Sandboxes: Supporting Social Play through Collaborative Multimedia Composition on Mobile Phones

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ABSTRACT
Media sharing over mobile devices is quickly becoming a common practice, used to support a variety of social processes. Most existing systems employ a model of sharing that treats each shared item as a distinct message. We argue that there are compelling reasons to utilize a more flexible, cohesive approach to media sharing. To test this idea, we developed Sandboxes, a prototype application for mobile phones that goes beyond basic media sharing to offer a form of collaborative multimedia composition. The design of Sandboxes is based upon three primary themes: interactivity, flexibility and cohesiveness.

Categories and Subject Descriptors
H.5.3 [Information Interfaces and Presentation]: Group and Organization Interfaces.

General Terms
Design, Human Factors

Keywords
Media sharing, mobile devices, multimedia composition, media spaces, social computing.

1. INTRODUCTION
Mobile phone users around the globe share millions of text and photo messages each day. Previous studies [2, 8] have shown the significance of this media sharing in many people's lives, despite the relative nascence of the technology. As more advanced hardware and mobile internet connectivity become available, we can expect novel forms of media sharing on these devices to emerge.

Most existing media sharing applications share three properties. First, the available interactions with other users are limited to transmission and consumption of media artifacts. Second, the organization of artifacts is highly structured and immutable, generally being limited to a chronological listing. Third, artifacts are treated as disparate entities and presented as such. These restrictions largely arise from the fact that these applications treat each artifact as a distinct message, much like an e-mail client. Previous work [5, 7] has shown that more loosely structured approaches to collaborative information organization have both practical and social benefits. However, there has been little work on applications that take a more freeform, cohesive approach to mobile media sharing.

Figure 1. Sandboxes, an experimental system for collaborative multimedia composition on mobile phones.

In this paper we explore how these restrictions may be lifted. We present Sandboxes (Figure 1), an experimental media sharing system for mobile phones, developed with an emphasis on three design themes: interactivity, flexibility, and cohesiveness. Taken together, these design themes offer not only opportunities for media sharing, but for *collaborative multimedia composition*.

2. BACKGROUND
2.1 Media Sharing
Social play through media sharing has a rich history, particularly the sharing of text and photos. Frohlich et al. [6] conducted a study of conventional photo sharing practices amongst several families, and found that storytelling was a major social process facilitated by the sharing. Thus, much research has focused on supporting storytelling over digital photos, e.g. [1]. However, Frohlich et al. also noted that many people engage in more complicated activities with photos, such as creating collages or other intricate compositions, which go beyond linear storytelling. Tasks such as these require flexible workspaces in which the photos can be freely arranged and associated.

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2.2 Mobile Devices

Mobile devices offer an alternative way to disseminate media artifacts amongst social networks. A study by Mäkelä et al. [8] of photo sharing on mobile devices suggests that this type of sharing tends to focus on photos captured in the stream of everyday life. The authors also found that when given the opportunity, users would utilize advanced functionality to express themselves creatively.

A number of hardware and software prototypes for supporting mobile photo sharing have been developed. In general, these works focus on easing the sharing process [4, 9].

Most of these systems, as well as current commercially available offerings, treat the process of media sharing as a sequence of disparate transmissions. Presentation of shared media artifacts is highly structured, and interaction with other users is limited to the act of transmission itself. Past messages are viewable only as part of a chronological list. In contrast to this manner of presentation, Mäkelä et al. [8] observed their users taking advantage of editing functionality to author narratives composed of multiple captured images.

There are few examples of research into more complex collaborative media composition on mobile devices. Davenport et al. [3] created Mov-Its, a mobile video editing system that lets users and their friends capture videos and assemble them together within predefined templates. In Mov-Its, the "separation between media and form" is emphasized, which supports a game-like process of "reinterpretation and reconfiguration… The material is freed from the original strict chronological ordering of the weblog, and instead offers up potential for discovery of alternative perspectives and interpretations."

