

UI flat design and skeuomorphism mediation with neumorphism (material design)

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Abstract. This study discusses the mediation between Skeuomorphism and Flat Design through the Neumorphism or Material Design approach in interface design or user interface (UI). Skeuomorphism UI is known to present user nostalgia with realistic visuals that maintain the correlation of real objects, but often loads the performance of handheld devices. In contrast, Flat Design UI offers memory efficiency through minimalist images with flat color blocks, but tends to disappoint and confuse users. Neumorphism UI emerges as a solution that combines the advantages of both, creating visuals that still resemble real objects but are lighter, presenting a minimalist realistic feel. This study uses a qualitative method with a descriptive approach, data collection through purposive sampling, literature studies and interface design observations. The results of the study are expected to contribute as learning materials in introducing, using, and creating better interface designs, both in terms of aesthetics and functionality. By understanding the role of Neumorphism UI as a mediator between visual nostalgia and efficiency of use, interface designers are expected to be able to present an optimal, innovative, and relevant user experience (UX) with technological developments.

Keywords: Skeuomorphism, Flat Design, Neumorphism, User Interface, User Experience

Introduction

In the early development of the iPhone, Steve Jobs put forward a skeuomorphic interface design that presented realistic visual elements to bridge the user experience with familiar physical objects (Darmawan, Arimbawa, et al., 2024). This approach aims to facilitate user adaptation to new technology by displaying icons and elements that resemble real objects, such as the book display in the iBooks application or the microphone in the Voice Memos application. However, over time, skeuomorphic design has been criticized for being considered a burden on device performance and excessive display (Page, 2014).

Despite the evolution from skeuomorphism to flat design, challenges persist in balancing visual appeal and usability. Skeuomorphism, while aiding user familiarity, often led to performance issues due to its detailed graphics (Page, 2014). Conversely, flat design improved efficiency but sometimes resulted in user confusion due to its simplicity (Oswald & Kolb, 2014). Recent studies suggest that Neumorphism, which combines elements of both styles, may address these issues by offering a more intuitive and visually appealing interface (Urbano et al., 2022). However, there is a lack of empirical research evaluating its effectiveness in enhancing

user experience and performance. This study aims to fill this gap by analyzing the impact of Neumorphism on user engagement and system efficiency.

In response to the limitations of skeuomorphism, the Google design team introduced the concept of Flat Design in the development of the Android interface. This design emphasizes simplicity and efficiency by eliminating three-dimensional elements, shadows, and textures, and using bright colors and simple iconography (Oswald & Kolb, 2014). The goal is to improve the performance and responsiveness of the interface. However, for some users, especially older ones, Flat Design is considered less attractive and confusing because of the uniformity of elements that can cause errors in the interaction of using related applications (Darmawan, Utomo, et al., 2024).

Microsoft then tried to bridge the two approaches through the Metro Design Language, which was applied to the Windows 8 operating system. Metro Design maintains the principles of Flat Design with a minimalist appearance and no color gradients, but adds strong typographic elements and grid-based layouts to create harmony between components. This UI was also applied in the handheld version when collaborating with Nokia on the Lumina product in 2013 (Basu, 2013). However, this approach still faces challenges in terms of user acceptance and design consistency (Lee, 2014). Realizing the need for a solution that combines the advantages of skeuomorphism and Flat Design, the designer community on platforms such as Dribbble and Behance began to develop a new approach known as Neumorphism or also known as Material Design (Jung & Kim, 2020). Neumorphism combines realistic and minimalist elements by creating subtle emboss and deboss effects, giving depth to the interface without sacrificing the simplicity of the design. This approach is expected to provide an intuitive and aesthetic user experience, while maintaining the efficiency of device performance (Hsu & Ling, n.d.).

