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PAPER

A Color Guide for Color Blind People Using Image Processing and OpenCV

K Prasanna Lakshmi[1](✉), Archana Kalidindi[2], Janakidevi Chilukala[1], Kumudini Nerella[1], Wajahath Shaik[1], Divija Cherukuri[1]

[1]Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad, India

[2]VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad, India

prasannakompalli@gmail.com

ABSTRACT

Colors are the smiles of nature. Digital image processing has widely employed the use of the function the color due to its effectiveness as a tool in classifying and identifying objects, which can be distinguished based on various relevant shades of color. This work aims to create a software tool that assists color-blind individuals in identifying the colors and edges in an image that may appear similar to them. If you are not suffering from a color vision deficiency it is very hard to imagine how it looks like to be color blind. Individuals with color blindness are limited and sometimes even disqualified from specific professions due to their inability to differentiate between colors. The objective of this research is to create a technique or approach for accurately identifying different shades of colors and predicting their names specifically for individuals with color blindness. This project utilizes image processing techniques to create a system that can recognize and distinguish colors in an image. The algorithm used for color detection in this project recognizes pixels in an image that correspond to a defined color or color range and provides the name of the color along with its corresponding B, G and R values. This work will be very helpful for people who suffer from color blindness especially when they want to know the color of the things.

KEYWORDS

image processing, color detection, computer vision

1 INTRODUCTION

Color refers the visible presence of things due to a particular outcome of the unique traits of reflected light or produced by them. Rods are responsible for detecting the existence or absence of light, while cones are responsible for detecting various wavelengths of light. A wholesome human eye has 3 styles of cone cells, every of which could stumble on kind of a hundred one of a kind color shades, thus most researchers estimate that we will be able to identify around a million different colors. The powerlessness of our eyes to check the initial color is

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named as "color blindness". It is decreased ability in differentiating the color. It is predicted that a normal color vision person can distinct one million shades, but a color blind person may differentiate as few as just 10,000 colors (1% of the normal range). Agenda: building software to detect the colors on the desktop to color blind people. Figure 1 depicts the difference between how a normal eye and color blind detects the colors.

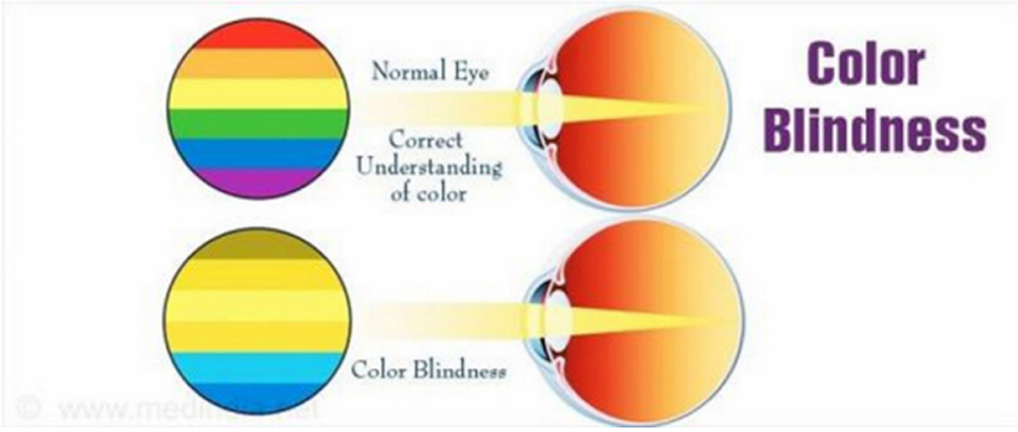

Fig. 1. Scenario of color blindness

The world of nature is bright and colorful. It is the blessing for us to see this colorful nature. We can't even imagine the life without colors. But when we think of color blind people, they don't have this blessing to enjoy the colorful nature. Certain colors are hard for color blind people to recognize. The only colors that people with complete color blindness can perceive are6 black, white, and grey. For those who are color blind, color perception issues can interfere with daily activities as well as academics.

Less than 1% of women and 8% of males reported having color biases from birth, respectively. Only a small percentage of the several colorblind individuals listed experienced absolute color blindness. Even yet, those who are color blind of any kind can experience difficulties in their everyday life, including being unable to tell the difference between the colors of objects like clothing, traffic lights, and some symbols like road signs and medical shop signs. For some fields of labor and careers, color blindness might be a barrier to further study. Various forms of color vision deficiency can result in difficulties distinguishing certain colors. There are three different kinds of categories in color blindness.

Green-Red color blindness: The utmost prevalent form deficiency of color vision makes it challenging to differentiate between green and red hues. Red-Green color blindness manifests into four distinct variations:

- Deuteranomaly is the utmost prevalent type of red-green color blindness, which enhances the appearance of red tones in green hues. Although this form is relatively mild and does not usually disrupt daily life.
- Protonomy, another type of green-red color blindness, results in a reduced intensity of red and greenish appearance. This form is also mild and typically does not significantly impact daily functioning.
- Protanopia and Deuteranopia are two forms of red-green color blindness that entirely prevent the differentiation between green and red hues.

