Personalizing Interfaces Using an Inclusive Design Approach

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Abstract. The Web is ubiquitous and yet many potential users are unable to access it at all or to access it in a way that works well for them. As more daily activities become tied to digital systems it becomes imperative that we design these systems for everyone to use. Personalized interfaces have the potential to help marginalized digital users overcome barriers to access and participation in an increasingly digital world. Interfaces that meet users where they are, adapt to their unique preferences, and empower them to participate are a necessity for many to "get in the digital door."

By using the rich tools and techniques afforded by the web, combined with the inherent mutability of the digital, we can design tools that allow users to customize their digital interaction. Below are details of an inclusive design approach to create preference management tools that allow portable interface personalization.

Keywords: Inclusive design, digital accessibility, user interface design, personalization, preference management tools, user needs and preferences.

1 Introduction

The Web is ubiquitous and yet many potential users are unable to access it at all or to access it in a way that works well for them. As more of our daily activities become tied to digital systems (kiosks, ticket machines, ATMs, library terminals, etc.) it becomes imperative that we design these systems for everyone to use. Personalized interfaces have the potential to help marginalized digital users overcome barriers to access and participation in an increasingly digital world. Interfaces that meet users where they are, adapt to their unique preferences, and empower them to participate by putting the personalization decisions in their hands are not only possible, but they are a necessity for many to "get in the digital door."

Users are unique, and the situations where users interact with technology are diverse. These complex and unpredictable combinations mean we can't take a one-size-fits-all approach to creating interfaces, and yet this is the current state of most digital interactions. Where solutions currently exist, they are often too specialized or apply to only a single application or web browser. By using the rich tools and techniques af-

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forded by the web, combined with the inherent mutability of the digital, we can design tools that allow users to customize their digital interaction to fit their specific contexts, needs, and preferences.

Through work on the Global Public Inclusive Infrastructure (GPII) carried out through the following projects (Cloud4All, Prosperity4All, Floe Project, and Preferences for Global Access) [1, 2, 3, 6], the design team has used an inclusive design approach to create preference management tools that allow portable interface personalization. This approach focuses on the full range of human diversity and aims to meet that diversity with flexible and transformable tools that are easy to use and understand.

2 Background

Design processes are often a negotiation between values and practice where values define overall goals and practice is the methods used to achieve the goals. An inclusive design approach's goal is to design interfaces that are inclusive of the full range of human diversity.

2.1 Values: Designing for Human Diversity

An inclusive design approach starts with a re-definition of disability as a mismatch between a given technology and the needs and preferences of the user in a particular context [7]. Working from this definition, accessibility becomes a match between the user's needs and the ability of the interface to meet or exceed those needs. This simple perspective shift reframes accessibility as a design and development problem that impacts all of us.

The common assumption that designing for accessibility is limited to addressing the needs of a limited number of "extreme" users or users "on the margins" motivates many designers to avoid addressing accessibility issues. Based on this assumption designers believe it is not worth the trouble or cost to try to meet the needs of so few users as they believe they can't address these "special" needs within a single, mainstream design. As a result designers miss rich and important input into the design process and users are delivered interfaces that suffer from inherent limitations in usability and personalization [8].

By considering disability as a momentary and/or contextual mismatch between technology and user needs we take on the challenge of addressing accessibility in all of our designs; in this way technology becomes more useable for everyone. The design problem becomes: how can we create flexible tools that adapt to an overwhelming diversity of needs and preferences?

This big picture helped the design team at IDRC think more broadly and keep an open perspective on context, individuals, cultures, ages, abilities and circumstances, and it presents a larger opportunity for all designers to broaden their perspective and improve their designs. In this paper we detail how the design team used an inclusive,

one-size-fits-one approach to address this problem through the design of tools that afford user interface personalization.

2.2 Practice: Making Flexible Tools

The design team focused on creating a tool that allows users to declare their needs and preferences and to create their own one-size-fits-one interfaces. It became clear that declaring needs and preferences first required an awareness or familiarity with the notion of adjusting settings in the digital environment – an awareness that cannot be assumed for all users. The challenge, then, was to conceive of a preference management tool that could enable and promote the discovery, adjustment and application of user preferences.

