

# RUCHIK MISHRA

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## EDUCATION

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**University of Louisville** Louisville, KY  
Ph.D., Electrical Engineering 2022-2025  
Dissertation: *Multimodal Emotion Recognition for Human–Robot Interaction Across Neurodiverse Populations*  
Advisor: Dr. Dan O. Popa and Dr. Karla Conn Welch

**Birla Institute of Technology and Science (BITS), Pilani** Hyderabad, India  
B.E.(Honors), Manufacturing Engineering 2015-2019

## RESEARCH EXPERIENCE

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**Georgia Institute of Technology** Atlanta, GA  
*Postdoctoral Fellow, School of Electrical and Comp. Engineering* June 2025 – Present  
Advisor: Prof. Omer T. Inan

- Clinically validated KneeMS, a low-cost wearable knee-acoustic sensing system, against a benchtop reference in 36 children with juvenile idiopathic arthritis (JIA), demonstrating strong correlations in key acoustic features (Spearman's  $\rho$  up to 0.79).
- Developed machine learning pipelines for classifying active versus inactive JIA knees using wearable acoustic signals, achieving an ROC-AUC of 0.77 ( $p = 0.005$ ) in subject-level cross-validation.
- Demonstrated a significant association between wearable acoustic predictions and clinical JIA severity ( $p < 0.001$ ), with exploratory longitudinal results tracking clinically expected changes in 4 of 5 knee transitions across follow-up visits.
- Advanced the clinical translation of KneeMS toward longitudinal, at-home monitoring of joint health, including evaluating wearable usability in pediatric patients (79% reported no discomfort).

**University of Louisville** Louisville, KY  
*Graduate Research Assistant, Dept. of Elec. and Comp. Eng.* July 2022 – Dec 2024  
Advisors: Dr. Dan O. Popa and Dr. Karla Conn Welch

- Developed personalized speech emotion recognition (SER) pipelines using vision transformers (ViT and BEiT), transfer learning, and model ensembles, achieving 97.49% classification accuracy on RAVDESS and 96.25% on ESD benchmark datasets. Conducted a human-subject study with 12 participants interacting with a NAO robot, demonstrating improved personalized emotion recognition using pretrained and ensemble models compared with baseline approaches.
- Conducted human-subject studies investigating affect, engagement, and speech-based interaction across neurotypical and neurodiverse populations, including children with autism spectrum disorder (ASD).
- Developed a human-mediated large language model (LLM) framework using GPT-2 and BART for generating interactive robotic content to support perspective-taking interventions for children with ASD.

- Evaluated the LLM-driven robotic framework in a pilot study involving four domain experts, obtaining a mean robot likeability rating of 4.30/5 and examining workload and usability.

### **University of Kentucky**

*Graduate Research Assistant, Dept. of Mechanical Eng.*

*Advisor: Dr. Hasan Poonawala*

Lexington, KY

May 2021 – July 2021

- Formulated the flight envelope estimation problem for small fixed-wing unmanned aircraft using Gaussian processes.
- Used an active learning strategy to sample new data points for exploring the flight envelope.

### **International Institute of Information Technology**

*Research Intern, Robotics Research Center*

*Advisor: Prof. K. Madhava Krishna*

Hyderabad, India

May 2019 – March 2020

- Worked in collaboration with Rockwell Collins Aerospace Company for collision avoidance of unmanned aerial vehicles.
- Developed and implemented path planning algorithms on an actual quadrotor platform.

### **Politecnico di Milano**

*Undergraduate thesis student, Department of Electronics, Information, and Bioengineering (DEIB)*

*Advisor: Prof. Andrea Bonarini*

Milano, Italy

May 2018 – Dec. 2018

- Worked on Physically Interactive Robo-Games (PIRG)
- Implemented entropy learning pruned hypothesis space to predict possible motions of a human player and classify players into attacking and defensive categories.

### **Srujana Center of Innovation**

*Summer Intern, L.V. Prasad Eye Institute*

- Worked on a project called Pupil+ to record the pupillary responses of the eye to screen for Relative Afferent Pupillary Defect (RAPD) in rural India.

