

Adaptive Color Strategies in App Icons in the Digital Era

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Abstract. As the digital age advances and brand and digital media globalization accelerates, color has gained heightened significance within application icon identification systems. Previous research has primarily centered on the impact of color in fundamental recognition processes and aesthetic appreciation, yet it has relatively overlooked the variations within color design frameworks and how these distinctions affect user 's cognitive patterns and communication efficiency. In modern society, there is a noticeable trend towards digital-oriented and minimalist aesthetics, which can be observed across various fields such as fashion, interior design, and media production, all tending to adopt a more straightforward and universally appealing approach. Under such circumstances, brand color plans need to not only stand out from competitors but also ensure their effectiveness across various platforms and media channels, with the ability to be adapted and extended. By employing case analysis and comparative research approaches, this research investigates how color strategies perform in mobile app icon designs, highlighting their role in enhancing brand recognition and boosting communication effectiveness within the digital context. The findings of this research aim to assist new brands in making the most of their color palettes throughout the design phase, offering valuable insights for subsequent brand identity creation and cross-platform message delivery.

Keywords: Mobile icons, color adaptation, digital era.

1. Introduction

To bridge this knowledge gap, this study seeks to investigate flexible color approaches for mobile app icons in contemporary digital environments. Previous studies on color have mostly focused on brand recognition and interface aesthetics, yet they have failed to conduct in-depth analyses of how colors evolve at the specific level of app icons. As smartphones have become increasingly prevalent and mobile internet usage continues to surge, app icons have emerged as the primary visual bridge connecting brands and users. Unlike conventional brand emblems, mobile icons serve not only as markers but also hold significant importance in people's daily routines of interacting with digital platforms. These elements serve as vital bridges between brands and their audience, significantly enhancing user engagement and communication efficiency. To better understand this dynamic, research has examined the color variations in prominent brand symbols across multiple aspects, including the progression through different eras, shifting aesthetic preferences, and the impact on user interaction, thereby uncovering the significance of color in enabling icons to function effectively across various digital environments and when reaching diverse cultural audiences. The research delves into the adaptive evolution of icon color strategies, spanning from the early 20th century to the 21st century, and how this process maintains brand recognition within intricate digital environments. This approach establishes fundamental principles, tracks emerging patterns, and highlights areas where existing investigations have not yet delved. Beyond that, the research incorporates case studies, choosing typical application symbols to analyze color application, adjustment approaches, and user perception, and thus extracts effective experiences that support the investigation. In the end, the objective is to put forward feasible color plans for new brands, aiming to boost the recognition of their icons, strengthen emotional connection, and improve the efficiency of digital communication, thus offering both theoretical and practical support for visual communication design.

2. Literature Review

2.1. Color Studies and Brand Research: Overview of Mobile Icon Design and Color Transformation

Color has long been regarded as an essential element in graphic design. Liu Hongyan argues that color is indispensable—it enhances brand recognition and communication through contrast, hierarchy, and atmosphere building [1]. As a core element of visual communication, color plays an irreplaceable role in brand identity and user perception. Sun et al. examined automated icon colorization based on structure and color conditions. Using a Dual Conditional GAN, the study achieved intelligent matching between structural outlines and color styles, advancing automated design tools for icon creation [2]. While this research contributed technical insights into color-matching algorithms, it explored less about stylistic evolution, color psychology, and user perception. Cultural and aesthetic interpretations of color transitions in icon design were also limited. Therefore, this paper expands the discussion by examining color as a strategic resource in icon design. Mobile icons must maintain brand consistency while achieving effective communication within constrained space and across media environments. This suggests that app icon color strategies differ substantially from traditional brand identity design.

