

AhG8: Measurement of User Exploration Behavior for Omnidirectional (360°) Videos with a Head Mounted Display



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Introduction

- Reporting on the exploration behavior of users while watching omnidirectional (360°) videos
- Are users exploring 360° video equally in terms of yaw and pitch direction?
- What is the percentage of time spent on different viewports?

Dataset (4K)

Target Bit-rates

- 1, 2, 5, 8, 15 Mbps



Content 1: Harbor



Content 2: KiteFlite



Content 3: Trolley

Experimental Set-up

- Developed a framework for recording the head movements
 - Compatible with HTC Vive and Oculus Rift
- Rift's coordinate system is used
 - Positive yaw values: turning head left
 - Positive pitch values: pitching head upwards
- Yaw and pitch values - measured every 0.14 s
 - For 10 s long video sequences, approx. 72 values were recorded
- Subjects sit on a Rotating chair
 - Subjects were instructed to freely move while watching the videos

Oculus Rift
-2160×1200
-110° FOV
- Whirligig player

29 Participants
-14 Females
-15 Males
- Avg. age = 25.62
- Median age = 25

Experimental Results (1/8)

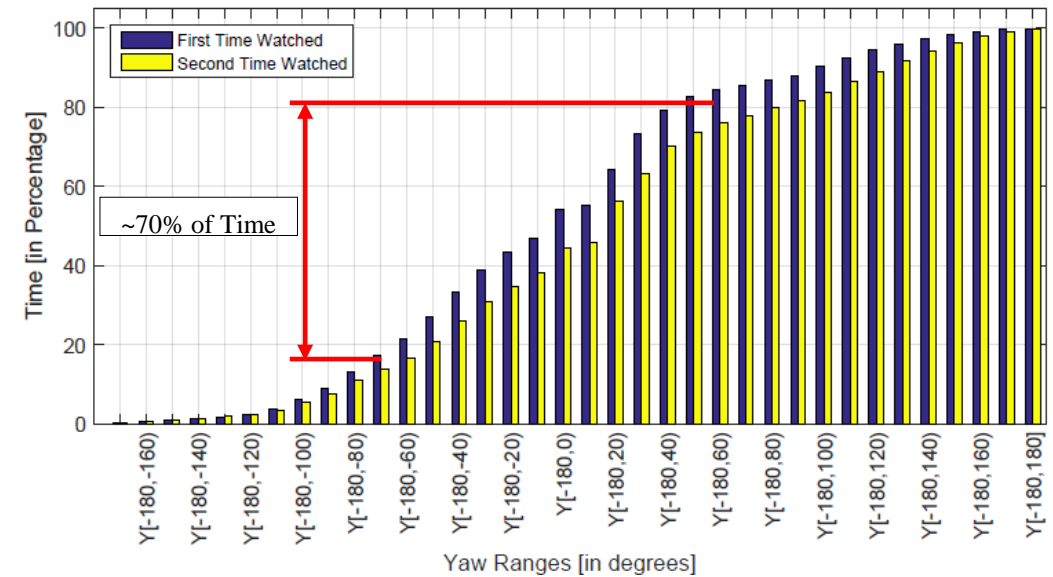
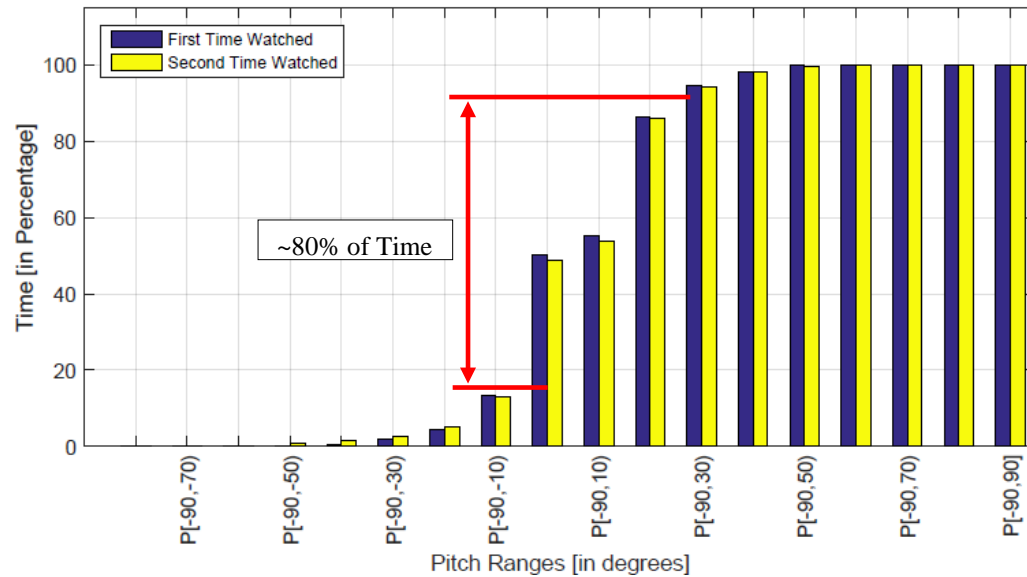


