FATIMA MUHAMMAD ANWAR

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INTERESTS

I lead the Emerging Embedded Technologies (EMTECH) lab where we design trustworthy systems around secure abstractions to provide key services to emerging applications running on commodity platforms and operating systems in distributed Cyber-Physical Systems.

EDUCATION

University of California, Los Angeles September 2014 - June 2019
PhD. in Electrical & Computer Engineering

- Advisor: Professor Mani Srivastava
- Dissertation: Quality of Time: A New Perspective in Designing Cyber-Physical Systems
- Awards: Qualcomm Innovation Fellowship Finalist 2018, Grace Hopper Scholar 2017, Departmental Fellowship

Ajou University, South Korea March 2009 - Feb 2011
MS. in Computer Engineering

- Advisor: Seung Wha Yoo, Ki Hyung Kim
- Thesis: Spherical Mapping based load-aware Routing for Wireless Sensor Networks
- Awards: BK21 - Brain Korea 21 Scholarship

University of Engineering & Technology, Lahore Pakistan September 2004 - August 2008
BSc. in Electrical Engineering: Electronics & Communication *(summa cum laude)*

ACADEMIC & PROFESSIONAL APPOINTMENTS

University of Massachusetts, Amherst September 2019 - Present
Electrical & Computer Engineering, Assistant Professor

University of California Los Angeles September 2014 - June 2019
Networked & Embedded Systems Lab, Research Assistant

Samsung Electronics, Mobile Communications Division March 2011 - December 2013
Advanced R&D Group, Software Engineer *South Korea*

HONORS & AWARDS

- **TVCG'23** paper on mixed reality presence got digital and social media coverage
- **NSF CAREER Award'22** for "Secure Timing Architecture for Untrusted Edge Systems
- **SenSys'22** student awarded best PhD forum award
- **QInF'18** Qualcomm Innovation Fellowship finalist
- **Sigcomm'17 N2Women** Best lightning talk awarded at N2Women Workshop at SIGCOMM
- **GHC Scholar'17** Awarded scholarship for grace hopper celebration in computing

RESEARCH PUBLICATIONS

CONTEXT

- Graduate and undergraduate students that I have advised are CAPITALIZED and BOLD. Students that I have advised as part of extending course projects for publication are UNDERLINED. All papers are available at https://scholar.google.com/citations?user=zRFcmiYAAAAJ&hl=en. By convention, in my field, student authors are listed first in order of contribution followed by senior authors.
- In computer systems research, the top conferences are generally considered as important as the top journals. For more details on the unique role of conferences in computer systems research see the published memo of Computing Research Association (CRA) on best practices in evaluating computer scientists for promotion and tenure.

JOURNAL ARTICLES

1. **YASRA CHANDIO**, N Bashir, V Interrante, Fatima M Anwar. Investigating the Correlation Between Presence and Reaction Time in Mixed Reality, IEEE Transactions on Visualization and Computer Graphics (TVCG), 2023
2. MT Raza, Z Tan, A Tufail, Fatima M Anwar. LTE NFV rollback recovery, IEEE Transactions on Network and Service Management 19 (3), 2468-2477, 2022
3. MT Raza, Fatima M Anwar, D Kim, KH Kim. Highly Available Service Access Through Proactive Events Execution in LTE NFV, IEEE Transactions on Network and Service Management 18 (3), 2531-2544, 2021
4. Fatima M Anwar, Mani Srivastava. A Case for Feedforward Control with Feedback Trim to Mitigate Time Transfer Attacks, ACM Transactions on Privacy and Security (TOPS), 2020