2.2. Trends Toward Digitalization and Minimalism

Early smartphone icons often adopted skeuomorphic design, using shadows, highlights, and gradients to increase realism—as seen in pre-iOS6 icon styles. Since the release of iOS7 in 2013, Apple promoted a “flat design” approach featuring clean color blocks and simplified graphic symbols. This trend quickly spread to Android and global digital platforms. Figure 1 shows the evolution of the Apple logo. Apple's 1976 design featured complexity and ornamentation. From 1977 onward, the company established the iconic minimal form still used today. Meanwhile, its color system shifted from multicolored gradients to modern monochromatic palettes such as black, white, and silver. Figure 2 illustrates even more dramatic changes in the Instagram icon. From 2010 to 2016, the design transitioned from photographic realism to simplified symbolic outlines and bold gradients. This transformation reflects the digital era’s emphasis on minimalism and symbolic representation. Studies suggest flat design improves readability on small screens and aligns with minimalist cultural aesthetics [3]. In color usage, the design trend has shifted from complex gradients and diverse palettes to single-tone, bright, highly saturated colors. Google’s Material Design reinforces this by promoting bold, vivid palettes for high recognizability and consistency. Recently, however, “neo-skeuomorphism” and gradient revival have emerged, using soft shadows and layered gradients to provide depth—indicating that icon color design seeks a dynamic balance between minimalism and ornamentation.

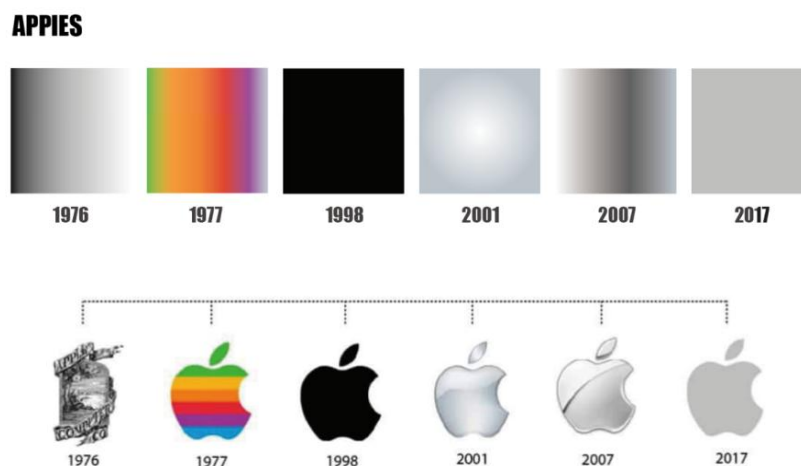


Fig 1. The color and shape evolution of the Apple logo [4]

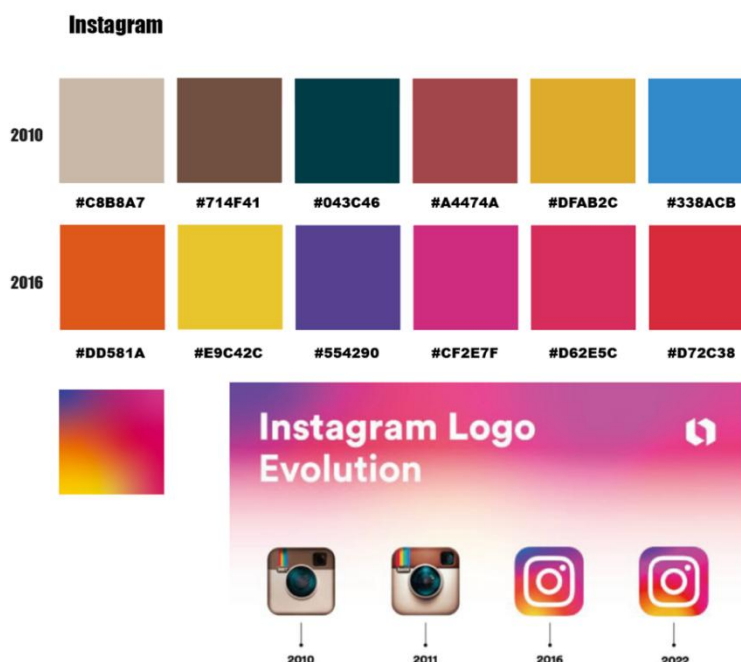


Fig 2. The evolution of colors and shapes in Instagram [5]