Methods

This study uses a qualitative method, with a descriptive writing style, using a purposive sampling data collection method (taking samples with consideration of the suitability of the objectives or research topics) with literature study techniques and observations on the interface designs in circulation. To apply this research topic, the author carries out the following stages:

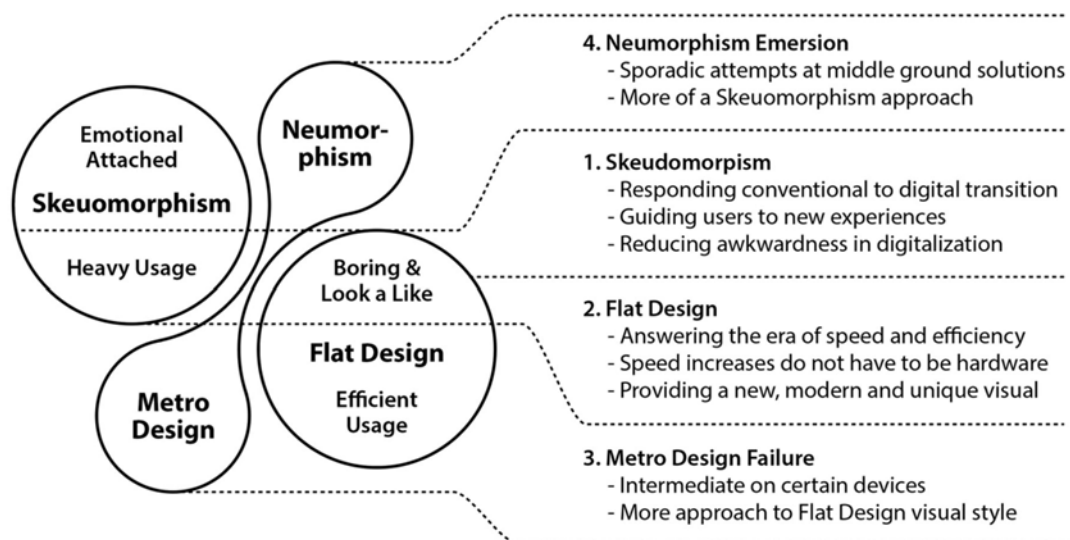


Fig. 1 Research Method.
Source: Author's Works



This research focuses as seen in Figure 1, on the study of user interface design from Skeuomorphism, Flat Design, Metro Design, to Neumorphism, along with their characteristics and reasons for their emergence. Skeuomorphism offers emotional attachment by displaying realistic visual elements that resemble physical objects, helping users adapt to digital technology, but is considered too heavy in terms of device memory usage. In response, Flat Design comes with a more efficient approach, eliminating realistic elements and using simple shapes and flat colors to increase the speed and responsiveness of the interface, although it is sometimes considered boring and uniform, confusing users, especially senior users.

Microsoft then introduced Metro Design as an intermediate solution by maintaining the principles of Flat Design but providing a more structured layout and visual element alignment, although it still tends to be close to the Flat Design style. Realizing the need for an approach that combines the advantages of Skeuomorphism and Flat Design, the designer community on the Dribbble and Behance platforms introduced Neumorphism (also known as Material Design) which presents a minimalist appearance with subtle emboss and deboss effects, providing a balance between realistic appearance and memory usage efficiency so as to offer an aesthetic, intuitive interface, and remains lightweight in device performance.

Result and Discussion

Getting to Know Skeuomorphism

Skeuomorphism was introduced to provide a familiar digital experience for users by displaying visual elements that resemble real physical objects by Steve Jobs as seen in figure 2. This design emphasizes the emotional attachment of users to the interface, thus facilitating adaptation to new technologies. However, this realistic design requires large resources, which ultimately reduces the efficiency of device use, especially on handheld devices.



Fig. 2 Introduction of UI Skeuomorphism in 1st Iphone by Steve Jobs.

Source: macpoin.com

In the transition from conventional to digital technology, skeuomorphism plays a vital role in bridging the gap between the physical world and digital interfaces. By integrating elements that mimic real objects, skeuomorphic design helps users recognize digital functions through

familiar visual representations. For example, a folder icon that resembles a physical folder makes it easier for users to understand where digital documents are stored (Urbano et al., 2022). This approach reduces the learning curve and makes new technologies more accessible to the general public.



