

## Investigation of Colors Categorized into Color Names on a Liquid Crystal Display to Enhance CAPTCHAs

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This study focuses on the human ability to tolerate subtle differences in color and categorize similar colors into a single mass to enhance completely automated public turing test to tell computers and humans apart (CAPTCHA). First, an experiment was conducted to check whether the color selection condition could control the color categorization results. Consequently, it was clarified that when the selection condition was added, the color to be categorized changed, implying the possibility of controlling the categorized result. Subsequently, an investigation was conducted to clarify the range of liquid crystal display colors categorized as major color names. As a result, it was clarified that the hue angle size of the colors categorized by more than half of the participants was sometimes greater than the hue angle size between the primary and complementary colors. It was also clarified that among the categorized colors, there were categorized colors in the two color names. Finally, results from the first and second experiments were collated. It was confirmed that by using the categorized color range and selection conditions, it is possible to obtain an answer with a color name that is different from the original color name. These results suggest that the ability of humans to categorize similar colors into a single mass enhances CAPTCHA.

**Keywords** : Color CAPTCHA, Human Interface, Color Categorization, Tolerated Range of Colors, Liquid Crystal Display