The Evolution of Web Design: Innovations, Accessibility, and Ethical Considerations

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Rashid Bah
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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Advisor

Bryn E. Seabrook, Department of Engineering and Society

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Introduction

Early websites were functional but minimal, prioritizing utility over aesthetics. Pizza Hut's first online ordering site, for instance, was basic—text-heavy, with few interactive elements—but it accomplished its goal. The process was straightforward: you filled in three text boxes—your name, phone number, and address—clicked submit, and moments later, you received a call to confirm your order. There were no pop-ups, animations, or AI-driven recommendations—just a simple form that got the job done efficiently. Fast forward to today, and web design has evolved into a highly sophisticated field, integrating AI-driven interfaces, interactive visuals, and accessibility tools. However, this rapid progress in web design presents challenges: Has the drive for innovation made websites more complex at the expense of usability and inclusivity? Ordering a pizza from Pizza Hut now happens through an app or website that remembers your past orders, pushes limited-time deals, offers algorithm-powered topping suggestions, lets you track the driver on a live map, and even syncs with voice assistants—so feature-rich that the barrage of pop-ups and upsells can feel almost overbearing. Modern websites offer sleek interfaces, personalized recommendations, and seamless interactions, they also come with longer load times, increased reliance on JavaScript, and potential accessibility barriers.

This paper examines the tension between UI/UX advancements and accessibility, using Actor-Network Theory (ANT) and Technological Momentum to analyze the interplay between designers, accessibility standards, and evolving digital frameworks. The study focuses on CNN's front-end redesign efforts to explore how media platforms navigate the balance between modern design trends and core functionality.

Web Design's Evolution and Accessibility Trade-offs

Web design has changed drastically over the last thirty years, shaped by technological advancements, evolving user expectations, and commercial priorities. From early static pages to today's dynamic, mobile-optimized experiences, the need for user engagement and accessibility remains paramount. The shift towards responsive design, mobile-first interfaces, and interactive elements reflects an industry-wide effort to keep pace with digital consumption habits. However, these advancements introduce technical and ethical challenges that impact various user demographics differently.

CNN, as a major news platform, demonstrates these shifts through initiatives like the "Article Elevate" project, which I worked on during my software engineering internship. The project aimed to refine article layouts for improved readability and responsiveness. The redesign incorporated modern UI components that enhance user engagement but also raised concerns regarding performance trade-offs and accessibility compliance (W3C, 2018; Babich, 2019). Certain interactive elements, such as auto-loading content and JavaScript-heavy navigation, can create usability challenges for individuals who rely on screen readers or keyboard navigation. As digital platforms strive for user retention, they must also contend with the ethical implications of UI/UX choices. Design choices that prioritize aesthetics and engagement can inadvertently exclude users with disabilities. Accessibility guidelines, such as WCAG 2.1, establish a framework to mitigate these risks, but compliance remains inconsistent across platforms. In addition, businesses must balance user needs with commercial pressures, as more engaging designs often correlate with increased ad revenue and user retention.

Mixed - Methods Approach

This study employs a mixed-methods approach to investigate the evolution of web design. First, a case study of CNN's "Article Elevate" project analyzes the motivations, challenges, and outcomes of CNN's recent redesign to better understand broader trends in web development. Through this case study, the research explores how decisions regarding UI elements, accessibility compliance, and engagement strategies were made, providing insights into the intersection of business goals and ethical considerations. Second, a content analysis examines accessibility guidelines, specifically WCAG 2.1, and UX design principles to assess their role in shaping web interfaces. This portion of the study includes a review of academic literature and industry reports to evaluate the effectiveness and limitations of current accessibility standards. Finally, a historical analysis reviews web design trends over the past thirty years to contextualize contemporary UI/UX strategies. By tracing the transition from early static websites to today's AI-driven and interactive platforms, this analysis highlights how shifts in technology, regulation, and user expectations have shaped digital design choices.

Actor-Network Theory and Technological Momentum in Web Design

This research applies Actor-Network Theory (ANT) and Technological Momentum to explore how web design innovations emerge and persist. Both frameworks offer insights into the relationship between technology, human actors, and the broader societal structures that shape digital experiences. ANT examines how human (designers, developers, users) and non-human actors (algorithms, accessibility guidelines, design frameworks) interact to influence technological changes. CNN's web redesign involved input from multiple stakeholders— engineers, accessibility specialists, and business executives—each contributing to the final

interface. ANT highlights how power dynamics between these actor's shape decision-making in UI/UX development, determining which features are prioritized and which are sidelined.