Fig. 3 Skeuomorphism UI in Calendar App.

Source: ux.stackexchange.com

In addition, skeuomorphism serves as a guide for users in navigating previously unfamiliar digital experiences. By presenting an interface that mimics a physical object, users can intuitively understand how digital systems work and navigate. For example, a calendar with a paper calendar application, as seen in figure 3, helps users adapt without confusion (Stevens et al., 2013). This kind of design provides a sense of familiarity, thereby reducing psychological barriers to using new technologies.

The implementation of skeuomorphism also contributes to reducing awkwardness during the digitalization process. By adopting design elements that resemble the real world, users feel more comfortable and confident when interacting with digital devices. For example, a note-taking application that displays a physical notebook-like appearance can increase user comfort in taking digital notes (Page, 2014). Thus, skeuomorphism not only facilitates technology adaptation but also increases user confidence in operating digital systems.



Fig. 4 UI Skeuomorphism (Left) and Flat Design (Right) in Several Apps.

Source: 360ss.com

Skeuomorphic designs, which mimic the appearance of physical objects in digital interfaces, often require greater computational resources. The use of realistic visual elements such as textures, shadows, and color gradients multiply graphical complexity, as seen in figure 4, which in turn burdens device performance. This can lead to longer load times and slower system response, especially on devices with limited processing capacity (Urbano et al., 2022). Additionally, excessive visual detail can result in interfaces that appear cluttered and confusing, reducing the efficiency of user interaction (Stevens et al., 2013). Therefore, while skeuomorphism can increase user engagement through visual familiarity, this approach is often considered suboptimal in terms of performance and overall user experience.

Flat Design Response

In response to the limitations of Skeuomorphism, Flat Design emerged, offering a more efficient and lightweight interface design in terms of memory usage. Flat Design eliminates realistic elements such as shadows and color gradients, replacing them with simple geometric shapes and flat colors. This approach increases the speed and responsiveness of the interface without requiring high hardware. However, this overly simple design is often considered boring and has similarities between elements that cause user confusion, especially for older users.

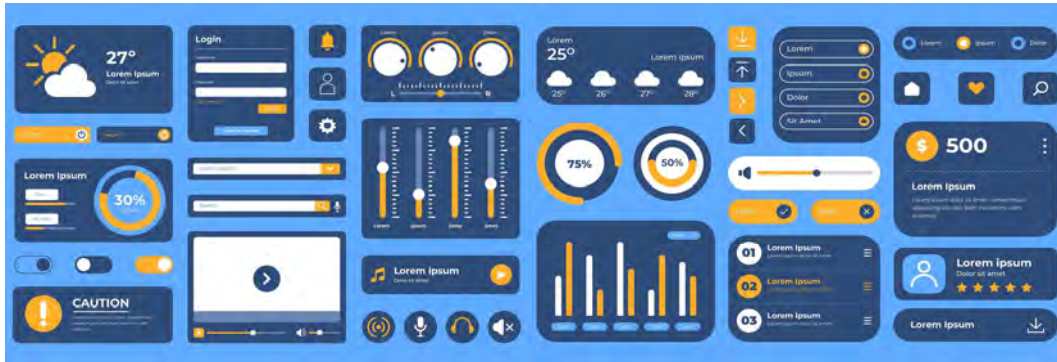


Fig. 5 UI Flat Design.
Source: Freepik Company, S.L.

Flat Design emerged as a response to the need for speed and efficiency in user interface design. By adopting simple two-dimensional elements and a bright color palette, as seen in figure 5, this approach reduces visual complexity that can slow down system load times and response. This simplicity allows content to adapt to different screen sizes more efficiently, supporting optimal responsive design (Burmistrov et al., 2015). Additionally, by reducing excessive decorative elements, Flat Design minimizes visual clutter, allowing users to focus more on the main content without unnecessary distractions (Okoye, 2020).



