Alice: design of a Time-oriented Collaboration Service for Design Teams

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ABSTRACT

This paper describes the design and implementation of *Alice*, an online collaboration system that integrates several commercial cloud storage services and reconfigures team member's interactions into a time-oriented visualization. Designers use social media and other general-purpose tools to collaborate across organizations due to their accessibility and ease of use and learning. However, such tools are cumbersome in covering the specific collaboration needs of design activities. *Alice* elicits ad hoc collaboration in design teams by facilitating team members to use their own set of tools in a seamless way. Participants highlighted that *Alice* serves as a central reference for the coordination of teamwork by providing an overview of rhythms and temporal relationships of design activities. Our work suggests that collaboration tools could be portrayed as technologies of time production. This reveals opportunities for future research on how the temporal agency embodied by the collaboration tools affects collaborative activities in design.

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous

Author Keywords

Collaboration; design teams; temporality; groupware;

INTRODUCTION

Designers depend a lot on social media and other general-purpose tools to meet their collaboration needs [11]. The reasons are that designers need to work across organizations, and

such tools allow them to work with different stakeholders by relying on common infrastructure and low threshold of entry, both in terms of costs and ease of use/learning. Widespread generic collaboration tools allow designers to work together without requiring access to the same set of specialized tools. General-purpose tools give flexibility and mobility to their users, and can be used across multiple devices. Surprisingly, social media websites, intended originally for recreational use and informal social contact, are particularly powerful as collaboration tools in such an open innovation context. Nevertheless, these tools appear to be cumbersome in handling large projects and the task and file management needs of group, who improvise and develop informal and suboptimal practices [11]. This results in designers adopting a large amount of generic tools to cover the collaboration needs of specific design tasks [11, 10]. Ultimately, this makes it difficult to keep awareness and a coherent overview of design inputs, to follow the progress of the project, and to trace over time and to integrate the contributions of different partners. Such findings suggest the need for new tools that will address these limitations while working seamlessly with mainstream social media and general-purpose tools.

We present *Alice*, an online collaboration system that integrates several commercial cloud storage services and reconfigures team member's interactions into a time-oriented representation, revealing tensions of the use of general-purpose tools and creating new opportunities for collaborative activities. *Alice* connects to Dropbox and Google Drive, two popular cloud storage systems, to collect information about recent file related events (e.g. file created or modified). *Alice* displays these events in a unified timeline where users can browse through and visualize a preview of the select file. Additionally, *Alice* enables comments and annotations over the visualization of the files to facilitate team discussions.

In order to understand the potential that our concept holds for design teams, we evaluated *Alice* among 5 post master students of a European industrial design faculty. We gathered insights

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about the interface and identified whether the prototype brings a perceived value to the quality of collaboration among design teams. With this paper, we shed light on the opportunities and challenges of integrating different general-purpose collaboration tools for supporting design teams. Furthermore, we reflect on the temporal perspectives that digital tools embody. Finally, we contribute to the inquiry of the agency of time over collaborative design activities, a promising topic for future research.

SUPPORTING AD HOC COLLABORATION IN DESIGN

Previous research [11] uncovered that design teams: a) do not have the proper means for tracing back ideas and work of different team members; b) have limited support for detailed feedback on the shared artifacts; and c) do not count with the mechanisms to track the progress of the project. We mapped the previous problems with the work from [8] to derive three main challenges for awareness in design collaboration: 1) to display the most relevant information to the designer team (Consequential communication); 2) to bring the material nature of design to online communication (Explicit communication); and 3) to track the changes and evolution of the process (Feedthrough). To approach these challenges, designers require additional awareness mechanisms that support ad hoc collaboration activities [6, 10].

Collaboration awareness consists of two mechanisms that provide means of coordination: group awareness and social awareness. Group awareness considers the availability of design teams and facilitates the coordination of work by providing knowledge about who is on the project, what are the others working on and what are they planning to do next [8]. Social awareness facilitates team-members to adjust their social and work interactions providing information about other team members' presence, availability and opportunities for social encounters [2].

The material and physical aspects embedded in the design studio support the team to maintain awareness about the team [4, 7]. Distributed design activities cannot depend anymore on the collaboration mechanisms facilitated by the spatial and artifact properties of the design studio. Artifacts have a key role in the way designers coordinate their team activities [15, 13]. Extra emphasis must be given on maintaining the highly material character of design practice through digital artifacts.

