

GitUI: A Community-Based Platform to Democratize User Interfaces

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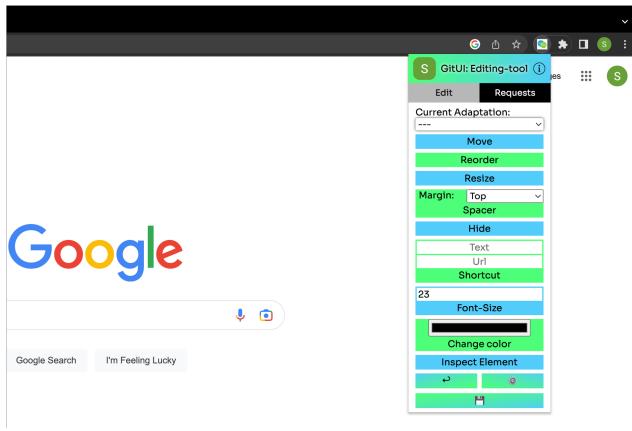
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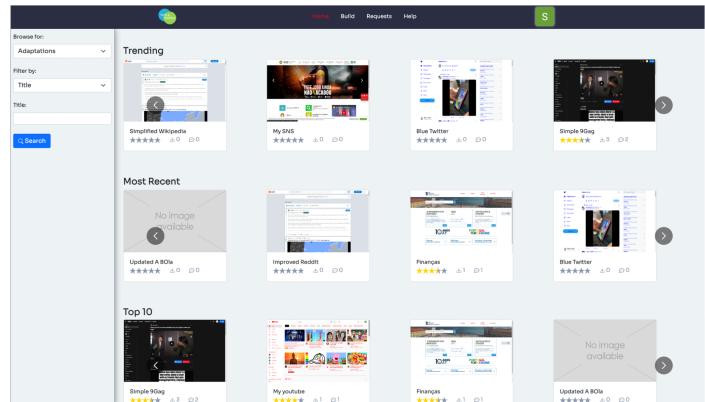
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a)



b)

Figure 1: The GitUI platform: a) the customization toolkit, a browser extension, allows the creation of customization templates and assistance requests; and b) a Web repository where the community can browse, manage and discuss templates and requests.

ABSTRACT

Customization empowers users to tailor user interfaces to their needs. Although beneficial, its adoption is limited by the required effort, skills, and creativity. Following the success of open software repositories, we present a novel community-based customization system where users can: 1) customize UIs for the self and others – using a customization toolkit; 2) use and further adapt public customization templates – found in an online repository; or 3) request customization assistance. We explored this concept in the context of Web technologies by developing GitUI. GitUI was iteratively developed and evaluated over two deployment phases. In a two-phase study (n=9), experts and non-experts 1) used, for two weeks, the customization toolkit; and 2) explored the repository. Results suggest that community-based customization is feasible. People

are motivated to customize for others and enjoy the convenience of public templates. We present challenges and opportunities for future research seeking to democratize customization.

CCS CONCEPTS

- Human-centered computing → User studies; Computer supported cooperative work;
- Information systems → Personalization.

KEYWORDS

Personalization, End-user, Customization, Agency, Democratization

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1 INTRODUCTION

User interfaces (UIs) are crucial in a digital society – providing access to essential services, information, or entertainment. These are, traditionally, created following a one-size-fits-all approach

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aimed at an average user, with designers detaining full control of the UI crafting process. On the other side, each individual has unique needs and experience using the software but limited agency to control how UIs are presented.

UI personalization [23] represents a solution to adjust UIs to the needs and characteristics of users. Customization, particularly, enables users to directly manipulate the graphical objects on the screen – defining new properties and values. It improves user experience [16] and allows people to feel in control, express their identity, or create a connection with UIs [11, 14, 22, 23]. However, although one goal of personalization is inclusiveness, not everyone is skillful enough to customize their UIs or wants to invest time doing it [13]. Moreover, people have different expertise and tech savviness levels that influence how they customize interfaces [23], and complex problems can require more knowledge than a single person possesses [17].