Fig. 6 Skeuomorphism vs Flat Design UI battle.
Source: creativebloq.com

Increasing interface speed does not always have to be achieved through hardware upgrades. Flat Design contributes to faster performance by reducing complex graphical elements, such as shadows and heavy textures, which can burden the system. This minimalist approach results in smaller file sizes, thereby speeding up page load times and application

responsiveness without requiring increased hardware specifications (Spiliotopoulos et al., 2018). That is why between Skeuomorphism and Flat Design are really competitive, as seen in figure 6. Thus, Flat Design offers an efficient solution for developers and designers to improve system performance through design optimization, not just through upgrading physical UI components in design perspective.

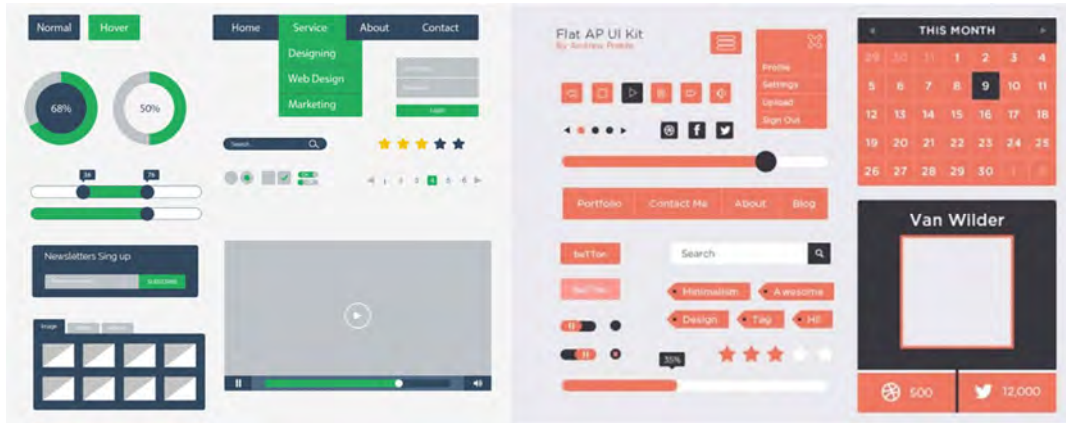


Fig. 7 Similarity of Flat Design UI Appearance between Applications.
Source: Freepik Company, S.L.

In addition to the functional aspect, Flat Design also introduces a modern and unique visual aesthetic. Inspired by the Swiss design movement, this style emphasizes the use of simple geometric shapes, contrasting color palettes, and clean typography to create a fresh and contemporary look (Oswald & Kolb, 2014), as seen in figure 7. This approach not only enhances visual appeal but also facilitates user navigation and interaction with the interface. By eliminating unnecessary elements, Flat Design ensures that each component has a clear purpose, thus improving the overall user experience (Burmistrov et al., 2015).

However, Flat Design is often considered monotonous and uniform due to its minimalist approach and the use of two-dimensional elements without three-dimensional effects such as shadows or gradients (Oswald & Kolb, 2014). This simplicity, although it facilitates the adaptation and responsiveness of the design, can result in a less attractive interface appearance that tends to be similar to each other, thus reducing the visual appeal for users (Spiliotopoulos et al., 2018). In addition, the limitations in the variety of design elements make each component look similar, which can cause boredom and reduce the uniqueness of a brand or product's visual identity (Page, 2014). Therefore, although flat design offers efficiency and simplicity, the main challenge faced is to create a look that remains attractive and different without sacrificing the basic principles of minimalism.

Metro Design Failure

To bridge the two approaches, Microsoft's Metro Design was introduced, combining the efficiency of Flat Design with the harmony of a more structured layout. While it provides good visual consistency, Metro Design still adheres more closely to Flat Design principles and falls short of being an ideal solution for users who need an emotional attachment to the interface.