Yellow-Blue color blindness: Blue-yellow color blindness comes in two different forms:

- Blue and green are difficult to distinguish from, as well as yellow and red, due to tritanomaly.
- Tritanopia, in which you can't distinguish between the colors yellow and pink, purple and red, or blue and green. Moreover, it dulls the brightness of colors.

Complete color blindness: You cannot see any colors if you are completely color blind. This is exceedingly rare and is also known as monochromacy. Individuals with color vision deficiency may also experience visual clarity issues and heightened light sensitivity, depending on the type. Types of color blindness is presented in Table 1.

Table 1. 3 types of cones and their prevalence in female and male [5]

Major Types of Color-blindness			
Type of Cone	***Cause***	***Prevalence in Female***	***Prevalence in Male***
Monochromacy	Missing of all types of cones	0.00001%	0.00002 %
Dichromacies			
Protanopia	Missing of L cone	0.02 %	1.0%
Deuteranopia	Missing of M cone	0.1 %	1.1 %
Tritanopia	Missing of S cone	Very rare	Very rare
Anomalus Trichr.			
Protanomaly	Abnormal L cone	0.02%	1.0 %
Deuteranomaly	Abnormal M cone		4.9 %

Color blindness [1], also referred to as deficiency in color vision [2], [3], is a condition that diminishes an individual's ability to perceive colors or discern variations in color. This impairment can have a negative impact on a person's daily routine. Tasks such as reading colorful materials, selecting fruits or clothing, and interpreting traffic signals can be difficult for individuals with color blindness, who often devise coping strategies. However, those with complete color blindness experience not only reduced visual acuity but also discomfort in bright settings, exacerbating the challenges they face in their daily activities [3]. Color vision deficiency (CVD) is more prevalent in males worldwide than in females. Apollo Hospital reports that India sees over 10 million cases of CVD each year. Color blindness which is inherited cannot be curable, but if color blindness results from another medical condition, compensatory measures can assist the affected person. Figure 2 shows how people with different types of color blindness see the colors.

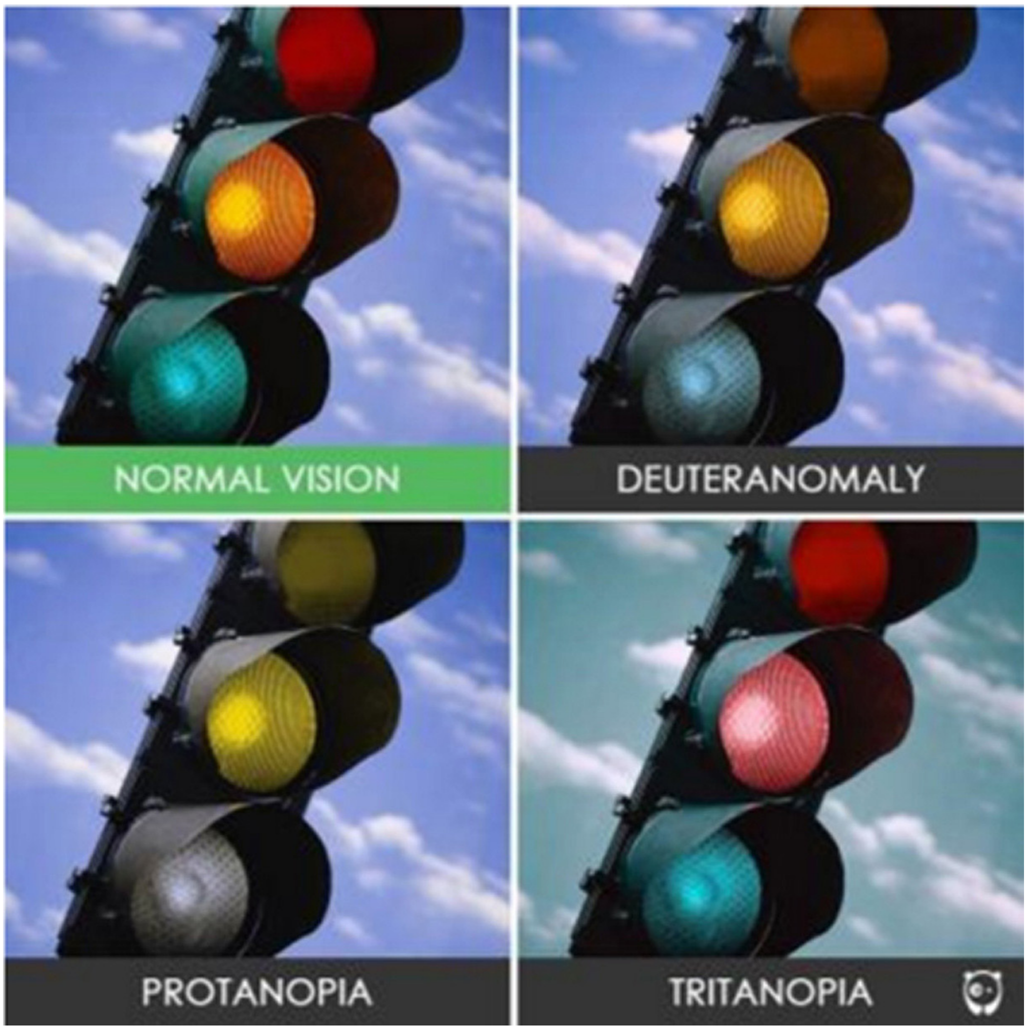

Fig. 2. Vision of color blindness

Here, our work comes into picture. The model for the color detection approach is costly for small-scale industries. It does shade matching or identification in programs requiring the simplest pass/fail output.

