of results delivered by inadequate surface conveyances and TD metric quality happens. Assess textural uniqueness metric in light of the circulation of composition then locate the underlying area by SRM calculation. At long last the limit esteem which characterizes the two sorts typical and sore skin is assessed and edge esteem 1 speaks to sore skin and 0 speaks to ordinary skin. After characterization, the sore picture is smoothened at edges of the outskirt..

V. PROPOSED METHODOLOGY

5.1 Methodology

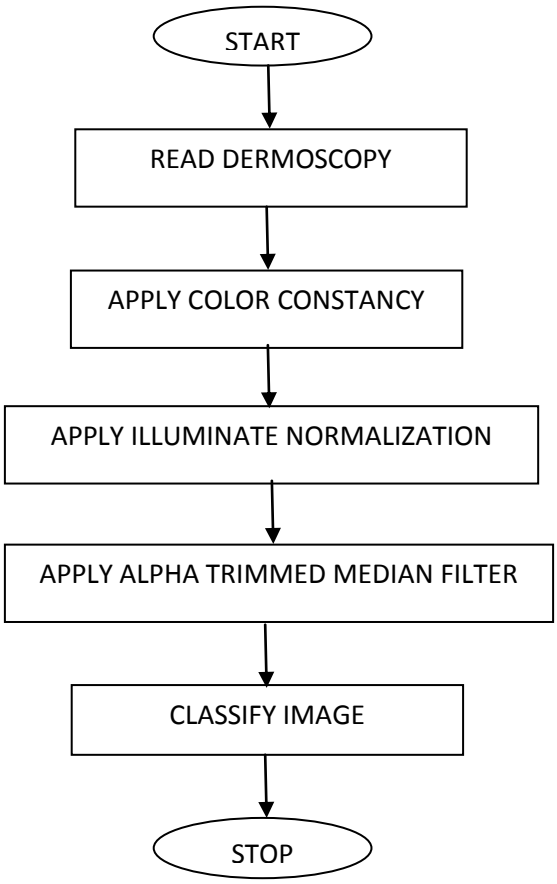

Figure 4: Flow Chart

Step 1: Start the algorithm.
Step 2: Firstly take any input color dermoscopy image for experimental purposes.
Step 3: Then apply Color Constancy technique as a proposed method.
Step 4: After then apply illuminate normalization.
Step 5: Then apply Alpha Trimmed Median Filter in order to eliminate noise from the dermoscopy image.
Step 6: Then classify the dermoscopy image.
Step 7: Stop the algorithm.

VI. RESULTS AND DISCUSSION

(a) Input image 5 **(b)Existing Result** **(c)Proposed Result**

Figure 5: Experimental Results

6.2 PERFORMANCE EVALUATION

This section contains the comparison table and graphs of the existing and proposed techniques. The proposed results are much better than the existing results as shown by following measures:

1. RMSE – Root-mean-square error is a measure of the differences between values predicted by a model or an estimator and the values actually observed. It can be explained as:

$$\mathrm{RMSE} = \sqrt{\frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}(f(i,j) - f'(i,j))^2} \qquad (3)$$

The values of Root Mean square error are shown below in the comparison Table 5.4.
This table has shown the results of existing algorithm as well as proposed algorithm.

Table 1: Root mean square error comparison table

INPUT IMAGE	EXIXTING RESULT	PROPOSED RESULT
1.	0.1504	0.0459
2.	0.2157	0.0787
3.	0.1754	0.0586
4.	0.1784	0.1049
5.	0.2359	0.1586
6.	0.1827	0.0784
7.	0.1683	0.0999
8.	0.1816	0.0537
9.	0.2257	0.0645
10.	0.2327	0.0998
11.	0.1686	0.0418
12.	0.2406	0.0994
13.	0.2155	0.0429
14.	0.2328	0.0428
15.	0.2074	0.0730
16.	0.1698	0.1328

Figure 6 has shown the quantized analysis of the Root Mean Square Error of different images by Existing value in(Blue line) & proposed values in(Red lines). It is very clear from the plot that there is value of RMSE is minimum in every case with the use of proposed method over other methods. This represents improvement in the objective quality of the image.

