

Quality Delivery of Mobile Video: In-depth Understanding of User Requirements

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ABSTRACT

The increase of powerful mobile devices has accelerated the demand for mobile videos. Previous studies in mobile video have focused on understanding of mobile video usage, improvement of video quality, and user interface design in video browsing. However, research focusing on a deep understanding of users' needs for a pleasing quality delivery of mobile video is lacking. In particular, what quality-delivery mode users prefer and what information relevant to video quality they need requires attention. This paper presents a qualitative interview study with 38 participants to gain an insight into three aspects: influencing factors of user-desired video quality, user-preferred quality-delivery modes, and user-required interaction information of mobile video. The results show that user requirements for video quality are related to personal preference, technology background and video viewing experience, and the preferred quality-delivery mode and interactive mode are diverse. These complex user requirements call for flexible and personalised quality delivery and interaction of mobile video.

Author Keywords

Mobile video, quality-delivery mode, user requirements.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Design, Human Factors.

INTRODUCTION

As mobile technology has advanced and the amount of video watched has increased, mobile video has become a very important service. Significant research has studied mobile video in different fields. Some studies investigated the usage of mobile video, such as when, how and why people use mobile video or/and mobile TV (Miyachi, Sugahara, & Oda, 2008; Song & Tjondronegoro, 2010). Other studies attempted to understand user's requirements for video quality and how users assess the quality (Jumisko-

Pykkö, Ilvonen, & Väänänen-Vainio-Mattila, 2005; H. Knoche & Sasse, 2009). Only a few studies have focused on the design of user interface and interaction of mobile video (Huber, Steimle, & Mühlhäuser, 2010; Hendrik Knoche & McCarthy, 2005). These studies indicate that different users have different perceptions of video quality and the user experience varies with situations. However, research still lacks an understanding of how and why a user's requirements for video quality change and what kind of quality-delivery mode can meet the user's requirements.

Focusing on these questions, this paper presents the qualitative results from semi-structured interviews, which were conducted together with quantitative research on quality acceptability assessment. It is found that user requirements for video quality depend on the user's preference for a particular video content, the technical background, and the richness of viewing experience. Each of the three aspects exercises its impact in multiple directions. Also, users like to be automatically provided with optimised quality based on network and mobile device conditions, but they also want a self-controlled quality mode. Unfortunately, so far few mobile video players support user-controlled quality delivery. Furthermore, the study provides the information that is needed in different viewing periods: navigating, loading, and playing time, and the preferred presentations of the information by different types of users. The study may benefit optimisation of video quality provisioning and user interface design in mobile video.

RESEARCH METHOD

Participants

This study involved a total of 38 participants from the age of 17-37 ($M=25.2$, $SD=4.8$). This demographic is regarded as the primary mobile video (TV) users (Buchinger, Kriglstein, & Hlavacs, 2009; Song & Tjondronegoro, 2010). The participants were stratified by gender, likes and experience. In terms of gender, there were 20 males and 18 females. The participants' preferences were assessed from five content types: animation 23, movies 34, music videos 23, news 9, and sports 14. The user's experience was based on how long and how often they use mobile video. 22 frequent users watch mobile videos at least once a week, and 13 long-term users have watched mobile videos for over 6 months.

Procedure and Data Collection

The qualitative interview was conducted along with a quantitative study on mobile video quality evaluation that was tested on an iPhone with a customised test application. The whole procedure consisted of three phases. At the beginning, a participant's basic information was collected using the test iPhone application, including name, gender, age, favorite video content types, duration and frequency of watching mobile video. We asked participants to talk about their background and experience in viewing videos in the first part of the interviews. The second phase was the quantitative task. We asked the participants to watch a set of videos from the five typical content types, which were selected from real video materials. While watching, the participants were required to select the lowest acceptable quality and the lowest pleasing (or enjoyable) quality for each video. To select the qualities, participants could use swipe gestures to gradually increase or decrease the displaying quality by swiping to the left or right and double tapping on the screen to confirm the quality selection. For a more detailed description refer to our previous study (Song, Tjondronegoro, & Docherty, 2011). Once the quantitative task was completed, the third phase - the second part of the qualitative interviews was performed. Voice recording and notes-taking was used to record data.

Semi-structured interviews were adopted to allow participants the time and scope to talk about their opinions on a particular subject. The interviews included three aspects: (a) experience in watching videos (on TV, computer and mobile devices) and in selecting video quality; (b) preferred mode of providing the quality of mobile video; and (c) desired interaction for quality adjustment and information. The last two aspects were investigated after the quantitative test. The corresponding structured questions for each aspect are shown in Table 1.

(a) Background and experience

- Could you introduce your area of study and interests?
- What is your experience of watching videos?
 - What type of device?
 - Do you download or watch on-line?
 - What content do you prefer?
- If you use a mobile device to watch videos:
 - When and where do you watch?
 - What kind of videos?
 - Do you encounter any difficulty when using the mobile video?
- Is quality important when you watch a video? If yes:
 - How and what kind of quality do you often choose?
 - Have you attempted to adjust the quality when using a mobile video? If not, why?