Technological Momentum highlights how prior technological decisions shape future innovation. Early web designs, constrained by limited functionality, evolved into today's feature-rich, responsive layouts. However, legacy infrastructure and user familiarity can limit the adoption of new UI/UX paradigms, requiring companies like CNN to navigate both innovation and historical design constraints. For instance, while new design trends emphasize minimalism and mobile adaptability, legacy users accustomed to traditional navigation structures may resist drastic changes, requiring a delicate balance between innovation and continuity. These perspectives contextualize the challenges of integrating modern UI/UX principles while maintaining core functionalities and accessibility standards. The evolution of web design is not solely a technological progression but also a negotiation between multiple forces, including regulatory frameworks, corporate objectives, and end-user needs.

Results and Discussion

Modern web design is not just a matter of aesthetics or technology—it sits at the intersection of business strategy, ethical responsibility, and user accessibility. To understand how these forces collide and collaborate, this section draws from three complementary angles: a case study of CNN's Article Elevate project, an analysis of WCAG 2.1 accessibility guidelines, and a historical review of UI/UX evolution. Through these lenses, the discussion highlights the trade-offs, challenges, and opportunities that define the creation of inclusive and high-performing digital experiences.

CNN's "Article Elevate" Redesign: Balancing Business and Accessibility

CNN's Article Elevate project was not just a UI/UX overhaul—it was a business-driven initiative aimed at increasing user engagement and revenue while maintaining the site's speed and accessibility. The project involved multiple stakeholders across design, product, and engineering teams, with each decision balancing aesthetics, performance, and user needs. As a major media platform, CNN's business model relies on both advertising revenue and user retention, making site performance a critical factor in decision-making. A slow or inaccessible website risk losing readers, reducing engagement metrics, and ultimately affecting ad revenue. Thus, while modernizing the article layouts, the team had to ensure that the redesign did not negatively impact load times, accessibility, or compatibility across different devices. The tension between aesthetics, performance, and accessibility is particularly evident in the UI decision-making process. Many designs were proposed through Figma mockups, and engineers worked closely with designers and product leads to determine feasibility. Meetings often focused on whether a design change would slow down the site or break existing functionality. A key takeaway from my internship was understanding that even small UI tweaks could have a ripple effect across the entire platform, requiring careful planning to avoid long-term technical debt.

Cross-Team Dynamics: Business Priorities vs. Technical Constraint

The agile nature of CNN's development environment meant that Article Elevate involved multiple teams, each responsible for different aspects of the platform. This cross-team collaboration added layers of complexity—any UI change had to be tested, approved, and validated across departments before deployment. For example, dark mode was being actively developed toward the end of my internship. While primarily an accessibility feature, it also had

business implications: It improves user retention by providing a more comfortable reading experience, especially for mobile users. It aligns with modern web trends, ensuring CNN's interface remains competitive. However, implementing it required restructuring existing styles, meaning it had to be planned alongside other UI updates to avoid excessive rework. This reflects the Actor-Network Theory (ANT) in action—designers, developers, and business executives were all part of the network shaping the final interface. The prioritization of features wasn't purely technical; it was also influenced by business goals, advertising strategies, and audience analytics.

Technical Roadblocks and the Role of Maintainable Code

One of the most significant technical challenges my team faced was the two-file issue. Initially, separate HTML and CSS files were created for the elevated and default versions of article components. However, when my team tried to push this structure to the testing environment, higher-level engineers rejected it, citing performance concerns. Since both the elevate and default CSS files would load regardless of which version was displayed, this created unnecessary resource consumption, slowing down the site. At scale, with millions of users accessing CNN daily, even small inefficiencies can compound into significant performance bottlenecks.

To resolve this, the team implemented *isElevated* and *elevateWhenNeeded*, allowing the same component to dynamically adjust without needing separate files. This code refactor:

- Eliminated redundant CSS and HTML, reducing the number of loaded assets.

- Made the codebase more maintainable, ensuring future UI changes could be applied to both versions without modifying multiple files.

- Improved performance, ensuring that only the necessary styles and structures were applied based on context.

Ethical Tradeoffs: Engagement vs. Accessibility in Web Design

Actor-Network Theory provides a useful lens here, illustrating how design choices are not simply technical solutions but outcomes of complex interactions between accessibility standards, business incentives, user expectations, and technical feasibility. The Article Elevate project demonstrated how UI decisions impact not only aesthetics and performance but also accessibility and long-term maintainability. Features like auto-loading content and dynamic elements were prioritized for engagement, yet they introduced potential barriers for users relying on screen readers or keyboard navigation. These trade-offs illustrate a recurring dilemma in web development: balancing fast, visually engaging interfaces with ensuring equal access for all users. A key takeaway from this project was that maintainable code is crucial for accessibility and long-term scalability especially in web development. Writing modular, adaptable code allows for smoother compliance with evolving WCAG standards and reduces friction when introducing new features like dark mode.