In this work, we explore the concept of community-based customization, where members of a community can collaborate to create customized UIs. In this approach, people can customize themselves, ask the community for assistance, or search for publicly available customization templates¹. Following the concept of file repositories and version control systems (e.g., Git [4]), people can build other, public or private, templates atop existing ones. Any user can assist others – each individual has unique expertise that can benefit the community. This approach ensures that people still have crucial customization benefits (e.g., the sense of control and identity) regardless of their skills or availability.

We explored this concept in the context of Web technologies by developing GitUI (Figure 1) – developed and evaluated iteratively over two deployment phases. In a two-phase study, with experts and non-experts, we evaluated the usability of the system, explored people's acceptance of the community-based customization concept, and identified key concepts for future research. Results suggest that people are interested in helping others – motivated by the challenge and feeling of helping others – and found it beneficial to be able to use and further customize community-based templates.

This paper contributes to democratizing access to personalized UIs by providing: 1) a conceptual contribution of a community-based UI customization system; 2) a technical contribution of a working prototype – GitUI; and 3) a preliminary study collecting the perspectives of experts and non-experts on GitUI.

2 BACKGROUND

One-size-fits-all approaches cannot handle the context variability that leads to an unpleasant user experience [9]. Existing work showed the benefits of having UIs adapted to people's needs [16], characteristics [5, 7], or cultural backgrounds [20].

However, previous UI personalization research – involving adaptation, driven by the system [6, 12], and customization, done by the user [1, 3, 8, 16, 18] – has limited impact on how UIs continue to be presented. Customization is allowed by operative systems (e.g., shortcuts), browsers (e.g., zoom in/out), and applications (e.g., color schemes). On mobile, for example, since iOS 15 it is also possible to set individual application preferences, including button sizes, contrast, or font [10]. Adaptation is mainly focused on content

adaptation based on users browsing history (e.g., YouTube video suggestions). Overall, existing personalization is still restricted: the offered customization operations are very limited and adaptation generally lacks users' input. Third-party solutions showed to be of users' interest [16] but failed to become an active part of digital life.

Adaptation approaches rely on predefined rules and on data collected from users to automatically adjust UIs. For instance, Split Adaptive Interfaces [6] predict the most relevant functionality to a user and copy it from the original location to an adaptive shortcut toolbar. Customization generally allows users to manually control the personalization. One example is CrowdAdapt [16], a direct manipulation toolkit that allows customization with seven operations: move, resize, spacer, hide, collapse, font size, and multi-column. Results from a study with 93 participants showed the potential to improve user experience with customization. Both adaptation and customization approaches have pros and cons. Customization stands out from other approaches as it does not require the collection of personal data and generally allows for more finely-tuned personalizations. This is done at the expense of more time invested by users, which may, however, outweigh customization benefits [3]. Overall, people tend to customize only when it is worth the effort [13].

Sundar and Marathe [23] found that the tech savviness level impacts people's personalization perspective. Less tech-savvy users have negative attitudes toward an interface when asked to customize it but a positive attitude when presented with an already personalized one. Tech-savvy users, on the other hand, showed more positive attitudes when allowed to customize. Our work aims to close this gap, allowing people, regardless of their expertise or tech savviness levels, to benefit equally from customized UIs.

2.1 Community-Based Customization

Community-based approaches can be a solution to democratize access to customized UIs; however, they remain under-explored. The idea is to allow people who need a solution for a specific problem to interact with a wide community, who share similar interests, and try to obtain a suitable solution for it [17].

Nebeling et al. [15] introduced the notion of crowdsourced Web site components. Components allow the evolution of content, presentation, and behavior by continuously refining the design of a website with the help of the crowd. In this scenario, non-experts can build their components on top of others created by more experienced users. This work informed CrowdAdapt [16], which is, to the best of our knowledge, the only customization tool – requiring no scripting – that allows users to obtain adaptations made by others. Created adaptations are automatically shared with other users and, when visiting a web page, automatically applied according to the user's settings. Users can also preview different adaptations, sorted by the number of positive votes. Overall, users enjoyed the idea of sharing customized layouts.

Two of the most used personalization tools currently available, Stylish [21] and Tampermonkey [2], allow users to create and share CSS and JavaScript personalizations, respectively. In both, non-expert users are overlooked (personalization requires code writing); however, it is possible to install personalizations of the crowd.