The team started by thinking extensively about the circumstances for realistic uses of the tools. To address a broad range of unique needs, the preference management tool must be inherently flexible and adaptable. The team also concluded that to be truly inclusive, the tool must meet each person wherever he or she is in any particular context.

Though it would be practically impossible to enumerate all of the potential contexts within which a user might encounter a digital interface, it is useful to put some thought to the various types of contexts that can have a significant impact on a user's ability to use an interface. The following are just a few of the many unique individual and contextual factors the team considered when thinking through user interactions with digital systems:

- Environment (noisy bus station, bright sunlight shining on a screen, etc.)
- Unique user abilities (age, digital literacy, comfort with technology, mobility, dexterity, preferred and necessary means of computer interaction, cognitive needs, etc.)
- Operating system and application variability
- Learning approaches (preferred ways of consuming content)

This list helped the design team keep the breadth and depth of contextual complexities in mind while conceptualizing interfaces for addressing user needs.

Meeting users where they are is fundamental to an inclusive design approach and requires consideration of a broad range of users from those who are not comfortable with technology at all to power-users who are technology savvy. To take the design thinking further, the team fleshed out use cases and associated scenarios to begin to understand these realistic uses and workflows. User testing (currently being conducted) will further help to guide the direction of the design process.

To fully meet users "wherever they are," we concluded that the tool must meet users both in the context of their current task (simpler for quick "on-the-fly" adjustments), as well as in full-featured applications that users can access at their leisure. It became clear that the design team needed to consider multiple tools to allow diverse users to discover, adjust, and apply needs and preferences. The preference management tools must allow for a range of users: first-time users getting in the door, users exploring new preferences that might meet their needs, and technology-savvy users

making advanced refinements for specific customizations. The tools must also allow users to move through levels of complexity as they become more comfortable with the idea and process of setting preferences.

The ultimate vision for these tools is that they will allow users to customize any interface they might encounter by exploring and then declaring preferences, saving them to the cloud, and applying them to devices (both private and public). This personalization meets users wherever they are and adapts the interface to their needs and preferences, getting users in the door and making their interaction with technology as painless and as enjoyable as possible.

2.3 Applications

The work described in this paper was done under the Global Public Inclusive Infrastructure (GPII), a project of Raising the Floor. This work applies to multiple projects including Preferences for Global Access (PGA), Cloud4All, Prosperity4All, and Floe Project.

The designs presented in this paper are works in progress and are at various stages of development. At the time of writing this paper the Preferences for Global Access project has completed Phase I (Knowledge Building and Design), and the Cloud4All project is about to complete a second round of reviews and user testing on the latest preference editing tools.

3 Methodology

In working on this project three interrelated methods emerged as the most relevant and useful to the design process. The team developed their own approach to using these methods, which included mind-mapping, use cases and wireframes. The team cycled through these methods, iterating repeatedly as the designs developed. With each iteration, the team revisited early assumptions and added greater layers of detail and granularity.

Mind-mapping allowed the design team to tackle the big picture early on in the design process, and revealed many possibilities and questions about a desired preference editing workflow. While working on the mind-maps it became clear that the team needed a way to evaluate how realistic the workflow was and to consider user behavior in more detail. As a result the team began to develop a number of detailed use cases and related scenarios in order to consider realistic situations and user needs that needed to be addressed by the preference editing tools. At the same time, the team began to sketch wireframes in order to zero in on a level of granularity of the interface and interactions and to consider the levels of complexity of user needs.

3.1 Mind-Maps

The space of preference discovery and declaration is quite complex. Early in the design process the team developed a number of graphical mind-maps for thinking through the complex workflow of someone using the preference management tools.

Sketching out these mind-maps allowed the design team to begin to visualize interface flows and to identify open questions related to workflow of the tools. The development of mind-maps quickly led to the need for use cases and wireframes to consider user behavior and contexts and to demonstrate the variety of interactions at each stage of the workflow.

