Framework for the creation of user-centred, adaptive national park maps

Based on the Master Thesis “Blazing the Trail — Creating a customisable Web Map for Yellowstone and Grand Canyon National Parks”

Vanessa Henkes

7. September 2023

Introduction

In the rapidly evolving digital landscape, the development of adaptable map interfaces has become paramount for organisations and individuals alike. These interfaces serve as dynamic tools, facilitating efficient navigation, information dissemination, and user engagement across various domains, from national parks to urban planning. However, creating such interfaces is a multifaceted endeavour that demands a structured approach to ensure usability, accessibility, and continuous improvement. This conceptual framework is born from the recognition that the journey towards a successful adaptable map interface is characterised by distinct stages, each laden with unique challenges and opportunities. Through a blend of research, practical experience, and user-centric design principles, this framework aims to provide a comprehensive guide for developers, designers, and stakeholders.

In this document, we will delve into the five core stages of adaptable map interface development: Knowledge, Preparation, Application, Evaluation, and Review. At each stage, we will unravel key insights, methodologies, and best practices that empower the creation of interfaces that resonate with user needs and preferences. As we navigate through this framework, we'll explore the critical importance of understanding project objectives, embracing user-centric design, and integrating accessibility guidelines. Strategies for responsive web design, aesthetic mapping, and efficient data processing will be shared. Furthermore, the process of evaluation will be clarified, offering guidance on gathering and analysing user feedback to facilitate ongoing improvement.

While this framework serves as a compass for developing adaptable map interfaces, it's crucial to acknowledge that the journey is not without its challenges. Limited sample sizes, subjective interpretations, and technical complexities are among the obstacles we'll address. By confronting these challenges head-on, we pave the way for future innovations and improvements in the realm of map interface development. Ultimately, this framework is a testament to the ever-evolving nature of digital cartography and user experience design. It is our hope that by sharing these insights and lessons, we empower creators to craft map interfaces that are not only adaptable but also intuitive, inclusive, and responsive to the diverse needs of their users.

Background of the Framework

The development of an adaptable map interface is a multifaceted endeavour that necessitates a structured approach founded on user-centric design principles and empirical insights. To lay the groundwork for our conceptual framework, it is crucial to delve into the context and motivations that have propelled its creation.

Complexity of Map Interface Development: The inception of this framework was driven by the recognition of the intricate nature of map interface development, especially when adaptability and user-friendliness are paramount. Crafting an interface that seamlessly caters to diverse user needs and preferences requires a systematic approach that balances technical prowess with user experience optimisation.

User-Centred Design: The cornerstone of this framework lies in the fundamental tenets of user-centred design. Acknowledging that the success of any map interface hinges on its ability to resonate with users, we have sought to prioritise their voices and preferences throughout the development process. User feedback, preferences, and experiences provide valuable guidance.

Empirical Insights: The framework draws from empirical insights garnered through a comprehensive user study. By engaging with participants from various demographics and backgrounds, it was possible gather a wealth of data that informs the design decisions. This empirical foundation lends credibility to the framework and ensures that it is grounded in real-world user experiences.

Technological Landscape: The rapid evolution of technology and the increasing reliance on digital maps for navigation and exploration underscore the need for adaptable and user-friendly map interfaces. As mobile devices become the primary medium for accessing maps, the framework acknowledges the shifting technological landscape and aligns its principles with contemporary usage patterns.

National Parks and Tourist Destinations: The framework's application domain, which initially focused on Yellowstone National Park and subsequently expanded to include the Grand Canyon National Park, recognises the unique challenges posed by such tourist destinations. These parks, with their diverse ecosystems, attractions, and visitor profiles, demand interfaces that can cater to a broad spectrum of user interests and preferences. For a more intricate and detailed analysis of the literature regarding the parks, the motivations of visitors to the latter, and user centred design, see the master thesis upon which this framework is based: "Blazing the Trail — Creating a customisable Web Map for Yellowstone and Grand Canyon National Parks".

