Mobile Video – The Next Killer Application or Not?

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ABSTRACT
In this position paper, I argue that mobile video has the potential to become the next killer application. However, in order to achieve this it is not enough to just transfer the traditional video and TV experience to handheld devices. Instead, adaptations on the contents should be done and sophisticated tools for replay and interaction have to be offered. I start with an informal introduction using examples which illustrate the potential of mobile video and limitations of current approaches. Then, I present three examples of what has to change in order to make mobile video successful: First, offer different content, second, adapt the way in which the content is presented and third, provide better interfaces and browsing functionality. Finally, I present some examples of our own research which addresses the latter issue, i.e. improving the usability of mobile video by providing an advanced interface design and a better interaction experience.

Categories and Subject Descriptors
H.5.2 [**Information Interfaces and Presentation (e.g. HCI)**]: User Interfaces – *Graphical user interfaces (GUI), input devices and strategies, interaction styles, screen design*

General Terms
Design, Human Factors.

Keywords
Video, mobile video, video browsing, interfaces, iPhone.

1. INTRODUCTION
There has been ongoing controversy about the usefulness and usability of digital video on handheld devices. Some people see it as the new killer application for mobile computing which naturally continues the increasing popularity of digital audio and images on handheld devices. Others question its usefulness completely. For example, in a recently posted video statement, which attracted lots of attention, famous director David Lynch made some very critical remarks about watching a movie on cellular phones[1]. Most of the skepticism about digital video on mobile devices is related to their small screen sizes. Generally, I agree that the experience of watching video on handhelds will never be the same as watching a movie in a theatre or even at home on your TV. Nevertheless, I see great value in mobile video and I believe that it has the potential of becoming the ultimate killer application for mobile multimedia. Ever since I started working with mobile video, I am constantly faced with statements such as "Who wants to watch a video on such a small device?", "Are people really using this?", etc. I usually answer to this kind of skepticism with an example:

Considering cellular phones, I was a rather late adopter and only got my first mobile phone in 2001. However, I was an early user of email and have been using it intensively since the mid 90s. If you had asked me at the end of the 90s if I would ever use email-like messages on a cellphone as well, most certainly the answer would have been no. Typing messages on such a small keypad and reading them on a very tiny screen just seemed ridiculous to me at that time. Today, I'm sending much more SMS messages on my mobile phone than I'm using it for making calls. Surely, those SMS messages look completely different than the emails I send. For example, I hardly use upper and lower cases, often ignore grammatical rules, make massive use of abbreviations, etc. In addition, my emails and SMSs differ in terms of content: For some messages, sending a short SMS seems to be the better choice where for others, using email is more appropriate. Nevertheless, despite these differences, I do use my cellphone to send and receive text messages, something I would never have expected about 10 years ago.

I use this example not only to illustrate why I see great potential in mobile video despite the small screen sizes of handheld devices. I also use it to demonstrate why it has not become a killer application yet and what has to change in order to increase its usefulness. Till now, developers and producers of tools and contents for mobile video think too much in terms of regular video and TV – in the same way as I originally made the mistake of thinking of SMSs being just an email version on cellphones. They seem to ignore the special characteristics of handheld devices and the mobile context of potential users. But in the same way as text messages sent via SMS differ from the ones sent via email, people want to use mobile video differently than traditional video. A recent study on the usage and experience of mobile video [1] basically confirmed these intuitive arguments.

2. REQUIREMENTS
As a consequence of my statements presented in the introduction, producers of mobile video as well as tools for their replay have to think of better ways to fulfill the users' needs for different contents and different ways to deal with. In the following, I present three examples of things which have to change in order to make video on mobile devices more successful and improve the user experience.

[1] "*Now if you are playing the movie on a telephone, you will never in a trillion years experience the film. You think you have experienced it, but you'll be cheated. It's a such a sadness that you think you've seen a film on your f*ing telephone. Get real.*"

Source: http://www.youtube.com/watch?v=wKiIroiCvZ0

2.1 Content – What users want

Before the world soccer championship in Germany two years ago, some cellphone providers expected people to be interested in watching or replaying soccer games on their mobiles. They created related services expecting a big boost for the usage and acceptance of video on cellphones. However, most of the related offers have not been very successful. Many people believe that an unreliable and complicated service and nonsatisfying cost models have been the main reasons for this failure. These issues certainly contributed to the missing user acceptance. However, I also believe that the provided content plays a major if not essential role here. It is hard to believe, that many users would be interested in watching a complete soccer match live on a cellphone because the loss of experience would be even greater than when watching a movie which was shot for the big screen. Similarly, I do not expect that many people would be interested in summaries of selected highlights which are created and distributed with a significant time delay after a match. However, I'm sure that being able to get an individually controlled live replay on your phone with which you can, for example, immediately replay and judge critical scenes or re-watch outstanding scenes on your mobile would be something lots of soccer fans would be quite interested in (and willing to pay a significant price for). Such a service would not try to transfer the TV experience to the cellphone but instead create a whole new experience when watching soccer videos. Being able to personally control this replay would be a service that is appealing even for people watching the live game in the stadium and on TV in a bar or at home.