Figure 1a: Cumulative Histogram of yaw and pitch interval for Content 1

Experimental Results (2/8)

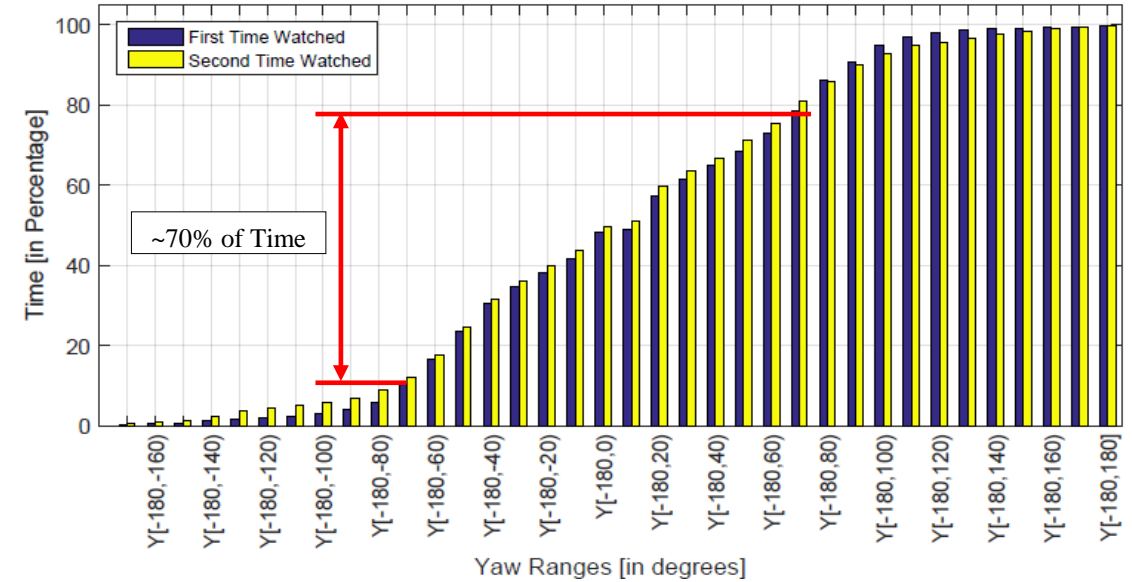
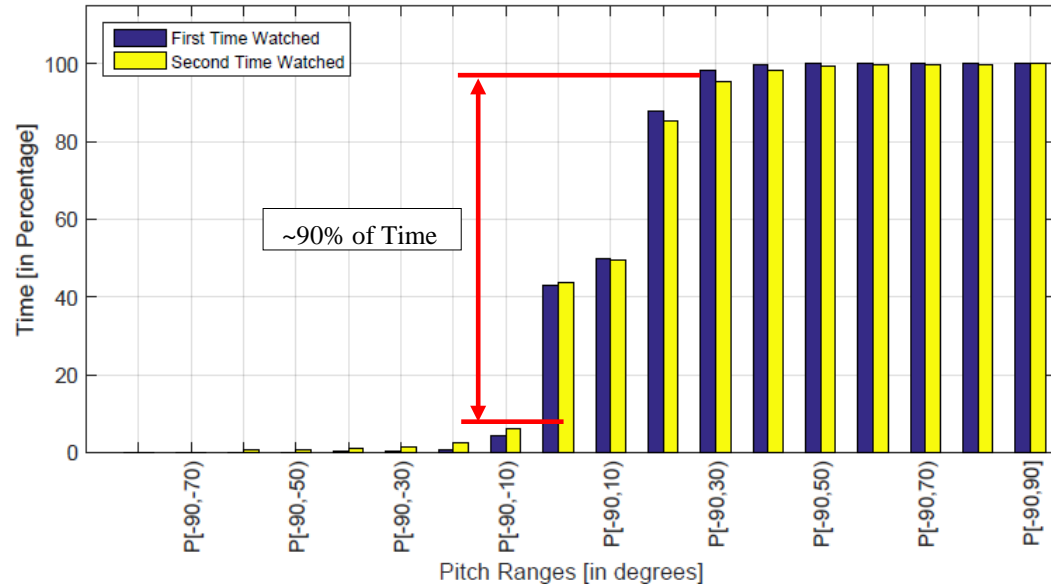