(b) Perceived quality & preferred quality-delivery mode

- What were the main criteria for you when choosing the lowest pleasing quality?
- Did you use different criteria for various content types when making the choices?

- Did you have any experience of selecting video quality on your mobile device before? If yes, how did you feel about it?
- How do you like video quality to be provided on a mobile device? Automatic provision, self-selected quality, or the option of both functions?

(c) User interface and interaction

- Before you select a video, what information do you want to know about it?
- For on-line video viewing, during the loading time, what do you want to see?
- When you are watching a video on a mobile device, do you like full-screen or do you keep the aspect fit?
- If you can adjust video quality, which do you prefer: scales, buttons, or swipe? Why?
- When you adjust the quality of a video while watching, what information do you want to know? What is the best way to show that information?

Table 1. Interview questions

FINDINGS

Recorded interview data highlight that mobile video is increasingly used in people's daily life. Over half of participants (21 out of 38) regularly watched videos on mobile devices, of which 41% watched every day. Even if a few participants did not have a mobile device with video display; they have watched videos on their friends' phones. However, participants' requirements for video quality are widely divergent.

Influencing Factors of User-desired Video Quality

Many factors influence the user-desired video quality. The following sections emphasises three interesting factors; of which the first two factors have been found in our previous study (Song, et al., 2011) but need more discussion. In addition, the significant impacts of these factors have been supported by quantitative data analysis. This paper only presents the understandings of how they exert the impacts from participant's perspectives.

Preference for Video Content

The impact of users' preference for content on required quality is not completely consistent with the findings from a quantitative study (Jumisko-Pyykkö, et al., 2005), where for music videos people evaluate the quality higher if they are interested in the content. Our quantitative analysis shows that the impact of preference turns out to be in different directions, depending on the content types. The interview results provide sufficient explanations for the phenomenon.

For "animation" videos, the quality acceptability was not significant different between ones who liked it and those who did not like. Correspondingly, both types of participants' judgments were similar – "*not much to say*". For the videos with mainly figures and audio as an important part, such as "music", people who liked them could tolerate a low quality compared to those who disliked the content type. Because, they paid more attention to what

they could hear and they thought *“the image is not necessary to be very good”*.

For “sports” featured by fast movement, ball and team such as soccer, people had difficulties to view it on a small screen. To delight the people who were fond of sports, higher quality was needed compared to the people who did not like sports. The soccer fans longed for a very high quality: big image resolution and smooth motion, e.g., *“I want to the best quality” (M, 18, like sports), “is it possible to get higher (than the given highest test quality)?” (M, 21, like sports)*.

There were two different attitudes from the people who did not like sports. Some did not care about the quality because they thought that the players were too small to recognise on the small screen even if in a high quality; thus a high quality was not necessary for sports video. And they accepted a quality in which they could see enough of the game to understand what was going on and movement without jerks. But, others required a high quality because they would like to see the small players and the ball clearly. *“... I just keep selecting (quality) higher and higher because I hope I can see the small players clearer in the next higher quality” (F, 20, dislike sports)*

Experience in Viewing Videos

It is not surprising that participants’ experience in viewing videos is one of predominant factors influencing their desired video qualities. What is interesting is how the prior viewing experience exerts the influence. In general, participants who had rich experience in viewing mobile videos (frequent and long-term view) on a small screen were most likely to request a high quality. This is probably because the experienced users are more sensitive to the quality change. For instance, a one-year user said, *“I feel the (mobile) video quality is becoming better and better. Nowadays I can’t stand the previous (quality) anymore.”*

Moreover, people who often watch high quality videos such as HD 720p and 1080p on a big screen, expect a similar visual perception on a mobile device. Since the commonly watched high quality videos are movies from DVD, theatre, and so on, the main impact is embodied in the content type “movie”.

“I can’t accept a movie with a low clarity because that’s not correct, I mean, that’s not a movie should be.” (F, 23)

Technology Background

Ten participants (eight males and two females) had backgrounds in information technology. They looked at the video quality from a technical point of view, and showed more understandings of how difficult to get a high quality video on mobile devices. But it does not mean that they had a lower quality demand. Most of them were keen to use state-of-the-art mobile devices and requested a reasonable quality related to their preferences.

“I understand a high (video) quality has a high bit rate so it needs a wide network bandwidth; otherwise it can’t be displayed smoothly. And, mobile device may not support a

very high resolution.... I’m ok with an average quality level – not too pixelated and looks smooth.” (F, 26)

Only one man had an extremely high quality requirement. He could not bear watching videos on a mobile device and usually watched Blu-ray quality of videos on his laptop. In this case, his viewing experience played a predominant role.

