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Original Contribution

DEVELOPMENT OF A COLOR PIXEL PROCESSING ALGORITHM FOR THE BIG FIVE PERSONALITY TRAITS SELF-EVALUATION MODEL

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ABSTRACT: A series of studies establishes the foundation for the development of algorithms, the potential application of which will facilitate the practical implementation of a model based on the Big Five Personality Traits (BFPT). The creation of algorithmic code would provide a programming toolkit applicable across various domains of human activity, specifically for the expert evaluation of individual behavior. The proposed algorithm is grounded in classification based on color ranges (and by extension, personality types), implemented through programmatically defined coded logic. The fundamental steps of the algorithm's logic are outlined. For each personality trait — Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism — a set of reference HSL (Hue, Saturation, Lightness) colors is redefined.

KEY WORDS: *Scripting, Algorithms, Program Models, Human Color Preferences, Big Five Personality Traits.*

1. Introduction

Based on the theory of colors and its relationship with the potential definition of human behavior [1,2,3,4,5,6,7] in a color contextualization, this publication addresses the part, following the main stages in the development of a given application. After constructing a conceptual model, as well as the functional model and architecture of the developed application, the coding development is initiated, adhering to the principles of the aforementioned theory. When examining the tools used by experts in the field of human behavior inflicted by colors, a limited set of software implementations is observed, or those that do not provide a range of functionalities [1,9] through which the expert can form their evaluation of the subject to a degree that allows for an in-depth analysis, thereby outlining a sufficiently broad set of

perspectives on the assessed individual. Moreover, in [1] it is claimed that it is impossible, for example, to conduct studies on a web-based platform for color control functionality including at spectral to be achieved.

The present publication aims to expose the code logic of the core component in the main task of the developed application — the algorithm that determines the classification of human behavior by color ranges, summarized into five main personality types, implemented through defined user functions.

2. Related work

A 2021 study [9] revealed a significant gap in research addressing the relationship between color and personality, despite their well-established theoretical interconnection. This finding indirectly highlights the underdeveloped state of software tools in this area. Existing technologies used for empirical research predominantly rely on physical color sample templates, which are limited both in type (mainly paper) and in available media formats and well-established questionnaire methodology as well [8,9].

The finding in [9] states that the domain of human behavior determined by color ranges is 'scarcely investigated,' which could be regarded as highlighting the need for the development of more effective applications with proper functionalities for studying such a phenomenon.

3. Main work

Based on the above and when studying the color dependencies among the main personality types, it is found that the methods and approaches used do not contribute to contemporary basic techniques and technologies:

- Computational process in information processing;
- Possibility for a large number of test procedures;
- High speed in processing empirical data;
- Natural time-dependent environment for conducting the test procedures;
- Use of databases/knowledge bases;
- Low cost of resources/materials (i.e., their digital equivalent);
- Very wide range of color pattern instances.

The application development presented here is based on a conceptual model, as well as a functional model and architecture previously described in the literature by the author. As a basic programming tools and standards, HTML[10], DOM[11], and the scripting languages have been chosen (JavaScript, PHP and MySQL) for the process. Below is an overview of the main set of application functionalities:

- Loading data referred for colors and personality traits from a database via PHP scripts;

- Visualizing an interactive canvas where the user "draws" with the pointing device in a selected color (set of colors);
- An analysis of the colors from the canvas is performed:
  - Each pixel is extracted and converted from RGB to Hue Saturation Lightness (HSL).
  - It checks which pixels match the HSL ranges of each personality type.
  - The percentage ratio is calculated and visualized with bar graphs.
- Enhancement with an HSL color picker, allowing custom colors to be set for each of the BFPT types.
- Data is stored and loaded from/to a database via Asynchronous JavaScript XML/Http requests (or AJAX).

These are the main components of the application:

- *Canvas* — Drawing color circles, visually expressing choices;
- *Personality analysis* - Processing pixels and searching for correlations with HSL ranges;
- *Control Panel* - Buttons for modes, analysis, loading, and color selection;
- *HSL Picker* (modal window) - Selecting a color by Hue, Saturation, Lightness for each personality type;
- *Bar chart* - Visualization of results (percentages and dominant traits).

The main steps of the algorithm in the application are presented below:

- ***Classification***:

```
function colorDistance(hsl1, hsl2) {
  if (hsl1[0] = = = null || hsl1[1] = = = 0 || hsl2[0] = = = null || hsl2[1] = = = 0)
    return Infinity;
  const dh = Math.min(Math.abs(hsl1[0] - hsl2[0]), 360 - Math.abs(hsl1[0] - hsl2[0])) / 180;
  const ds = (hsl1[1] - hsl2[1]) / 100;
  const dl = (hsl1[2] - hsl2[2]) / 100;
  return Math.sqrt(dh * dh + ds * ds + dl * dl);
}
```

It calculates the Euclidean distance between two HSL colors in a normalized 3D space (H, S, L). The components are normalized:

- Hue → in the range [0, 2], accounting for cyclicity (e.g., 359° and 1° are close).
- Saturation and Lightness → in the range [0, 1].

If the color is gray (S = 0) → it is not classified (Infinity).