2.3 Collaborative Multimedia Composition

Our experimentation with collaborative multimedia composition on the mobile phone was partly informed by similar work on personal computers and large displays. Greenberg and Rounding's Notification Collage [7] and Fass et al.'s MessyBoard [5] use multimedia collages as a means to build interpersonal awareness and interaction amongst small groups of colleagues. Unlike the Notification Collage, the MessyBoard is a what-you-see-is-what-I-see (WYSIWIS) system, so the exact visual context of all information is preserved across all views.

In trial use, both the Notification Collage and the MessyBoard were found to have social as well as practical applications. On the Notification Collage, users often chatted with one another using textual notes, and posted personal media artifacts for others to see. On the MessyBoard, users exhibited similar behavior, but also took advantage of the system's shared visual context to play games by moving items around. Thus, the what-you-see-is-what-I-see (WYSIWIS) nature of the MessyBoard allowed for richer social interaction.

The observations of Frohlich et al., Mäkelä et al., Davenport et al., and Fass et al., indicate that collaborative composition of media within a freeform visual workspace can be an important tool for facilitating social play. The intersection of flexible manipulation and a cohesive product appear to offer many possibilities, including collage, storytelling and gaming.

3. SANDBOXES

3.1 Design Themes

Throughout the design of Sandboxes, we sought to emphasize three themes. We chose to explore these themes because our survey of collaborative multimedia composition in other domains indicated that these principles have been repeatedly shown to be useful; yet they have received little explicit attention within the mobile domain. We hope that our experiences will help to encourage discussion around these topics in future mobile device design.

- *Interactivity*: Interaction should be ongoing and rich. Users should have multiple opportunities to engage with the shared media artifacts in a variety of ways, as opposed to being limited to transmission and consumption.
- *Flexibility*: The system should be flexible in terms of the organization of shared artifacts. Certain structures may be encouraged, but users should be free to ignore them.
- *Cohesiveness*: Users should be able to build a cohesive product out of shared artifacts. To do so, they should be able to form a variety of connections and associations amongst these artifacts.

Furthermore, all sharing in Sandboxes is group-centric and persistent, as these attributes were found to positively impact user experience in a previous study [2].

3.2 System Overview

A Sandbox is a WYSIWIS multimedia collage on a shared 2D canvas. Users begin a Sandbox by capturing media artifacts, and positioning them on the canvas. From there, they can post more artifacts, move or resize the existing artifacts, or view the contents of the collage in one of two playback modes. The types of media available include text, symbols, photos and audio recordings. Since the system is WYSIWIS, all changes made to a Sandbox are distributed to all users with access to that Sandbox.

Figure 1 shows an example Sandbox. The canvas extends infinitely along the horizontal axis, but is limited to the height of the screen along the vertical axis. We found this combination to be an effective tradeoff between facilitating user freedom and maintaining navigability of the space. An overview strip at the top of the screen (Figure 2) shows a zoomed-out preview of a large segment of the canvas. Similarly, small arrows appear at the edge of screen to indicate off-screen content to the left or the right, respectively.

Each item on the canvas has a border with a color corresponding to the user who posted it. Though only a limited number of distinguishable colors are available, the colored borders offer a rough at-a-glance idea of who has contributed what to the Sandbox. For more detailed information, a status bar along the bottom of the screen shows the name of the currently selected item's poster, along with the date and time of the post.

The Sandbox client was implemented in C# using the .NET Compact Framework, and was deployed on HTC smartphones with Windows Mobile 2003.