¹Template: something that is used as a pattern for producing other similar things.

In all these works, there is no communication or mutual help between users. We expand previous work by proposing a novel approach to provide direct customization assistance to those who lack the skills or time to do so. We have seen the application of these concepts in the field of accessible computing. For instance, Takagi et al. [24] introduced the concept of Social Accessibility. The idea is to make existing content accessible by using the power of the open community. When users encounter an accessibility problem, they can report it to a social computing service. Volunteers then discuss, create, and publish a fix.

3 A COMMUNITY-BASED APPROACH TO CUSTOMIZATION

UI customization is today limited by people's skills, creativity, and availability. Our goal is to democratize access to personalized UIs by reducing the customization burden and the impact of individual skills.

3.1 The Importance of Community-Based Customization: Use Cases

The following use cases exemplify the usefulness and novelty of our approach.

Robert, a 55-year-old researcher, likes to keep track of the latest published research in his field. He uses Google Scholar² to search for scientific publications and to follow his favorite authors – so he can be notified of every new publication. However, when visiting the website homepage, he finds no information about his favorite authors or interests. He realizes there is enough free space to include these in the UI. As he recently discovered a community-based customization platform – GitUI – he uses it to add shortcuts for the content he wishes to visit more frequently. In the middle of the process, he realizes there could be a custom table with this information where users could easily add and remove the shortcuts. As this is a complex operation, requiring code writing, he decides to request assistance from the crowd. He submits an assistance request describing his need.

Lisa, a 40-year-old computer engineer, enjoys helping others during her rest time. She has an account on several question-and-answer websites (e.g., Stack Overflow³), including GitUI. Every day Lisa consults their website to check if someone needs assistance. She sees Robert's request and accepts to help him. Lisa decides to discuss possible solutions with Robert and implements one. Robert is happy with the solution and asks Lisa to make it publicly available to others.

Helen, a 28-year-old computer science researcher and GitUI user, is diagnosed with color blindness. She is already a GitUI user and finds Lisa's solution. However, she needs to further customize the colors. Helen installs Lisa's solution, customizes it, and publishes it online as a branch of the original solution with the tag "color-blindness".

3.2 The Community-Based Customization Concept

Our concept is divided between a customization toolkit, available while interacting with UIs, and a customization repository. We

based our approach on the analysis of the benefits and limitations of previous work (e.g., [15, 16, 24]).

3.2.1 Customization Toolkit. We aim to empower citizens. It is, therefore, fundamental to have the possibility to customize. The customization toolkit should work atop any UI to allow for direct manipulation of elements – contrary to existing solutions [2, 21] requiring programming skills but following the example of CrowdAdapt [16]. The toolkit should be minimalist and unobtrusive [11].

Operations. Customization operations should be based on people's needs – including efficiency, simplicity, and accessibility – already studied in previous work [16]. There should, however, be a balance between the offered operations: experts or self-learners should not be limited by the toolkit. Therefore, it is necessary to support code writing – including help in identifying elements (e.g., identifying an HTML class attribute) and defining its values or properties.

Templates. The result of a set of customization operations becomes a template. People should decide whenever a customization template is applied/active. They should also be able to redesign and experiment with existing templates, and apply multiple, complementary, templates to the same UI. One challenge of a customization toolkit is UI update. The system should detect outdated templates, inform users, and provide support to update those templates (e.g., identify visual differences or ask which operations should be applied to the new UI).

Community-Based Assistance. The system should allow customization assistance. Ideally, original software developers would provide this assistance, but members of a customization community can also do it – following existing approaches like Stack Overflow. These members, regardless of the expertise level, may have a better understanding of that specific UI, or may already possess a template that only requires a few tweaks to be useful to others. An assistance request ranges from building an entire template to performing a specific operation on an existing one.

3.2.2 Customization Repository. Users can decide to publish any personal template – making it available to others. A customization repository, connected with the toolkit, should allow people to browse and install public templates. Following the concept of distributed version control systems (e.g., GitHub⁴) users should be able to clone, redesign, and publish (as a different branch) templates.

Browsing Experience. The browsing experience should follow the concept of Stylish [21], where users can filter existing templates by device type, website, rating, or popularity. It should, however, also be possible to filter them by category (e.g., accessibility, readability, color blindness). This allows, among others, personalized templates suggestion based on category or website.