Continuous Improvement: Finally, the iterative nature of the framework itself reflects the commitment to continuous improvement. As users' needs evolve and technology advances, the framework remains flexible and adaptable, ready to incorporate new insights and innovations to enhance map interfaces.

By acknowledging these contextual factors and embracing the principles of user-centric design, empirical research, and adaptability, our framework seeks to provide a comprehensive guide for the development of adaptable map interfaces that not only meet but exceed user expectations. As we delve deeper into the framework's components, we aim to illuminate the intricate interplay between knowledge, preparation, application, evaluation, and review, ultimately fostering a user-centric approach to map interface development.

Knowledge

A fundamental pillar of a project is the acquisition of knowledge. To embark on the journey of designing a map interface, one must first understand the project's objectives and the philosophy underpinning it. For instance, if the design is meant to emulate paper maps created by an organization like the National Park Service (NPS), an understanding of the NPS philosophy is essential. This includes grasping the design principles they adhere to, such as incorporating a relief map and landcover data. Additionally, when crafting an adaptable interface, it is imperative to comprehend the needs and preferences of potential users. In the context of a National Park, visitors may have distinct requirements compared to users of public parks or city squares. Once the project's aim and user preferences are reasonably clear, the next phase can begin.

Preparation

The preparation stage is a critical bridge between acquiring knowledge and actual implementation. During this phase, insights gathered are translated into actionable design strategies. This involves creating an initial draft and layout outline for the map, identifying key elements, and establishing a foundation for project management and time allocation. A well-structured layout, defined in this phase, streamlines interface development by reducing the need for later adjustments. Accessibility guidelines, especially for inclusivity, must be integrated at this stage. Data acquisition and processing also draw heavily from the knowledge stage. For example, insights from a study of hiking formulas inform the development of optimal functions — an essential component of this phase. An outline of filtering algorithms, central to the adaptable user interface, is also created during preparation.

Application

With the layout established in the preparation phase, the actual programming of the interface can begin. This stage involves translating design concepts into a functional map interface, with a focus on aspects like visual aesthetics, user interaction, and intuitive navigation. Research findings from the knowledge stage can now be applied. For example, if research was conducted on creating responsive web interfaces for multiple screen sizes, this knowledge becomes invaluable, particularly as more users access maps on mobile devices. Aesthetics, design principles, and philosophies — such as the NPS design philosophy — are applied rigorously. Depending on the underlying basemap, a suitable programming environment is chosen, ensuring the map performs seamlessly. Navigation between

graphical user interface (GUI) elements is carefully considered, adhering to user expectations of button placement. Questions also arise about the initial user experience: should filtering windows be open by default, is the legend best kept closed initially, or does the site require an onboarding tutorial for new users? The approach in this stage is to create a functional interface, knowing that it will be revisited and refined based on new knowledge and user feedback in the iterative framework.

Evaluation

As the initial version of the project takes shape, it's crucial to subject it to thorough evaluation. The first step is to determine the type of evaluation needed. A mixed-methods approach, combining both quantitative and qualitative measures, proves effective in assessing the website interface. Quantitative measures often employ Likert scale-type questions, allowing users to rate their experience on a scale. Open short-answer questions complement these quantitative ratings, providing qualitative insights. Formulating questions that users can easily understand is paramount. User studies should be structured to avoid complexity and technical jargon. The user study should assess all aspects of the interface, considering intuitiveness, aesthetics, usefulness, and potential issues. Feedback from domain experts, if applicable, can also be valuable. It is essential to allocate ample time for the user study since recruiting participants can be time-consuming. While a limited sample size, like in the study this framework is based on, has its limitations, it can still provide valuable insights. Third-party software, like Microsoft Clarity, can further assess website performance by capturing user sessions and providing insights into dead-clicks, quick-backs, and potential JavaScript errors.