While face-to-face interactions do not suffer from a fragmented experience of time, digital tools impose their own temporal relationships to social interactions [3]. The interactive experience changes according to the degree of immediacy that each different system offers [9]. The dominant perspective of time on digital interactions is an “almost infinite fragmentation of different synchronous and asynchronous time contexts” [14, p. 197]. Therefore, when driving relationships across several online tools, we must match the different temporal and interactive opportunities that each tools implements with the needs of the designer for immediate real-time access.

ALICE IMPLEMENTATION

Alice is a digital service that connects to commercial cloud storage services (such as Google and Dropbox) and reconfig-

Figure 1. This is the first concept, containing a diversity of information and visualizing it in a temporal order.

ures the traditional folder structure of files into a temporal perspective. *Alice* organizes the files contained in the cloud storage service into a timeline visualization and provides the possibility to preview, annotate and categorize the files. The development of *Alice* followed an iterative design process consisting of 2 iterations. During the first iteration, a concept of the tool was created and the wireframes of the tool were designed. During the second iteration, we developed a web-based application as a high fidelity prototype of the concept. Finally, we did a preliminary evaluation of the web application among 5 designers.

First iteration: Concept Definition

Throughout this stage, we aimed to understand how to visualize the digital data that is generated in a design project on a temporal perspective. We initially identified what would be the typical information that any given designer works with, for instance: documents from stakeholders, design briefs, list of requirements according to the design, results from market research, findings from explorations of existing solutions, mood-boards, mind-map, notes from brainstorming sessions, findings from user research, sketches, pictures and videos from prototypes. Designers use a large amount of digital tools and data, and in reference to cloud storages, the file repository of a given project contains several folders in a multi-hierarchical structure containing multiple nested folders.

Using Adobe Photoshop, the wireframes were designed as a web application running on a desktop browser. As shown in Figure 1, the initial concept aggregates all the information and categorizes it according to colorful labels according to the specific user generated categories. The interface consists of two major elements: the timeline and the board with information. The role of the timeline is to provide visual temporal information about the progress of the project. The board shows several types of information according to the selected period of time and progress stages. The stages are not predefined and the users decide when a new stage is created. The board represents different types of information. During this phase we visualized pictures, text documents and notes in the mock-ups. Each piece of data belongs to one or many stages. To understand whether we were on the right direction, we proceeded

to gather feedback about the concept. We asked all students involved in a post master program of a European industrial design faculty to participate in the validation. We conducted an open ended interview with 5 post master students (2 males and 3 females, from ages 27 to 32, and 5 different nationalities). The interviews lasted less than 15 minutes and were conducted in English. One participant was Native English speaker, while the interviewers and other participants were proficient English speakers. All post master students had at least 1 year of working experience in design projects that involved collaborating within a team. During the interview the concept was described to each participant using the wireframes. They were asked to provide critique on the mock ups and to point out the weak and strong points of the interface. Afterwards, we asked them to share their thoughts about the tool: whether they envisioned other possible features and whether they would add or change something in the concept. At the end, they were asked if they were willing to participate in a follow-up session to evaluate the prototype. All participants agreed to be contacted for the follow-up evaluation.

The results of this feedback session showed that the core idea of the tool will be useful for tracking and visualizing the progress of a project. Participants welcomed the opportunity to connect to their preferred cloud services. The interviews also revealed several opportunities for improvement. First, we identified that the timeline was not informative and that the relationship between timeline and the information shown in the board was not clear. Participants were confused about how the data was distributed over different stages; in contrast, they preferred to filter the project information for a specific period of time (e.g. day, week). The meaning behind each colored category was not clear, however participants suggested that it would be helpful to group information in a logical way. A participant suggested the option to use the tools across multiple projects and the possibility to switch between projects. Another suggestion was to provide a summary or preview of the document, together with a list of the team members involved in the document and a feature to communicate in relation the specific file or project, similar to instant messaging or a commenting option. Participants noted that the tool serves as a guide to follow the evolution of a project. Furthermore, they commented that instead of using the tool for modifying or creating files, the tool will encourage them to engage into discussions about the development of a project with other team members. All the participants were positive about the approach of representing files from a temporal perspective, suggesting that it looks much more pleasant to use and work with in comparison to the typical folders structure. The feedback collected confirmed that our concept can serve as a coordination tool by the way the timeline connects the information throughout the design process.