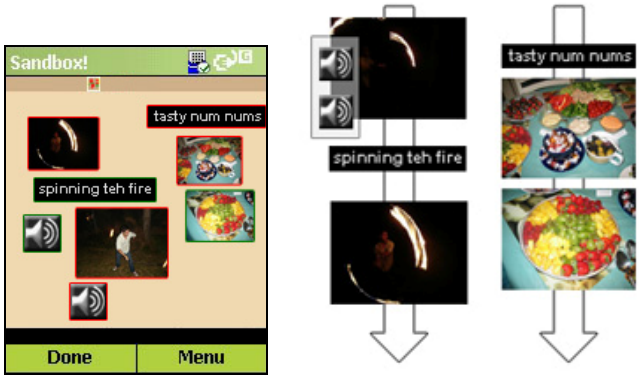

Figure 3. An example depicting how the contents of a Sandbox are organized for a slideshow. The canvas (left) contains two vertical stacks (right). During the slideshow, stacks are shown in order from left to right, and items within a stack are shown in order from top to bottom. Audio items are included in stacks, but play over top while the visual media is being displayed.

3.3 Posting Media

Users post media to a Sandbox by selecting Add from the main menu, and selecting the appropriate media type. From there, depending on the media type being created, the user either: fills out a textbox; selects an icon; takes a photo; or records an audio clip.

After capture of the new media is completed, the new item appears on the canvas in "move mode", so that the user may position it. The initial position of the new item is slightly inset from the currently selected item when capture was initiated. Thus, Sandboxes supports a lightweight form of annotation. For example, the user can select a photo, then add audio, effectively annotating the photo.

When a user posts a new item, other users receive a notification on the home screen of their phone. They can click on the notification to open the updated Sandbox and jump directly to the new media.

3.4 Interacting With Media

Users select items on the canvas using the phone's four-way joystick. Clicking the center of the joystick brings up a context menu for the selected item. From here, the user may select one of several options: View/Play, Move/Resize, or Delete.

View/Play is only available for photos and sounds, and shows a close-up or plays the audio, respectively. Move/Resize switches the system to "move mode," which allows the user to move the item around the canvas using the joystick. The user then clicks the joystick to finish moving the item. If the item is a photo, then the system switches to "resize mode," which allows the user to resize the photo. Clicking again returns the system to the default selection mode. Finally, Delete removes the item permanently from the canvas.

3.5 Decay

The opacity of existing items in the Sandbox decreases as new items are added. Eventually, old items disappear. However, if an item is moved or resized, it returns to full opacity. This decay of aging media prevents a Sandbox from becoming too cluttered over an extended period of time. Decay also offers an indication of which content is new or is currently being attended to, since frequently manipulated items never fade away.

3.6 Playback

There are two formats for playback of media in a Sandbox: slideshow and historical.

3.6.1 Slideshow

Slideshow playback shows a Sandbox's photo and text items in a serial sequence (summarized in Figure 3). Audio items are played in sequence while the visual media is being displayed, offering a narration or soundtrack to the slideshow.

Text and photos on the canvas are organized into a sequence as follows. Items on the left end appear first, and items on the right end appear last. In the event that all items are ordered in a straight line across the canvas, playback simply proceeds from left to right. However, if set of items are stacked vertically, then this set is considered a distinct unit. When playback reaches the stack, playback proceeds from top to bottom within the stack, then continues to the right as before. Different transitions are used to distinguish between items within the current stack, and items further along the horizontal axis. Audio media is organized similarly.

3.6.2 Historical

Historical playback shows a Sandbox's history of changes made over time by users. Changes include new items being posted, items being deleted, and items being moved or resized.

Playback starts at a user specified point in time, showing a snapshot of the Sandbox as it looked at that point. From there, the playback proceeds to show each following change up until the current time. For each change, the view of the Sandbox first moves to the position on the canvas where the change occurred, and an animation depicting the change then plays. Simultaneously, a box appears with the name of the user who made the change, along with the date and time of the change. The user can also use the joystick to manually navigate back and forth between changes. A timeline at the bottom of the screen shows the distribution of changes throughout time.

4. TRIAL DEPLOYMENT

We evaluated Sandboxes in two separate series of trial deployments. The purpose of these trials was to discover whether collaborative multimedia composition could generate enjoyable social experiences. We also wanted to discover how users would put this sort of sharing to use in everyday situations.