Figure 1b: Cumulative Histogram of yaw and pitch interval for Content 2

Experimental Results (3/8)

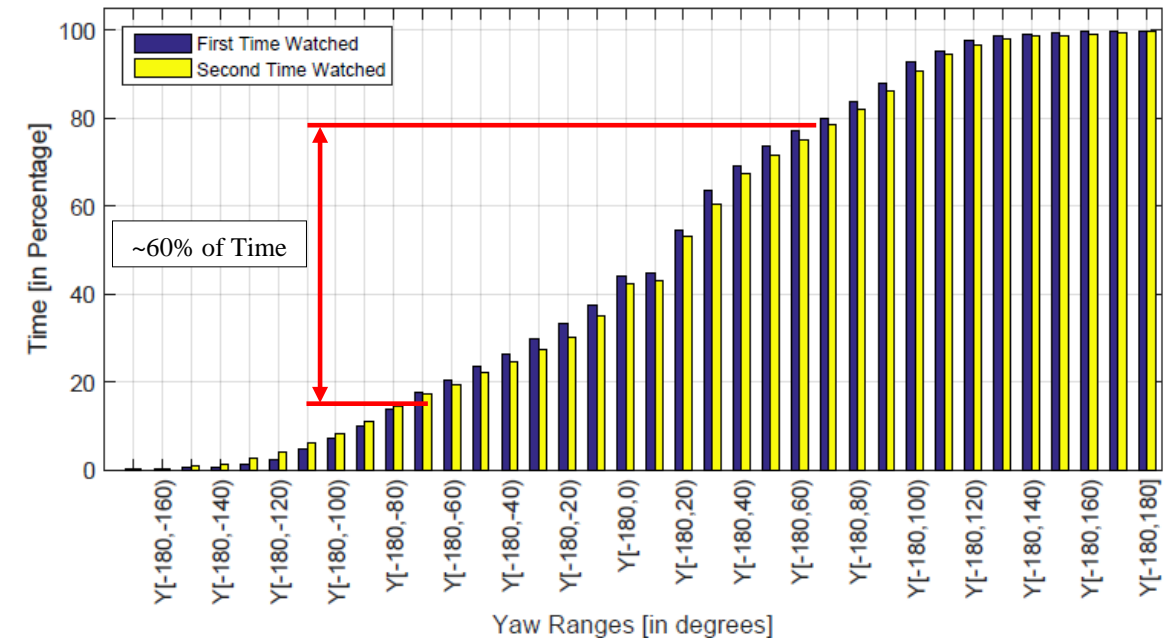
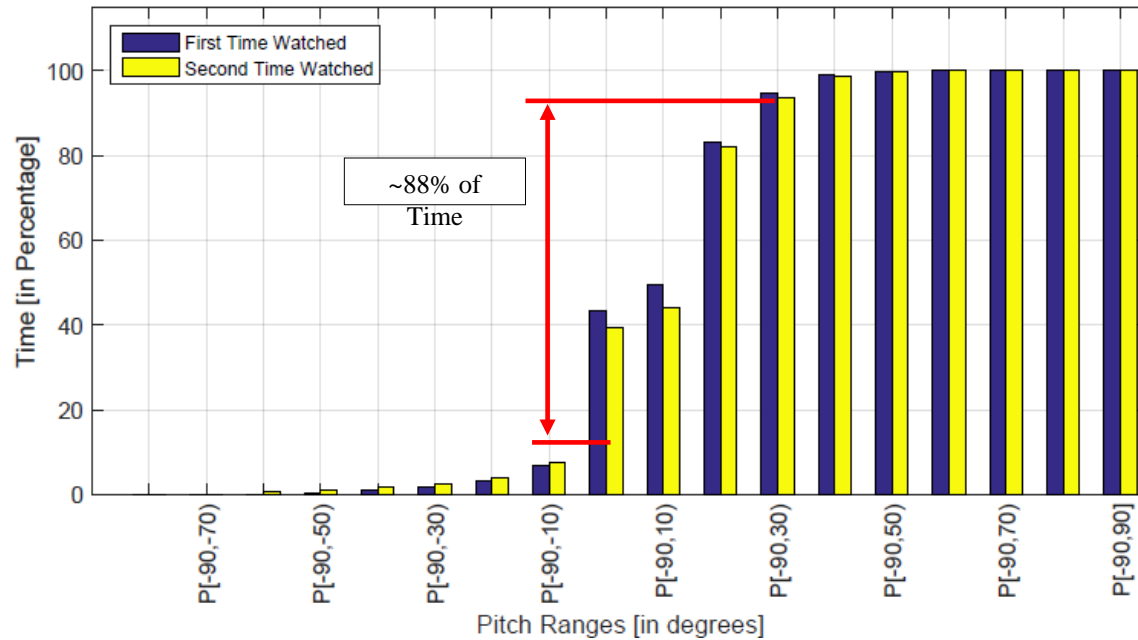