Review

After collecting sufficient data from the user study, it is time to review and analyse the results. Various data analysis methods can be applied, depending on the type of questions asked. For Likert scale questions, bar charts depicting answer frequencies and statistics like the mean, variance, and standard deviation can be informative. Qualitative questions, as seen in this study, can benefit from clustering analysis, helping identify user concerns and preferences. The significance of these issues informs the next steps when returning to the application phase. The review stage completes the iterative cycle, allowing for continuous improvements and refinements based on user feedback.

Contributions and Limitations

This conceptual framework offers a systematic, user-centric approach to the development of adaptable map interfaces. It harmonises design, user preferences, and iterative feedback, making significant contributions to this domain. However, there are limitations, including a limited sample size in the user study, potential subjectivity in qualitative analysis, and the need for technical expertise. Addressing these limitations involves expanding sample sizes for broader insights, using different approaches for more robust analyses, and creating user-friendly tools to simplify algorithmic integration. Despite these constraints, this framework serves as a valuable guide for map interface development, enriching the design process with insights and lessons, and providing a foundation for future innovations in this field.

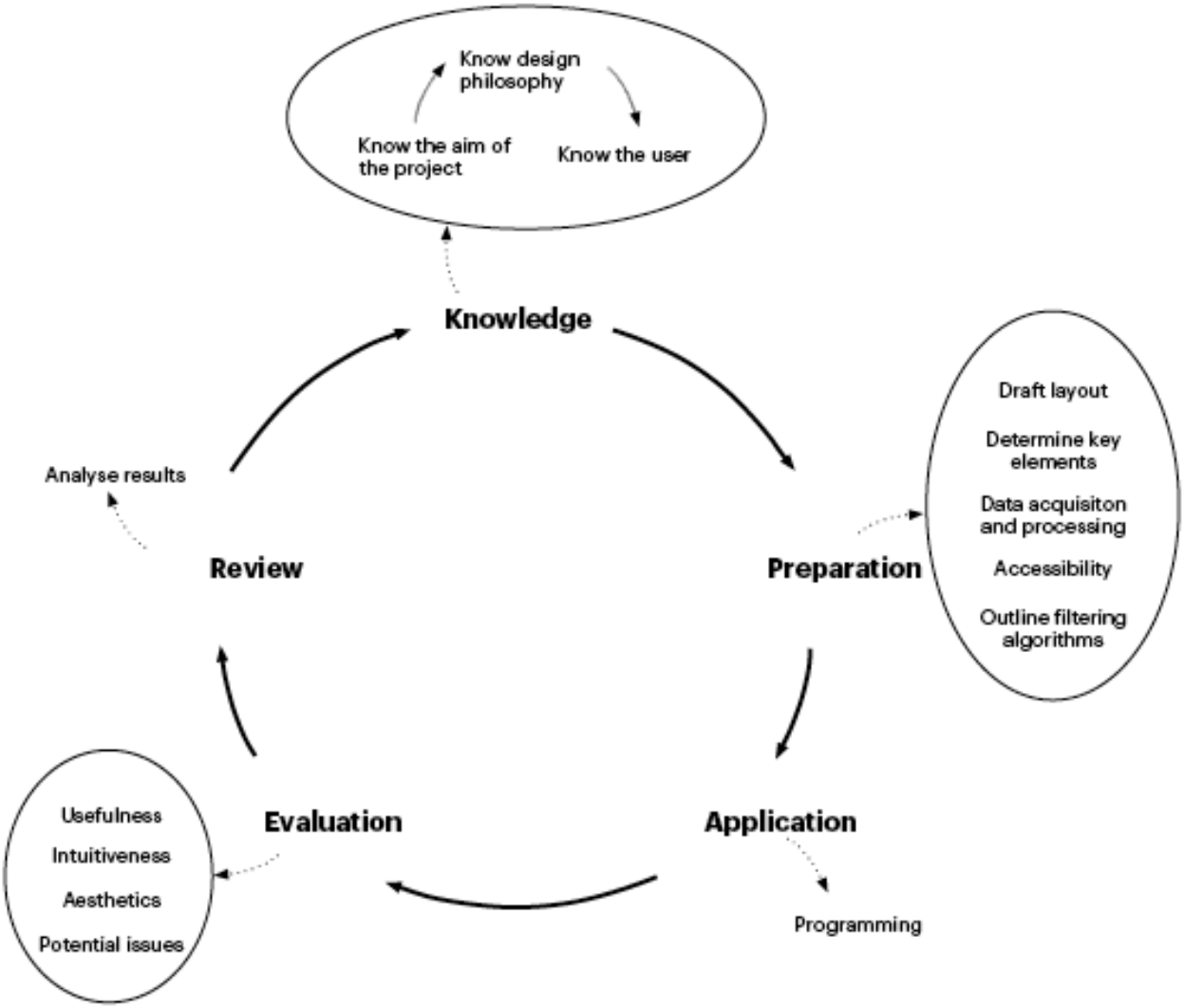

Figure 1: Conceptual Framework for creating adaptable web map interfaces

Conclusion

In an era where digital maps have become indispensable companions for travellers and explorers, the development of a user-centric and adaptable map interface emerges as a critical endeavour. The framework presented herein represents a culmination of extensive research, empirical insights, and a commitment to enhancing the user experience in navigating the natural wonders of Yellowstone National Park and the Grand Canyon National Park.

Empowerment through Knowledge: At the heart of this framework lies the recognition that knowledge is the cornerstone of effective map interface development. Understanding the aims of a project, the philosophies of the relevant institutions, and the unique needs and preferences of users lays the foundation for success. By comprehensively exploring these aspects, developers are equipped with the insights needed to make informed decisions at every stage of interface creation.