In the first set of trials, 3 groups of 4 participants each used Sandboxes while co-attending an event. At the start of each event, smartphones containing the Sandboxes software were distributed. For the second series of trials, 3 groups of 6 – 8 participants used Sandboxes for one week. Their use of Sandboxes was embedded in their everyday lives throughout the deployment period. At the end of each trial, participants engaged in a roundtable discussion regarding their experiences, and filled out a questionnaire. All participants in both deployments were in their late teens or early-

Figure 2. The overview strip at the top of the screen shows a zoomed-out preview of the canvas' contents.

to-mid twenties, and all were familiar with or users of SMS/MMS technology.

4.1 Usage

In the questionnaires and interviews, we asked participants to specify the kinds of activities and tasks that they engaged in using Sandboxes.

Many of the responses we received were expected. For instance, experience sharing was the most commonly reported activity, confirming observations in studies as such as [2] and [8]. Creative expression was the second most commonly reported activity, which diverges slightly from previously documented usage of mobile media sharing. However, as we were party motivated by the suggestions in [8], we designed Sandboxes with the facilitation of creative expression in mind.

Some participants used Sandboxes in ways that we completely did not expect. One of the most popular was as a social gaming medium. The precise nature of the games we saw varied. One set of users engaged in a "tug-of-war" using artifacts on the Sandbox canvas, moving the items back and forth in an attempt to gain mastery over the content layout. In another instance, users competed to produce the most humorous images. Other users attempted to construct humor from existing media, by leaving funny comments or rearranging the media in an amusing manner.

These observations also highlight Sandboxes' role as an entertainment medium. While not a specific activity or task, many users who participated in the one-week deployment viewed Sandboxes as a pastime that was always on-hand. One participant expressly valued the ability to take out his phone and play around with Sandboxes when he got bored at work. Even when serious interaction was not possible, passive consumption of the media produced by other users was still considered to be an entertaining diversion. Thus, another participant described using Sandboxes specifically to "entertain others in the group."

Another unexpected use case we observed was as a form of documentation on physical environments. For example, one participant used the Sandbox canvas as a bird's eye view onto the room she was in, and arranged photo or text artifacts to depict the organization of people and objects in that room.

4.2 Usability Issues

The most frequently cited difficulty was the complexity of capturing and posting artifacts. This process consisted of 6 steps for posting photos, 5 steps for posting audio, and 3 steps for posting text or symbols. Most of the time, participants also had to go through the additional step of opening the software from the phone's home screen, since the phone would automatically return there after a few minutes of inactivity. While the length of this process was not always a significant issue, participants found it almost impossible to capture artifacts spontaneously. Participants suggested shortcut commands as a means to solve this issue. For instance, when a photo is captured using the camera hotkey on the side of the phone, that photo should be automatically posted to a Sandbox.

For the same reasons, users were frustrated by having to position and resize items as part of the posting process. Instead, they wanted the system to automatically and intelligently place new items on the canvas. At some later point they would then take the time necessary to come back and reorganize the items to their satisfaction. Most users suggested some sort of chronological ordering by default, with the ability to apply different templates. Thus, participants wanted some amount of predefined structure in the system, but they also wanted the ability to override it.

Several users had trouble discerning the relationships of items arranged on the canvas. In particular, they had difficulty determining which items were posted in response to what other items. We specifically did not incorporate any comment or annotation feature in the software, in attempt to keep the interface simple. Instead, we included the ability to automatically post a new item slightly inset from an existing item, as a lightweight means for indicating annotation. However, this effect was too ambiguous for some participants, who wanted a more explicit means of linking items together.

5. CONCLUSION

Ultimately, our findings indicate that collaborative multimedia composition on mobile phones supports many of the same behaviors as conventional, message-based media sharing. However, collaborative composition supports a greater degree of complexity in these behaviors. For instance, while gaming and creative expression are both possible with conventional sharing, users of Sandboxes played games and expressed themselves in ways that took particular advantage of Sandboxes' unique functionality.

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