Colorblind Aid: Make Color-Blinded Life Easier

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Abstract—In this project, a trial is an attempt to make aid for color blinded people so they can detect and classify colors. Color spaces that will be used in this program is RGB (Red Green Blue). The image processing technique is used for identifying the colors in an image. The program has features such as Find A Color, Specify This Color, Articles About Color Blind, Color Blind Test, Mini Quizzes, Find Nearest Eye Doctor, Clothing Guide, and Color Harmonies.

Index Terms—color, colorblind, image processing, RGB color space

I. INTRODUCTION

Color is one of the most important things in human's life. It defines the characteristics of an image. Unfortunately, not all people can see the difference between these colors. The purpose of this project is to develop an application that can solve the color blindness problem, and make colour blinded people can easily see the difference in the colors. The oxford dictionary defined color as "The property possessed by an object of producing different sensations on the eye as a result of the way it reflects or emits light" [1]. A range of colors can be created by the primary colors of pigment and these colors then define a specific color space. Color space, also known as the color model (or color system), is an abstract mathematical model which simply describes the range of colors as tuples of numbers, typically as 3 or 4 values or color components [2]. There are some color spaces, one of them that will be used in this program is RGB (Red Green Blue). An RGB image is a colorful image consisting of fixed values of color contents for each pixel. These color contents have different values ranging from 0 to 255 [3]. Colourblind, also known as color vision deficiency is a decreased ability to see the differences of color. Color blindness may make someone's activity more difficult because color blinded people more difficult to distinguish certain colors such as blue and yellow or red and green [4].

II. FEATURES EXPLANATION

The features of this app are described below.

A. Find A Color

This feature allows user to upload an image and the application will find the color that the user desires. The program will tell which part of the image contains desired color and if user choose 'Specify This Color' then the output will be the color of the picture.

B. Specify This Color

The user will input the image. After that, the image will be processed. An image consists of a lot of pixels (i.e. a physical point in a raster image, or the smallest addressable element in an all points addressable display device [5]). Each pixel corresponds to a code. These codes can be used for the definition of colors and these defined colors are used to recognize colors in the picture after the analyzation.

C. Articles about Color Blind

The program will provides many articles that related to the color blind which user can read, and user can also search articles based on the title.

D. Color Blind Test

The program will display the several tests for the user to take. and after the test is ended, the program will display the result of the test, either the user has colorblind or not, and if so, the program will display the type of colorblind.

E. Mini Quizzes

The program provides multiple-choice questions. Users select one answer and after it, the app will immediately show its right answer and explanation about it.

F. Find Nearest Eye Doctor

This feature is intended to help people to find nearest eye doctor.

G. Clothing Guide

This feature helps people with color blind to choose clothing based on their colors to avoid mismatching colors since they can't distinguish them.

H. Color Harmonies

Color harmonies feature's way of work is not quite different with clothing guide. The difference is, color harmonies only shows tonal color while the clothing guide shows not only

tonal colors but also main colors and some non-tonal color that still match with it.

III. SIMILAR PROJECTS

A. Paper titled 'Color palette extraction with K-means clustering: Machine Learning from Scratch' by Nandini Bansal
B. App called 'Color Grab (color detection)' by Loomatix Team
C. Aplikasi Tes Buta Warna dengan Metode Ishihara Pada Smartphone Android (Colorblind Test App using Ishihara Method in Android Smartphone) by Randy Viyata Dhika, Ernawati, and Desi Andreswari

IV. DEVELOPMENT ENVIRONMENT

A. Choice of Software Development Platform

The app can be accessed via web so it won't need complicated installment to do and also the group members have more experience in building website than app. HTML5 and JavaScript version 1.8.5 will be used to build this website. For the feature called 'Find The Nearest Eye Doctor', Google Map API will be used and the price is 7 USD for 1000 requests. Since we only will do 1 request, the API will be free. So, 7 USD is our maximum expenses.