2.3. Media Perception and User Experience

Color transitions in icons not only reflect aesthetic changes but also improvements in user experience. Research by Wu Zhengxin and Bao Yixi shows that color affects attention distribution and operational efficiency [6]. Since mobile icons often appear in groups, color becomes important for distinguishing functions and improving recognition speed. Unified, simplified color schemes help users quickly locate target apps, while overly complex or similar colors reduce recognition. With increased cross-device usage, color adaptability has become crucial. Icons must maintain consistent clarity and recognition across differing screen sizes, resolutions, and operating systems. Thus, global brands prefer simple, high-contrast color strategies suitable for cross-media communication.

2.4. The Potential of AI in Visual Design

AI's going to be an inevitable trend in the digitalization process. How should designers use AI effectively? Chaudhuri discussed AI's role in restructuring design creativity. AI acts not only as a tool but as a “cognitive collaborator” that stimulates creative potential [7]. Generative models assist in concept development, form evolution, and visual decision-making. However, Chaudhuri focused on creativity at a macro level, with limited examination of practical applications such as icon color evolution, symbol recognition, or cultural adaptation. Thus, this study explores AI and visual design from a micro-perspective, focusing on icon color evolution and recognition. Similarly, Becerra argued that in digital transformation, designers shift from visual creators to interdisciplinary information integrators [8]. Design becomes dynamic and data-driven, rather than static.

3. Case Analysis

3.1. Apple iPhone Music

As illustrated in Figure 3, iPhone music-related iconography underwent a striking transformation spanning from 2007 to 2025, transitioning from a detailed, realistic aesthetic to a highly simplified, flat visual approach. During the period spanning 2007 to 2009, the prevalent aesthetic was a representational approach characterized by muted color palettes and an abundance of intricate details. This approach involved mimicking physical items, like a speaker positioned on a CD case, to help

users better understand how the digital interface worked. During the period from 2011 to 2013, unnecessary elements were gradually eliminated, and the color palette evolved to be more vivid and intense, indicating a steady shift towards a flat design. In the period spanning 2014 to 2015, all traces of highlights and shadows were entirely discarded, with a purely flat aesthetic being embraced to emphasize simplicity and uniformity. During the period from 2015 to 2020, the icons began to incorporate color variations and internal details again, thus creating a richer visual hierarchy. Following this period, the years 2020 through 2025 saw a notable shift back toward minimalist design principles. This resurgence was characterized by the adoption of vivid, intensely saturated color palettes paired with straightforward, uncomplicated forms, which ultimately led to widespread acclaim on a global scale. This shift manifests itself as a progression that moves away from a focus on utility toward visual representation, and transitions from mirroring the physical world to highlighting the use of digital expression.