Second iteration: High-fidelity prototype

Based on the feedback collected during the first iteration, we developed a high-fidelity prototype, implemented as a web application. We identified 3 main requirements for the implementation of the tool. The first requirement was to connect the tool with existing cloud storage services. Since designers already use specialized services for sharing their files within

Figure 2. This image shows a sketch of the timeline, containing a set of files, 3 categories, and the possibility to navigate through days and to search files.

their team, we decided to develop a tool that can be integrated into the existing way of working of the team, reducing the threshold of adoption and avoiding forcing the designers to switch to a new tool. Users have the possibility to create shared projects for their team, linking the specific shared repositories used for a given project. Designers will be able to create a new project and invite their team members to join. The second requirement was to design the timeline in a way that serves as a coordination tool, tracking the development of the project and providing an overview of the information for specific periods of time (days and weeks). Besides supporting the navigation across the project files, the timeline will provide information about recent activities of other team members, for example: when someone created or edited a file or when someone commented on a file. Based on the feedback we received during the first iteration, the tool will provide a mechanism to categorize the information contained in the timeline, however, the categories remained open and flexible to change so that the team can decide how to use each category.

Figure 2 displays a sketch of the timeline, each block represents a file. One emerging challenge was how to display the names of the files in a consistent and aesthetic way, since filenames vary in length and can be very long. Instead of displaying the full name, we envisioned that an abbreviation of the filename consisting of three letters would be used. All files are shown in the timeline without taking into account the hierarchies of the folders in which they are located. This means that if a file *foo* is inside Folder A, and file *bar* is inside a subfolder of folder A, both files are shown in the timeline. The files are ordered in the timeline, from left to right, based on the temporal order of events related to the file. Similarly, when a user leaves a comment in the preview panel of one file, the temporal order of the file will be updated and the file will be moved to the right end of the timeline. Initially, the timeline displays only the files that were created or edited on a given day (e.g. today), the user can change to previous days using the navigation arrows in the top. Since the tool has a coordinating purpose, the last requirement was to enable and support team discussions about the content of the project. The tool should provide a mechanisms where the users can share their thoughts have discussions about specific content of the project, for example, comment on specific item and to annotate on specific parts of a design file. Figure 3 shows the final design including the preview panel where the selected file is displayed and the user can add comments and

Figure 3. This figure shows the timeline and the preview panel in a single-page interface. The preview panel displays a visual preview of the files is shown. The right side of the panel implements the commenting and annotating feature.

annotations over the preview of the file. The technical architecture of the prototype consisted of 2 main components: the user interface and the backend module. The user interface is where the designer interacts with our application. The user interface was implemented as a single-page web application. A single-page web application is characterized by an interface containing individual components that can be updated and replaced asynchronously and independently, without the need of reloading the application. Single-page web applications are developed using AJAX (Asynchronous JavaScript And XML) web technique. The user interface runs in the web browser of the user as a single-page user interface, and sends XMLHttpRequests to the server. The interface was developed in Javascript, Jade templating engine, D3.js, Bootstrap (version 3) for the layout, CSS and HTML. The backend module of *Alice* rests in the server and it is in charge of handling all the requests from the UI module and connect to the cloud storage service. This component consisted of an application server and a database server. The application server was developed in node.js (JavaScript) and it contained 3 submodules: 1) the API module that receives the requests from the UI and replies with the required data in JSON format; 2) the database module, which connects to the database and processes the user generated data, such as login details, the categories of the files, the comments and annotations of the users; and 3) the cloud service module, which connects to Dropbox and Google Drive via their public API (Application Programming Interface) and processes all the necessary information for generating the timeline. The database server was executed on MongoDB, a free and open source NoSQL database program. Figure 4 displays

Figure 4. This figure displays the system architecture of the prototype: the frontend containing the User interface, the backend, containing the database and logic of the tool, connected to the cloud storage services of Google Drive and Dropbox.