Over the course of the design process the team returned to these mind-maps several times to refine the workflow, consider alternate workflow options, and to tweak the corresponding wireframes.

3.2 Use Cases and Scenarios

Use cases provide a way for the design team to consider the many situations and contexts in which users might encounter and use the preference management tools. Through the development of these use cases and scenarios the team began to understand both the breadth of requirements for the tools design as well as the specifics of how to meet individual users' needs. By their very nature these use cases are limited in that they cannot cover the full spectrum of potential users, and in no way do they replace the need for user testing. However they provided a starting point for the design team to map out various scenarios in which the preference management tools might be used and thus provided a starting-point for interface and interaction design. The use cases allowed the design team to consider a broad range of potential users including first-time computer users, power users, and users with and without assistance.

The following use case example was developed under the Cloud4All project. The details described in the scenarios refer to specific design concepts related to preference management. The use case shown here is partial only. For more detailed use cases please refer to the following wiki page:

http://wiki.fluidproject.org/display/fluid/%28C4A%29+Use+Cases [5].

Use Case Example – Sam .

> Sam is an artist and an instructor at a local art college. She teaches three classes per week, and spends approximately 20 hours outside of teaching marking papers, preparing lectures, and updating the online forums for her classes. Outside of her teaching duties she dedicates about 15 hours per week to her art practice, including online research.
>
> Sam usually goes to the coffee shop every day around 9:00 am. She likes to avoid the early morning rush of people on their way to work, since when the coffee shop is too crowded she finds it difficult to maneuver freely in her wheelchair. This morning Sam has some emails she needs to respond to. After she gets her coffee and wheels over to her table, Sam gets out her laptop from the pouch at the side of her chair. Once on the table she slides the laptop out of its sleeve and

sets it up. Sam gets out her type-aid from the side pocket of the sleeve and straps it to her right hand. The type-aid allows her to type on the keyboard more quickly and with better accuracy than would be possible with her hand alone. When she is using her laptop she relies on keyboard input as she does not use a mouse. Sam prefers to use speech recognition rather than typing, but isn't comfortable doing it in a public place. She also occasionally likes to use text-to-speech because she likes to give her eyes and neck a break from looking up at the monitor, especially when reading long research papers.

Scenarios

Scenario 1: Creation of Base Set (Preferences Management Tool)
Sam recently used her desktop computer to register her Cloud4all account and set up her base preference set. When she logged into the preference management tool she was asked if she wanted to create her base preference set from the device settings, using the editor, or with a step-by-step guided setup. She chose to create her base preference set using the device settings on her desktop computer, as she already had it set up the way that she likes it.

The following settings were detected in the preference management tool:

- **speech recognition turned on** (gathered from system preferences)
- **optional text to speech turned on** (gathered from system preferences)
    - sub-settings including voice selection, speaking rate, and customized control keys
- **slow keys turned on** (gathered from system preferences)
    - with medium-short delay setting
- **mouse control** (gathered from system preferences)
    - double-click speed set to slow
    - cursor movement set to "no inertia"

Based on the detected settings, the Cloud4all system recommended that sticky keys also be turned on. Sam had tried the sticky keys setting in the past but had not found it to be helpful to her, so she declined the recommendation and reviewed her detected preferences in the overview. Since everything looked good to her, she confirmed her settings and her base

> preference set was saved. She then exited the preference management tool and carried on with her work. [5]

3.3 Wireframes

As the mind-maps became more detailed the team began to sketch wireframes of the interface designs corresponding to stages in the workflow for different preference editing tools. Several iterations of wireframes were developed as the team returned to the mind-maps and use cases repeatedly. For examples of wireframes see http://wiki.fluidproject.org/display/fluid/Preference+Editing+Tools+Design [4].

3.4 User Testing

At the time of writing this paper user testing has not been completed on the PGA or Cloud4All designs. However, much of this design work is based on the foundation laid by the work done under UI Options and related user testing results.

