Saving Bitrate vs. Pleasing Users: Where is the Break- Even Point in Mobile Video Quality?

Wei Song, Dian W. Tjondronegoro, Michael Docherty

Outline

- Introduction

- User study

- Result

- Conclusion

Introduction

- This paper presents a user study on mobile video quality requirements, aiming to find the lowest requirement for a pleasing viewing experience

- Maintaining a balance between users' satisfaction and bandwidth(cost) saving

User study

- Equipment
  - iPhone 3GS
  - H.264/AVC video format's baseline profile
  - AAC-LC audio format
- Test Materials
  - Test video was encoded using various combinations of parameters: quantization parameter(QP), spatial resolution(SR) and frame rate(FR)

User study(2)

- Test Materials(2)
  - Use five video content types in the user study, namely, news, music, animation, sports and movie
  - The 30 test clips were divided into three groups L, M and H, corresponding to three SR: 320x240 pixels, 480x320 pixels, and 640x480 pixel respectively

No.	QP	FR (fps)	No.	QP	FR (fps)
Clip1	40	12.5	Clip 6	32	25
Clip 2	40	25	Clip 7	28	12.5
Clip 3	36	12.5	Clip 8	28	25
Clip 4	36	25	Clip 9	24	12.5
Clip 5	32	12.5	Clip 10	24	25

User study(3)

- Participants
  - Equal number of males and females
  - In the age range of 17-35 (average age = 23.2)
  - Also collected other participants' profiles related to their experience using mobile video

Experience in watching mobile video	
• Frequency: at least once a week	21 (52.5%)
• Duration: less than six months	20 (50%)
Preference for content types	
• Animation	11 (27.5%)
• Movie	24 (60%)
• Music	16 (40%)
• News	10 (25%)
• Sports	12 (30%)

User study(4)

- Procedure
  - Step1: told participants that the purpose of this study and the test scenario
  - Step2: the participant randomly chose the video contents and decide the preferred quality under the scenario of cost saving
  - Step3: a short interview (about five minutes) was performed to further understand the user's experience.
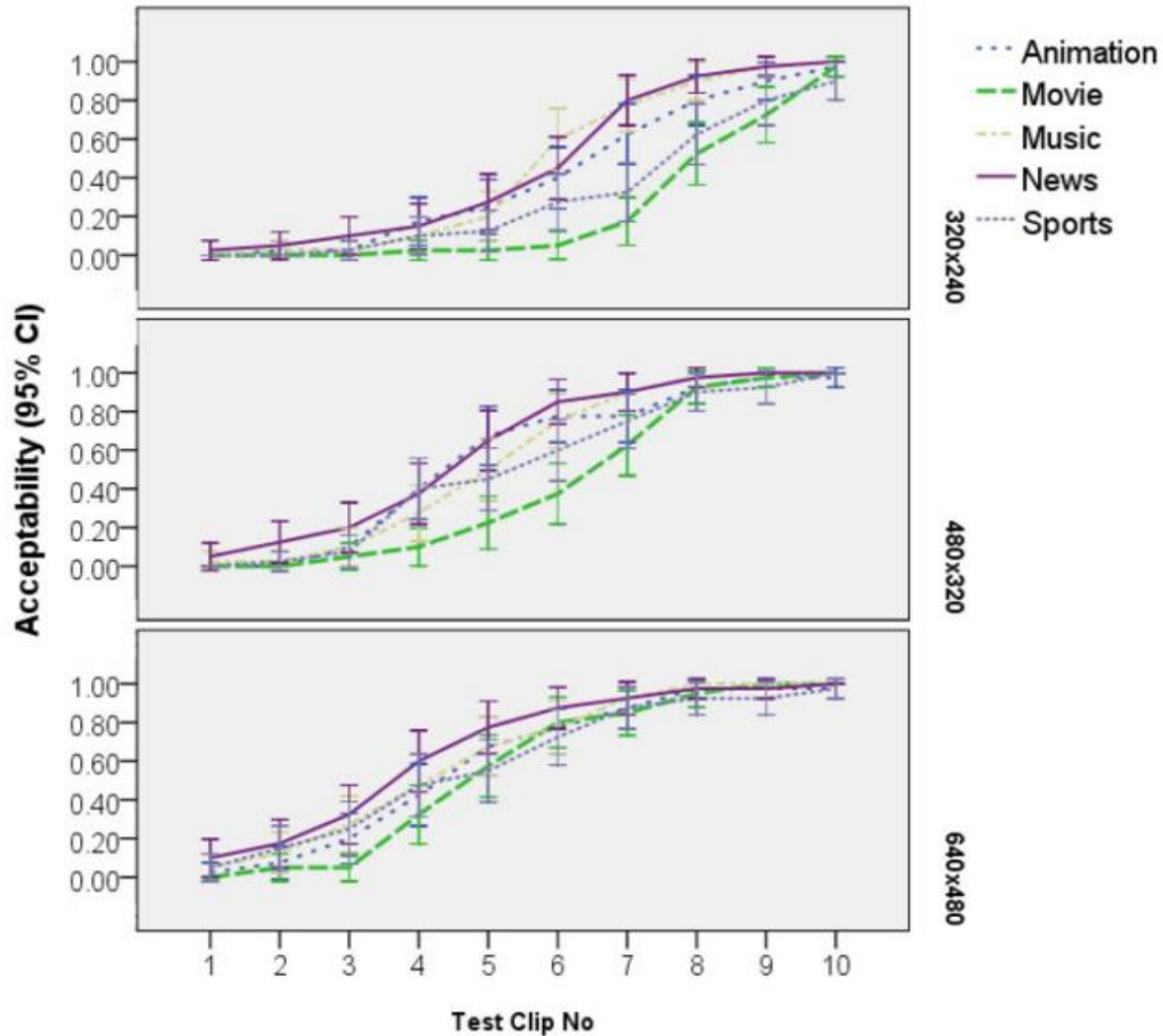
User study(5)