a diagram of the architecture of the system. To access *Alice*, the designer needs a web browser to open the welcome page of the application. The user must create an account and log into the application. If the user has not created any project, the settings panel is presented where the user will create a new project, connect it to the cloud storage services (Dropbox and Google Drive), and select the existing folders located in the cloud storage service that will be tracked by *Alice*. The user can select several folders and subfolders. The interface provides granular control to filter out subfolders from specific folders. By default, when a folder is selected, all files and subfolders contained in the folder are taken into account. The user can invite other team members by introducing their email addresses. The designer is able to see the projects that have been shared with him or her. After creating the project, the timeline will be generated based on the files contained in the selected folders. Consequently, the user can browse through the timeline and select a file to view it in the preview panel. As we explained before in the preview panel, the designer can write comments and make annotations on the preview visualization of the file.

EVALUATION

In order to gather further insights about the value and the acceptance of the prototype, we sent an email to the same five students that had previously participated in the validation of our concept, as described in the previous section. We invited the same participants since they indicated their preference to be contacted for further evaluation of our prototype and, therefore, we believed it will be beneficial for gathering more detailed feedback since they were already familiarized with the concept. The 5 students, involved in a post master program of a European industrial design faculty, agreed to participate again. We conducted an evaluation study involving the 5 students (2 males and 3 females, from ages 27 to 32, all from different nationalities). This evaluation served as a preliminary study to validate the prototype before we deploy it in a field study.

The evaluation was done on a laptop equipped with a mouse and the Google Chrome web browser. The study was performed inside a room destined for user evaluation within the university campus. The fictional scenario was a logo design project. Before the evaluation, we prepared the set of digital files (logos, sketches, pictures) related to the fictional scenario and uploaded them in a folder inside a Dropbox account created for the purpose of the test. When the participants ar-

rived, we introduced them to the study and explained them the procedure and the fictional design scenario. Participants were asked to imagine that they were part of a team that was designing a logo for a brand and that the Dropbox shared folder of the team was accessible via *Alice*. Following a think aloud protocol, participants were asked to execute a list of activities using the prototype, for example: log in, connect to the test account of Dropbox, select certain folders, deselect specific subfolder, find the most recent file, filter files by day and week, find specific files by name and by date, categorize a set of files, reply to specific comments and to annotate on certain files). After completing the list of activities, we did a semi-structured interview about their experience with the system, and participants were encouraged to interact with the prototype to support their answers. During the evaluation and the interview, the voice of the user and the screen of the laptop were recorded.

FINDINGS

The 5 evaluation sessions were conducted in English and each session took 30 minutes approximately. All provided tasks were completed successfully and the audio recording was analyzed and the quotes from the participants were extracted and digitized. To structure and discover the relationships among the qualitative data from the user test, we used affinity analysis [12, p. 95]. All quotes were structured according to the 3 elements of the interface (the project settings, the timeline, the preview panel) in relation to the tasks performed.

The feedback on the tool was very positive, and the majority of the participants pointed that they already want or need such a tool for coordinating their activities within their team. The results showed that participants found the timeline visualization very useful in the way it serves as an upper layer connecting other tools on a temporal perspective. *Alice* provides a clear overview of the changes and focuses the conversation around changes on the files. *Alice* is not intended for creating or editing the original documents. Instead, our prototype provides an overview of what the team has been working on during the last days and weeks. Participants compared the timeline to the revisions of Dropbox or to the way Google Drive displays all notifications of changes in a temporal order. To a certain extent, they all implement a temporal filter of the changes. The main difference with our tool is the immediacy it provides. The immediacy was related to two features: First, the timeline highlights the files that were updated recently and second, the preview panel displays creates the opportunity for the team to immediately leave comments and make annotations.

Users stressed that the tool will support them for tracking the shared documents and being up to date of what is happening. One participant commented that tracking changes is specially useful for understanding what happened in the project while the participant was gone or not working on the project, giving a perspective of what other people have been working on. One emerging problem for a participant was that our tool completely disappears the folder structure and, according to her, the folder structure provides with context about the project. The traditional approach for the folder structure is based in creating subfolders according to specific parts of the

project. Better ways of categorizing the files in the timeline will provide context to the file and support the lack of folder structure.