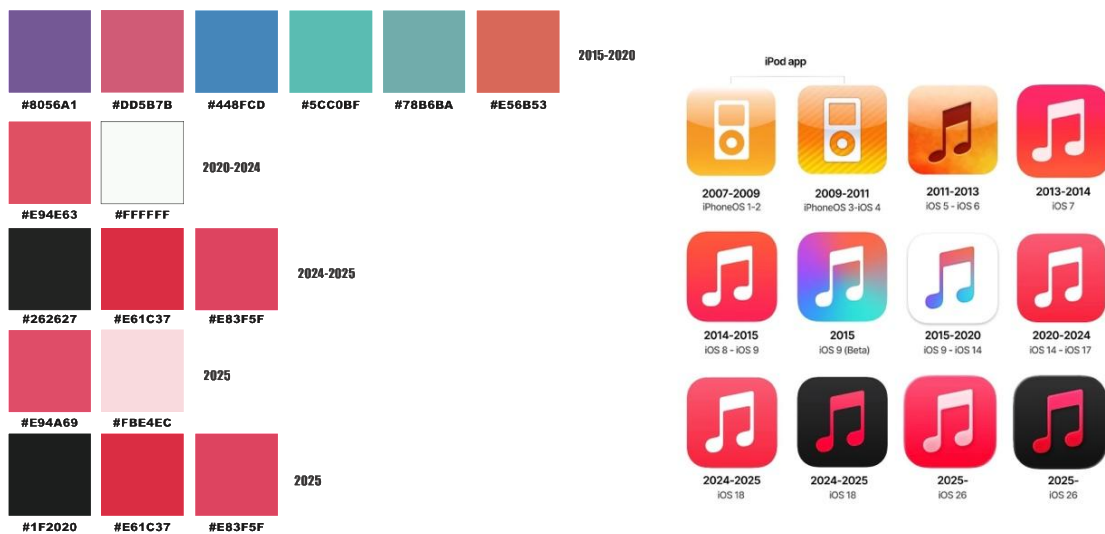


Fig 3. The color and shape evolution of the music App

3.1.1 Netflix

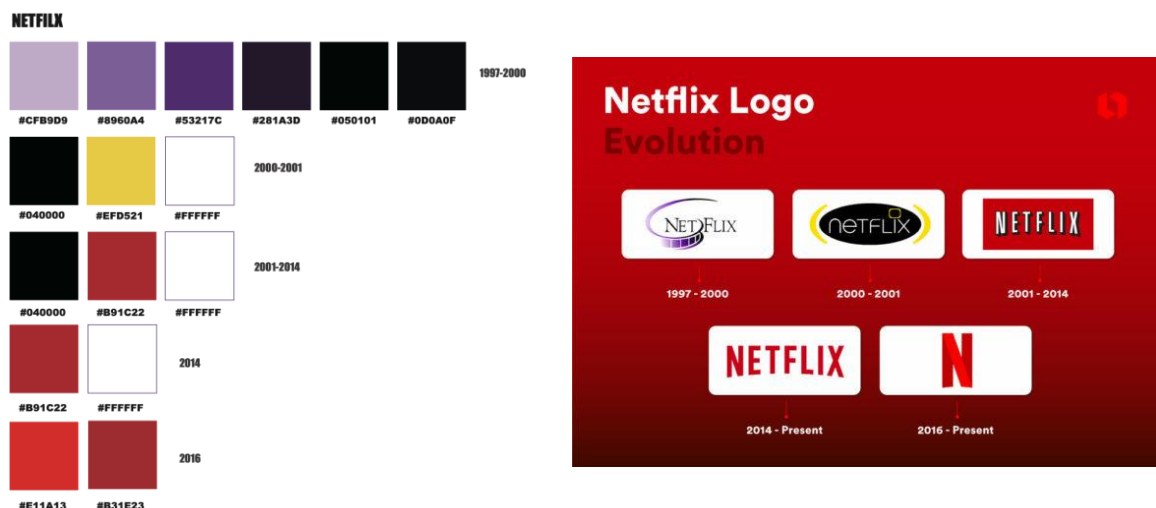


Fig 4. The color and shape evolution of Netflix [9]

The evolution of Netflix's icon design. As shown in Figure 4, Netflix initially used a complex font design. It started using a black and red film reel-style logo in 2001. After 2016, a unified black background and red "N" symbol was adopted. The high-contrast color scheme stands out in digital interfaces and dark backgrounds, which not only suits the screen environment of streaming media applications but also enhances the visual impact of the brand.