2.2 Presentation – How they want it

Soccer matches are also a good example for another issue which people seem to have noticed but which has not made it into actual applications and contents yet. For mobile video to be successful, it is not only important what we present to the user but also how we present it. In addition to providing a different kind of content (e.g. user-controlled live replays instead of pure live transmissions), we also have to consider that they are replayed on a different device in a different context. The small screen size of a mobile device makes it often hard to follow the video of a soccer game. Fortunately, researchers have started to address this problem and already came up with promising solutions [2, 3]. For example, approaches for automatic zooming can be used to increase visibility by adapting the visible screen area according to the small display size of the mobile device. Similar concepts are developed for motion pictures as well [4]. In addition, the actual content providers have to get aware of the different characteristics and user requests for mobile video as well. For example, if a network company broadcasts both TV and radio of the same live event, they do not re-use the audio track of the video but produce an additional one, since a radio broadcast is experienced much differently than a live TV show and therefore the same content – a verbal description of the sports event – gets delivered differently. Why not adapt the production process of the video track for mobile video as well, for example, by using different camera angles or additional cameras which show a perspective that is more suitable for smaller screens? Why not add zooming information to the video signal in order to enable cellphone providers to adapt the content to the respective screen sizes more easily?

2.3 Usage – What they want to do with it

The examples from watching soccer games on mobile devices given above implicitly assumed one characteristic which is not offered with current mobile video services: That users are able to easily navigate and skim video data on their mobile devices. Even the interface of the video player on the iPhone™ – which offers a very advanced, functional, and intuitive interaction experience for other media types – provides only very basic support for video browsing (at least at the time of this writing). However, situations as described above require flexible interactive navigation in a video. For example, if a soccer fan wants to check if a ball was really outside of the field as claimed by the referee, a very fine granular navigation – maybe even on single frame level – might be required. If during halftime he wants to review the scenes he liked the most, a coarser, quick navigation along the timeline is required. Approaches for interactive video browsing which support flexible and intuitive navigation within a video have been developed for video replay on laptops and desktop PCs (see [5,6], for example). However, they have not made their way into mobile video players yet, although the mobile context and different usage scenarios make them even more important and useful here.

In the following section, I will present three examples of our own research which aims at improving the mobile video experience by providing more advanced interfaces and sophisticated video browsing functionality on handheld devices.

3. EXAMPLES FOR ADVANCED INTERACTION AND INTERFACE DESIGN

As said before, users experience video on mobile devices differently than traditional video and TV. I often like to explain the differences by looking at how people use and read books. Watching a TV show or a movie on a video tape in your home can be compared to reading a novel: Even if they make longer pauses in between, people generally read a novel from the beginning to the end. They might go back to check specific issues and refresh their memories of certain details, but generally, not much navigation is going on. The same is normally true for watching movies and TV shows. In contrast, in my opinion, experiencing mobile video can be compared to the usage of text books. When using text books, people often do not read them in a linear order, but skip parts of minor interest, read complicated parts more carefully and repeatedly, etc. Hence, they navigate through the textbook and consume its content at different granularity levels. If they run over a complicated sentence that they do not understand, they want to re-read that single sentence over and over again till they finally understand it – similar to the example given above where a soccer fan is searching for the few frames proving that the ball was outside of the field or not.

Common video players normally offer a timeline-based slider which allows users to interactively navigate along the timeline. However, because of the small screen size, these timeline sliders do not allow users to navigate a video at random granularity levels. Moving the slider's thumb just one single pixel on the screen already results in a large jump in the file preventing users from accessing individual frames and smaller scenes. Comparing the resulting situation to the book example above, assume you want to re-read the last sentence because you have not understood it. But in order to do that, you have to read the last five sentences