CONFERENCE PROCEEDINGS

5. **ADEEL NASRULLAH**, Fatima M Anwar. Haest: Harvesting ambient events to synchronize time across heterogeneous IoT devices, accepted at Proceedings of the 30th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS), 2024
6. **ADEEL NASRULLAH**, Fatima M Anwar. Trusted Timing Services with TimeGaurd, accepted at Proceedings of the 30th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS), 2024
7. **YASRA CHANDIO**, Fatima M Anwar. Stealthy and practical multi-modal attacks on mixed reality tracking, accepted at Proceedings of the 6th IEEE International Conference on Artificial Intelligence and extended and Virtual Reality (AIXVR), 2024
8. N Bashir, **YASRA CHANDIO**, D Irwin, Fatima M Anwar, J Gummeson, P Shenoy. Jointly Managing Electrical and Thermal Energy in Solar-and Battery-powered Computer Systems, 14th ACM International Conference on Future Energy Systems, 2023
9. **MOMIN AHMAD KHAN**, V Shejwalkar, A Houmansadr, Fatima M Anwar. On the pitfalls of security evaluation of robust federated learning, 7th Deep Learning Security and Privacy Workshop, IEEE Security and Privacy (Oakland S&P), 2023
10. RH Anwar, Fatima M Anwar, MK Haider, A Efrat, MT Raza. Redefining the Driver's Attention Gauge in Semi-Autonomous Vehicles, ACM Conference on Modeling Analysis and Simulation of Wireless and Mobile Systems, 2023
11. **KHOTSO SELIALIA**, **YASRA CHANDIO**, Fatima M Anwar. Federated Learning Biases in Heterogeneous Edge-Devices: A Case-Study, 20th ACM Conference on Embedded Networked Sensor Systems, AICHallengeIoT, 2022
12. **YASRA CHANDIO**, N Bashir, Fatima M Anwar. HoloSet-A Dataset for Visual-Inertial Pose Estimation in Extended Reality: Dataset, 20th ACM Conference on Embedded Networked Sensor Systems, DATA, 2022
13. **MOMIN AHMAD KHAN**, V Shejwalkar, A Houmansadr, Fatima M Anwar. Security Analysis of SplitFed Learning, 20th ACM Conference on Embedded Networked Sensor Systems, AICHallengeIoT, 2022
14. **ADEEL NASRULLAH**, **MOMIN AHMAD KHAN**, Fatima M Anwar. Universal Timestamping with Ambient Sensing, 19th Annual IEEE International Conference on Sensing, Communication, and Networking (SECON), 2022
15. MT Raza, Y Guo, S Lu, Fatima M Anwar. On Key Reinstallation Attacks over 4G LTE Control-Plane: Feasibility and Negative Impact, Annual Computer Security Applications Conference (ACSAC), 877-886, 2021
16. N Prabhu, D Naik, Fatima M. Anwar Trusted Video Streaming on Edge Devices, IEEE International Conference on Pervasive Computing and Communications (2021)
17. Sandeep Singh Sandha, Luis Garcia, Bharathan Balaji, Fatima M Anwar, Mani Srivastava. Sim2Real Transfer for Deep Reinforcement Learning with Stochastic State Transition Delays, 4th Annual Conference on Robot Learning (CoRL) (2020)
18. **YASRA CHANDIO**, Fatima M Anwar. Spatiotemporal security in mixed reality systems, Proceedings of the 18th Conference on Embedded Networked Sensor Systems (SenSys) poster, 725-726 (2020)

19. Joseph Naoor, Sandeep Singh, Fatima M Anwar, Mani Srivastava. Time Awareness in Deep Learning-Based Multimodal Fusion Across Smartphone Platforms, ACM/IEEE Conference on Internet of Things Design and Implementation (IoTDI) (2020)
20. MT Raza, Fatima M Anwar, D Kim, KH Kim. FERRET: Fall-back to LTE Microservices for Low Latency Data Access, 3rd USENIX Workshop on Hot Topics in Edge Computing (HotEdge) (2020)
21. Fatima M Anwar, Luis Garcia, Xi Han, Mani Srivastava. Securing Time in Untrusted Operating Systems with TimeSeal, IEEE Real Time Systems Symposium (RTSS'19).
22. Fatima M. Anwar, Mani Srivastava. Applications and Challenges in Securing Time, USENIX Workshop on Cyber Security Experimentation and Test (CSET'19).
23. Joseph Noor, Sandeep Singh, Fatima M. Anwar, Mani Srivastava. Exploiting Smartphone Peripherals for Precise Time Synchronization, IEEE Symposium on Precision Clock Synchronization for measurement, control, and communication (ISPCS'19).
24. Fatima M. Anwar, Amr Alanwar, Mani Srivastava. OpenClock: A Testbed for Clock Synchronization Research, IEEE Symposium on Precision Clock Synchronization for measurement, control, and communication (ISPCS), Oct 2018, CERN, the European Organization for Nuclear Research.
25. Fatima M. Anwar, Mani Srivastava. A trust in time saves millions, USENIX Summit on Hot Topics in Security, Aug 2018, Baltimore, USA.
26. Muhammad Taqi Raza, Fatima M. Anwar, Songwu Lu. Exposing LTE Security Weaknesses at Protocol Inter-Layer, and Inter-Radio Interactions, 13th International Conference on Security and Privacy in Communication Networks (SecureComm), Oct 2017, Niagra Falls, Canada.
27. Fatima M. Anwar, Mani Srivastava. Precision Time Protocol over LR-WPAN & 6LoWPAN, ISPCS, Aug 2017, California, USA.
28. Amr Alanwar, Fatima M. Anwar, Yi-Fan Zhang, Justin Pearson, Joao Hespanha, Mani Srivastava. Cyclops: PRU Programming Framework for Precise Timing Applications, ISPCS, Aug 2017, California, USA.
29. Fatima M. Anwar, Sandeep D'souza, Adwait Dongare, Anthony Rowe, Raj Rajkumar, Mani Srivastava. Timeline: An Operating System Abstraction for Time-Aware Applications, IEEE Real Time Systems Symposium (RTSS), Dec 2016, Porto, Portugal.
30. Zhou Fang, Mulong Luo, Fatima M. Anwar, Hao Zhuang, Rajesh K. Gupta. Go-realtime: a lightweight framework for multiprocessor real-time system in user space, ACM SIGBED Review - Special Issue on Real-time Computing and Distributed Systems in Emergent Applications (REACTION 16) archive Volume 14 Issue 4 Pages 46-52.
31. Amr Alanwar, Fatima M. Anwar, Joao Hespenha, Mani Srivastava. Realizing Uncertainty-Aware Timing Stack in Embedded Operating Systems, ACM Embedded Operating Systems Workshop in conjunction with ESWEEK, Oct 2016, Pittsburgh USA.
32. Fatima M. Anwar, Seung wha Yoo, Ki hyung Kim. Spherical Mapping based Load Aware Routing for Wireless Sensor Networks, Technical Report, 2011.
33. Fatima M. Anwar, M. Taqi Raza, Seung wha Yoo, Ki hyung Kim. ENUM based service discovery architecture for 6LoWPAN, IEEE Wireless Communication and Networking Conference (WCNC), April 2010, Sydney, Australia.
34. Fatima M. Anwar, Seung wha Yoo, Ki hyung Kim. Survey on service discovery for Wireless Sensor Networks, ICUFN, June 2010, Jeju Island, Korea.
35. M. Taqi Raza, Fatima M. Anwar, Seung wha Yoo, Ki hyung Kim. Requirements and Design Architectures of Sensor Service Portal (SSP) in Ubiquitous Pervasive Environment, Handbook of Research on Mobile Software Engineer Design, Implementation and Emergent Applications, IGI Publishing, 2011.