Figure 1c: Cumulative Histogram of yaw and pitch interval for Content 3

Experimental Results (4/8)

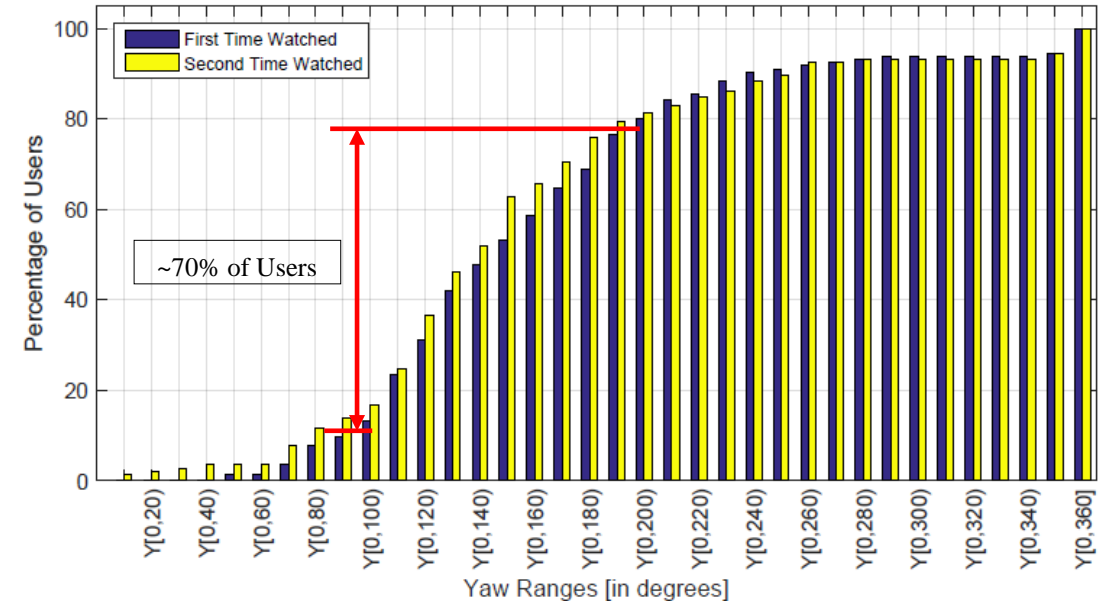
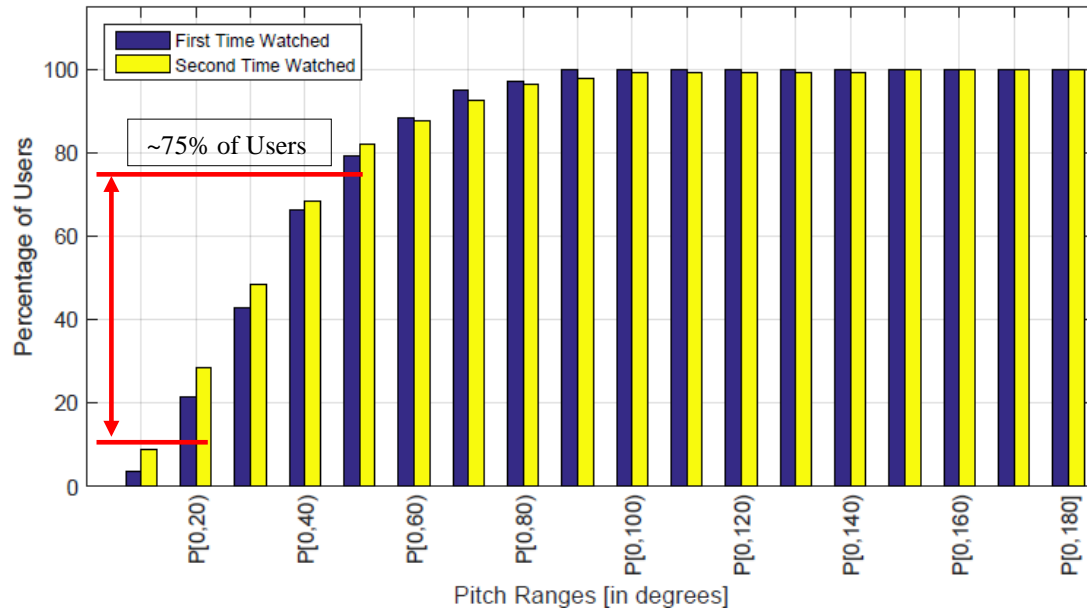