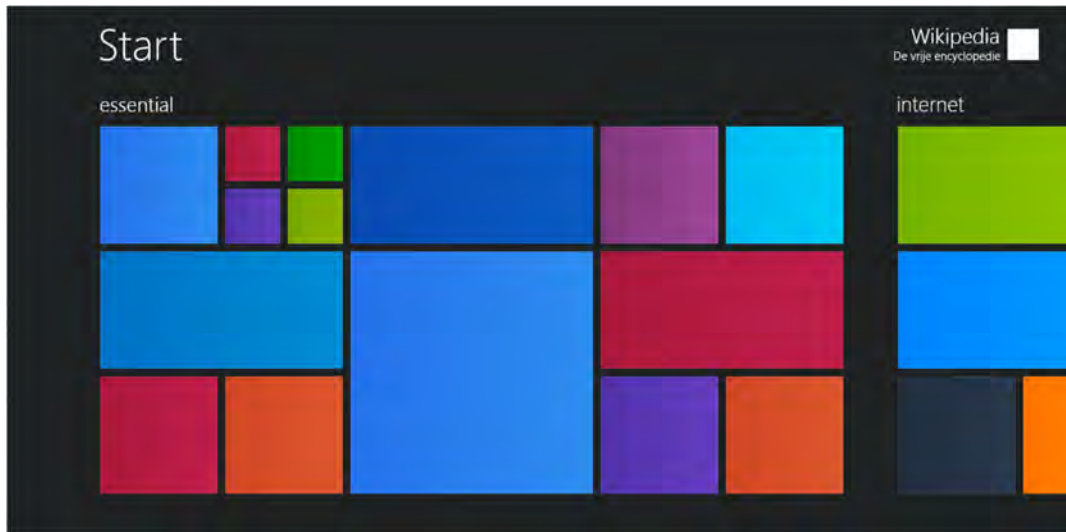


Fig. 8 Metro Design UI Mapping on Windows 8.
Source: learn.microsoft.com

Metro Design was introduced by Microsoft as an attempt to bridge the gap between skeuomorphic and flat design, with the goal of creating a consistent interface across devices (Lee, 2014), as seen in figure 8. This approach was first implemented on Windows Phone 7 and was later adopted in various other Microsoft products, such as Windows 8, Nokia Lumia, and Xbox. However, Metro Design implementations are often limited to the Microsoft ecosystem, making it less widely accepted on other platforms. This has led to limitations in adoption and consistency of user experience outside of Microsoft devices (Basu, 2013).

Although Metro Design aims to be a middle ground between skeuomorphism and flat design, its approach leans more towards the flat design visual style. It emphasizes the use of strong typography, simple iconography, and grid-based layouts, while eliminating the three-dimensional elements and textures commonly found in skeuomorphism (Basu, 2013). As a result, some users find the Metro interface too rigid and less intuitive, especially for those accustomed to more realistic visual elements. This criticism suggests that an overly minimalist approach can sacrifice aspects of emotional engagement and ease of use (Lee, 2014).