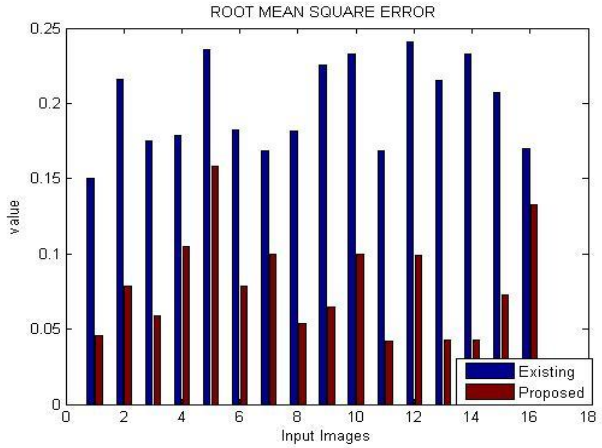

Figure 6: Root Mean square error graph

As RMSE need to be minimized; so the main goal is to decrease the RMSE as much as possible. Table 1has clearly shown that the RMSE is minimum in the case of the proposed algorithm therefore proposed algorithm is providing better results than the available methods.

This RMSE graph proves that the values of proposed algorithm is low than the existing algorithm. so the proposed work results are much better than the existing results.

2. BER - It is defined as the rate at which errors occur in a transmission system. This can be directly translated into the number of errors that occur in a string of a stated number of bits. The definition of bit error rate can be translated into a simple formula:

$$BER = \frac{Number\ \ of\ errors}{Total\ number\ \ of\ bits\ sent} \quad (4)$$

The values of Bit error rate are shown below in the comparison Table 2.

Table 2: Bit error rate comparison table

INPUT IMAGE	EXISTING IMAGE	PROPOSED RESULT
1.	0.0155	0.0134
2.	0.0163	0.0142
3.	0.0158	0.0137
4.	0.0158	0.0148
5.	0.0165	0.0156

6.	0.0159	0.0142
7.	0.0157	0.0147
8.	0.0159	0.0136
9.	0.0164	0.0139
10.	0.0164	0.0147
11.	0.0157	0.0132
12.	0.0165	0.0147
13.	0.0163	0.0132
14.	0.0164	0.0132
15.	0.0162	0.0141
16.	0.0157	0.0152

Figure 7 has shown the quantized analysis of the Bit Error Rate. It is very clear from the plot that the value of BER is getting reduced in every case with the use of proposed method over other methods. This represents improvement in the objective quality of the image. This BER graph proves that the values of proposed results are much better than the existing results.

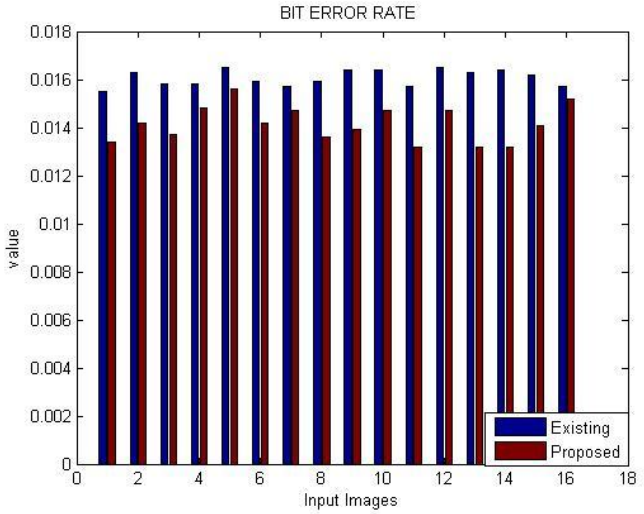

Figure 7: Bit error rate graph

VII. CONCLUSION AND FUTURE WORK

The recent techniques for color constancy has been considered for review purpose. The related techniques to color constancy has shown several limitations. The use of illuminate normalization is ignored in dermoscopy image classification but its use may reduce the uneven illuminate issue of color constancy. The color constancy algorithm may introduce low intensity image, so adaptive color enhancement algorithms are required to be integrated with existing techniques. The use of alpha trimmed median based noise reduction is also ignored in the most of existing literature. This paper has evaluated the performance of the existing algorithms for dermoscopy image classification using color constancy. To handle above discussed issues, a improved dermoscopy image classification is proposed and implemented using color constancy technique by using illuminate normalization. Also integration of proposed image classification is also done with alpha trimmed median filter. The comparative analysis have clearly shown that the proposed technique outperforms over the available methods. In near future we will use some other filters to enhance the results further.

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