The fundamentals of computer vision are employed to detect and follow three distinct colors: blue, green and red. Upon successful compilation, when the code is run, an image is displayed in a new window, with the images file path given as an input argument. We retrieve the color name of the color of the pixel, as well as the individual blue, red and green values that make up the color. To determine the color name, we utilize the k-means algorithm to calculate distance(d) that indicates our proximity to the color, and select the color with the minimum distance. It's useful for robotics and perception of color. Computer vision for color sensing is used in self-driving cars, for example. The system is beneficial for identifying traffic signals and vehicle break lights, and determining whether to stop, start, or continue driving accordingly. Additionally, this technology has significant applications in the industrial sector, such as enabling robotic arms to identify and select objects of varying colors for placement and assembly. Color detection is employed in a variety of picture editing and drawing applications.

2 LITERATURE SURVEY

Matthew Simunovic et al [9], stated deficiency of color vision is a prevalent visual impairment that can be classified into two types – congenital and acquired. Effective management of congenital deficiency of color vision primarily involves counseling, including career counseling. Although, visual aids may assist individuals with deficiency of color vision in certain tasks, research indicates that they do not provide complete restoration of normal color vision. Gene therapy is a prospective option for future treatment, as animal models have shown improvement following the therapy.

Tomoyuki Ohkubo et al [10], stated statistics indicate that the most prevalent types of color blindness are red-deficient and green-deficient. Therefore, our focus is on developing a vision compensation system that allows individuals with color blindness to perceive red and green colors. To address deficiency of color in color-blind individuals, we created a vision system that compensates for color vision.

Muhammad Waseem Iqbal et al [11], stated that color blindness is a physical impairment in which certain colors or all colors are indistinguishable by the affected individuals. Those with normal color vision are called Trichromats and can recognize various colors, such as yellow, coral, blue, navy blue, orange and canary yellow. However, individuals who are green/red Dichromats cannot distinguish any of these colors. Hence, Green-red dichromats are not just color deficient but are entirely color blind.

Anupam Agrawal stated that et al [12], deficiency of color vision is mainly caused by a genetic defect during the development of the 3 types of chromatic reactive cones in the eye. These cones are responsible for detecting colors and are located in cone photoreceptors cells located in the retina. Abnormal visual pigments are the cause of color blindness which is inherited.

Rachel A Munds et al [13], stated that, one characteristic that distinguishes catarrhine primates is that they have uniform trichromacy. According to Miguel Angel Martinez [14] it is widely believed that individuals with color vision deficiencies have a greater ability to detect objects that are camouflaged compared to individuals with normal color vision. However, studies examining the performance of individuals with normal color vision and those with CVD in camouflage detection tasks have produced conflicting results under different conditions.

Thomas J Flotte [15], according to his statement pathologists and cytotechnologists who have color vision deficiencies have developed methods for examining slides that do not affect their ability to make accurate interpretations. The use of digital pathology may offer various strategies to assist color vision deficient pathologists in interpreting particular stains. Aryaman Taore et al [16], the statement suggests that a motion nulling technique combined with automated analysis of eye movements can be used as an objective test to diagnose and evaluate the severity of protanopia and deuteranopia, which are types of deficiency of color vision.

Moudgil et al [17], stated that many individuals have color blindness but most of them are not aware of it as they adapt to their environment to a certain extent and some may not know they have the condition. The study suggests that color blindness is more prevalent among males that females, which is consistent with previous studies. Furthermore, the study indicates that protanopia is more common than deuteranopia.

The sphere of image processing is constantly evolving. in the course of the past 5 years, there was a good-sized boom inside the stage of hobby in image morphology, neural networks, full coloration photograph processing, photograph information compression, photograph popularity, and expertise-based total photo evaluation structures. photograph processing strategies stem from two essential software regions: improvement of pictorial facts for human interpretation, and Colors are made from 3 number one colors; crimson, green, and blue. In computer systems, we outline every coloration fee within a number of zero to 255. So in what number methods we will define a coloration? the solution is 256 x 256 x 256 = 16,581,375. There are about n16.5 million one of-a-kind methods to symbolize a color.

D Bradley et al [1], he stated that the prediction of color is a process of identifying the name of a color in a set of 9 photos. While this may be a straight forward task for humans, it can be challenging for computer systems. The human eye and brain work together to perceive and recognize colors, with light receptors in the eye transmitting the signal to the brain for processing. In this python shade detection tutorial, an application will be created that allows users to determine the name of a color by simply clicking on it.