3.1.2 Airbnb

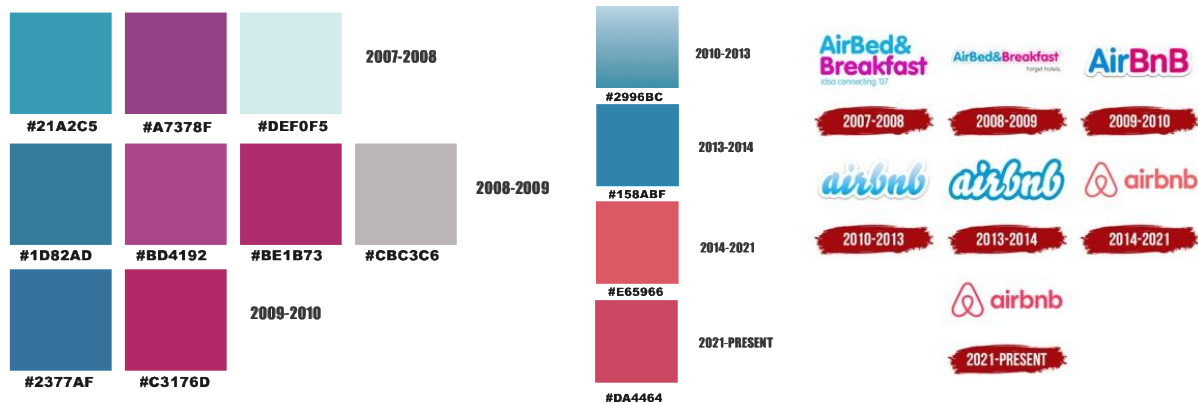


Fig 5. The color and shape evolution of Airbnb [10]

The Color Strategy of Airbnb's Logo. As shown in Figure 5, the initial design style employed a variety of colors, including blue, green and purple. It wasn't until 2010 that Airbnb adopted a monochromatic design. In 2014, it launched the "Bélo" logo, featuring a soft coral pink contrasted with white. Unlike the blue color preferred by the traditional tourism industry, Airbnb's color strategy emphasizes warmth, community spirit and friendliness, conveying the brand concepts of sharing and belonging.

3.1.3 YouTube

Evolution of the YouTube Logo. As shown in Figure 6, since 2005, the icon of YouTube has evolved from the red-white-black TV screen style to the red-play-button and black-font combination since 2017, without shadows or gradients, and with a bold red symbol that reinforces the digital recognition of "play instantly". At the same time, emerging applications have also established unique visual languages through high saturation and strong contrast color strategies. For example, TikTok uses a black background with bright colors to create a visual impact, and Spotify uses a single-color wave symbol to highlight the brand characteristics. Overall, contemporary application icons present a design trend of high saturation, strong contrast, and symbolization. Color becomes the core identification symbol, which not only meets the functional adaptation across platforms and different display modes, but also reflects the simplicity and efficiency of visual communication in the digital age.



Fig 6. The color and shape evolution of YouTube [11]

3.2. User Experience and Color Perception

According to studies, interfaces utilizing straightforward color pairings with strong contrasts have been found to notably enhance users' ability to efficiently locate and process information (Li Mupu). Conversely, when color schemes become too complicated, they tend to elevate visual burden and

slow down the process of recognition. In the domain of visual perception, color blocks that are highly saturated and feature strong contrasts tend to have higher visibility, enabling them to swiftly attract users' focus in the initial stage of information processing, which in turn facilitates faster recognition of target icons as users navigate through the interface [12]. When icons are closely packed together, variations in color attributes such as hue, lightness, and saturation play a direct role in determining how distinguishable the icons are to users. Due to the small size of icons, which tends to cause loss of details, color blocks emerge as the main indicators for recognition. When scaled down, complex gradients or textures tend to blur, which in turn diminishes overall clarity and recognition precision. Beyond visual clarity, color plays a significant role in both functional recognition and evoking emotional reactions, as well as shaping brand recall. Varying hues are linked to unique emotional undertones: blue evokes a sense of trust and logical thinking, red communicates liveliness and a sense of urgency, and green represents the natural world and a feeling of security. These emotional connotations influence how users initially perceive a brand. Moreover, color also plays a vital part in the process of memory encoding and retrieval. When serving as a semantic hint in the association between color and a brand, it helps users more readily remember and identify brands after prolonged usage. Beyond this fundamental recognition, distinct color schemes or innovative gradient techniques can significantly boost a brand's distinctiveness, allowing its products or services to stand out more effectively in a crowded market and cultivate deeper emotional bonds and greater customer adherence during visual interactions.

