Toward Mobile Video Interaction with Rollable Displays

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ITS'12, November 11–14, 2012, Cambridge, Massachusetts, USA.

Abstract
Recent technological advances in creating thin-film, rollable displays indicate their prospective implementation in mobile devices. In this position paper, we argue that such displays have a great potential to advance the field of mobile video interaction due to their flexible screen size and rich physical interaction capabilities. To support the discussion, we depict exemplary interaction concepts and outline promising research directions, which shall guide future research.

Author Keywords
mobile device, rollable display, screen, video browsing, resizing, thin-film display, flexible display, mobile.

ACM Classification Keywords
H.5.m. Information interfaces and presentation: Miscellaneous.

General Terms
Human Factors, Theory

Introduction and Background
Recent technological advances in creating thin-film, rollable displays [9] indicate their prospective implementation in mobile devices. Such displays will allow for dynamic reshaping and resizing [6], pertaining

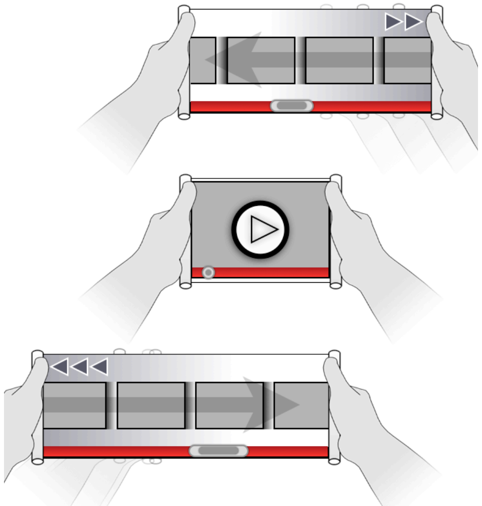

Figure 1: Temporal browsing by pulling-out to the left (rewind) or the right (fast-forward); the further pulled-out, the faster the playback speed (cf. top vs. bottom).

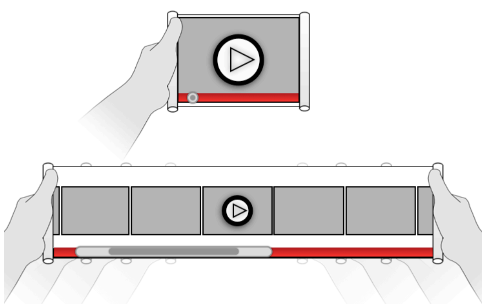

Figure 2: Getting overview in a video by pulling-out the rollable display

to the respective context of use. These rich physical interaction characteristics open up a manifold set of applications [7, 8, 10]. We believe that they particularly cater to the mobile interaction with *continuous media*. In this position paper, we therefore advocate the exploration of rollable displays for *mobile video interaction*.

In this very field of research, the community has mainly focused on interaction with fixed-size mobile devices [3–5, 11], such as the Apple iPhone. There, users have to deal with *occlusion* (fingers occlude widgets while interacting with the device), as well as *fat finger problems* (interface elements which cannot be targeted easily) [2]. Future resizable displays may alleviate these restrictions of current fixed-size devices. We believe they will therefore pave the way for more usable and enjoyable interaction techniques for mobile video browsing due to their flexible screen size and rich physical interactions [6].

In the following, we illustrate how we envision rollable displays to overcome common usability issues of contemporary mobile video browsers and depict exemplary interaction concepts. We point out promising future research directions toward video interaction with rollable displays. We feel that this amalgam of *continuous media* and *continuous interaction* support is a most promising approach to advance the field of mobile video interaction.

Exemplary Interaction Concepts

In this section, we depict three exemplary interaction concepts, which show how resizing as a core interaction principle can be leveraged to support video interaction.

Temporal Video Browsing

Pulling-out the display can be seen as a physical instantiation of the rubber band metaphor used for temporal video browsing [11]. Resizing is therefore mapped to spanning a rubber band, which is connected to the timeline of a video: the further the display is pulled-out, the stronger the band is spanned, the faster the video is played back. In turn, pulling-out to the right can be mapped to fast-forwarding, whereas pulling-out to the left means rewinding, respectively.

Temporal video browsing has considerable advantages over existing approaches. On the one hand, resizing allows for occlusion-free and fine-grained interaction. On the other hand, the additional screen space can be used to scaffold a user's navigation process by allowing for a detailed overview over the key frames at the current playback position (see Figure 1). We believe that this has the potential to minimize *overshooting* while searching for a scene in a video.

Getting an Overview

Maintaining an overview in a video is essential for video browsing. This can be achieved by visualizing key frames of the video [2]. However, key frames occupy screen real estate [4]. Resizing the display provides more screen space on-the-fly, for instance: pulled-out to the left, created space shows key frames of previous video content relative to the current position in time; pulled-out to the right the following video content is displayed,respectively. Key frames on both sides provide an easy access to video content (Fig. 2).

Accessing Additional Content

Users typically access additional information (e.g. user comments or related content) while engaging with

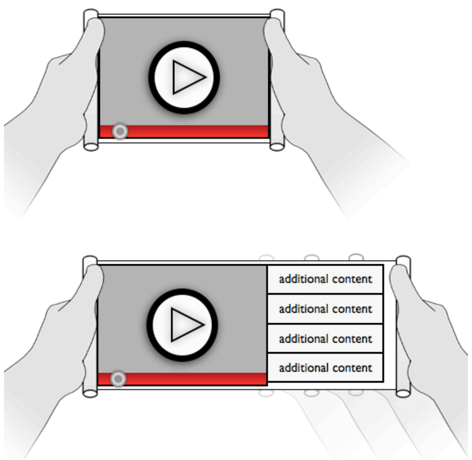

Figure 3: Viewing additional content while resizing the screen

videos. The fixed screen size of mobile devices restricts the visualization thereof and as a worst case, e.g. on the iPhone, users have to switch to a different view and might lose the connection to the currently viewed video (e.g. comparable to being lost in hyperspace [1]).

The created screen space through resizing addresses this problem and allows for the flexible visualization of additional content (see Figure 3). This has two main advantages: (i) the viewing context does not need to be changed and (ii) content can be dynamically enhanced, depending on the available space.

Conclusion & Future Work

In this paper, we advocated the use of rollable displays for mobile video interaction, backed by an exemplary set of *physical* interaction concepts. As found in [2], physical interfaces excel in terms of hedonic qualities, but lack pragmatic qualities, resulting in a decreased usability. We envision rollable displays to excel in both qualities, leading to more attractive interfaces, due to the flexible screen size and rich physical interactions. This leads to the following challenges, which set the stage for future research directions:

(1) How can the rich physical interaction capabilities such as resizing, tilting, bending or folding be leveraged for novel mobile video interaction techniques? (2) How can these techniques be situated within existing design spaces for mobile video browsing [2] and (3) how do they relate to other physical or gesture-based approaches in terms of both usability and user experience? (4) In particular, how can the dynamic characteristics of resizing be leveraged to support the interaction with large video collections? (e.g. to support knowledge work or technology-enhanced learning with lecture recordings, see [2] for use patterns). Furthermore, (5) how precisely can users interact with videos on rollable displays? Is resizing suitable for fine-grained in-scene navigation? And (6), is physical interaction as the only input modality 'enough' or should it be complemented by e.g. touch input?

We believe that rollable displays will enable next generation mobile video browsers and that the outlined challenges will guide the field toward more usable and enjoyable interfaces for mobile video interaction.

Acknowledgements

This work was partially funded by AGT International.

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