A user testing protocol for the Cloud4All tools is under development and will address both broad issues as well as granular questions about the designs. Broader questions include:

- When (in a user's workflow) are settings changed?
- Where do users go to make changes to settings/preferences (website, browser, operating system, hardware)?
- How does the process of changing settings vary across different circumstances?
- What do users view as a preference?
- Do users distinguish between temporary preference and a permanent preference? This relates to saving preferences - when and how?

More granular questions for testing include measuring the ease of use of the search bar, relevance of curated categories, switching between preferences and presets, adjuster design variations, tool panels layout, etc.

4 Results – Tool Design for Personalization

Throughout the process of sketching out mind-maps, creating wireframes and writing use cases, several design questions emerged. These questions presented interesting and complex design problems that the team grappled with in an effort to create an inclusive solution to the challenge of personalizing interfaces. Through the grappling, the team came up with unique, inclusive approaches to each challenge detailed below. These design concepts have been gathered into four sections that broadly define the range of user actions: discovering preferences, declaring preferences and saving preferences.

4.1 Discovering Preferences

How does a user discover preferences and preference tools? For someone who has never changed their system settings how can preference management tools most effectively be presented to them? How can a user be encouraged to explore and discover preferences in ways that are engaging and simple while at the same time minimally obtrusive? These considerations are essential to address the needs of users who are not already using a computer or other device, or who are not comfortable with technology. The novice user or the user with cognitive needs must be supported in determining what is necessary in order for them to be able to use the computer (or other devices) at all. To ensure that users can access these tools it must be possible to use them in a variety of ways from the start, including visually, aurally, with mouse control, with keyboard-only control, in any language, etc.

> "...how can we create a computer-based tool to help novice users set up their first preference sets if they cannot perceive, operate, or use the computer? Accessibility solutions must be flexible and responsive enough to balance the need to overcome serious barriers to entry with the need to showcase diverse preference possibilities to users who are interested in them."[1]

Methods of Preference Discovery

The team considered different ways that a user might discover preferences. "Learning to learn" was the starting point for many aspects of the tools design, particularly on the Preferences for Global Access project. A user may come to the preference editing tools with little or no previous experience in changing their settings and/or with little knowledge of what settings and preferences exist – one goal of the tools is to help users discover what preferences work for them and in so doing they learn about themselves and about their preferred ways to learn or to consume digital content. As a result the team considered preference exploration-based tools as well as various features within more advanced and/or complex tools that would allow for this discovery: for example the option of a guided "wizard" and the presentation of preference bundles or "starter combos".

The idea of "learning to learn" also precipitated discussion about whether and how to use evaluation and inference to determine a user's needs. The team aimed to design the tools to make the learning to learn process as playful and engaging as possible. In its simplest form such a tool or features of a tool could allow the user to try things out in a safe and enjoyable way, rather than putting the user in a position of being evaluated or having their preferences prescribed to them.

Guide
Preference management tools may include the option of a step-by-step guide or "wizard" to walk a new user through the steps of setting up an account, choosing and adjusting preferences, and saving preferences to a set.

Primary Preferences
Basic or common preference may be shown to the user when they first enter the tool (see Figure below). Adjusters are set to default values and may be accepted as-is or modified by the user. The user is also given the option to explore related preferences (in this case by selecting the gear icon) or they can search for other preferences.

Starter combos
Starter combos or "presets" are preference activation bundles and contain a group of preferences, related through a particular user need, which are activated all at once. They provide a means of "getting in the door" for users unfamiliar with modifying their settings or users who cannot access the tools as-is.

When a starter combo is turned on, it activates all associated preferences and automatically sets the preferences to pre-determined values. Starter combos get the user to a "good enough" place, thus allowing them to use the tools to further modify their preferences, or to carry on with the task at hand. For example, selecting a "No mouse" starter combo might activate Mouse Keys and Sticky Keys as well as set the Repeat Key settings to pre-determined values. Selecting a "Speak" starter combo might turn voice over on as well as set the words spoken per minute and volume settings to default values.