- ***Checking if the pixel belongs to a given range:***

```
function isInColorRange(hsl, shadesArray, threshold = 0.25)
  return shadesArray.some(shade => colorDistance(hsl, shade) < threshold);
```

This function returns true if the distance is less than the threshold (0.25).

- ***Accumulation and Normalization:***

After all pixels are processed, percentages are calculated: `percentages[trait] = (colorCounts[trait] / totalValidPixels) * 100;`

The highest percentage determines the dominant trait.

On the Fig.1 a workflow of application is presented.

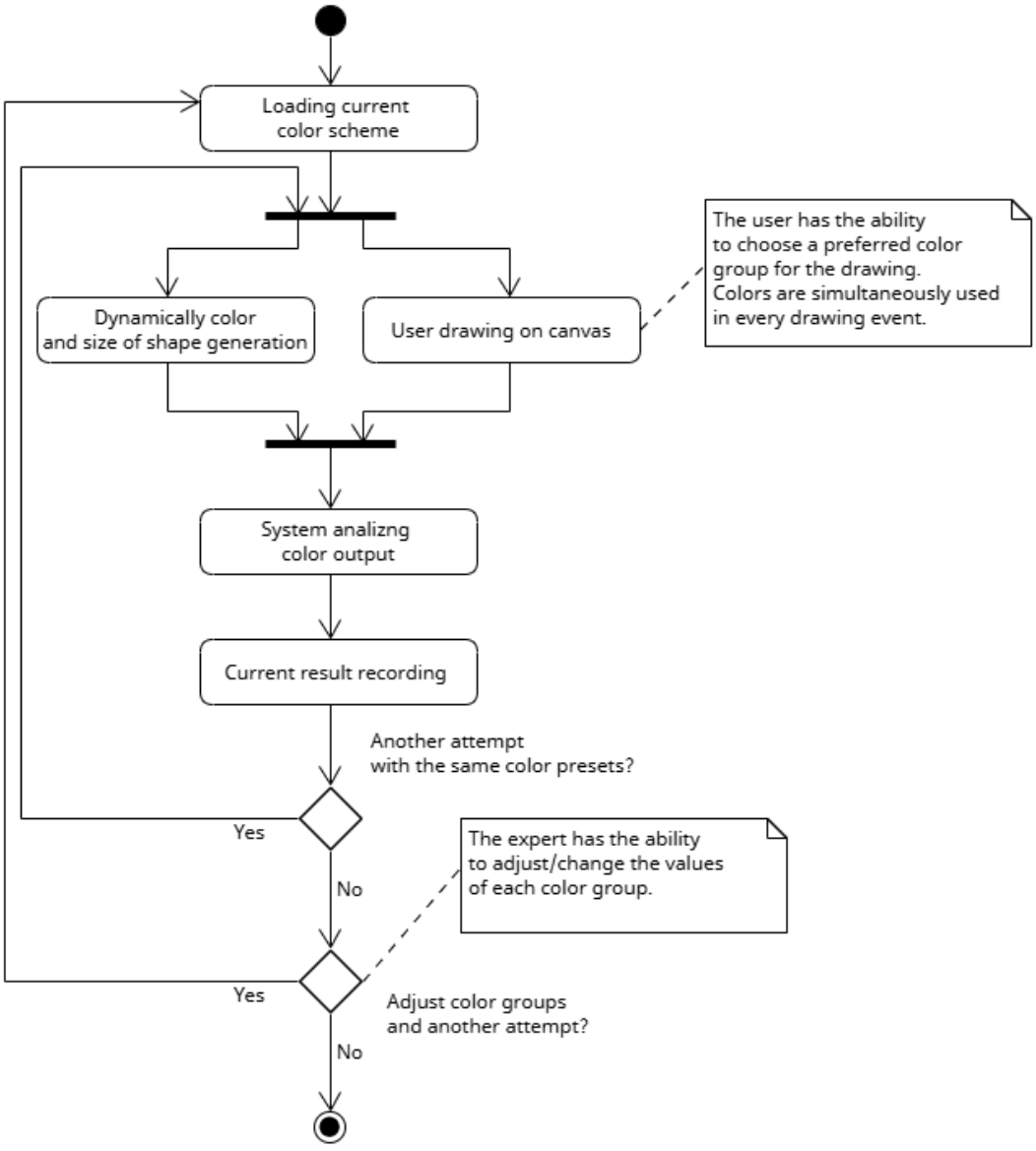

Fig. 1. Workflow of the application.

4. Conclusion

The application presented here relies on an algorithm for classification based on color ranges, using a metric comparison of the Euclidean distance between the pixel's HSL color and reference HSL points for each personality type. If the distance is below a given threshold (default 0.25), the pixel is assigned to the corresponding personality type.

Such an approach would enhance experts' tools in their studies, adding greater effectiveness to the process of analyzing the relationship between color preferences and personality traits. A series of experiments are upcoming, using the application under the chosen methodology.

Acknowledgments

This publication outlines the second phase of a multi-stage research project focused on establishing a more effective methodology for investigating the influence of color preferences on personality traits.

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