(a)

(b)

(c)
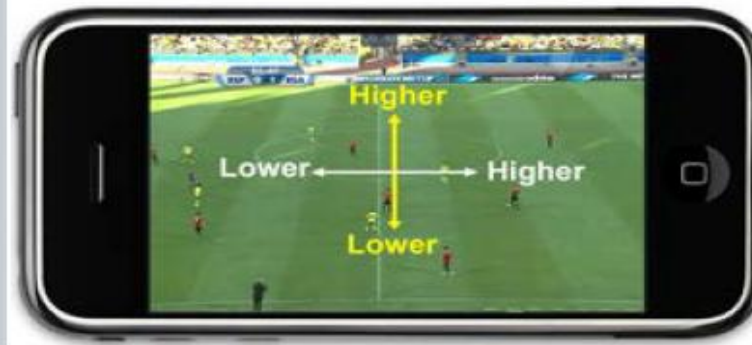
(d)

Result

Result(2)

- Acceptability and Encoding Parameters
  - highest resolution of 640x480 pixels, QP<=32 can meet 80% of user requirements for all content types
  - at 320x240 and 480x320 pixels resolutions, a higher quantization level (QP<=28) is needed for movies and sports than for other content types (QP=24).
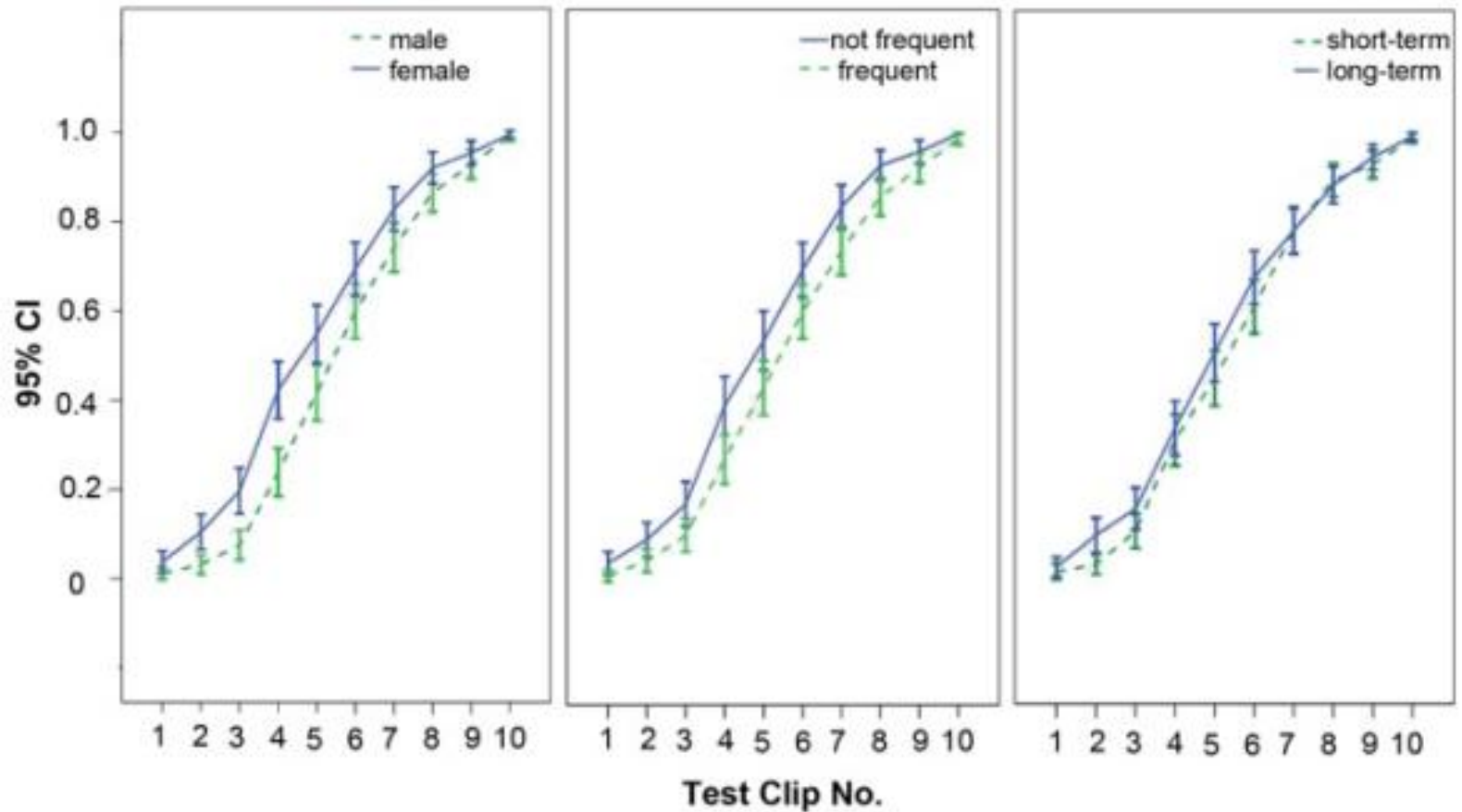
Result(3)

Accept-ability (%)	SR (pixels)	FR (fps)	Animation	Movie	Music	News	Sports
41-60	320x240	12.5	180-230	230-290	210-250	120-150	250-380
		25	200-270	230-290	220-270	150-200	400-580
	480x320	12.5	200-230	230-290	260-300	140-180	320-450
		25	200-270	270-320	300-350	160-210	320-460
	640x480	12.5	300-350	270-310	350-430	210-280	420-600
		25	350-410	270-320	380-480	250-300	450-620
61-80	320x240	12.5	230-320	290-360	250-300	150-200	380-520
		25	270-350	290-380	270-350	200-250	580-850
	480x320	12.5	230-350	290-360	300-380	180-230	450-630
		25	270-350	320-390	350-400	210-260	460-850
	640x480	12.5	350-450	310-400	430-550	280-360	600-850
		25	410-550	320-400	480-670	300-450	620-1000

Result(4)