Hyderabad, India

May 2017 – July 2017

- Developed the PCB for the device and interfaced with an ODROID XU-4 platform as an on-board computer.

### **HONORS & AWARDS**

University of Louisville, *Dissertation Completion Award (Fellowship)* 2025

*Winner (Mark of Distinction), In Annual SuperCollider Conference for Kentucky NSF EPSCoR Research Poster Session, Louisville, KY* 2024

*Finalist for the 2023 IEEE-HKN Best Student Paper Award* presented at IEEE SoutheastCon in Orlando, Florida 2023

*Winner at Research!Louisville* poster presentation 2022 on Severity metric development for autism diagnosis using social robots. 2022

## PUBLICATIONS

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### Journals

- [J5] **Mishra R**, Welch KC, Popa DO. Human-mediated large language models for robotic intervention in children with autism spectrum disorders. arXiv preprint arXiv:2402.00260. 2024 Feb 1. (under review)
- [J4] **R. Mishra**, Q. Goossens, C. Nichols, A. R. Emirdagi, C. Chen, O. S. Kilic, M. Nikbakht, P. Bindra, C. Yang, C. Garretson, L. Ponder, S. Prahalad, and O. T. Inan, "KneeMS to Monitor Knee Acoustic Emissions for Juvenile Idiopathic Arthritis," *IEEE Journal of Translational Engineering in Health and Medicine*, 2026
- [J3] **R. Mishra**, A. Frye, M. M. Rayguru, and D. O. Popa, "Personalized Speech Emotion Recognition in Human-Robot Interaction Using Vision Transformers," *IEEE Robotics and Automation Letters*, 2025
- [J2] M. V. Kondaurova, A. Smith, **R. Mishra**, Q. Zheng, I. Kondaurova, A. L. Francis, and E. Sallee, "Empatica E4 Assessment of Child Physiological Measures of Listening Effort During Remote and In-Person Communication," *American Journal of Audiology*, 2024
- [J1] A. Ashary, **R. Mishra**, M. M. Rayguru, and D. O. Popa, "MIRA: Multi-Joint Imitation with Recurrent Adaptation for Robot-Assisted Rehabilitation," *Technologies*, vol. 12, no. 8, 2024

### Conferences

- [C9] **R. Mishra**, A. R. Emirdagi, C. Chen, C. Yang, H. E. Ernst, L. Ponder, S. Prahalad, and O. T. Inan, "Predicting Disease Activity in Juvenile Idiopathic Arthritis Using KneeMS and Machine Learning," in *Proceedings of the 48th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, 2026. (in press)
- [C8] **R. Mishra**, L. Prasanna, A. Adair, and D. O. Popa, "Multimodal Sensing and Machine Learning to Compare Printed and Verbal Assembly Instructions Delivered by a Social Robot," in *Proceedings of the IEEE 21st International Conference on Automation Science and Engineering (CASE)*, 2025
- [C7] **R. Mishra** and K. C. Welch, "Social Impressions of the NAO Robot and Its Impact on Physiology," in *Proceedings of the 11th International Conference on Affective Computing and Intelligent Interaction Workshops and Demos (ACIIW)*, 2023
- [C6] **R. Mishra** and K. C. Welch, "Towards Forecasting Engagement in Children with Autism Spectrum Disorder Using Social Robots and Deep Learning," in *Proceedings of IEEE SoutheastCon*, 2023. **Finalist, IEEE-HKN Best Student Paper Award**
- [C5] **R. Mishra**, "Towards Adaptive and Personalized Robotic Therapy for Children with Autism Spectrum Disorder," in *Proceedings of the 10th International Conference on Affective Computing and Intelligent Interaction Workshops and Demos (ACIIW)*, 2022
- [C4] P. Saxena, Ri. Mishra, K. Gupta, R. Gupta, and **R. Mishra**, "A Low-Cost and Portable Subcutaneous Vein Detection System Using a Combination of Segmentation Methods," in *Proceedings of the Sixth International Congress on Information and Communication Technology (ICICT)*, 2022
- [C3] **R. Mishra**, C. Vineel, and A. Javed, "Indoor Navigation of a Service Robot Platform Using Multiple Localization Techniques Using Sensor Fusion," in *Proceedings of the 6th International Conference on Control, Automation and Robotics (ICCAR)*, 2020