Kok-meng lee et al [2], according to the statement, color information plays a crucial role in the domain of vision-based feature detection, specifically in the context of applications related to food processing variations in color make it difficult to use greyscale-based machine vision algorithms. To address this challenge, the author proposes two methods. The first method involves generating an artificial color contrast to highlight the target and reduce the background. The second method, known as the SFBB: statistically based fast bounded box makes use of the essential issue evaluation approach to characterize goal functions in coloration area from a hard and fast of schooling data, allowing for accurate and efficient color categorization.

G.M. Snoek et al [3], stated because practically all chromatic properties are shift-invariant, the impact of changes in light color depth cannot be easily evaluated. The three color histograms are chromatic properties that are responsive to light intensify shifts. Given that SHIFT and its color versions have the greatest results, shift-invariance has no negative influence on efficiency.

Koen E A Van De Sande et al [3], specified that the ability to retrieve visual data related to objects and types of scenes requires image category recognition. Feature extraction at key places has traditionally relied on intensity based descriptors. Color descriptors are planned to enhance illumination in variance associated discriminative power. as a result of there are numerous totally different color invariant descriptors, the statement suggests the need for a comprehensive summary of color – invariant descriptors within the scope of image class recognition. It also advises against the use of mixed SI and CGS units as it can cause confusion since equations may not balance dimensionally if mixed units must be used, it is important to clearly state the units for each quantity in an equation.

Rao Muhammad Anwar et al [4], stated that classification in order to comprehend high resolution remote sensing photos, aerial scene classification is a difficult challenge. Convolutional Neural Networks are used in the most modern aerial scene classification methods (CNNs). CNN models are typically trained on a large amount of labeled data, with BGR patches commonly used as input to the networks. However, the significance of color in the deep learning framework for arial scenes classification is yet to be explored. The paper aims to address this by examining the use of deep color models trained using color representations to classify arial scenes through a fusion approach.

Claudia nieuwenhuis et al [5], stated that we can offer an interactive multi-label segmentation algorithm that explicitly accounts for color distribution geographic variation. To do so, we apply a method of using generalized Parzen density estimator to estimate a probability distribution that considers the combination of color variable and geographical location based on user scribbling. This estimation enables the likelihood of observing particular color values at a specific spatial coordinate to be calculated. The probability obtained is then applied in an estimation approach of Bayesian MAP to segment multiple regions. This segmentation process is for the refined using convex relation techniques. The method guarantees global optimality for the 2-region scenario(background/foreground) and limited optimality solutions for the multi region case.

C J. Van de Weijer et al [6], states that High frequencies dominate curved orientated patterns, which have zero slopes on ridges and valleys. Existing curvature estimators are ineffective in this situation. The estimation of native curvature is missing within the characterization of incurved directed patterns supported translation in variance, leading to a skew curvature-dependent confidence live. We propose a new method to compute the local gradient energy of the model gradient while considering the curvature of the model.

Rakib hassan et al [7], stated that the split of an image into discrete items or related sections that do not overlap is referred as segmentation. Despite numerous study on various image segmentation methods and algorithms, it remains uncertain whether a given algorithm outperforms another in accurately segmenting images, either for individual or collections of images, or in a broader sense, across an entire image category. By purely automatic means, it is quite difficult to establish a trustworthy and precise image segmentation. Current picture segmentation research utilizing clustering algorithms suggests that the algorithm for K-means clustering delivers the greatest results so far, although there are several enhancements that can be made to improve the results. The utmost notable drawback associated with our frequent utilization of k-means clustering is the necessity to manually determine the value of k for each instance, which can be cumbersome since we desire the algorithm to autonomously determine their parameter. As a result, we endeavored to discover K automatically and generate segmentation without the assistance of a human.

A. Goralski et al [8], stated that artificial intelligence (AI) refers to the ability of computers or robots controlled by computers to perform tasks that are typically carried out by intelligent beings. This term is frequently employed to depict the creation of systems that possess human-like cognitive abilities, such as reasoning, learning, and analysis. Ever since the emergence of the digital computer during 1940s, it has been demonstrated that the computational machines can be programmed to execute intricate assignments, including but not limited to playing chess with impressive proficiency or deducing mathematical proofs. However, despite advances in computing power and memory, there are still no programs that can match human flexibility and common knowledge in a wide range of areas. Nonetheless, there are some applications that have achieved performance levels similar to those of specialists in specific tasks, such as scientific analysis, information retrievals, and speech or hand writing identification.

3 PROPOSED WORK

In this proposed project, we managed to extract the necessary color space from a BGR image. This method's ability to differentiate between colors in a monochromatic image is its key benefit. The method described here is the only one that can identify extreme colors in all six channels: R, G, B, C, Y, M, and Z. It is also the one that is most selective in distinguishing extreme colors when compared to the other methods examined. The suggested technique can be employed in computer vision applications for real-time detection of objects with extreme colors because it is highly quick, operating at speeds comparable to or exceeding those of previously proposed systems.

3.1 Dataset collection

For our study, we used a data set, one from Simolife. On kaggle.com, this data set has been published. There are 864 different colors in our data set, each having a name and RGB value. Green, blue, and red are the 3 fundamental colours that makes up all the other colours. On a computer, colors are represented as numerical values ranging from zero to 255, providing approximately 16.5 million distinct color combinations. In this project, we need to convert the BGR values of each color in our dataset into their corresponding color names. Our dataset contains both the BGR values and their corresponding color names.