User-preferred Quality-delivery Mode

Over 60% of participants said they did not choose a video quality, because they either never knew they could do (36%) or they did not want to do (24%). However, though they had not realised, they actually had made quality choices by not watching “bad quality videos”. As one said, *“I have no idea about choosing quality. I only search content. ... When I find an interesting video, I just open it and watch it. If it is bad - too blur, I close it”*. About 40% of participants had ever made quality selection. Some of them selected good quality videos for downloading or on-line streaming by scanning the word “HD” from video’s title or description. Only a few knew that they could use the quality button to select different quality settings on YouTube. However, all these users had confronted difficulties when choosing the video quality. Firstly, it was doubtful whether the word “HD” was reliable and whether other videos without “HD” were not in good quality; and secondly, it was unsure what the quality settings (e.g., 360p, 720p) really meant.

None of participants found any movie player on a mobile device could provide a function to select quality. Only one man demonstrated that using YouTube website on an iPhone, he could pick up video quality between “HQ” and non-“HQ”; but he disliked the way of switching quality because he had to *“stop the current display, back to the video page, click the quality option button, and then watch it again from the beginning.”*

We also investigated participants’ opinions on two quality-delivery modes: automatic and optimal delivery, and self-selecting. The former refers to automatically delivering users an optimal quality based on current network condition, mobile device’s displaying resolution, and even general users’ quality acceptability. And the later refers to allowing users themselves to select a preferred quality. Almost everyone liked the idea “automatic and optimal delivering” except one. He said, *“the generally acceptable quality is not as the same as what I need. I need check the limitation of my data amount, and I may want to a good quality when I watch a favorite movie.”* In fact, the “available data amount” and “personal preference” was concerned by many participants. That is why around 78% of participants would like to adjust the quality by themselves if they could have the chance to make choices. A few who did not bother to control the quality were from the population without information technology background. Their attitudes were *“just give me something to watch”* and *“quality selection will confuse me.”*

To sum up, video users have demands for quality selection, but they face some difficulties to make the decision such as no available function and unclear quality indicators. As for mobile video, lack of quality selection service has disabled the interaction with users in offering a preferred quality on mobile devices. The ideal quality-delivery mode for mobile video is the combination of automatic delivery and self-selected delivery, so that a user can *firstly watch the automatically provided quality, and then if it does not meet the user's needs, the quality can be adjusted manually.*

User Interface and Interaction

Touchable screen has become a trend of the state-of-the-art mobile devices. How to take the advantage of the touchable screen into the quality control of mobile video becomes an interesting question in user interface (UI) design. We demonstrated three options: buttons scales and swipe gestures to participants and asked their opinions. It turned out that different users had different tastes – the buttons and the scales obtained equal supports of 36% and the swipe gestures gained 28%. The advantages of using buttons were “*simple*”, “*accurate*”, and “*straight to the particular quality*”; and the main reasons of using scales were “*easy to use*” and “*easy to understand*” with the labeled quality scales (e.g., 1-2-3, or high-medium-low); while the benefit of using swipe gestures lied in its “*natural*” characteristic. No matter which option the users liked, the common requirement was that when quality switching the video should continue to play from the current time, rather than replay from the beginning.

As to the interactive information, there are different needs during different periods of mobile video delivery. Before opting a video to watch, users need some information to help them make a decision, including content (what about), duration (how long), others' comments (how popular), and file size (how big). Taking YouTube as an example, the first three needs have been well met, however, the last need – file size has not been supported. This need is actually related to the people's concerns on data amount and quality. Based on the file size, they can judge whether they are able to watch it under the network limitation; and with the duration together, they can estimate how the quality might be. In these situations, the information about bandwidth occupancy is more helpful but may not be understood by many people who do not have IT background.

During the loading time, the wanted information contains advertising, images from the video, images about other related videos, and text description of the video. However, about half of participants did not mind a black screen. They could stand it for a short time (several seconds), whereas if the loading took a bit longer they were happy to see some information.

During the watching time, despite the fact that most participants said they usually did not use a full-screen mode to watch on-line videos on a desktop or laptop, almost all of them liked the full-screen mode for mobile video on the

small screen, even though the video edges may be cropped. When manually tuning the quality of a displaying video, participants liked to see relative information on the selected quality to be temporarily shown on the screen. The information includes bandwidth (or bit rate) and image resolution requested by the people who have knowledge in network and video technology, or literal description of the quality, e.g., low, medium, high, requested by those who are not familiar with information technology.

CONCLUSION

This study is limited in that it does not take context into consideration. However, based on previous studies, the still usage (e.g., watching at home and during work break) is one of the most common situations for mobile video (Buchinger, et al., 2009; Song & Tjondronegoro, 2010). Thus, the results from this paper are helpful in addressing the issues under this context.

Regarding the issues discussed in the paper, to meet users' requirements, a flexible and personalised mobile video delivery is necessary, which can not only automatically provide an optimal quality, but also allow user's interaction. The former requests an adaptive quality delivery system and the later can be implemented by customised settings, such as enabling self-selecting quality mode and enabling button (/scales/gesture) to make the quality selection. Our future work will build and evaluate a video delivery prototype to meet user requirements.

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