- [C2] **R. Mishra**, Y. Ajmera, N. Mishra, and A. Javed, "Ego-Centric Framework for a Three-Wheel Omni-Drive Telepresence Robot," in *Proceedings of the IEEE International Conference on Advanced Robotics and Its Social Impacts (ARSO)*, 2019
- [C1] **R. Mishra** and A. Javed, "ROS-Based Service Robot Platform," in *Proceedings of the 4th International Conference on Control, Automation and Robotics (ICCAR)*, 2018

### Peer-Reviewed Workshops

- [W1] **R. Mishra** and K. C. Welch, "Social Impressions of the NAO Robot and Applications in Robotic Intervention of Autism Spectrum Disorder," in *Socially Acceptable Robots Workshop, IEEE International Conference on Robotics and Automation (ICRA)*, 2023

### Conference Abstracts and Posters

- [A6] **Mishra R**, Yang C, Goossens Q, Nichols C, Emirdagi A, Chen C, Kilic O, Garretson C, Nikbakht M, Bindra P, Ponder L, Inan O, Prahalad S. KneeMS for Juvenile Idiopathic Arthritis [abstract]. *Arthritis Rheumatol.* 2026; 78 (suppl 3). <https://acrabstracts.org/abstract/kneems-for-juvenile-idiopathic-arthritis/>. Accessed October 18, 2026.
- [A5] L. Prasanna, A. Adair, **R. Mishra**, and K. C. Welch, "Simulated Industrial Assembly: Robot vs. Paper Instructions," in *22nd Annual Kentucky Posters at the Capitol*, Frankfort, KY, 2024
- [A4] M. Kondaurova, A. Smith, **R. Mishra**, Q. Zheng, I. Kondaurova, A. Francis, E. Wooten, and S. King, "Assessment of Child Physiological Measures of Listening Effort During Telepractice," in *Kentucky Speech-Language-Hearing Association (KASHA)*, 2024
- [A3] **R. Mishra**, G. Olde Loohuis, and K. C. Welch, "Real-Time Biomedical Data as a Shaper of Robot Behavior in Human-Robot Interaction," in *Annual SuperCollider Conference, Kentucky NSF EPSCoR*, Louisville, KY, 2024.

### Mark of Distinction

- [A2] Armand Zedric Greenwell, **Ruchik Mishra**, and Karla Conn Welch. Accuracy Analysis of Program Compliance and Additional Developments for Human Robot Interaction in the Observation of Autism Spectrum Disorder. In Proc. of the 21st Annual Kentucky Posters at the Capitol Undergraduate Research Poster Session, Frankfort, KY, March 2, 2023
- [A1] **R. Mishra**, I. Kondaurova, and N. Taghavi, "Severity Metric Development for Diagnosis of Autism Using Social Robots," in *Research!Louisville*, University of Louisville, KY, 2022. **First Place**

### TEACHING EXPERIENCE

#### University of Louisville

Teaching Assistant, Dept. of Elec. and Comp. Eng.

Louisville, KY

Jan– May 2022

- Conducted lab sessions independently and graded lab reports for Logic Design Laboratory, Control Systems Laboratory, and Network Analysis Laboratory
- Made instructional videos for lab sessions as pre-lab materials to aid student understanding

*Research Assistant, Dept. of Elec. and Comp. Eng.*

2023 – 2024

- Three-part workshop on machine learning and deep learning methods for time-series classification, Department of Psychological and Brain Sciences, University of Louisville.
- Two-part workshop on transformer architectures for language and vision data, AIMS Lab, Department of Computer Science, University of Louisville

**University of Kentucky**

Lexington, KY

*Teaching Assistant, Dept. of Mechanical Eng.*

Jan– May, July-Dec 2021

- Conducted lab sessions and graded lab reports for Engineering Experimentation

## **MENTORING EXPERIENCE**

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### **PhD Students**

Ahmet Rasim Emirdagi, [Fulbright Masters student to PhD Electrical and Computer Engineering at Georgia Tech] 2025 – present