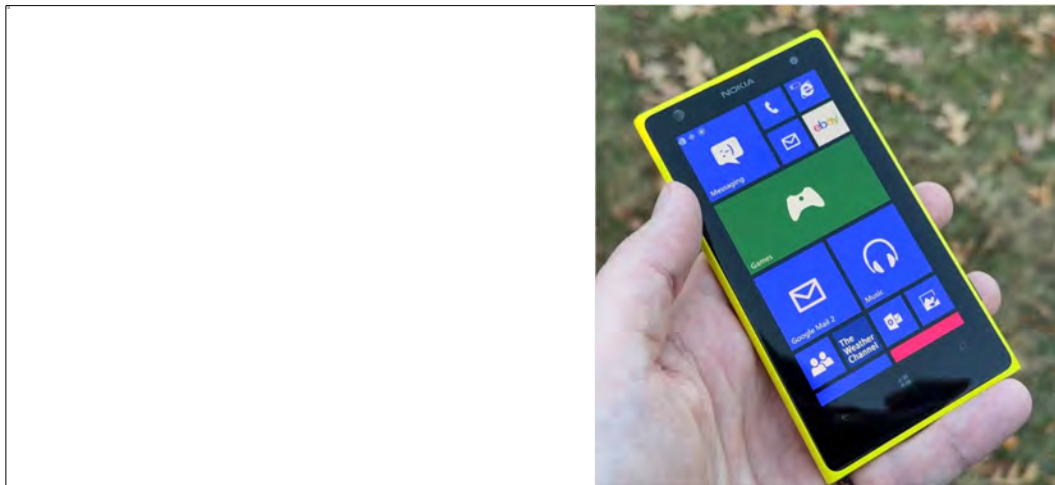


Fig. 9 Metro Design UI (left) and Nokia Lumia 1020 UI (right).
Source: learn.microsoft.com

Metro Design, which aims to unify the user experience across devices through a consistent and minimalist interface which also applied in UI Nokia Lumia series, as seen in figure 9, unfortunately faced criticism for being too prioritizing the structured aesthetic of functionality over the aesthetic of ambiguity (which addresses the monotony and similarity of UI that are the main problems), this is especially seen on non-touch devices such as desktop computers and/or smartphones. Overly structured designs and the use of full-screen elements are actually considered to reduce user efficiency and multitasking, which ultimately contributes to the impact of the lack of widespread acceptance of Metro Design (Lee, 2014).

Fresh Efforts of Neumorphism (Material Design)

Realizing that there is still a need for a UI that can combine the advantages of Skeuomorphism and Flat Design, the designer community on the Dribbble platform (from SimpleBits) and Behance (from Adobe) then came up with the concept of Neumorphism (or also known as Material Design). This design adopts subtle emboss and deboss effects, creating a realistic yet minimalist appearance. Neumorphism seeks to be a middle ground solution that connects the visual nostalgia of Skeuomorphism with the efficiency of using Flat Design, offering an interface that is aesthetic, functional, and remains lightweight in terms of device performance.

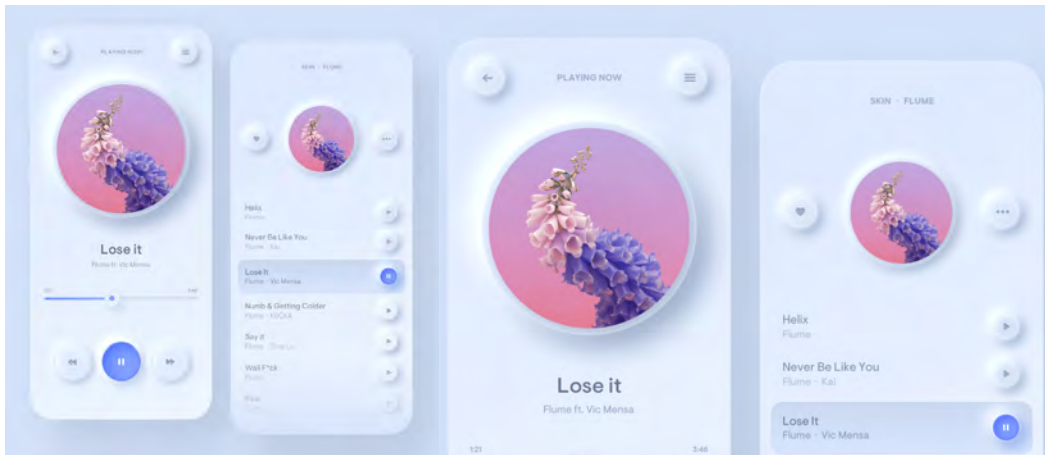


Fig. 10 Neumorphism UI display.

Source: justinmind.com

Neumorphism emerged in response to the need for an interface design solution that connects skeuomorphism elements with flat design elements, as seen in figure 10. This approach seeks to create a balance between realism and minimalism by presenting elements that appear to emerge from the background through the use of subtle shadows and highlights (Hsu & Ling, n.d.). Despite its appealing aesthetic, Neumorphism's implementation is often sporadic and is found more in design concepts than practical implementations, due to challenges in terms of usability and accessibility (Park, n.d.).