Figure 2a: Cumulative Histogram of relative yaw and pitch ranges for Content 1

Experimental Results (5/8)

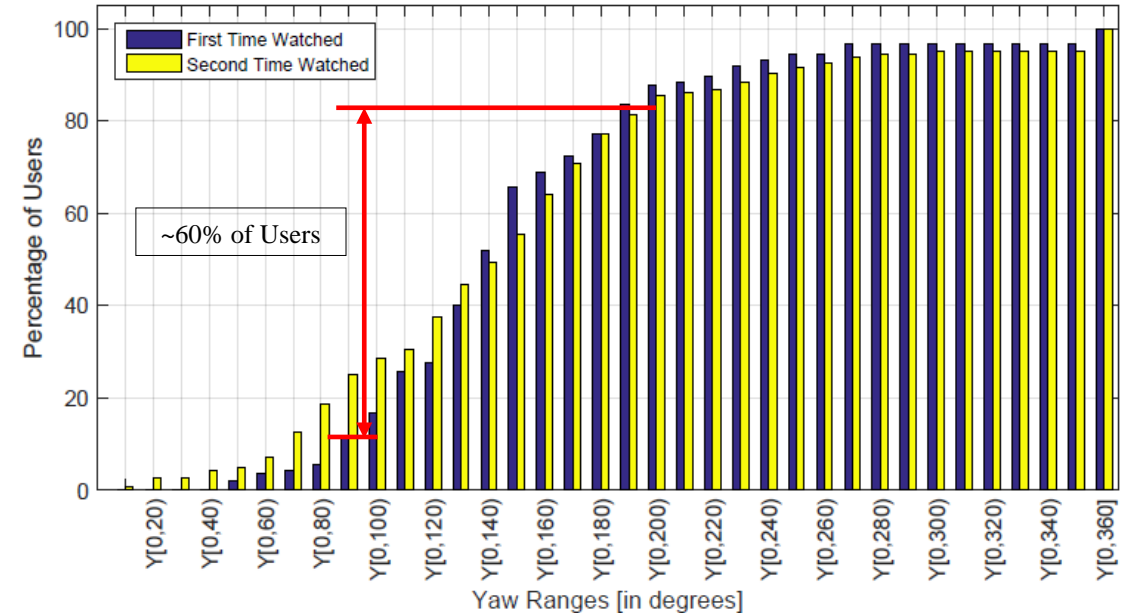
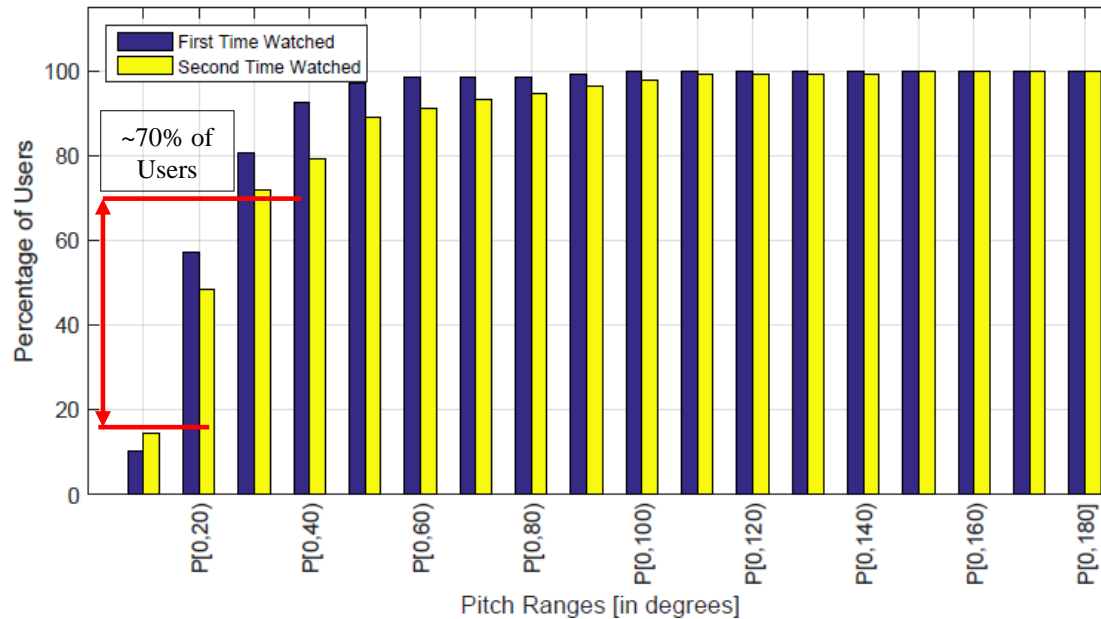