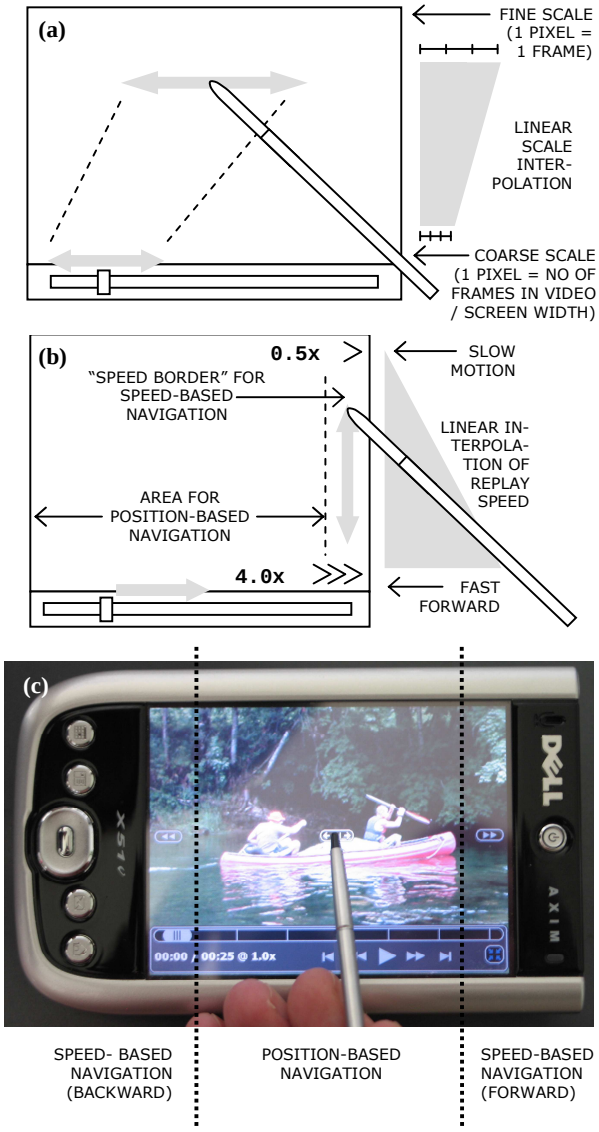

Figure 1. MobileZoomSlider design (copied from [8]).

because you are not able to navigate to the beginning of the last sentence directly. Certainly not a very engaging user experience!

Motivated by this, we developed and evaluated different user interfaces for touch-sensitive, pen-operated PDAs. Our designs enable users to interactively navigate along the timeline of a video at different granularity levels. Since the small screen size of a PDA prevents us from offering many GUI elements (e.g. different sliders at various resolutions), interaction with all our designs is done by moving the pen directly on the screen (i.e. over the video content) in different directions. In all four designs, direction and speed at which a user navigates along the timeline depends on the horizontal and vertical pen position as well as on the pen's movement over the screen (e.g. faster vs. slower, straight vs. circular, etc.).

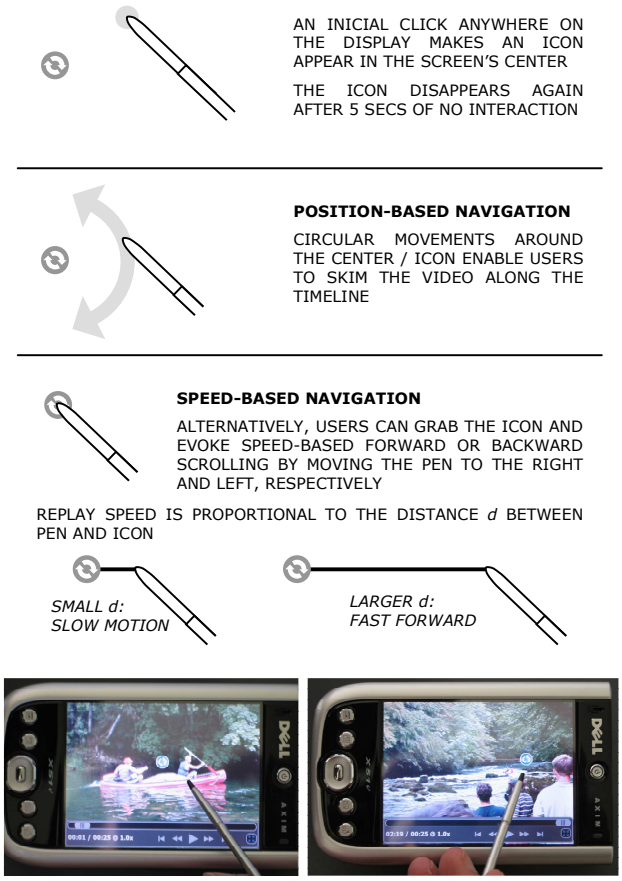

Figure 2. ScrollWheel design (copied from [8]).