OPEN SOURCE SOFTWARE & HARDWARE ARTIFACTS

- `TimeSeal`: A secure time architecture
- `QoT Stack`: Timeline centered Quality of Time (QoT) architecture
- `wPHC`: Wireless Precise Hardware Clock enables PTP over WPAN & 6LoWPAN
- `OpenClock`: A testbed for clock synchronization research
- `Cyclops`: Cycle level operations for timing detrminism
- `GoodClock`: Providing Shared Notion of Time across Smartphones

TEACHING

ECE 231: Introduction to Embedded Systems Spring 20,21,23
Assistant Professor *UMass Amherst*

- Introducing embedded systems concepts to sophomores with a particular focus on programming in embedded C and Linux. Labs deliver hands-on experience with AVR and Beaglebone Black embedded boards

ECE 535/635: Advanced Networked Embedded Systems Design Fall 19, 20, 21, 22, 23
Assistant Professor *UMass Amherst*

- Major emphasis on (1) Hardware platforms for emerging applications at the edge, (2) Software for bare-metal platforms, and embedded OS (3) Network based coordination for distributed entities and (4) Cloud-based services for compute-intensive tasks
- Student course projects span various domains in secure design, machine learning and emerging applications. Project repositories maintained online at,
https://github.com/emtechlab/

Invited Lectures

- UMass ECE 303 Junior Seminar on "Computer Software Systems and Networks" - Fall 2020-2023
- UoArizona MIS "Timing in Data Centers" - Fall 2021
- UMass ECE 547 Security Engineering "IoT Security& Privacy" - Spring 2020

INVITED PRESENTATIONS AND SEMINARS

- Secure Timing Architecture for Untrusted Edge Systems, OCP-TAP talk, organized by Meta 2023
- Human-Centered computing in Mixed Reality Systems, Adobe-UMass Workshop 2021
- Quality of Time: A New Perspective in Desigining Cyber-Physical Systems, GTech, UVA, UMass, OSU 2019
- Stale time is a security threat, ENGR 191 Research Seminar, UCLA 2018
- Lip Sync: Achieving perfect synchrony in audio and video, Grad Slam 3 minute research talk, UCLA 2018
- Clocks & Time Synchronization, CS/ECE M119 guest lecture, UCLA 2018
- TNT: Trusted Notion of Time for Resilient Autonomous Driving, QInF'18 Finalist talk 2018
- Quality of Time in Cyber Physical Systems, at System Energy Efficiency Lab (SeeLab), UCSD 2017
- Embedded Linux Time Stack, EEM202A guest lecture, UCLA 2017
- Timing Abstractions & Programmable Clocks in Network Programming, SIGCOMM lightning talk 2017
- Timeline: An Operating System Abstraction, ECE Annual Research Review, UCLA 2017
- Introduction to Embedded Systems, Los Angeles Computing Circle, UCLA 2017-2018
- Introduction to Energy & Power Efficiency, Los Angeles Computing Circle, UCLA 2016