Figure 2b: Cumulative Histogram of relative yaw and pitch ranges for Content 2

Experimental Results (6/8)

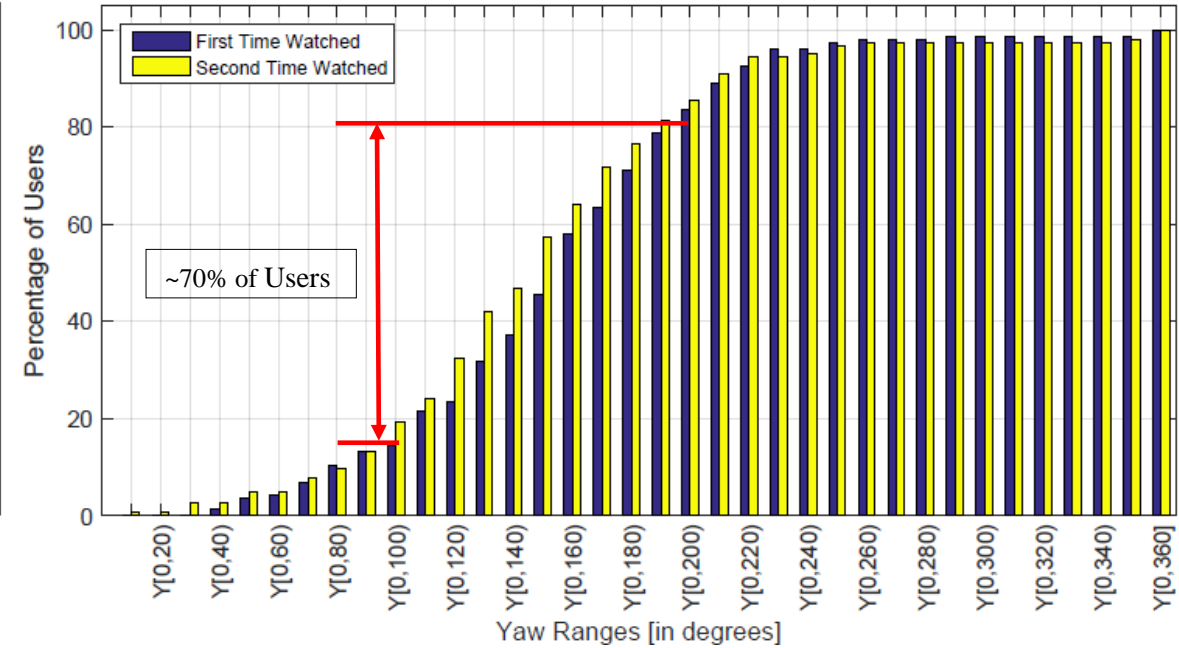
