# Sidharth Anupkrishnan

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## Research Summary

PhD researcher at UMass Amherst developing multimodal wearable sensing systems using EEG, eye-tracking, and EDA to model human engagement and behavior. My work combines biosignal processing, human-subject studies, and machine learning for real-world applications.

## Education

**University of Massachusetts, Amherst** **Sep 2023 – June 2028**
*PhD in Computer Science (Advised by Prof. VP Nguyen)* *Expected Graduation*

**University of Massachusetts, Amherst** **Sep 2021 – Aug 2023**
*Master's in Computer Science*

**SRM Institute of Science and Technology** **Jul 2014 – July 2018**
*Bachelor's in Mechanical Engineering*

## Publications and Submitted Manuscripts

*Submitted manuscripts and preprints; * indicates equal contribution.*

1. **S. Anupkrishnan***, I. Sayar*, J. Lee, S. H. Musunuri, G.-M. Su, M. Endres, R. Karkar, and P. Nguyen. "E3Sense: Head-Confined Multimodal Sensing of Learner Engagement." *Submitted to ACM CHI*. Co-first author. arXiv:2609.26569.
2. Y. Wang*, **S. Anupkrishnan***, P. Nguyen, and L. Sanders. "Multimodal Engagement Decoding During Live Classroom Lectures." *Submitted to IEEE ICASSP*. Co-first author; related poster presented at CNS 2026.
3. "EMG-FoundBench: A Systematic Benchmark of Foundation Model Transfer and Adaptation for Electromyography." *Under review at ICLR 2027*. **S. Anupkrishnan**, co-author.

## Research Experience

**Benchmarking EEG Foundation Models for Wearable EEG** **August 2026 – Present**
*(Ongoing work)*

- Benchmarking pretrained EEG foundation models on wearable EEG datasets to assess transfer feasibility and identify limitations of existing models.
- Evaluating robustness to reference shifts between mastoid or average referencing used in pretraining and the reference configurations of wearable EEG devices.
- Assessing sensitivity to electrode-position shifts between conventional scalp EEG and wearable sensor layouts to characterize model failure modes.

**Fetal Health and Continuous Blood Pressure Monitoring** **June 2026 – Present**
*(Ongoing work)*
*In Collaboration with Columbia, Dartmouth and Lumious Ultrasound*

- Designing and fabricating an ear-based device for fetal heart health monitoring.
- Building a biosignal hub to acquire and preprocess data from multiple fetal monitoring devices, including ultrasound, an ECG belt, and the ear device.
- Developing continuous blood pressure monitoring using pulse arrival time (PAT) derived from in-ear photoplethysmography (PPG) and chest ECG.

**Inter-Brain Synchrony using Wearable EEG** **March 2026 – Present**
*(Ongoing work)*
*In Collaboration with Dolby Laboratories*

- Designing an inter-brain synchrony monitoring platform using wearable EEG headbands to assess group-level synchrony as a proxy for classroom or group engagement.
- Conducting feasibility analysis of frontal and over-the-ear EEG channels, focusing on channel reliability, artifact sensitivity, and suitability for in-the-wild deployment.

**E3Sense: Head-Confined Multimodal Sensing of Learner Engagement** **April 2025 – September 2026**
*(Co-first author, Submitted to ACM CHI)*
*In Collaboration with Dolby Laboratories*

- Designed a head-mounted multimodal wearable integrating EEG, eye tracking, and forehead EDA to measure learner engagement.
- Conducted a 30-participant study collecting 450 engagement ratings and comprehension measures during educational videos.
- Developed participant-disjoint multimodal ML pipelines for ordinal engagement prediction and exploratory personalization using learners' definitions of engagement.
- Achieved 75.0% balanced within-one-level prediction versus a 63.0% majority-rating baseline on 15 held-out forehead-sensing participants.

**Multimodal Engagement Decoding During Live Classroom Lectures** **Sept 2025 – September 2026**
*(Co-first author, Submitted to IEEE ICASSP; Poster presented at CNS 2026)*
*In collaboration with Dr. Lisa Sanders, Neurocognition and Perception Lab.*

- Designed a 12-participant live-lecture study synchronizing a 64-channel scalp EEG system, wearable EEG headband, eye tracking, and instructor speech.
- Co-developed a multimodal CRNN combining headband EEG, gaze, and the speech envelope; achieved MAE 0.628 and 91.2% balanced within-one accuracy on held-out participants.
- Compared wearable and scalp EEG configurations and conducted speech-locked ERP analysis of N400 responses to LLM-identified unexpected words.

**EMG-FoundBench: Benchmarking EMG Foundation Models** **Jan 2026 – May 2026**
*(Co-Author, Under review at ICLR 2027)*
*In collaboration with MoSIS Lab, University of Georgia*

- Contributed to EMG-FoundBench, a unified benchmark spanning 20 public datasets, over 1 million EMG segments, and nine pretrained foundation models.
- Implemented standardized EMG preprocessing and evaluation for linear probing, full fine-tuning, cross-user generalization, few-shot adaptation, and sequence-to-sequence decoding.
- Evaluated transfer and personalization across heterogeneous EMG hardware, classification tasks, and continuous EMG-to-text decoding.

**Omnibuds Earable Device** **June 2024 – Aug 2024**
*Nokia Bell Labs, Cambridge, UK*

- Designed and developed adaptive load balancing strategy for stateful applications in ear based wearable devices for optimal vital signs monitoring using PPG, IMU and audio playback user experience.
- Experimented with model partitioning (TinyML) across earbuds and collaborative inference.
- Tested our implementation on OmniBuds earable platform. Patent was filed.

**Design Optimization of Activity Recognition System on an Embedded Platform** **May 2017 – Apr 2018**
*Solarillion Foundation, Chennai, India*

- Designed an HAR platform optimizing computational complexity, energy consumption and cost.
- Performed preprocessing, feature extraction on accelerometer, magnetometer, gyroscope data for activities.
- Optimized model performance on embedded devices by choosing minimal features and small ML models.

## Technical Skills

**Programming & Analytics:** Python (NumPy, Pandas, Pytorch, MNE, Scikit, Tensorflow, Matplotlib, Seaborn), C, C++ (Unity), MatLab (EEGLAB), GoLang
**Sensors/Devices:** Pupil Labs Neon Eye Tracker, Emotibit, Frenz EEG Headband, ESP32, OpenBCI Cyton, Omnibuds, XReal AR Glasses
**Distributed Systems:** Docker, Kubernetes, Prometheus, Gluster, Ceph
**Microcontrollers:** ESP32, MAX78000, Arduino

## Industry Experience

**Research Scientist Intern, Nokia Bell Labs** **June 2024 – Aug 2024**
*Ombibuds Earable Device*

**Software Engineer, IBM** **June 2019 – Aug 2021**
*Distributed Storage Design for ML/HPC workloads*

**Associate Software Engineer, Red Hat** **Aug 2018 – June 2019**
*Logging Pipeline for Distributed Storage*