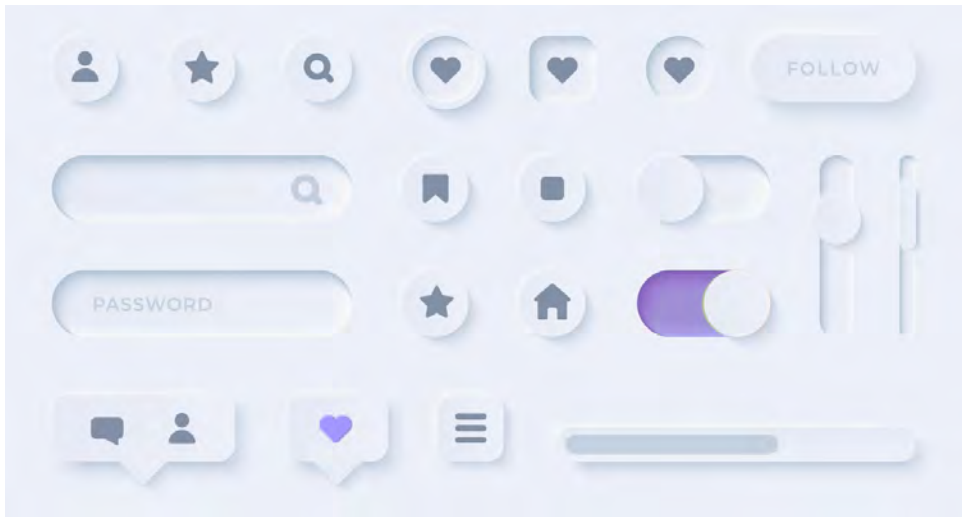


Fig. 11 Neumorphism UI Asset.

Source: justinmind.com

The Neumorphism approach tends to lean more towards skeuomorphism by adding dimension and depth to UI elements as seen in figure 11, but with a more subtle and modern touch (Okoye, 2020). Rather than directly mimicking realistic textures and details, Neumorphism uses soft color palettes and shadows to create the illusion of depth without sacrificing the simplicity of the design. However, criticisms of Neumorphism include low contrast issues that can affect readability and user interaction, limiting its adoption in high-functionality oriented interface designs (Park, n.d.).

Neumorphism is believed to be successful because of its ability to combine elements of skeuomorphism and flat design, creating a modern and aesthetic interface. This approach presents a subtle visual effect with shadows and highlights that give the illusion of depth, making elements appear to emerge or disappear from the background (Hsu & Ling, n.d.). In addition, Neumorphism offers a clean and minimalist look, which can improve the user experience by providing an intuitive and visually appealing interface (Kwan et al., 2022). However, it is important to consider accessibility and contrast aspects when implementing Neumorphism in interface design.

Conclusion

In conclusion, the evolution of user interface (UI) design from Skeuomorphism, Flat Design, to Neumorphism shows how the development of user needs and preferences influences design trends. Skeuomorphism provides a realistic approach that supports the transition from the physical to the digital world by offering a familiar visual experience. However, its graphic complexity causes device performance to be slower, especially on handheld devices. On the other hand, Flat Design emerged as a solution to improve the efficiency and speed of the interface through minimalist design and the use of simple graphic elements. Although lighter and more responsive, this design has been criticized for being too similar and boring, reducing the emotional experience and sometimes confusing users.

The emergence of Neumorphism as an attempt at a middle ground presents an approach that combines the subtle realism of Skeuomorphism and the simplicity of Flat Design. By using soft shadows and minimalist depth effects, Neumorphism creates a visually appealing interface

without burdening device performance. Although still facing challenges in terms of accessibility and contrast visibility, Neumorphism shows the potential to be a functional and aesthetic design solution. This study shows that each design approach has its own advantages and disadvantages, and choosing the right UI design style should take into account the context of use, user needs, and the overall purpose of the digital product.

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