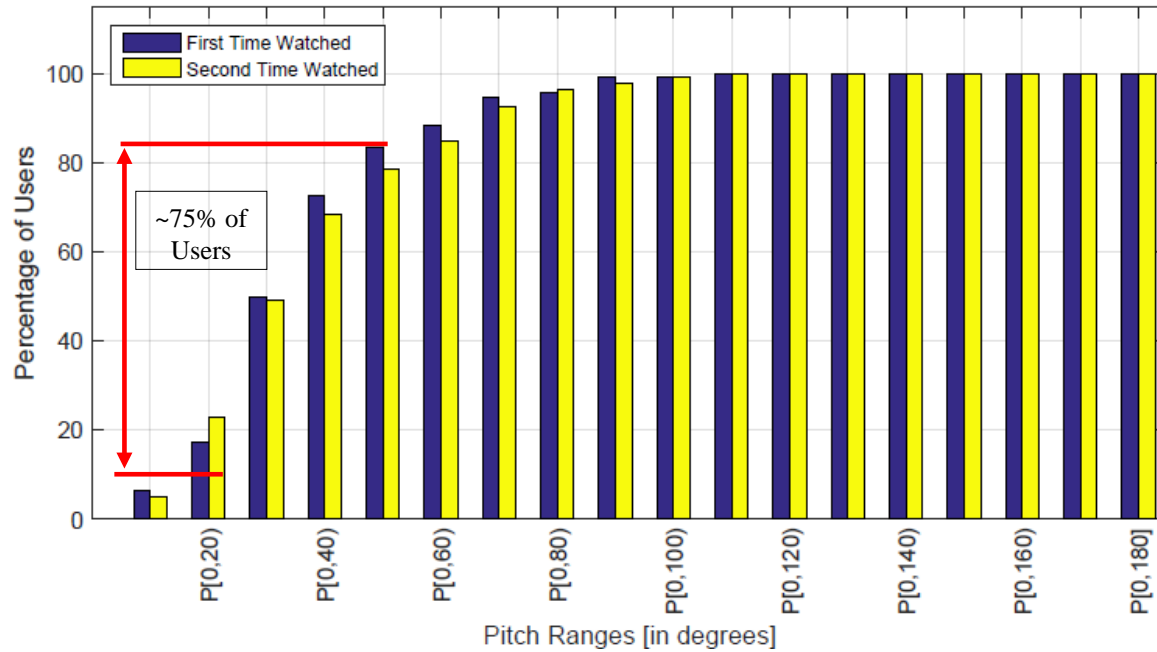
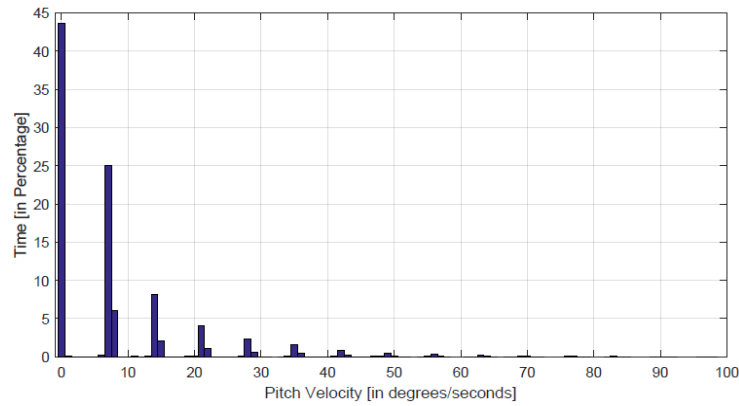
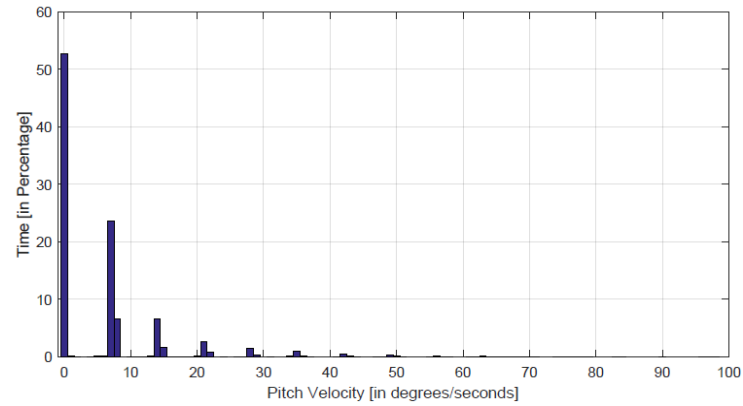