3.1 MobileZoomSlider design

The MobileZoomSlider interface enables users to skim a video at different levels by providing timelines at various resolutions. Clicking anywhere on the screen and moving the pen to the right or left results in a forward and backward navigation along the timeline, respectively. The granularity of the timeline depends on the vertical pen position – horizontal pen movements at the top are done on a finer timeline, coarse timeline resolutions are available at the bottom of the screen. The basic idea of this approach is illustrated in Figure 1a. At the border of the screen, users can skim the file at a fixed replay speed as illustrated in Figure 1b. Again, scrolling speed (i.e. navigation granularity) depends on the vertical pen position – slow (i.e. fine granular navigation) at the top of the screen, faster replay at the bottom. Figure 1c shows the implementation of this design on a Dell Axim™ PDA. More information about this interface and a detailed evaluation and discussion can be found in [7].

3.2 ScrollWheel design

In the ScrollWheel design, the timeline of a video is mapped onto a circular shape, similar to a clock-face. Clicking anywhere on the screen makes an icon appear in the screen's center. Circular movements around this icon result in a navigation along the timeline. The advantage of such an implementation is that users

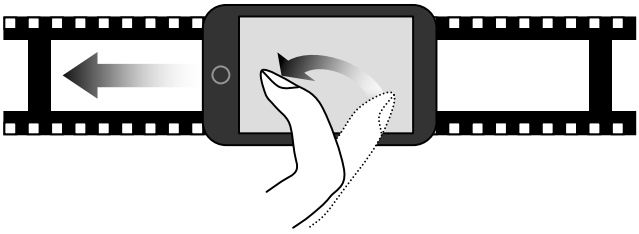

Figure 3. Video browsing by flicking (copied from [9]).

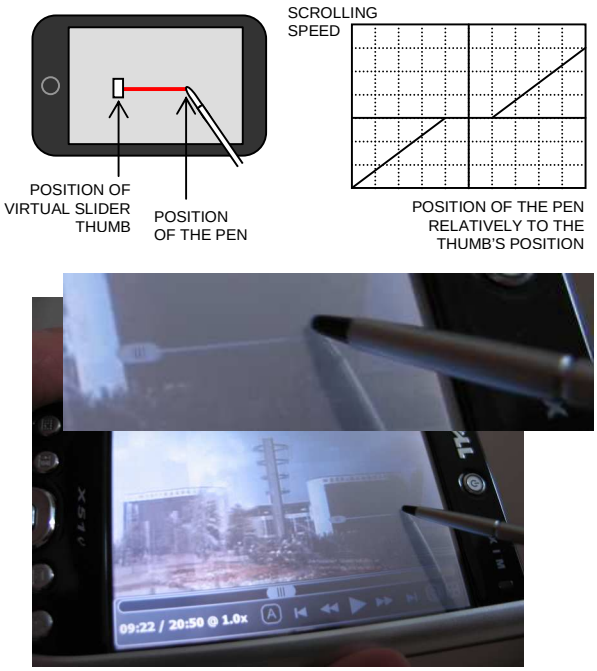

Figure 4. Elastic panning.

can indirectly manipulate the timeline's resolution by varying the size of the circles made around the ScrollWheel's center – larger circles result in a finer timeline and thus slower navigation, smaller circles enable faster video browsing. Skimming the video at a fixed replay speed is done by grabbing the icon and moving it to the left or right for backward and forward browsing, respectively. Replay speed is set proportionally to the distance between the pen and the screen's center. Figure 2 illustrates this interface design and shows the actual implementation. More details about this approach can be found in [8].

3.3 Flicking and Elastic Panning

In a recent evaluation, we compared two additional approaches for video browsing: Flicking and elastic panning [9]. The technique of flicking is used on the iPhone™ for navigation through long lists of text files, for example, titles of a music collection. By flicking the finger (or in our case, the pen) over the screen, users can interactively skim through a text list (or in our case, a video) in the direction in which the finger is moved, cf. Figure 3. Initial scrolling speed depends on the momentum of the finger's movements, i.e. faster movements result in a faster initial scrolling speed. After a while, scrolling slows down till the file comes to a complete stop, unless the user keeps moving her finger over the screen. Fine navigation on a line-by-line or frame-by-frame level can be done by resting the finger on the screen and moving it up and down (for text) and left and right (for video), respectively.

Elastic panning is based on the idea of elastic interfaces. Here, the slider's thumb is not moved directly along the timeline, but instead pulled with a virtual rubber band. Scrolling speed (i.e. the speed at which the thumb follows the mouse pointer's or pen's movements) depends on the length of the rubber band: A larger distance between pen and thumb increases the tension on the rubber band and thus results in a larger scrolling speed. If the distance between pen and thumb gets shorter, the tension on the rubber band decreases and hence, scrolling slows down (cf. illustration in Figure 4). Hence, by manipulating the length of the rubber band, users can interactively skim a video at different speeds and thus granularity levels.

Both designs have been evaluated in a comparative user study where they showed similar performance (measured in time to solve typical browsing tasks) but different user perception, cf. [9].

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