B. Software in use

We use Google API to run the 'Find The Nearest Eye Doctor' feature and K-Means Clustering. A

V. SPECIFICATIONS

A. Register

User have to register their account first before they can login to the application. When register, user must enter their username, gender, date of birth, email address and password. After user enter the register requirements the system will check the data from user whether already in database or not, if the data already in the database, then the system will send a message to user that the account already in used and user only have to login, if not then the system will input the data to the database and send a message to the user that the register success.

B. Login

User have to login first before they use the application. for login, user have to input the username and the password that they already registered. and after user input the data, system will check whether the data already at the database or not. if the data already at the database, then the system will send a pop up message that the login is success, if not then the system will send the pop up message about user caused login failure.

C. Find A Color

First, we need to define the upper and lower limits for pixel values based on the color that we want find. Then we look into

data set and specifying which pixels fall into specified upper and lower range. Then it will show image with only one color that was intended to be found.

D. Specify This Color

The method that will be used is K-Means Clustering. Kmeans clustering is a type of unsupervised learning, which is used when you have unlabeled data (i.e., data without defined categories or groups). The goal of this algorithm is to find groups in the data, with the number of groups represented by the variable K [6]. First, we convert the image to points that our clustering algorithm can use. Next, the color distance is calculated using Euclidean distance formula, which is:

$$d(p, q) = \sqrt{\sum_{i=1}^{n}(q_i - p_i)^2}$$

(1)

After that, we find the center for a set of points by adding the values for each dimension and divide by the number of points.Then, the clusters are sorted and the value will be converted into hexadecimal form.

E. Articles about Color Blind

The articles will be found manually and then inputted to the app along with the article source (e.g. URLs). This would be a feature for admin. Admin will type the article in the text box provided and the javascript will get the value from the input in HTML. After that, the article will be posted.
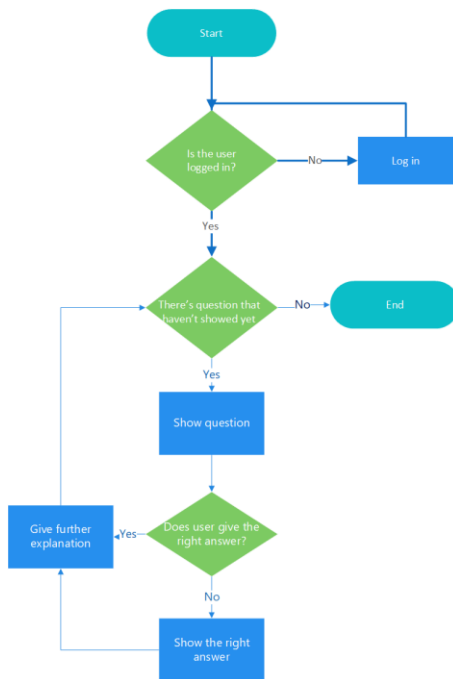
F. Color Blind Test

The flow for the algorithm described in image below:
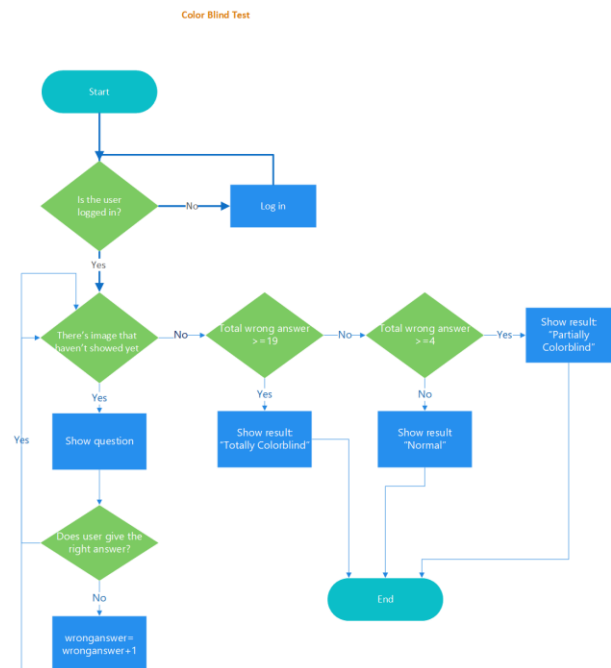
G. Mini Quizzes Explained

in flowchart:

H. Find Nearest Eye Doctor

we decide to purchase the Google Map API to create this feature, the step to build this feature is:

a. Creating a table in MySQL, in this step we creating a table that containing attributes of the markers on the map, like the marker id, name, address, lat, lng. To keep the storage space for the table is minimum, we specify the lat and lng attributes to be floats of size(10,6). this allows the fields to store 6 digits after the decimal and plus up to 4 digits before the decimal.

b. Populating the table, the next step is we input the data to the database table that we create.

c. Outputting data as XML using PHP, in this step we should have a table named markers that containing the map marker data. this section show us how to export the table data from the SQL database in an XML format. the map can use the XML file to retrieve the marker data through asynchronous JavaScript calls. Using an XML file as an intermediary between our database and our Google map allows for faster initial page load, and a more flexible map application. It makes debugging easier as we can independently verify the XML output from the database, and the JavaScript parsing of the XML. we also can run the map entirely based on static XML files only, and not use the MySQL database.

d. Finding locations with MySQL, to find locations in our markers table that are within a certain radius distance of a given latitude/longitude, we use a SELECT statement based on the Haversine formula. The Haversine formula is used generally for computing great-circle distances between two pairs of coordinates on a sphere. Here's the SQL statement that finds the closest 20 locations within a radius of 25 miles to the -33, 151 coordinates. It calculates the distance based on the latitude/longitude of that row and the target latitude/longitude, and then asks for only rows where the distance value is less than 25, orders the whole query by distance, and limits it to 20 results. To search by kilometers instead of miles, replace 3959 with 6371

```
 SELECT id, (3959 * acos(cos( radians(37) ) * cos( radians( lat )
) * cos( radians( lng ) - radians(-122) ) + sin( radians(37) ) * sin(
radians( lat ) ) ) ) AS distance
FROM markers
HAVING distance ¡ 25
ORDER BY distance LIMIT 0, 20;
```

e. Using PHP's DOM XML functions to output XLM, the DOM XML functions of PHP take care of subtleties such as escaping special entities in the XML, and make it easy to create XML with more complex structures. we use DOM XML functions to create XML nodes, append child nodes, and output an XML document to the screen. f. Creating the map, This section shows how to develop the map example using JavaScript, and the output XML file. first thing that we do is setting up the controls, we have to sets up the following controls on the map such as 'Search Near user input field', 'Radius drop down list', 'Search button', 'See all results drop down list of search results'. and after that we pulling it all together all the steps.

I. Clothing Guide

the idea of this feature is to find the matching color of the clothes, the color will be matching if the color has the same tone or the distance tone between two color and another is quite similar. To apply this feature, first is we convert the color from RGB form to hexadecimal. since the hexadecimal has 256 character so the data of that we receiving is from 0 to 255. this is te algorithm that we planing to use to convert the color.

```
var rgbToHex = function (rgb)

var hex = Number(rgb).toString(16);

 if (hex.length ¡ 2) hex = "0" + hex;

return hex;
```

after we already have the color in hexadecimal, we will generate the color and use the function to find the color that the same or has the minimum distance to another.

J. Color Harmonies

To run this feature, there are a several steps to build the algorithm for this feature. The first step is determine the

average color of the image, we have to reducing the image to make it easy to determine the average of the color, and after that we convert the average color to the RGB form and from RGB form to hexadecimal form The second step is after we determine the average color on the image, we define its complementary color in the color wheel (we create the function that create the color wheels that has parameter tones/hue(ranges 0-360°), and the last thing is we calculate the area of the color objects to determine the saturation of the complementary color.

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