Assistance Support. Assistance requests can be addressed in the repository. Any user may choose to help others. In that case, the request should be "locked" – preventing unnecessary duplicated work. It should become unlocked after completion, withdrawal, or a

²<https://scholar.google.com>

³<https://stackoverflow.com>

⁴<https://github.com>

timeout. Requests should also be categorized so that people willing to help can follow requests on specific topics or websites.

The Community Role. The repository is the hub of the community. People should be able to interact with each other to discuss templates, assistance requests, or report issues. These discussions can be public as different people may share the same problem or work together to find a solution.

Gamification and Long-Term User Engagement. Following the concept of GitHub or Stack Overflow, people should be rewarded for the published templates, the assistance provided, or even assistance requests. The goal is to keep users motivated and active. The system should allow users to build a reputation – for instance, by displaying the number of contributions or letting them know how many people benefited from their templates [19].

4 GITUI

To explore the community-based customization concept, we developed GitUI (Figure 1). GitUI allows website customization – users can create, share, and apply templates on any website (to current and future sessions of usage) – and create and reply to assistance requests. Users can be at the same time requesters or volunteers, in a context where they are making an assistance request or replying to a request, respectively. Starting from the customization toolkit, the system was iteratively developed and evaluated in a two-phase process. The presented system is the result of this process.

Customization Toolkit. The customization toolkit was implemented as a Google Chrome extension. It was built using JavaScript, HTML, and CSS and uses Firebase as a storage platform. Users access the tool through a popup menu divided into the *customization* and the *request* tabs. The *customization* tab (Figure 1 a)) allows nine operations and the injection of JavaScript or CSS. Users can reorder, resize, and move elements; edit margins, colors, and font size; and add shortcut buttons. Templates can be specific to a web page or the whole domain of a website. When a template is saved (publicly or privately), users can activate it in the popup menu. An active template is applied every time the user visits the target web page. Public templates require a preview image and a description.

The *request* tab allows users to create customization requests, view a list with the ones created, and another with the received. A request contains the target website URL, a detailed explanation, and, optionally, an image with a visual explanation. Users can then consult the status (pending or solved) of their created requests, and apply a reply template when available.

Customization Repository. The customization repository was implemented as a website, and shares its database with the toolkit. Users can consult and manage their templates (private and public), consult and install community templates, and discuss and volunteer to reply to requests. The main page (Figure 1 b)) provides users with the *Trending*, *Most Recent*, and *Top 10* templates, sorted by rating, and allows browsing for both adaptations and requests, using the filters on the left sidebar. Each template has a dedicated page where users can consult a preview image, categories, description, and general details (the creator, creation date, and last update); or rate, comment, and install the template.



Figure 2: Example of customization: the before (a) and after (b). The participant customized the colors and margins, and hid elements.

When installed, templates can be activated using the toolkit on the target website. Users can then further customize the UI and save the new template as a private or public copy. The system, internally, keeps a record of all the branches of a template.

A requests section allows users to find, manage, or create assistance requests. We developed a process to ensure that any user can reply to any request and that the requester is satisfied with the reply. To reply, volunteers indicate, by clicking a button, the intention to address a request – locking it. Requesters can then see which user is addressing their request and the start date. If requesters are unhappy with a reply or want to select a different volunteer, they can unbind the current one and make the request available to others. On the opposite, if a reply is submitted and the requester is happy with it, s/he can confirm the reply (i.e., close the request). During the process, both can publicly discuss the customization. From the volunteers' perspective, to reply they should navigate to the target website, develop the reply using the toolkit, save the template, and navigate back to the repository to submit the reply – the system matches the URLs so that volunteers can select a reply among the available templates for the target website.

5 PRELIMINARY RESULTS

We performed a two-phase study to evaluate the acceptance, usability, usefulness, and perceived benefits of our approach. In an iterative process, we first explored the customization toolkit and then the repository.

Study sessions were audio recorded, annotated, and analyzed by two researchers, who individually and deductively created a set of relevant themes(organized according to the research goals). Themes were then discussed among the authors, who created a table of findings.