ADVISING

Ph.D. Dissertation Advisor and Doctoral Committee Chair

- Yasra Chandio (entered Spring'20, Passed RQE, Honorable Mention in 3MT competition, Best PhD Forum Award at SenSys, CRA-E Fellow, Heidelberg Laureate Forum Participant)
- Adeel Nasrullah (entered Spring'20, Passed RQE)
- Khotso Selialia (entered Fall'21)
- Momin Khan (entered Fall'21)

Doctoral Committee Member

- Noman Bashir "Improving the programmability of networked energy systems" - 2021
- Santiago Correa Cardona "Models and machine learning techniques for improving the planning and operation of electricity systems in developing regions" - 2021

Masters Thesis Committee Member

- Ning Wang ("Semantic-Aware Blockchain Architecture Design for Edge-enabled Metaverse"), Advisor: Beatriz Lorenzo - 2024
- Yinxuan Wu ("Cross-Domain Lifelong Learning for Age of Information Minimization in Satellite-Terrestrial Networks"), Advisor: Beatriz Lorenzo - 2023
- John Murray ("Multimedia Networking in Mixed Reality Settings"), Advisor: Mike Zink - 2023
- Aiden Gula ("Internet Infrastructure for large scale emulation with efficient HW/SW co-design"), Advisor: Russ Tessirt - 2021

Senior Design Project Advising (ECE416)

- Samridh Tuteja, Arham Mohammad, John Wheeler, Shravan Janga ("GymSense") - 2023
- Dhanraj Bhoj, Shayan Abtahi, Owen Ross, Sarive Kadate ("FireSafe") - 2022
- Jonathan Yip, Alexander Dickopf, Anthony Chan, Cameron Kluza ("TrueTouch") - 2020
- Owen Boucher, Aisha Ben-Neticha, Angela Wong, Madelyn Wright ("Pest Alert") - 2020

Independent Study (ECE 696)

- Kalyani Patle ("Personalized Perception and Visuals in Mixed Reality") - 2022
- Meghana Vishwanath ("Machine Learning at the Embedded Edge") - 2020
- Akshata Ashok Kulkarni ("Internet of Things (IoT) device discovery, configuration and control using Augmented Reality") - 2019

SERVICE

Community Outreach

- Amherst Girls Scout Programming for Cybersecurity Badge, **2022**
- UMass Massenberg Summer STEM Institute, **2021**
- UMass Summer Engineering Institute (SENGI), N2Women (Networking Networking Women) Mentoring Chair, **2020**
- Los Angeles Computing Circle (LACC) Workshop, and Engineering Day for Girls at UCLA, **2016-2018**
- Panelist in Students with Dependents Working Group at UCLA, **2018**

Departmental

- Department Personnel Committee (DPC) **2023**
- Seminar Management Committee, **2020-2021**
- Diversity, Equity and Inclusion Committee (DE&I), **2020-2024**
- Faculty mentor for "PhD Women in Electrical and Computer Engineering" group. This group consists of almost 25 female PhD students in ECE who seek community and academic mentorship **2019-now**

College

- Year long "Young Investigator" project under CoE for high school juniors or seniors. This program is a part of Public Service Endowment Grant (PSEG), **2021-2022**

University

- Mutual mentoring effort with academic mothers, **2019-2021**

Conference & Workshop Chair

- Co-Chair for the International Workshop on Security and Privacy of Sensing Systems (Sensors S&P), co-located with 20th ACM Conference on Embedded Networked Sensor Systems (SenSys), **2023**
- Publicity Chair for ACM/IEEE Conference on Internet of Things Design and Implementation (IoTDI) **2024**
- Workshop Co-Chair for ACM Conference on Embedded Networked Sensor Systems (SenSys), **2022**

Journal Reviewer

- ACM Transaction on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT) **2023**
- IEEE Transactions on Systems, Man, and Cybernetics: Systems, IEEE Transactions on Vehicular Technology, **2020**
- Transaction on Cybernetics, Transactions on Vehicular Technology, Transactions on Parallel and Distributed Systems, **2021**

Technical Program Committee Member

- ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN) **2024**
- Time-Centric Reactive Software Workshop (TCRS) **2023**
- Real Time Systems Symposium (RTSS), SafeThings Workshop, CPS-IoTBench, **2021**
- Real Time Systems Symposium (RTSS), EAI SecureComm Conference, ACM/IEEE Conference on Internet of Things Design and Implementation Poster (IoTDI), International Conference on Hardware/Software Codesign and System Synthesis (CODES-ISSS), Artifact Evaluation (AE) for Real Time System Symposium's Proceedings, **2020-2021**

External Grant Reviewer

- National Science Foundation/CISE/CNS panel - Real-Time and Embedded Systems, **2020**

- National Science Foundation Gen4 Engineering Research Centers panel, **2021**
- National Science Foundation adhoc reviewer for the NSF/FDA Scholars in Residence Program, **2022**