Explore Tool
One design solution that the team explored is an in-context tool aimed at encouraging and allowing users to explore the idea of setting preferences as well as to explore the effects of specific preferences. With this tool users are encouraged to try new preferences and combinations of preferences. A successful exploration will allow users to try things without fear of permanently losing their current level of access (e.g. by providing a clear way to undo changes). Users should also be confident that once they find preferences they like, they will be able to save them for future sessions. A functional demo of an explore tool can be found at: http://build.fluidproject.org/prefsEditors/demos/explorationTool/

Inference/Recommendations
One example of inference would be to have the system recommend preferences related to those selected or adjusted by the user, at the moment that they make the adjustment. Common preferences may also be suggested, or preferences indirectly related to a search term.

Preference Organization
The design team considered various ways of organizing preferences to determine what might provide the highest level of findability for users and the greatest ease of navigation through the preferences. Curated categories provide one way of organizing preferences. Categories organize all available preferences into

their broadest groupings; they are containers for related preference families e.g. the "visual alternatives" category might include the Text size preferences, Speak text preferences Contrast preferences, Cursor size preferences, and Text style preferences. Search-based categories are temporary categories that appear in search results and which contain preference families that are related through a search term.

4.2 Declaring Preferences

When a user knows what they want or is comfortable with the idea of preference-setting, how can they declare their preferences? The design team aimed to provide a number of different ways of allowing users to declare preferences to try to meet them where they are in different situations.

Ingest
If a user is already using a computer that they have set up to their liking, their current settings can be used as a starting point to create a preference set. When the user first logs into the preference management system, they can be offered the option to ingest the current device settings.

Adjust
This activity involves providing the user with the ability to easily adjust a single preference, or adjust multiple preferences. This also allows users to: a) adjust the setting of a preference (i.e. change the size of the text for a text enlargement preference); b) undo previous settings; and c) instantly apply changes to content that the user is viewing (independent of whether or not the user saves or stores their settings for later application to other devices).

Share & Sync
A user may want to apply preference sets that have been created by others with similar needs, or a teacher may want to create preference sets for her students and then share these sets with multiple students. Sharing sets would allow users who aren't familiar with changing their settings or who aren't sure which preferences might help them to try out preferences recommended by other users.

"On-the-fly" Adjustments
The team discussed the need to support adjustments that a user would make frequently and temporarily, which would be applied to their device immediately and which they wouldn't necessarily want to have stored in a preference set (for example, volume and brightness). Preferences could be determined by the user (manually "favourited"), they may be inferred by the system (based on most frequently made adjustments), or they may be determined by an implementer who wishes to limit the functionality of the tool(s) – for example a museum kiosk which does not allow saving to the cloud and which is intended only to provide temporary and basic settings to be adjusted.

4.3 Saving Preferences

The question of how and when preferences should be saved relates to many other aspects of the tools including the complexity of an "on the fly" tool as well as the concept of preference sets. Which tools should allow saving? How should this be presented to the user? Should adjustments be saved locally only, until the user chooses to add them to a preference set which applies to multiple devices? Should adjustments be saved automatically with an option to undo? This concept of the "stickiness" of settings/adjustments came up frequently in the design process. It presents a challenge to meeting the needs and expectations of diverse users.

5 Discussion

In addressing the issue of a one-size-fits-one solution to digital accessibility, the design team developed both a methodology for inclusive design as well as designs for flexible and adaptable preference management tools. To see the latest designs as well as all iterations and design artifacts from the project visit the team wiki workspace at http://wiki.fluidproject.org/display/fluid/Preference+Editing+Tools+Design [4].

6 Conclusion

With a clear problem statement and an approach that focuses on human diversity the design team designed preference management tools that empower users to personalize their experience, adapting the interface to their own unique needs and preferences.

Since no one interface will meet the needs of all users, the design team produced interfaces that adapt to individual user needs. And since the situations where users will encounter these interfaces are as diverse as users themselves, the team produced a number of tools for those different contexts.

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