Chuoqi Chen, Georgia Tech Bioengineering 2025 – present

### **Masters Students**

Holland E. Ernst, Georgia Tech Electrical and Computer Engineering 2025 – present

Logan Wibberly, University of Louisville Electrical and Computer Engineering 2023

### **Medical Students**

Catherine Yang, MD [Emory Med student to Emory resident in Pediatrics] 2025 – 2026

### **Undergraduate Students**

Mohamed Abucar, GT Computer Engineering 2026

CJ Garretson, GT Biomedical Engineering 2025

Andrew Frye, University of Louisville 2024 – 2025

Shikha Surupa, University of Louisville 2024 – 2025

Doug Duggan, University of Louisville 2024 – 2025

Adair Adair, University of Louisville 2022 – 2024

Laksita Prasanna, University of Louisville 2022 – 2024

Gerhardus Olde Loohuis, University of Louisville 2023

Armand Zedric Greenwell, University of Louisville 2022

Yug Ajmera, BITS Pilani, Hyderabad 2018 – 2019

Nikhil Mishra, BITS Pilani, Hyderabad 2018 – 2019

C. Vineel, BITS Pilani, Hyderabad 2018 – 2019

### **High School Students**

Mary Crowell, GT 2026

Calina Havette, GT 2026

### **Hackathons**

Mentor, 5th Engineering the Eye Hackathon, L.V. Prasad Eye Institute and MIT Media Lab — rapid prototyping of game concepts for visually impaired users 2017

## GRANTS

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### As Principal Investigator:

NIH/NIAMS K99/R00 proposal on “*characterizing the cholinergic anti-inflammatory pathway in juvenile idiopathic arthritis using transcutaneous cervical vagus nerve stimulation and wearable sensing*”, PI: R. Mishra [**Under Review**, \$947k (up to \$747k for First Three Years of Assistant Professorship)]  
2026

Burroughs Wellcome Fund Career Award at the Scientific Interface (CASI), PI: R. Mishra [Letter of Intent Submitted] 2026

### As contributing author:

ARPA-H proposal on *transcutaneous vagus nerve stimulation for sleep disorders*; multi-institutional with GT, University of Illinois Urbana-Champaign, Johns Hopkins University, and Cornell Tech, **PIs:** O. T. Inan and J. M. Rehg. Drafted the vagus nerve stimulation aim. [not funded] 2026

ARPA-H proposal on *joint acoustics and bioimpedance for longitudinal JIA monitoring*, **PIs:** O. T. Inan and S. Prahalad 2026

NIH R21 proposal on “*Wearable Acoustic and Bioimpedance Sensing for Digital Monitoring of Juvenile Idiopathic Arthritis*” **PIs:** O. T. Inan and S. Prahalad [To be submitted October 16]  
2026

## PRESENTATIONS

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### Invited Talks

Emory University School of Medicine, Division of Pediatric Rheumatology, Atlanta, GA, USA “*Joint-Associated Mechanical Sounds*”  
2026

Talking Robotics Podcast “*Personalized Robotic Intervention for Children with Autism Spectrum Disorder*” 2023

### Research Demonstrations

National Science Foundation site visit, Louisville Automation and Robotics Research Institute (LARRI), University of Louisville 2023

Doss High School visit, LARRI, University of Louisville (NSF outreach) 2023

LARRI Summer Open House, University of Louisville 2023

U.S. Navy site visit, LARRI, University of Louisville 2022

NAO and MILO robot demonstration, St. Aloysius Catholic School (NSF outreach) 2022

## ACADEMIC SERVICE

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Program Committee, ACM Symposium on Applied Computing (SAC) 2024-2025  
Reviewer, PLOS One 2026

Reviewer, IEEE Robotics and Automation Letters 2022, 2025

Reviewer, IEEE Transactions on Affective Computing 2023

Reviewer, ACM/IEEE International Conference on Human-Robot Interaction (HRI) 2025, 2026  
Reviewer, Affective Computing + Intelligent Interaction (ACII) 2023