Application icons' color approaches not only embody the blend of global brand identity and local cultural stories but also act as a visual carrier for cross-cultural exchange. Major tech firms typically opt for color schemes that are broadly acceptable, aiming to minimize cultural hindrances and uphold a consistent worldwide brand appearance. Nonetheless, as they expand into distinct regional markets, color selection emerges as a critical means of tailoring their products to local contexts. Brands can adjust their primary or secondary color schemes to match the cultural inclinations of local consumers, such as how red represents happiness and prosperity in Chinese society, thereby realizing an accurate transition from a universal brand image to a localized one. Liu Lei's research has revealed that cultural differences lead to substantial variations in how people perceive colors [13]. As a result, international companies frequently adopt straightforward and globally recognized color combinations to minimize the possibility of cultural misinterpretations and cognitive prejudices. Additionally, the way people respond to colors can be shaped by age, gender, and their social and economic backgrounds, which further emphasizes the need for global color planning to account for such intricate and culturally responsive aspects.

3.3. Cross-platform Adaptation: Technical and Presentation Differences

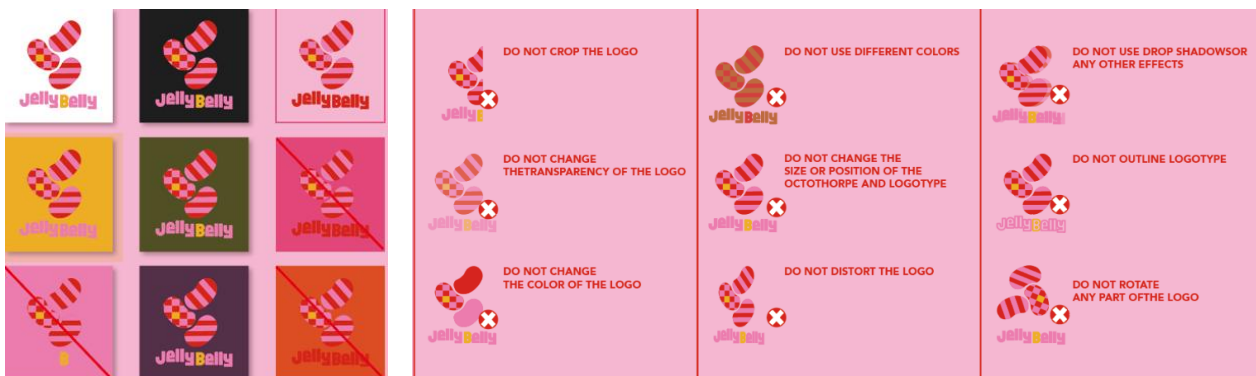


Fig 7. Considerations for icon design adaptability

As shown in Figure 7, in a multi-platform and multi-device environment, the icon design must fully consider the technical adaptability. Firstly, since the icon sizes vary in app stores, desktops, notification bars, and settings pages, the design needs to remain clear and distinguishable even at the smallest size, avoiding the loss of details. Secondly, different devices support different color gamut (such as sRGB and Display P3) and rendering methods (gamma), which may cause distortion of

gradients or colors on some screens. Moreover, the icon processing mechanism at the system level also affects the visual presentation, such as Android's adaptive icons and iOS's shape masks and rounded corners, which will change the fusion effect of the icon edges and the background. Finally, the dark/light mode switch poses challenges to color recognition: light-colored icons are more readable on dark backgrounds, but may "disappear" on light backgrounds, and vice versa. Therefore, designers need to strike a balance between visual uniformity and system compatibility to ensure that icons have good recognizability and consistency in various display environments.

