EECS 598: Mobile Interactive Multimedia Systems

Jiasi Chen

Winter 2024

Schedule and Topics

Week 1: Introduction

- Course overview + networking review
- How is multimedia created, stored, and disseminated?

Week 2: How to measure user experience?

- Lecture / paper discussion
    - A Balachandran, V Sekar, A Akella, S Seshan, I Stoica, H Zhang, "Developing a predictive model of quality of experience for internet video", ACM SIGCOMM, 2013.

Week 3: Adaptive video streaming

- Lecture / paper discussion
    - J. Jiang, V. Sekar, H. Zhang , “Improving Fairness, Efficiency, and Stability in HTTP-based Adaptive Video Streaming with FESTIVE”, ACM CoNEXT 2012.
    - Te-Yuan Huang, Ramesh Johari, Nick McKeown, Matthew Trunnell, Mark Watson, “A buffer-based approach to rate adaptation: evidence from a large video streaming service”, ACM SIGCOMM 2014.
- In-class exercise: dash-js adaptive video player

Week 4: Live video and gaming

- Lecture / paper discussion
    - Mark Claypool, Kajal Claypool, “Latency and player actions in online games”, Communications of the ACM, 2006.
    - Bolun Wang, Xinyi Zhang, Gang Wang, Haitao Zheng, Ben Y. Zhao, “Anatomy of a Personalized Livestreaming System”, ACM IMC 2016.
    - Yang Xu, Chenguang Yu, Jingjiang Li, and Yong Liu, “Video Telephony for End-consumers: Measurement Study of Google+, iChat, and Skype”, ACM IMC 2012.
- In-class exercise: Understanding Skype

Week 5: Virtual reality

- Lecture / paper discussion
    - Jian-Guang Lou, Hua Cai, Jiang Li, “A real-time interactive multi-view video system”, ACM Multimedia 2005.

    - Kevin Boos, David Chu, Eduardo Cuervo, “FlashBack: Immersive Virtual Reality on Mobile Devices via Rendering Memoization”, ACM MobiSys 2016.
    - M. McGill, D. Boland, R. Murray-Smith, S. Brewster, “A Dose of Reality: Overcoming Challenges in VR Head-mounted Displays”, ACM CHI 2015.
    - F. Qian, B. Han, L. Ji, V. Gopalakrishnan, “Optimizing 360 Video Delivery Over Cellular Networks”, ACM All Things Cellular Workshop 2016.
    - Anlan Zhang, Chendong Wang, Bo Han, and Feng Qian, "YuZu: Neural-Enhanced Volumetric Video Streaming download", USENIX NSDI 2022.
- In-class exercise: Exploring VR hardware

Week 6: Mixed reality

- Lecture / paper discussion
    - Kiryong Ha, Zuo Chen, Wenlu Hu, Wolfgang Richter, P. Pillai, M. Satyanarayanan, “Towards wearable cognitive assistance”, ACM MobiSys 2014.
    - P. Jain, J. Manweiler, R. Choudhury, “Low Bandwidth Offload for Mobile AR”, ACM CoNEXT 2016.
    - Tiffany Yu-Han Chen, Lenin Ravindranath, Shuo Deng, Victor Bahl, Hari Balakrishnan, “Glimpse: Continuous, Real-Time Object Recognition on Mobile Devices”, ACM SenSys 2015.
- In-class exercise: TensorFlow tutorial

Week 7: Mixed/virtual reality security

- Lecture / paper discussion
    - Yicheng Zhang, Carter Slocum, Jiasi Chen, Nael Abu-Ghazaleh, “It’s all in your head(set): Side channel attacks on augmented reality systems”, *USENIX Security,* 2023.
    - Carter Slocum, Yicheng Zhang, Nael Abu-Ghazaleh, Jiasi Chen, “Going through the motions: AR/VR keylogging from user head motions”, *USENIX Security*, 2023.
    - Kaiming Cheng, Jeffery F. Tian, Tadayoshi Kohno, and Franziska Roesner. “Exploring User Reactions and Mental Models Towards Perceptual Manipulation Attacks in Mixed Reality”, *USENIX Security*, 2023.
    - John Vilk , David Molnar, Benjamin Livshits, Eyal Ofek, Chris Rossbach, Alexander Moshchuk, Helen J. Wang, Ran Gal, “SurroundWeb: Mitigating Privacy Concerns in a 3D Web Browser”, IEEE Symposium on Security and Privacy 2015.
- In-class exercise: AR side channel leakages

