Overview Study of Color Enhancement Techniques for the Aid of Color Blind Individuals

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***Abstract*— Color enhancement and feature extraction are used in many application areas. Color Vision Deficiency is one of the biggest problems across the globe. There are several types of CVDs with difference in their parameters based on the conditions of the patients such as monochromacy, dichromacy, trichromacy as parental disorders within which there exists certain other subtypes. Based on the functionality of certain proportions of people, spectrum analysis and wavelength adjustment for each affected patients depending upon the colors which hit the wrong rods and cones, the feature extraction used will replace the particular color from the spectral data and replace it with the correct color after simulation and processing. It uses MATLAB software based on the system specification and processing it will thereby improve the efficiency and functioning of the simulation of the images and the videos. The feature extraction used helps in studying the different types of CVD's and based upon the type of diseases it performs RGB to LMS color bifurcation and helps in change of scale of color processing so that the particularly affected patients featured upon the deficiency in the colors can thereby, after processing and simulation of the different images and the video, can distinguish between shades in the re colored frames of the images and other modes of media.**

Keywords—Color vision deficiency (CVD), protanopia, deuteranopia, protanomaly, deuteranomaly

I. INTRODUCTION

Color blindness, also known as color vision deficiency, is the decreased ability to see color or differences in color [10]. Simple tasks such as selecting ripe fruit, choosing clothing, and reading traffic lights can be more challenging. Color blindness may also make some educational activities more difficult. However, problems are generally minor, and most people find that they can adapt. People with total color blindness (achromatopsia) may also have decreased visual acuity and be uncomfortable in bright environments. Following are the targeted areas:

Protanopia:

It is type of Color Vision deficiency which falls under the category of Dichromacy, in this disorder, the person is not able to see Red color but Green and Blue are visible. Wavelength distribution plays a very important role is this discrepancy of visibility. A person with missing Long Wavelength Cones or L-Cones is said to be as suffering from Protanopia. Such a person will not be able to see colors which have long wavelength (i.e. Red). The missing L-cones will not only affect the ability to see Red Color, but it will also affect absorbing the colors which are present in the vicinity of Red color in the color spectrum.

Deuteranopia:

In this type of Color Vision Deficiency, the color of conflict is Green. This deficiency is basically caused due to the absence of Medium Wavelength Cones. This absence results in the person's inability to see Green color which has medium wavelength. Also, this does not mean that the presence of L-cones will help to completely distinguish and see the colors in the far end of Spectrum. The absence of Medium Wavelength Cones will also affect the person's ability to see the colors which have wavelength greater than the range that falls in the Medium Wavelength. Thus, apart from Green, the respective person will not be able to see.

Tritanopia:

In this type of Color Vision Deficiency, the colors in the near end of spectrum are difficult to recognize. In Tritanopia, the Short Wavelength Cones or S-cones are missing completely, hence the person is not able to view colors having short wavelength. Though the Medium Wavelength Cones are present but the Colors dependent on M-cones are not really visible in their true form. This is also known as Blue-Yellow Color Blindness because of its effect on a person's ability to recognize true hues of Blue and Yellow colors.

Protanomaly:

This falls under the name of anomalous trichromats because of the presence of all the three cones. In Protanomaly, unlike Protanopia, the Long Wavelength Cones or L-cones are present but are defective in some form. Due to the presence of defective L-cones, some intensity of Red will be visible to the respective person, but the actual intensity will always be different from the visible one.

Deuteranomaly:

This is a less deficient form of Deuteranopia in respect of a person's ability to recognize colors. In

Deuteranomaly, unlike Deuteranopia, the Medium Wavelength Cones or M-cones are present but are defective in some form. Due to the presence of defective M-cones, this can be everything between almost Normal color vision and Deuteranopia. The green sensitive cones are not missing in this case, but the peak of sensitivity is moved towards the red sensitive cones.

Tritanomaly:

This is an alleviated form of blue-yellow color blindness or Tritanopia, where the S-cones are present but do have some kind of mutation. The presence of S-cones or Short Wavelength Cones do help in recognizing few intensities of blue and yellow but the mutation of those cones makes the person see anomalous shades of actual color, hence the name tritanomaly, depicting anomalous behavior.

II. PROPOSED SYSTEM

Vision is a vital aspect of Human Life. The ability to perceive the environment with correctness and completeness can prove to be of utmost important and can have a huge impact on a person's lifestyle. People are never always aware about being suffering from a Color Vision Deficiency, thus a system is needed to detect such anomalies in a person's system. Now, a simple detection will not solve the problem, hence a system of image processing is required to modulate the frequency as per the color spectrum and produce a vivid image which will look real to a person suffering from Color Vision Deficiency.

Here, the main aim is to present an efficient system, in aspect of processing time as well as the image quality. The proposed system is a Software based on MATLAB, which carries out the task of image processing by conversion of entities. Conversion of RGB spectral coordinates into the LMS vectoral coordinates is done in order to convert subjected multimedia into a multimedia form which can be correctly interpreted by the person suffering from color vision deficiency. We propose a system in which a color blind users (anomalous trichromats) will access the system using the given User Interface. Since, our algorithm is for the users suffering from anomalous trichromacy (deuteranomaly or tritanomaly), the user will select the appropriate type of color deficiency out of two. Then the user will select the image or video he wants to process. Input Image will be taken by the system as it is while videos will be converted to frames and then the system will process each frame.