3.4. Design Methodology: Process for Constructing Technological Adaptive Color Strategies

As screen resolutions continue to improve, dark mode has become increasingly widespread. High-saturation and high-contrast colors stand out more effectively in dim environments, reduce unnecessary detail, adapt well to compact displays, and sharpen the recognition of essential elements. When users have limited attention and must scan the interface quickly, taking advantage of pre-attentive perception becomes crucial—vivid, sharply contrasted color blocks can be registered in roughly a tenth of a second, easing cognitive load and speeding up visual search. For brands aiming to reach global markets, cultural variation presents a major obstacle. Selecting universally familiar hues—such as blue or green—or developing a flexible color system in which the main tone remains consistent while regional accents can shift, helps establish emotional resonance and recognizability across cultures.

As a brand matures, its color strategy often becomes more focused: moving from multiple hues to a singular dominant tone, and from flat colors to more nuanced blends. This visual consolidation strengthens the core color identity and builds a sense of authority and stability. When shaping a brand's color plan, designers must first clarify the brand's values, primary audience, and key usage scenarios. These foundations determine what visual qualities should take priority. After defining them, color selection can be guided by established theoretical models. For example, when visibility is essential, theories of color psychology and cognitive load suggest choosing high-contrast, high-saturation pairings. If global acceptance is the goal, cross-cultural research should inform the choice of a widely accepted main hue (such as blue), supported by an adjustable secondary palette tailored to local preferences. Next, testable hypotheses must be proposed and verified—for instance, evaluating emotional responses to specific hues or testing readability in dark-mode interfaces. A/B comparisons and user feedback data help determine whether the scheme is genuinely effective. A long-term update system should then be established, defining application rules, adjustable parameters, and strategies for market-driven refinement so the color system can evolve with changing contexts. Looking ahead, color strategies for mobile app icons will likely shift from fixed palettes toward more adaptive, personalized systems. Powered by AI and large-scale data, future color schemes may respond to environmental lighting, task types, or even users' emotional states. In this evolution, accessibility and cultural inclusiveness will become the core of the design rather than secondary considerations—allowing color systems to balance scientific reasoning with empathetic design, and to create a precise, meaningful visual connection with each user across diverse screen environments.

4. Conclusion

As the digital landscape continues to evolve at a rapid pace, the visual elements of mobile apps have shifted from the realistic, texture-rich skeuomorphic style to sleek, unadorned minimalist icons, marking a significant change in their design language. Accompanying this shift in visual representation, the color strategies used in these icons have also evolved, moving away from soft, single-tone color combinations toward eye-catching gradients or monochromatic sets characterized by elevated saturation levels and pronounced contrast. In the digital landscape, this shift toward high saturation, pronounced contrast, and symbolic representation has emerged as a core principle in icon creation, thereby boosting brand distinctiveness and message clarity across diverse platforms and cultural settings. The importance of this study is to uncover how color functions in a multi-layered

way within mobile icon recognition, acting not only as a practical component for conveying information but also as a primary tool for building brand recall and emotional bonds. These results offer meaningful insights for follow-up mobile visual design projects, brand identity system development, and cross-cultural communication approaches, highlighting the intricate link between color choices and user mental processes, as well as cultural backgrounds. Moving forward, further studies need to explore how color evolves in animated symbols, as well as the underlying ways in which AI-powered design frameworks incorporate color elements within interfaces that adapt to different situations and immersive visual environments. Such studies are anticipated to foster breakthroughs in digital visual communication tools, enable new brands to integrate color strategies more effectively into their creative workflows, and offer actionable insights for advancing brand recognition and cross-platform messaging initiatives.

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