3.2 Comma-Separated Values (CSV)

CSV is the most used export and import format for Excel files (Comma Separated Values). Instructions for analysing and writing tabular data inside the CSV layout are included within the CSV module. It enables programmers to make statements like "write this information within the arrangement preferred by way of Excel" or "case based entirely off this document that was generated by way of Excel" without needing to be familiar with the specifics of Excel's CSV format. Additionally, programmers can create their own customized CSV layout or specify the CSV formats that are compatible with other packages.

3.3 Data processing

Data processing, involves manipulating computer data which includes the flow of data through the process of converting raw data into machine-readable format involves using the CPU and memory to transmit data to output devices, modifying or formatting the output, and converting the data into a form that can be understood by machines. To put it simply, data processing refers to performing certain tasks on data using computers. This is particularly important for businesses and organizations, as they need to process data in order to carry out their operations effectively.

3.4 K means algorithm

An algorithm for clustering is K Means. As unsupervised algorithms, clustering algorithms must work without access to labelled data. The similarity of data can be utilised to differentiate between various classes or clusters in the input data, relying on how much alike the data is. Data points from the same group are more comparable to other than those from each other distinct groups. The algorithm for K-means clustering is a widely used technique for clustering. The quantity k here denotes the number of clusters.

4 IMPLEMENTATION

4.1 Image capture

The first phase will be to import every one of the necessary modules alongside OpenCV, and then load the photo however ensure the photograph is in the equal folder as the code record.

4.2 Pandas

It is software package for the Python programming language that is used to manage and evaluate data.it is used in particular for huge calculations or bigger data, it has additionally Numpy in it. To perform operations on data files such as csv, we use the pandas library. We utilize the pd.read_csv( ) feature to import and analyze the data stored in a csv file. Additionally, to make accessing data easier, we give names to each column and store them in an index list.

4.3 Wikipedia

As we all understand Wikipedia is an incredible supply of understanding much like Geeks for Geeks we have used the Wikipedia module to get information from Wikipedia or to carry out a Wikipedia search.

4.4 Process of retrieving the RGB colors and values

This step involves extracting the three basic pigments from the input image, which are blue, green and red. In electronic screens like TVs, computer monitors, laptops and mobile phones, all color images are produced by the combination of these 3 basic pigments. You can generate a wide range of colors by blending three basic pigments at various levels of intensity, with each primary color having an intensity value that can vary from 0 (minimum) to 255 (maximum). To give an example, if the intensity value of all three basic pigments is set to 0, the resulting linear combination will be black. On the other hand, if the color depth of all three basic pigments is set to 1 the resulting linear combination will be 255. Index = ["color", "color name", "hex", "R", "G", "B"]. A new window needs to be generated to display the given image. Then, we offer a callback characteristic on the way to be activated simplest whilst a mouse event takes place throughout the photograph. To understand the purpose of the draw feature it will take the BGR values of area that is double-clicked, and record the mouse function's (x, y) position on the screen. After obtaining the BGR values from the image the next step is to convert the BGR values to the corresponding color name. To obtain the name of a color, a function calculates a distance metric(d) to determine how close the color is to a particular one, selecting the name of the color with a minimal distance. The process is carried out in the function below.

4.5 Compute the smallest distance based on given coordinates

To determine the minimal distance, the calculation involves moving towards the origin point from each color, and choosing the color that produces the best match. Figure 3 presents various shades of different colors. The pandas library is a valuable tool for executing different tasks on comma separated values, such as loading csv file into pandas data frame via pd.read_csv(). The measurement of space between two points is determined by utilizing the subsequent formula:

D = abs(B–int(csv_loc[i,'B'])) + abs(R-int(csv_loc[i,'R'])) + abs(G-int(csv_loc[i,'G'])