- Effect of User Profile
  - frequent watchers (at least once per week) had a lower acceptability than those who do not often watch mobile video
  - the acceptability score for women was much higher than that for men
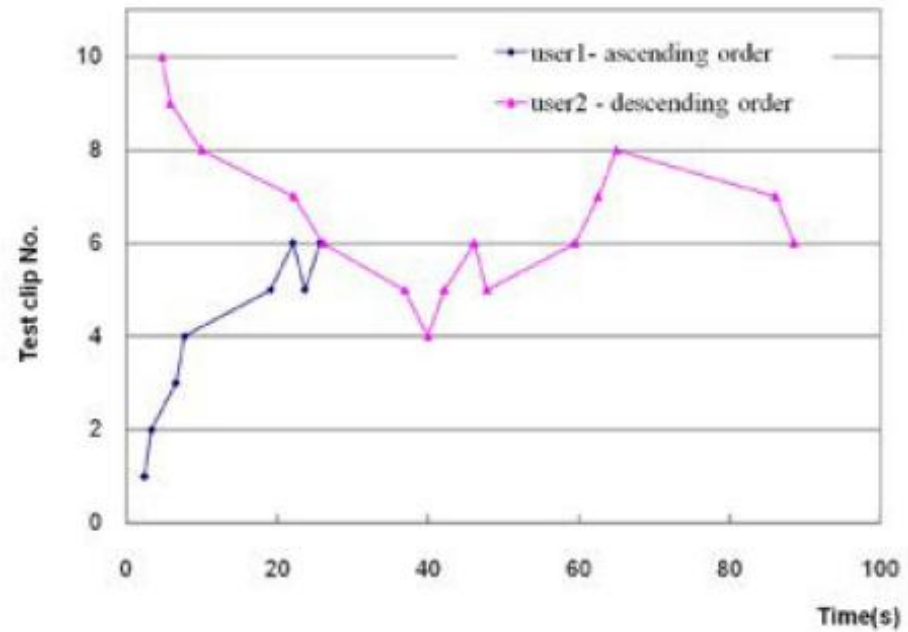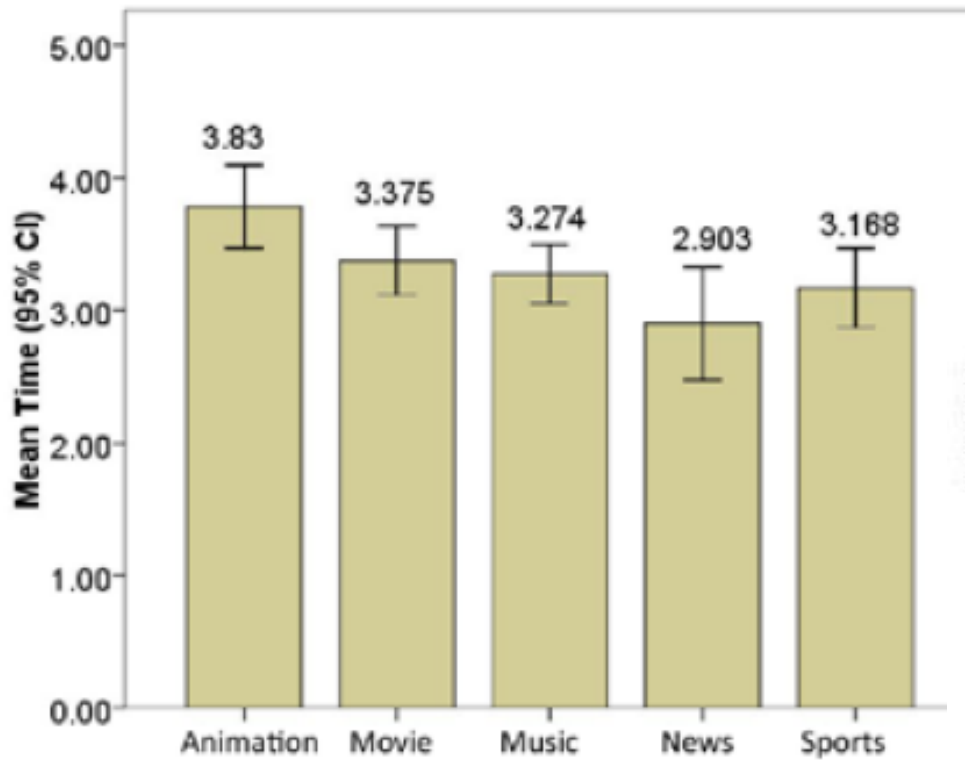
Result(5)

Result(6)

- Quality Selection Patterns
  - When users viewed videos from low quality to high quality, once they found the current quality was good enough, they could directly choose the current one as the lowest pleasing quality
  - When viewing from high to low, they often had to check at a low quality stage to see how poor the next quality would be

Result(7)

Result(8)

- Criteria of Acceptable Quality
  - For movie: at the highest resolution(640x480), a medium quantization quality (QP=32) can meet their needs. In low resolution (480x320, 320x240), a higher quantization quality (QP = 28, 24) is needed
  - For music, participants mentioned the audio quality

Result(9)

- For animation, they mainly do not like blockiness, as smoothness is the key for achieving a pleasing quality

- For sports, most participants agreed that when small objects exist, they need a higher quality compared to the big objects. The objects should also move smoothly.

- For news, news fans do not necessarily require a high quality because their main purpose in watching news video was for information

Conclusion

- The acceptability of video quality increases significantly with the decrease of the quantization parameter(QP) and the increase of spatial resolution(SR) and frame rate (FR)

- Users expect a high quality movie. They do not expect high video quality for music and news, but good sound and synchronization of audio and video.