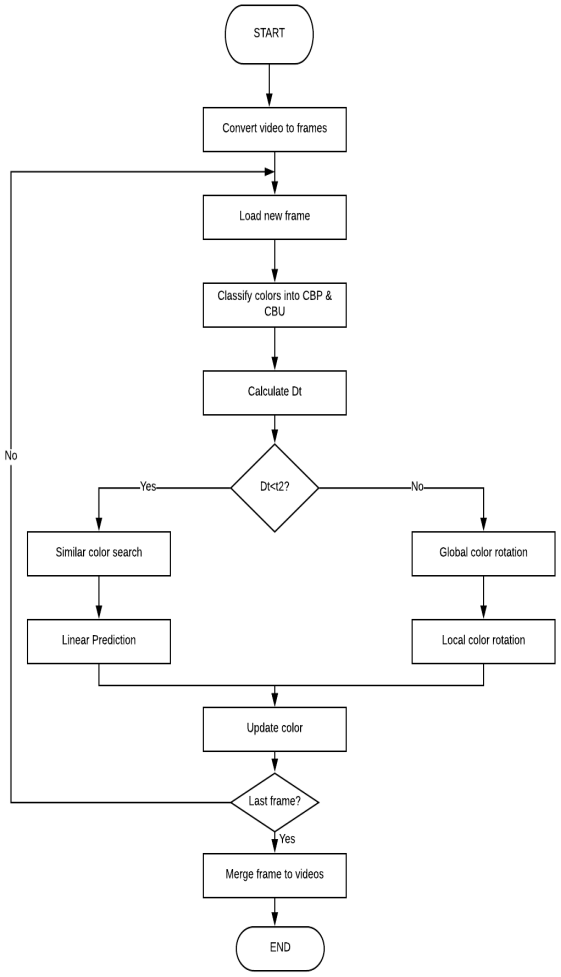

Fig. 1. Flowchart of the gradient map method, [1]

III. SCOPE

The current scope of the project is to target the major color blind patients across the globe along with their difficulties they face in day to day activities as the technology advancements have been done in the previous years there are major concerns to recoloration along with the time of processing as per the bits and frames of images and videos which are used for the RGB to LMS using the spectral analysis as per the feature extraction to drag out the type of recoloration required for the desired patients and maintaining accuracy along with the originality of the size and the frames .To use the higher values of the GPU's along with increase in processing power and specifications to provide better platform for matlab to use the given input images and the other types of media to break, simulate, recolor and display the vectorical distribution of the RGB to LMS in context with the CVD's of the patients with regards to the deficiency.

IV. Analysis

A. Load Image/ Save Image

Loading the particular image for the image processing in the particular bitmap using the specific modules. This is by opening the user interface and selecting the given image or video file and after alteration will save the processed image.

B. Image Processing Techniques

Various processing techniques are included in the project (grey, Long, Medium, Saturation, Hue, Brightness and color).

C. Image Recolor

In this module, recolor the image with particular type of deficiency eg. protanopia, deuteranopia and etc. Recoloring is the technique in image processing and here, added in each module recoloring is done.

D. Data acquisition

This is the main module in this project. First converts to binary image (grey scale), passes color to matrix using RGB to LMS and converts by combination colors of image.

V. Methodology

Following are the methods to be followed:

Re-Engineering

Re-Engineering means a new piece of software with similar functionality as an existing one. Reverse engineering process involves identifying the geometry of existing part, creating a geometric model of the part from the identified data and passing this model to designing software for manufacturing. We currently have the slightly efficient modules of protanopia, deuteranopia, protanomaly, deuteranomaly. Our main aim will be to identify weak sections in these modules and replacing the, with new, more efficient algorithms, hence re-engineering these modules.

Identify Processes:

Identify weak sections in the existing modules with as much detail as possible by interviewing the efficiency of the system.

Review, Update, Analyse As-Is:

The existing modules will be reviewed by the color-blind users for accuracy and we will try to analyse and update the modules so as to bring efficiency keeping the accuracy intact.

Design To-Be:

The modules will be redesigned according to the required user interface and will simulate, process and generate output for easy access.

Test and Implement To-Be:

To use different systems with various configurations and specification for using the image processing with matlab platform and implement upon the best system GPU's with faster processing time.

VI. Conclusion

The color blind people(anomalous trichromats) are usually under confident due to their color vision deficiency and have the desire to be like normal trichromats. But it is not possible for them to see colors without using any hardware tools. Even if the tool is available, not everyone would be able to afford it. The best alternative would be an interface that helps them to distinguish different colors. Visual media is something that everyone is fascinated to, like watching movies, images, learning, etc. But for color blind users, it's a bane. Hence, if they would be able to distinguish colors then they would also enjoy the visual media and it will turn out to be a boon for them.

We have understood all the results of the recolored pictures and videos using various multimedia files using different modules of color blindness as the subject of color vision deficiency, the types of algorithms are implemented in MATLAB using the efficacy of the programming languages the existing system gives the quick response but the output somehow lags behind which in the proposed system using the extendable GUI can be modified and pursued even for the images and the videos.

Hence, we are making recoloring algorithms that will be later applied to an interface and will allow anomalous trichromats to enjoy the visual media like other people do. It will be done by enabling feature distinction in visual media. It will be obtained by using any of the two algorithms, which will be selected on the basis of their speed and accuracy. Finally that algorithm will be applied to the interface.

Obviously, the above system will not give the complete satisfaction to the anomalous trichromats as they won't be able to see the actual color but at least by distinction, which removes confusion, could be a

beginning of a new ‘visual’ world for them and maybe, in future, they attain the ‘complete satisfaction’.

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