Week 8: Content distribution

- Lecture / paper discussion

    - Erik Nygren, Ramesh K. Sitaraman, Jennifer Sun, “The Akamai Network: A Platform for High-Performance Internet Applications”, ACM SIGOPS 2010.
    - Minlan Yu, Wenjie Jiang, Haoyuan Li, Ion Stoica, “Tradeoffs in CDN designs for throughput oriented traffic”, ACM CoNEXT 2012.
    - Xi Liu, Florin Dobrian, Henry Milner, Junchen Jiang, Vyas Sekar, Ion Stoica, Hui Zhang, “A Case for a Coordinated Internet-Scale Video Control Plane”, SIGCOMM 2012.
    - M. Mukerjee, D. Naylor, J. Jiang, D. Han, S. Seshan, H. Zhang, “Practical, Real-time Centralized Control for CDN-based Live Video Delivery”, ACM SIGCOMM 2015
- In-class exercise: Video distribution simulations

Week 9: Wireless video

- Lecture / paper discussion
    - Jeffrey Erman, Alexandre Gerber, K. K. Ramakrishnan, Subhabrata Sen, Oliver Spatscheck, “Over the top video: the gorilla in cellular networks”, IMC 2011.
    - T. Stockhammer ; M.M. Hannuksela ; T. Wiegand, “H.264/AVC in wireless environments”, IEEE Trans. Circuits and Systems for Video Tech., 2003.
    - Jiasi Chen, Rajesh Mahindra, Mohammad Amir Khojastepour, Sampath Rangarajan and Mung Chiang, “A Scheduling Framework for Adaptive Video Delivery over Cellular Networks”, ACM MOBICOM 2013.
    - Szymon Jakubczak, Dina Katabi, “A Cross-Layer Design for Scalable Mobile Video”, ACM MobiCom 2011.

Week 10: Alternate delivery mechanisms

- Lecture / paper discussion
    - Dongyu Qiu, R. Srikant, “Modeling and Performance Analysis of BitTorrent-like Peer-to-Peer Networks”, ACM SIGCOMM 2004.
    - Paramvir Bahl, Ranveer Chandra, Thomas Moscibroda, Rohan Murty, Matt Welsh, “White Space Networking with Wi-Fi like Connectivity”, ACN SIGCOMM 2009.
    - Lorenzo Keller, Anh Le, Blerim Cici, Hulya Seferoglu, Christina Fragouli, Athina Markopoulou, “MicroCast: cooperative video streaming on smartphones”, ACM MobiSys 2012.
    - Bo Han, Feng Qian, Lusheng Ji, Vijay Gopalakrishnan, “MP-DASH: Adaptive Video Streaming Over Preference-Aware Multipath”, ACM CoNEXT 2016.
- In-class exercise: multipath video streaming

Week 11: Net neutrality and pricing

- Lecture / paper discussion
    - Sangtae Ha, Soumya Sen, Carlee Joe-Wong, Youngbin Im and Mung Chiang, “TUBE: Time-Dependent Pricing for Mobile Data”, ACM SIGCOMM 2012.
    - Richard T. B. Ma and Vishal Misra, “The Public Option: A Non-Regulatory Alternative to Network Neutrality”, IEEE/ACM Transactions on Networking, December 2013
    - F.P. Kelly, A.K. Maulloo, and D. K. H. Tan, “Rate Control for Communication Networks: Shadow Prices, Proportional Fairness and Stability,” Journal of Operational Research, 1998
- In-class exercise: time-dependent pricing

Week 12: Generative AI

- Lecture / paper discussion
    - Alex Nichol, Heewoo Jun, Prafulla Dhariwal, Pamela Mishkin, Mark Chen, "Point-E: A System for Generating 3D Point Clouds from Complex Prompts", arXiv, 2022.
    - Heewoo Jun, Alex Nichol, "Shap-E: Generating Conditional 3D Implicit Functions", arXiv, 2023.
- In-class exercise: HuggingFace demos

Week 13: Overflow / TBD

Week 14: Final project presentations

Week 15: Final project presentations

Grading

- Paper presentation: 20%
- Discussion: 20%
- In-class exercises: 20%
- Final project: 40%