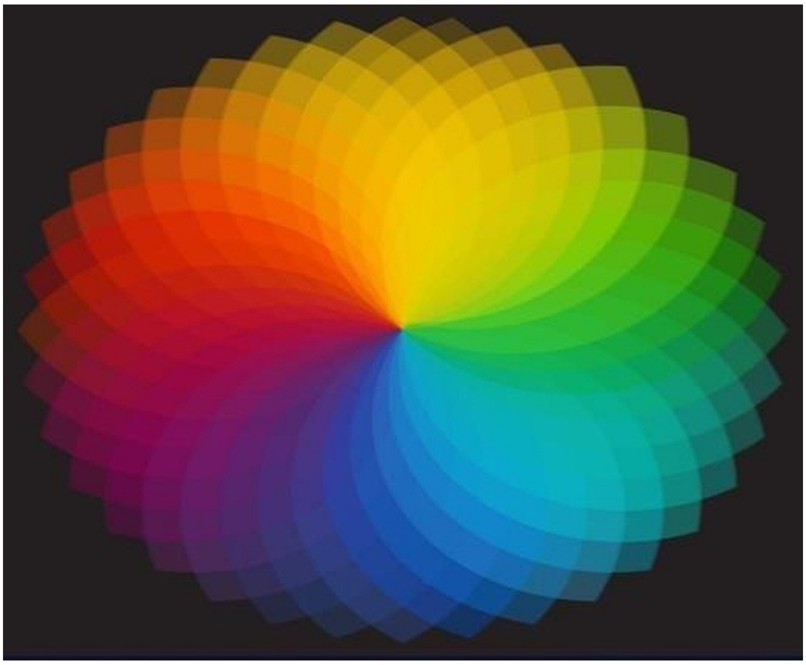

Fig. 3. Different shades of colors

4.6 Demonstration of an image with varying degrees of a particular color

To exhibit an image with a range of hues, a rectangular new window is utilized. When a double click is initiated, the color name and corresponding BGR values are modified accordingly. The display of the image is accomplished by invoking the method CV2.imshow(). Additionally, the combination of CV2.rectangle() and CV2.putText() functions enables the retrieval of the specific hue name and its respective color depth level.

Text = getColorName (b,r,g) + 'B=' + str(b) + 'R=' + str(r) + 'G=' + str(g).

4.7 Computer vision

OpenCV is a big open-supply pc vision, pc learning, and photograph evaluation library. OpenCV is like minded with numerous programming, which include Python, C++, Java, and others. It is capable of analyzing images and videos to identify human faces, objects, or even hand writing. To present the picture on the pre-set window, we use the CV2.imshow() function. Whenever the viewer dual click on the screen, a box is created on the image that specifies the color combination on the screen using the CV2.rectangle() and CV2.putText() functions respectively.

5 SYSTEM ARCHITECTURE

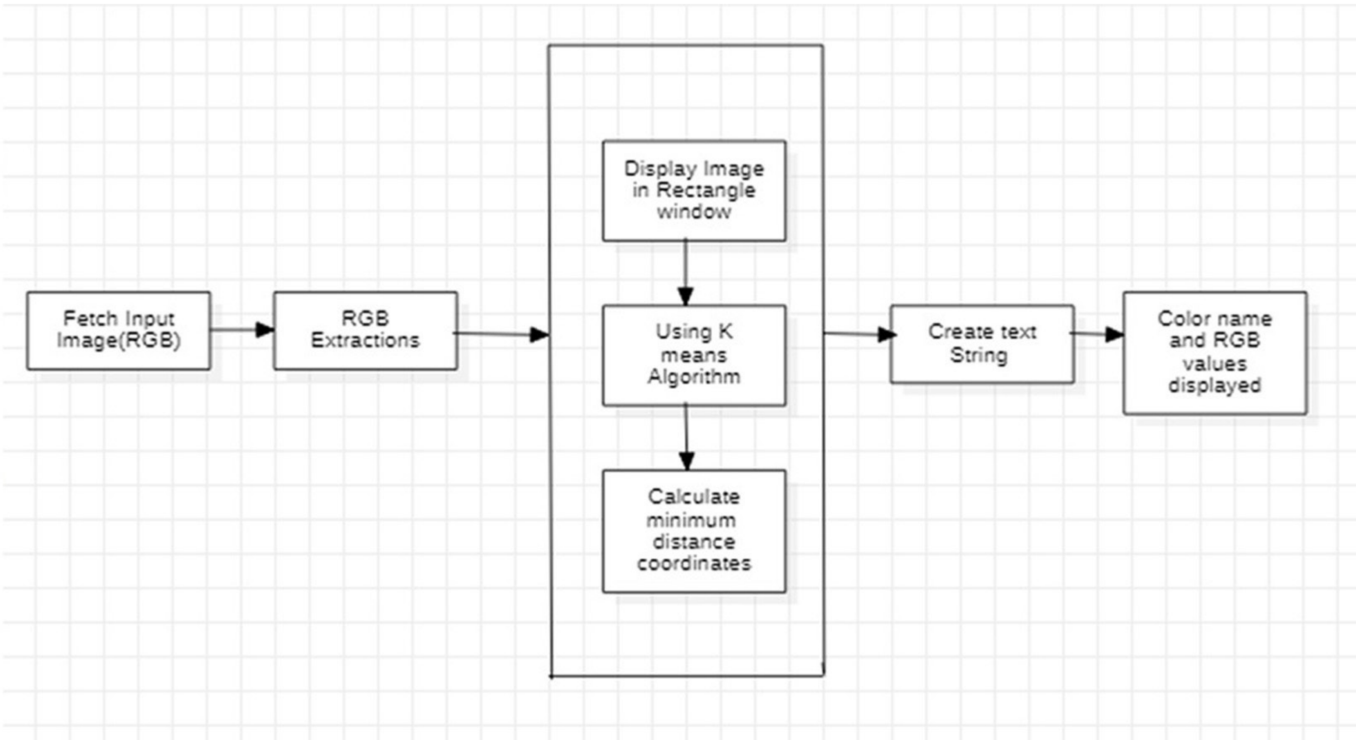

Fig. 4. System architecture

System Architecture is an illustration of all the factors that cross into making up apart, or the complete system. It helps the engineers, designers, stakeholders – and all and sundry else concerned inside the venture – apprehend a device or app's layout.