5.1 Phase 1: Customizing for the Self and Others

We first studied the concept of end-user customization of UIs for the self and others. We were particularly interested in understanding: 1) how people, independently, use the customization toolkit; 2) how they benefit from having the possibility of requesting personalizations from the crowd; and 3) how they react to the possibility of supporting others' to personalize.

Nine participants (six experts and three non-experts), aged between 25 and 59 years (31.8 ± 10.4 years), used the customization toolkit to customize at will and to reply to personalization requests

from the crowd. Participants were recruited using the university mailing lists and social networks. The study started with a think-aloud session where participants learned to use the tool. Then, for two weeks, they used it on a minimum of three websites per week, either by customizing themselves or creating a request asking for assistance. To ensure the flow of the study, participants also accessed fictional requests (rationally created by the research team exploring different personas, websites, or complexity). In the end, participants were interviewed about their general experience with the tool, motivation, goals, context in which the tool was used, and future opportunities for community-based customization.

Participants successfully used the customization toolkit. Results suggested that people enjoy customizing for others. Participants were motivated by the challenge that it represents (i.e., people see an assistance request as a challenge to solve) and the positive feeling of helping others, with some assuming a similarity to the feeling of helping others in a physical context. When customizing for the self, the *shortcut*, *move*, and *change color* operations were particularly valued. Figure 2 is an example of a participant's customization on a news website⁵.

Participants suggested important aspects that were considered in the conceptualization of GitUI, particularly to leverage their motivation factors:

- *Recognition*. People want to be recognized for their successful replies, for instance by having a classification system. If they customize more and better than others, they want that information to be public and comparable.
- *Gamification*. People desire gamification mechanisms, particularly to allow others to show gratitude and increase their emotional reward for helping others.
- *Feedback and communication*. It turned out to be crucial to have feedback on the replies. It was not clear, however, whether direct communication between requesters and helpers would be beneficial: for some participants, it would be good to talk with requesters, for others it would not. Participants also mentioned the importance of locking requests (i.e., no one else can reply to a request).
- *Manage volunteers' confidence*. To keep people motivated, it is also important to be able to select requests suited to one's skills.

5.2 Phase 2: A Community-Based Customization Repository

The second study aimed to explore and evaluate the functionalities and usability of the Web repository. Four participants of phase 1 (27.5 ± 1.4 years) showed availability to participate in this phase. In a one-hour session, using the think-aloud protocol, people were asked to complete a set of predefined tasks (login; browse, install and edit templates; create and reply to requests). The tasks allowed participants to explore all the functionalities of the repository and to reflect on the community-based customization concept.

People successfully performed the predefined tasks, highlighted the possible benefits of the repository (i.e., helping others), and improved user experience by being able to manage their templates outside the customization toolkit. On the opposite, participants

⁵<https://www.record.pt>

showed concerns with the privacy of their templates. They highlighted the importance of having private templates and replies that subsequent branches could never make public. Another suggested improvement regards the requests workflow: to fully explore the community concept, one participant suggested that the same request could be addressed by multiple users at the same time, resulting in a list of replies submitted to a single request. The requester would then select the preferred.

6 CONCLUSION

Existing customization solutions do not allow equal opportunities for non-experts or less tech-savvy users. They often require significant effort, skills, and creativity beyond the reach of many users. In this work, we introduce the concept of community-based customization. People can still customize for themselves but, when necessary, ask for customization assistance. Following the concept of file repositories and version control systems, people can publish their customization templates and create others atop existing ones. To explore this concept in the context of Web technologies, we iteratively developed and evaluated GitUI. A two-phase study, with experts and non-experts, showed that community-based customization is feasible and valuable to end-users.

6.1 Future Work

Our preliminary studies did not allow us to study the full extent of the community-based customization concept. Our approach offers different challenges, when compared with traditional customization tools, that should be studied in future work. We need to understand how to 1) ensure compatibility between existing templates – so that people can use multiple at the same time; 2) prevent the duplication of templates and requests; 3) allow to propagate changes when a master (i.e., the original) template is updated; 4) take advantage of the community to openly discuss requests and have different solutions from different volunteers (instead of locking requests); and 5) guarantee users' security against possible malware within community templates.

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