Figure 2c: Cumulative Histogram of relative yaw and pitch ranges for Content 3

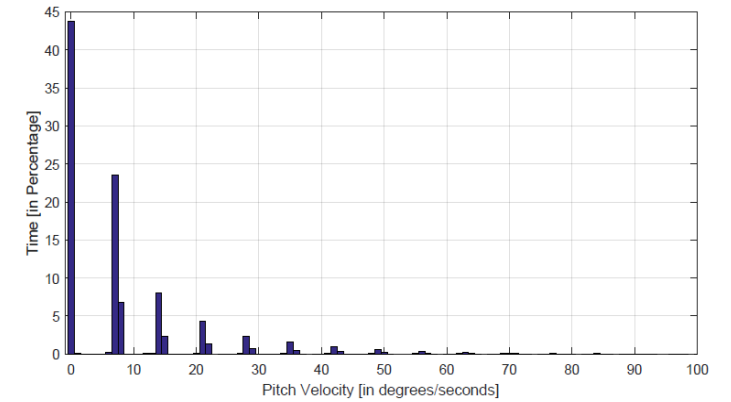
Experimental Results (7/8)



Content 1



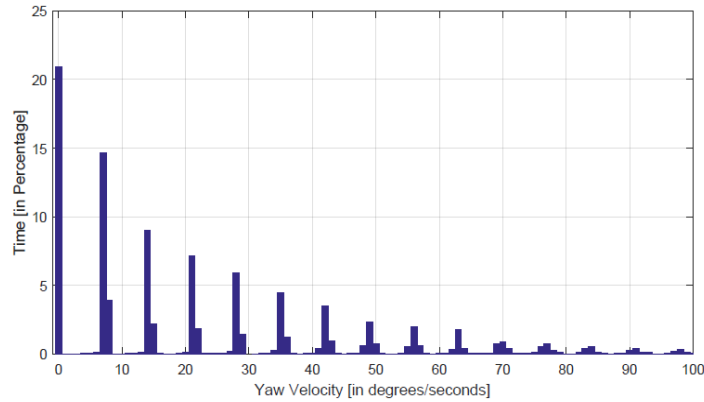
Content 2



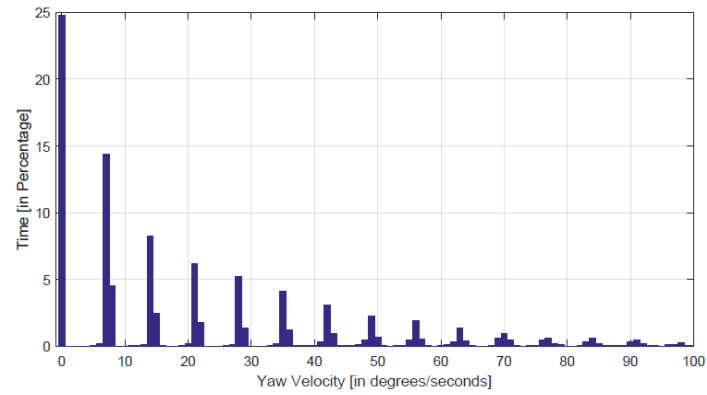
Content 3

Figure 3: Histogram of pitch velocities for all stimuli

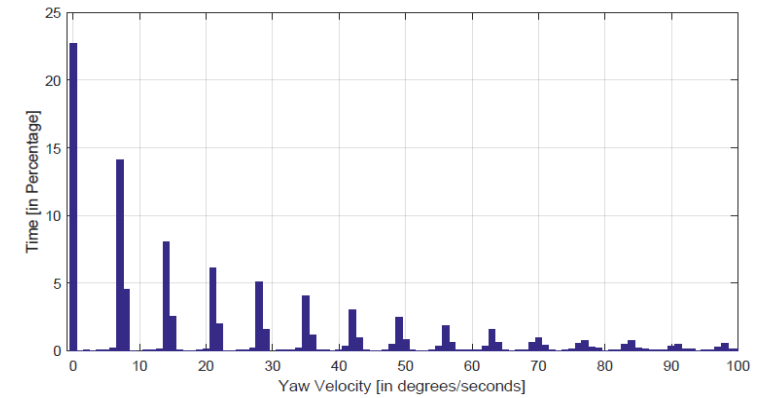
Experimental Results (8/8)



Content 1



Content 2



Content 3

Figure 3: Histogram of yaw velocities for all stimuli

Conclusion

- Subjects did not explore the complete yaw and pitch ranges
 - Yaw: Subjects prefer to move their head instead of rotating the chair
 - Pitch: Subjects don't feel comfortable to vertically move their head
 - Almost no subject explored the pitch range between $[-90, -50]$ and $[50, 90]$ and yaw range between $[-180, -140]$ and $[140, 180]$
- Relative exploration range
 - Pitch: 40°
 - Yaw: 110°
- Histogram of yaw and pitch velocities
 - Pitch: 45% stationary
 - Yaw: 20% stationary

Questions/Suggestions

