A Component-Level Evaluation of Web Interface Vulnerability Under Simulated Colour Vision Deficiencies

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***Abstract*—Abstract goes here**
***Index Terms*—Keywords go Here**

I. Introduction

A. Description of Theme and Topic Rationale

Web accessibility is crucial for ensuring the widest possible audience in modern day interfaces. Approximately over 300 million individuals worldwide have some type of Colour Vision Deficiency (CVD), 1 in 12 men and 1 in 250 women. Despite this, most web interfaces frequently rely on colour distinguishability to communicate interaction states, alerts, aesthetic design and data visualisation. As a result, users with CVD may experience reduced perceptual clarity and decreased usability when interacting with colour-dependent interfaces.

Previous research has stated that simulated CVD conditions can significantly influence how functionality and overall clarity is perceived in user interfaces (UI). Literature shows that interfaces viewed under simulated CVD conditions may experience reduced perceptual clarity and aesthetics, particularly when high-contrast modes are used as the primary accessibility strategy [1]. Their findings suggest that contrast enhancement alone may not guarantee effective accessibility. Similarly, a study conducted by Sajek et al. (2025) found that accessibility performance varies depending on the structure of the selected predetermined colour scheme in the design stage and that contrast ratios alone are insufficient to ensure clarity across different types of CVD [2]. These findings indicate that accessibility under CVD conditions is influence by multiple factors beyond simple foreground and background contrast values.

While existing studies provide valuable information into colour perception and interface usability, they primarily evaluate full interfaces or colour schemes completely. Limited research has focused on examining individual UI components and their behaviour under simulated CVD conditions. This highlights the need for a structured, component-level evaluation that is capable of identifying specific elements that may indicate component visibility risks.

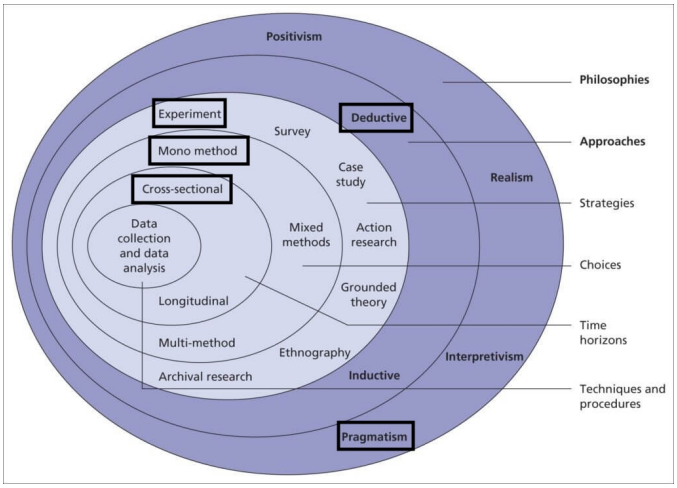

Fig. 1: Enter Caption

B. Positioning and Research Onion

This study adopts a pragmatic research philosophy to focus on addressing a practical accessibility evaluation challenge. A deductive approach is used by applying established WCAG contrast ratios/principles and CVD simulation models to real-world websites. The methodological choice is quantitative, relying on measurable foreground and background contrast values and component-level analysis. The research strategy involves structured experimental evaluation, and the time horizon is cross-sectional, as selected websites are analysed at a single point in time.

C. Background to this research theme

CVD affects the ability to distinguish between certain colour ranges, the most common being within the red and green spectrums. Due to colour playing a central role in user interfaces, reduced differentiation can affect recognition of buttons, navigation elements, error indicators, and graphical components. The Web Content Accessibility Guidelines (WCAG), provide established contrast thresholds intended to

support accessibility, however, these primarily focus on the colour difference of the foreground and background of an element such as a button white text and a black background.

Simulation-based research has shown that perceptual degradation may occur even when common contrast thresholds are met. A study demonstrated that perceived functionality can decrease despite compliance with accessibility standards [1]. Sajek et al. (2025) confirmed that accessibility varies significantly depending on colour schemes and the primary colour of the interface [2]. Whilst these studies provide valuable theoretical and empirical information, they do not quantify UI component vulnerability across multiple websites.

D. Hypothesis

The hypothesis chosen for this study is that a measurable proportion of UI components across selected websites will fail to maintain acceptable foreground-background contrast threshold when evaluated under at least one simulated CVD condition.

E. Research Aim and Purpose Statement

The aim of the study is to apply a structured automated evaluation approach to assess UI elements' visibility under simulated CVD conditions. The purpose is to quantify contrast degradation, identify vulnerable UI elements, and generate empirical proof regarding accessibility risks that may not be captured by traditional WCAG foreground-background checks.

II. Literature Review

Lit Review goes here

III. Research Methodology

Methodology goes here

IV. Findings and Results

Findings go here

V. Conclusion

Conclusion goes here

References

[1] A. Jamil and G. Denes, "Investigating color-blind user-interface accessibility via simulated interfaces," *Computers*, vol. 13, no. 2, 2024. [Online]. Available: https://www.mdpi.com/2073-431X/13/2/53

[2] D. Sajek, O. Korotenko, and T. Kyrychok, "Research on the accessibility of different colour schemes for web resources for people with colour blindness," *Journal of Imaging*, vol. 11, no. 8, p. 268, Aug. 2025.