Unlike static, one-time designs (MySpace), web development is an ongoing process, and failing to plan for future iterations can lead to technical debt and performance issues down the line. From a business perspective, sustainable UI development is just as critical as innovation. CNN's agile workflow emphasized planning and cross-team collaboration, reinforcing that well-

structured code prevents bottlenecks and enables faster iteration. The rejection of the two-file approach during testing was a direct example of how technical inefficiencies can impact broader business decisions, underscoring the need for scalable, performance-driven solutions. Ultimately, this experience reinforced that UI/UX decisions are never purely technical—they are shaped by business goals, accessibility standards, and evolving user expectations. In a field as dynamic as frontend development, where trends shift rapidly and performance expectations rise, a strong, adaptable codebase is the foundation that allows companies to keep up with change while ensuring usability for all users.

Content Analysis: WCAG 2.1

The Web Content Accessibility Guidelines (WCAG) 2.1, established by the World Wide Web Consortium (W3C), set the standard for web accessibility. These guidelines outline best practices to ensure websites are perceivable, operable, understandable, and robust (POUR) for all users, including those with disabilities. Compliance with WCAG 2.1 is not just a legal requirement in many regions but also a best practice for ensuring inclusivity and improving overall user experience.   A core principle of WCAG 2.1 is designing for multiple modes of interaction—allowing users to navigate using keyboards, screen readers, and other assistive technologies. However, adherence to these guidelines varies significantly across industries. Many companies implement basic accessibility features, such as alt text for images and color contrast adjustments, but fall short in areas like keyboard accessibility, dynamic content handling, and proper ARIA (Accessible Rich Internet Applications) labeling.

Effectiveness and Limitations of Accessibility Standards

While WCAG 2.1 provides a strong foundation, it is not without limitations. One challenge is that accessibility standards lag behind technological advancements. For instance, the rise of AI-driven interfaces, voice assistants, and complex web applications creates new accessibility challenges that WCAG guidelines do not fully address. Additionally, compliance does not always translate to usability. Many organizations treat accessibility as a box-checking exercise, focusing on technical adherence rather than real-world functionality. For example: Text-to-speech compatibility may be implemented, but without testing with actual screen reader users, usability issues persist. Keyboard navigation might be enabled, but improper focus management can still confuse users when interacting with modal windows or auto-scrolling elements. Studies show that user testing with individuals who rely on assistive technologies often reveals gaps that WCAG compliance alone does not catch. While WCAG 2.1 establishes baseline requirements, true accessibility requires continuous usability testing and iterative improvements. Applying ANT, we can see that standards like WCAG act as non-human actors in the network, guiding but also constraining developers' and designers' decisions based on how strictly organizations prioritize them.

The Intersection of UX and Accessibility

Modern UX (User Experience) design principles emphasize seamless, intuitive interactions, but these often conflict with accessibility needs. Many contemporary UI/UX trends—such as auto-playing videos, infinite scrolling, and complex animations—prioritize engagement and aesthetics over usability. While these elements can enhance user experience for some, they introduce barriers for others, especially those with cognitive or motor impairments. A prime example is dark mode. While it is often marketed as an accessibility feature (reducing eye strain and improving readability), it can also reduce contrast for certain users, making text harder to

read. This highlights the nuanced trade-offs in accessibility design—what benefits one group of users may negatively impact another. To bridge this gap, companies must adopt a universal design mindset, ensuring that flexibility and personalization are built into web interfaces. This includes:

Content analysis of WCAG 2.1 and UX design principles highlights both the strengths and limitations of current accessibility standards. While WCAG establishes a crucial foundation, true accessibility requires a proactive approach—iterative testing, real-world user feedback, and adaptability to emerging technologies. As web interfaces become more complex, the challenge is not just meeting standards but ensuring that all users can engage with digital content effectively.

Historical Analysis: The Evolution of Web Design

Over the past thirty years, the web has transformed from a space of static, text-heavy pages into a rich, interactive ecosystem defined by personalization, accessibility, and engagement. This evolution was not just technical but deeply shaped by user expectations, regulatory standards, and ethical imperatives. By analyzing the emergence and endurance of key design elements—such as navigation bars, dropdown menus, and side scrolls—we can trace the broader currents of change and the role of Technological Momentum in web development.