Figure 4 indicates the architecture of our machine wherein it describes all the procedures, strategies, capabilities, and much more content in our version from the input to output.

6 EXPERIMENTAL RESULTS

For experimenting this work, we used some real time images to detect the colors in that image. Figure 5 shows basic traffic lights image, which is very useful for colorblind people.

Fig. 5. Basic traffic lights

Figure 5a, shows yellow color with R = 245, G = 207 and B = 8. Figure 5b shows green color with R = 0, G = 255 and B = 109. Figure 5c shows Red color with R = 243, G = 33 and B = 20.

Fig. 5a. R = 245, G = 207 and B = 8

Fig. 5b. R = 0, G = 255 and B = 109

Fig. 5c. R = 243, G = 33 and B = 20

Figure 6, depicts the graph with green, red and blue lines which depict the ratios of b, g, and r in the image represented with Figure 5.

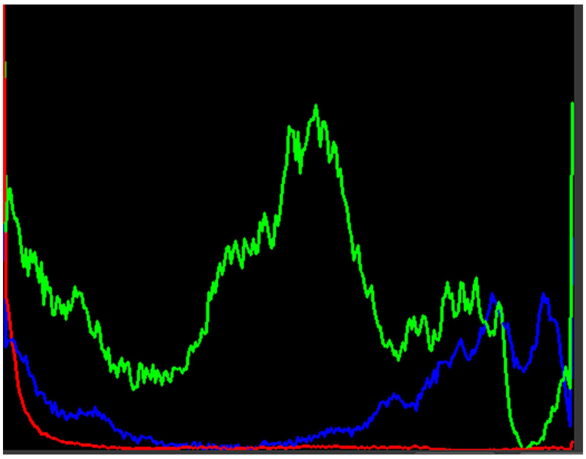

Fig. 6. Ratio of r, g and b

Figure 7, shows an image with all colors which is used as sample for analyzing the algorithm.

Fig. 7. Sample image1

Figure 7a, Shows maroon color with R = 195, G = 25 and B = 72.

Fig. 7a. R = 195, G = 25 and B = 72

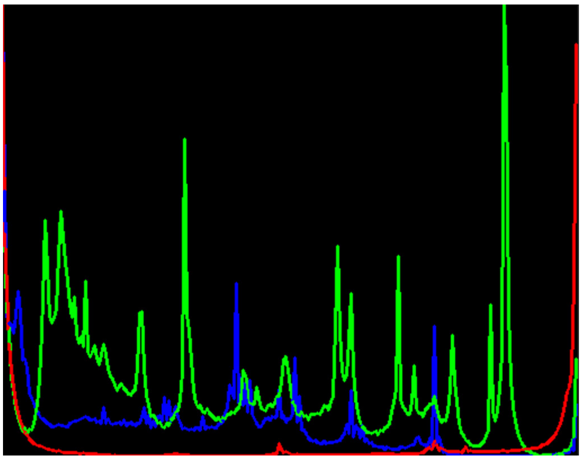

Fig. 8. Ratio of r, g and b

Figure 8, presents a graph with green, red and blue lines which depict the ratios of r, g, and b in the image, respectively Figure 7. Figure 9, depicts a sample image 2, used for analyzing the correctness of algorithm in detecting colors. Figure 9a: Showing Blue (Pigment) color with R = 49, G = 25 and B = 175.

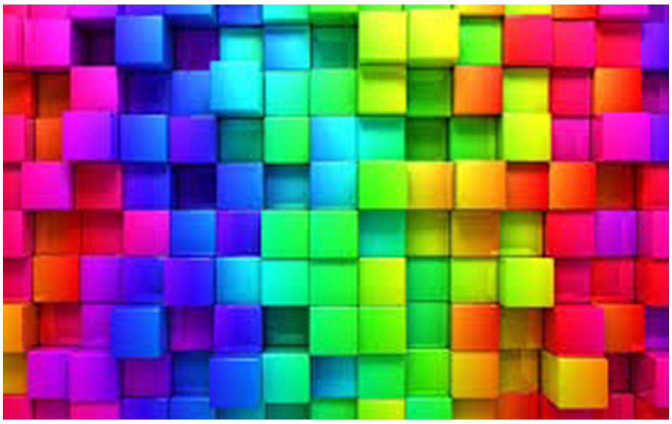

Fig. 9. Sample image2

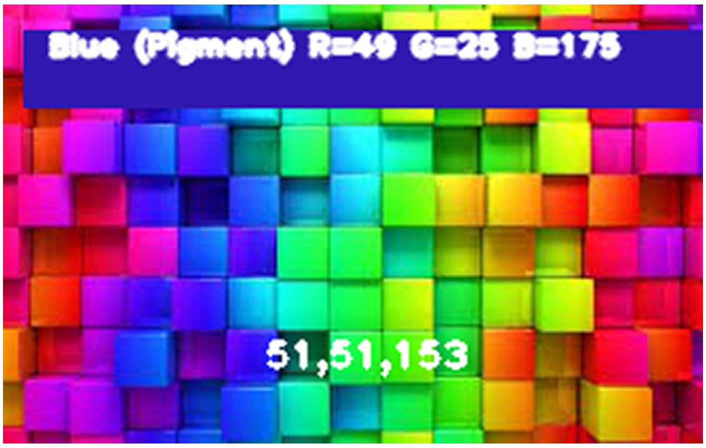

Fig. 9a. R = 49, G = 25 and B = 175

Figure 10, presents a graph with red, green, and blue lines which represent the ratios of r, g, and b in the image, respectively Figure 9.