One participant made a remark on how the timeline highlights the working rhythms of the design team. She commented that her patterns of work are dependent on periods of a day. Accordingly, by making visible the work that was done in a certain day, and in a certain week, the timeline creates points of reference for the team to coordinate their actions. Furthermore, recent information is more important than something that was done far in the past. This suggests that the timeline should make the most recent changes more salient and that it should also offer the option to filter the most meaningful events based on personal preference. Another relevant remark was about how would the timeline behave and be used in projects of long duration: the longer the project, the larger the amount of files that are produced. Finally, several participants commented that having the option to search files by name or by other type of information will facilitate the navigation, especially when having a large collection of files.

DISCUSSION

Alice explores how to extend such popular collaboration tools by integrating them into a single tool as an effort to support design teamwork given the contemporary context of innovation processes. The original focus of social media and many general-purpose tools used by designers was to connect people instead of supporting design practices. Everyday communication tools have proved to be flexible and powerful enough for design teams to adopt them to support their teamwork. Digital tools play a critical role in contemporary design practices since much of the work activities of the designers is digitized. Ideas, sketches, concepts and the final designs are computerized so that they can easily be shared with other team members and stakeholders, allow external stakeholders to be involved in the design process and to have a say on specific artifacts. However, general purpose tools lack of support to artifact-mediated communication. We aim to help the designer to have a logical and transparent way to integrate all the different artifacts that were created during the design process. This aid is intended to be persistent through all the different creative activities, starting from the means in which files are shared, stored, archived and retrieved, followed by the difficulties to visualize, communicate and discuss ideas within the team. We are aware that our on going work must be validated in a real design situation.

Alice works as a central point for interaction and coordination through the shared artifacts. Our intention was to explore new ways of artifact-mediated collaborative activities in design by capturing and visualizing all the team interactions in relation to specific shared artifacts. As the results suggest, the temporal visualization of interactions and shared artifacts provides additional information regarding the activities of the design team. The dynamic character of the design process is reflected on the evolution of the files. Shared files are arranged in folders depending on the task. New files are generated as the design project evolves until the file structure becomes more static. The history of changes on files can be used to visualize and reconstruct the evolution of the design process from the

perspective of the joint coordination of the team. Previous work [5] was showed how filesystems are a rich source of information to understand collaborative activities and rhythms. Our work aims to support the collaboration patterns of designers by highlighting their daily rhythms of work.

Our results indicate that *Alice* is a tool for coordinating team-work based on the way it traces and visualizes activities over periods of time. This can be linked to Barbara Adam's concept time as a social construction strategically used to coordinate one's actions in relation to other individuals [1]. According to Adam, humans design "technologies for time production" to regulate, organize and synchronize social activities. The most dominant and pervasive technology for time production nowadays is the clock. Similar to the way the clock structures our daily interactions, digital tools regulate and structure the activities of their users and arrange them into a given order [1]. In principle, *Alice* could be considered as a technologies for time production since, technically, it imposes a temporal order upon the designers' activities to coordinate interactions. But we must be critical about the present limitations of our prototype as a system of time production. This suggests future directions for exploring the concept of time in relation to digital tools and how it affects distributed design teams.

CONCLUSION AND FUTURE WORK

We designed and evaluated a prototype that connects general-purpose tools and integrates them into a single interface to support collaborative design activities. *Alice* elicits ad hoc collaboration in design teams by facilitating team members to use their own set of tools through such seamless integration. General-purpose tools are commonly used by the designers to coordinate their team activities across multiple organizations and with different stakeholders who do not have the same tools. However, this tools were not designed to cover the collaboration needs of designers. *Alice* was designed considering these challenges focusing on facilitating the designer through the highly artifact-mediated collaborative activities. With our prototype, we found that by bringing forward the temporal perspective of collaborative design practices, we aid designers to coordinate their actions, track their progress, provide feedback to their work and generate team discussions about their activities. While a thorough evaluation of the prototype within real design teams is still pending, our findings suggests that the combination of different general-purpose tools into a single tool has potential for supporting collaboration among design teams. Finally, our prototype has surfaced the discussion that collaboration tools can be portrayed as technologies of time production. This invites us to rethink our traditional understanding of information technologies. Our work triggers new directions towards the inquiry of the temporal agency of collaboration tools and invites us to make critical questions about how such technologies not only mediate the designers' interactions but also how they generate opportunities and impose constraints through the temporal discourse that they embody.

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