Preparation for Excellence: Preparation serves as the bridge between knowledge and application, transforming insights into actionable strategies. It is here that the framework underscores the importance of careful planning, layout design, accessibility considerations, and the creation of filtering algorithms. By meticulously laying the groundwork, the stage is set for a seamless and user-friendly interface.

Application with Precision: The application phase transforms concepts into functional map interfaces, focusing on aesthetics, user interaction, and intuitive navigation. Drawing from the wealth of knowledge acquired in earlier stages, developers craft interfaces that resonate with users. The choice of mapping libraries and technologies, coupled with adherence to cartographic principles, ensures that the final product meets and exceeds user expectations.

Evaluation for Continuous Improvement: Continuous improvement is a cornerstone of the framework, and evaluation serves as the vehicle for enhancement. A mixed-methods approach, encompassing quantitative and qualitative measures, empowers developers to gather invaluable feedback from users. The iterative process of refining the interface based on user responses ensures that it remains relevant, intuitive, and adaptable to evolving needs.

Reviewing for Relevance: The review phase brings clarity to the successes and challenges encountered during interface development. Through data analysis and clustering, the framework identifies critical areas for improvement, providing a roadmap for future enhancements. By revisiting the knowledge phase armed with fresh insights, developers ensure that the interface remains a dynamic and responsive tool for users.

The framework's contributions extend beyond the confines of interface development. It paves the way for a systematic and user-centric approach that harmoniously integrates user preferences, design considerations, and iterative feedback. However, limitations such as sample size constraints and technical expertise requirements must be acknowledged. Future researchers are encouraged to expand sample sizes and consider mixed-method approaches to further enrich the understanding of adaptable map interfaces. In conclusion, the conceptual framework presented here offers a comprehensive guide for creating adaptable and intuitive map interfaces. Rooted in user-centred design principles, empirical research, and a commitment to continuous improvement, it empowers developers to craft interfaces that not only meet but anticipate user needs. By embracing the framework's principles, one can embark on a journey toward map interfaces that not only facilitate navigation but also inspire exploration and appreciation of our natural wonders. As the digital landscape continues to evolve, this framework stands as a testament to the power of user-centric design in shaping the way we interact with the world around us.