Early websites in the 1990s were largely static. Built with basic HTML, these sites featured linear layouts, minimal interactivity, and limited styling. Navigation often consisted of a list of blue, underlined hyperlinks stacked vertically. There were no dropdown menus, modal windows, or real-time updates—each page was a standalone file, and any update required manual coding and re-deployment. By the early 2000s, the introduction of CSS and JavaScript

enabled dynamic behaviors and layout control, giving rise to now-familiar elements like navigation bars, dropdown menus, and interactive buttons. These tools brought usability and hierarchy to content. "Navigation bars, in particular, became a staple, illustrating Hughes' (1994) concept of Technological Momentum, where user familiarity locks in certain interface patterns over time despite innovations". Despite dramatic shifts in web aesthetics, nav bars have persisted in nearly all websites today—whether placed at the top, side, or hidden in mobile hamburger menus. This persistence reflects Technological Momentum: once users become familiar with certain patterns, it becomes increasingly difficult to replace them, even as new design possibilities emerge.

The Rise of Personalization, Interactivity, and Mobile

The 2010s marked a turning point in user interaction, with the rise of responsive design, mobile-first frameworks, and client-side scripting libraries like React and Angular. These technologies enabled websites to adapt dynamically to screen size, internet speed, and user behavior. Perhaps the most defining shift during this period was the explosion of mobile device usage. Today, many global internet users access websites primarily through their phones. Gonzales (2016) argues that digital inequities now revolve not just around access, but the capacity to maintain and effectively use technology—making mobile-first accessibility critical. This shift forced developers to rethink web design entirely. Features once built for desktops— such as multi-column layouts, hover menus, and dense sidebars—were replaced or reimagined for smaller screens. This led to the widespread adoption of:

- Hamburger menus instead of traditional nav bars
- Touch-friendly dropdowns and buttons

- Single-column layouts for easier vertical scrolling

Mobile growth also had a significant impact on accessibility. In many regions, particularly low- and middle-income countries, mobile phones are the primary gateway to the internet. As a result, ensuring that websites are fully functional on mobile devices became a matter of digital equity. If a page is not mobile-accessible, it is effectively inaccessible for large portions of the global population. In this way, the mobile web did not just expand access—it reshaped the very standards by which web usability and inclusivity are measured.

Ethical Considerations and Regulatory Influence

As web interfaces became more complex, concerns over digital inclusion and accessibility gained prominence. In response, guidelines like WCAG 2.0 and 2.1 were introduced to ensure that websites were usable by people with disabilities. These standards helped shape design decisions, pushing developers to include keyboard navigation, alt text, and contrast control features. However, many web trends have historically prioritized aesthetics and performance over accessibility. For example, visually rich components like autoplaying videos and animated carousels often lack proper labeling or focus control. These ethical tensions highlight the ongoing need to balance innovation with inclusion—especially as websites become central to everything from job applications to health information.

Moments like the enforcement of the Americans with Disabilities Act (ADA) in digital contexts or lawsuits against companies for inaccessible websites marked turning points, forcing businesses to reckon with their digital responsibilities. While legal mandates like the ADA have expanded to include digital content, Wentz et al. (2011) note that retrofitting accessibility often

leads to suboptimal user experiences compared to accessibility-first design. .In this way, ethics, regulation, and public pressure have directly shaped the design and functionality of web platforms.

The Enduring Influence of Technological Momentum

Technological Momentum helps explain why certain interface elements remain central to the web despite innovation. Features like top nav bars, dropdowns, and pagination persist because users expect them—and because shifting away would require retraining, reengineering, and potentially alienating long-time users. This concept also explains why legacy systems and outdated codebases continue to influence how new systems are built. Companies, especially large ones, often design around existing architecture rather than starting from scratch. At the same time, momentum can slow the adoption of newer, more inclusive practices. For example, while voice navigation, gesture control, and AI-enhanced accessibility tools offer great promise, widespread implementation remains limited. Breaking free from entrenched patterns requires not just technical capability, but a shift in organizational priorities and user education.

Conclusion

This research demonstrates that the evolution of web design is not solely driven by aesthetics or technological capacity, but by a complex negotiation between accessibility, user expectations, and commercial priorities. Through the case study of CNN's Article Elevate project, analysis of accessibility standards like WCAG 2.1, and a historical review of web development trends, modern UI/UX strategies must balance innovation with ethical responsibility. Technologies like dropdowns, responsive layouts, and personalization features have persisted and evolved, often guided by momentum from earlier design conventions.

However, as digital platforms continue to grow in complexity and reach, especially in a mobile-first world, the need for inclusive, maintainable, and adaptable design becomes more urgent. Ultimately, the takeaway is that building the future of the web requires both honoring proven design patterns and challenging the status quo to create more equitable and user-friendly digital experiences.

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