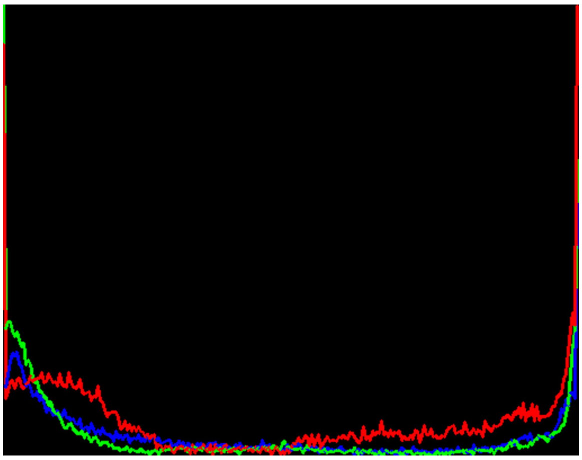

Fig. 10. Ratio of r, g and b

7 CONCLUSION AND FUTURE ENHANCEMENT

In this work, we use specialized tools and methods to assist color-blind people and improve their capacity to recognize monochromatic hues. Every element of life is affected by our tool, from the jobs that a person with color blindness can complete to the tiniest choices like what to eat or the kind of paint to use when painting. Despite the fact that someone with normal vision might not think it's crucial to be able to discern between colors, our tool helps color-blind people get through numerous difficulties in daily life. This helps those who are colorblind feel more included in activities that need vision. This platform costs a lot less than the available options for colorblind people.

There is currently no accurate color illustration of colors in devices. We are introducing the CV datasets and the range of sunglasses that it recognizes, together with their hex values and RGB values, for the suggested machine. The pointer automatically displays the RGB color values when it moves over an image. The technique we suggested uses OpenCV to categorize simple coloration. We can identify more shades with their RGB values by using a dataset with more colors. This will lead to a gradual rise in accuracy. With this software, we can assist colorblind persons and artists. For instance, a color-blind artist would use our software to identify the RGB ratios and the name of a color if they became stuck on it.

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9 AUTHORS

K Prasanna Lakshmi, earned her Doctorate in Computer Science and Engineering from Jawaharlal Nehru Technological University, Hyderabad, Master Degree in Computer Science and Engineering from Osmania University, Hyderabad. She is currently working as Professor in Information Technology Department, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad. She has more than 20 years of Teaching Experience and 4 years of Research Experience. Published 32 research publications in reputed journals which are indexed in Web of Science and Scopus. Guided 9 PG projects and 15 UG projects. She published 1 Indian Patent and been granted with 1 Australian Patent. An active member in Advisory Board Committee for many International Conferences organized through IEEE. Reviewed more than 100 manuscripts being a member of Technical Review Committee in various renowned journals and conferences. Awarded with Global Eminent Teacher award in 2021 and with 50 Fabulous EduTech Leaders award in 2019. She has professional memberships from IACSIT, IAENG and CSTA. Completed more than 50 online certification courses from reputed universities and organizations like Edx, Coursera and IITBombay and NITs. Apart from research activities, she also served the institution in many administrative roles like Member Secretary for Academic Council, Chairman Board of Studies, Head of Information Technology Department and Dean of Faculty Development in GRIET. Currently serving Institution with Dean Academics role. Implemented OBE based teaching in classroom. Her research interests include Data Stream Mining, Machine Learning, Natural Language Processing, IoT and Social Networking. Dedicated, resourceful and goal-driven professional educator with a solid commitment to the social and academic growth and development of every Student. Email: prasannakompalli@gmail.com

Archana Kalidindi is the Assistant Professor in Department of CSE-AIML and IoT at VNR Vignana Jyothi Institute of Engineering and Technology, Hyderabad, India. She received the Bachelor's Degree in Information Technology (2007), Master's Degree in Software Engineering (2011) and currently pursuing Ph.D in Computer Science in the area of IoT and Deep Learning. Her research interest includes Deep Learning, Data Science, Machine Learning. Published many research articles in renowned journals and conferences. Email: archana.buddaraju@gmail.com

Janakidevi Chilukala is an UG student finishing her last year at Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad, India. Currently she is doing an internship at IBM as a Software Engineer. Janakidevi's research concentrates on Machine learning. Email: devichilukala900@gmail.com

Kumudini Nerella is an UG student finishing her last year at Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad, India. Kumudini's research concentrate on Machine Learning. Email: kumudininerella119@gmail.com

Wajahath Shaik is an UG student finishing her last year at Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad, India. Wajahath's research concentrate on Machine Learning. Email: wajahathshaik2002@gmail.com

Divija Cherukuri is an UG student finishing her last year at Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad, India. Divija's research concentrates on Machine learning. Email: divijacherukuri4122@gmail.com