

Subrata Biswas

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Research Interest

Multi-modal (Audio, Video, Sensor) Machine Learning, Audio and Speech signal processing, Deep-Learning

Professional Experience

- Aug'24 – current **Part-Time Student Researcher**, Meta Reality Labs.
Mentor: Dr. Sanjeel Parekh, Dr. Vladimir Tourbabin
- Extending on developing a real-time on-device executable hair-brushing noise detection and suppression algorithm.
- To be submitted at *INTERSPEECH, 2025*.
- May'24 – Aug'24 **Research Scientist Intern**, Meta Reality Labs.
Mentor: Dr. Sanjeel Parekh, Dr. Vladimir Tourbabin
- Analyzed the effect of long hair on the signals picked up by the microphones of a glasses form-factor device.
- Designed a method to detect and suppress the noises stemming from long hairs..
- Developed an offline on-device executable suppression mechanism of hair-brushing noise if detected.
- Feb'21 – Aug'22 **Software Engineer (AI & IoT)**, ACI Limited.
Key Projects:
- Person re-identification and tracking using multiple CCTV camera feeds. 🔗
- Personalised promotion generation for super shop customers. 🔗
- Warranty claim forecasting for motorbike parts.
- Medicine name recognition system from handwritten prescription. 🔗
- Chatbot for consumer brand's website and social media handles.

Education

- Aug'22 – Current **Ph.D. in Electrical & Computer Engineering**, Worcester Polytechnic Institute.
Advisor: Dr. Bashima Islam.
- 2016 – 2021 **B.Sc. in Electrical & Electronic Engineering**, Bangladesh University of Engineering & Technology.
Advisor: Dr. Farhad Hossain.
Thesis title: *A deep learning-based energy efficient downlink power control mechanism for cellular networks.*

Research Project Highlights

- Missing Information Retrieval in Multi-Stream Sensing Systems**
We utilize correlations and mutual information among multiple input streams to retrieve perturbed information caused by corrupted input streams. We estimate the information entropy at every element of the input feature to the network and retrieve the missing information in the input feature matrix.
- Developed a DNN-based missing information retrieval framework that allows any multi-input DNN downstream task to perform similarly for both full and rank deficient input streams and defined the **mathematical foundation** of the proposed framework with *information theory*.
- Created a large sound source localization *dataset* of 50 hours with 10 different environments.
- Proposed a novel **guided replacement** method to map the *rank-deficient data* into a *full-rank feature set*.
- Currently under review of **SenSys: Embedded Artificial Intelligence and Sensing Systems, 2025**

Research Project Highlights (continued)

Quantized-Distillation (Q-DIST) for On-Device Speech -Language Understanding.

The Quantized-Distillation (Q-DIST) project aims to enhance on-device speech-language understanding by developing a compact, efficient model through a process of quantized distillation. This approach distills the knowledge from a large, pre-trained language model into a smaller, quantized version optimized for mobile and edge devices.

- Introduced a novel quantization-aware distillation (QAD) framework that combines model distillation and quantization techniques..
- Compatible with dynamic compression strategy (different bit length), allowing the model to adapt its complexity based on device-specific constraints and real-time latency requirements.

Meta-Learning for Audio Excellence: Bridging the Gap Between Domains and Environments.

Our goal is to use Meta-learning to train a model that can adapt to new domains with minimal data. We aim to overcome the variability (reverberation, ambient sounds, speakers, recording devices) of different acoustic scenarios

- Developed robust audio processing models for different tasks (e.g., sound classification, speech enhancement) encountered in different domains.
- Introduced a novel quantization-aware distillation (QAD) framework that combines model distillation and quantization techniques.
- Compatible with dynamic compression strategy (different bit length), allowing the model to adapt its complexity based on device-specific constraints and real-time latency requirements.

FreeML: Zero Energy TinyML Using Pre-Trained Networks..

We propose an end-to-end TinyML framework that exploits an early-exit approach to make pre-trained DNN models responsive to dynamic power environments. We introduce a general early exit model, one architecture that fits all that works for any layer and any network without retraining the base DNN model and reducing early exit memory overhead.

- Proposed **exit-aware pooling mechanism** to address the missing intermediate outputs of the future layers that are the input to the general early exit (**gNet**) model.
- Reduced the memory overhead of early-exit branches by **8.66 - 3.33** times without sacrificing accuracy or increasing inference time.
- Selected the appropriate intermediate layer by a **probabilistic model** for *energy harvesting patterns*.

Publications

- 1 **Biswas, Subrata**, P. Farina, E. Yildiz, *et al.*, "Memory-efficient energy-adaptive inference of pre-trained models on batteryless embedded systems," in *21st International Conference on Embedded Wireless Systems and Networks*, 2024.
- 2 P. Mohapatra, S. Likhite, **Biswas, Subrata**, B. Islam, and Q. Zhu, "Missingness-resilient video-enhanced multimodal disfluency detection," Sep. 2024, pp. 5093–5097. [DOI: 10.21437/Interspeech.2024-1458](https://doi.org/10.21437/Interspeech.2024-1458).
- 3 A. C. Dhar, A. Roy, **Biswas, Subrata**, and B. Islam, "Studying the security threats of partially processed deep neural inference data in an iot device," in *Proceedings of the 20th ACM Conference on Embedded Networked Sensor Systems*, ser. SenSys '22, Boston, Massachusetts: Association for Computing Machinery, 2023, pp. 845–846, ISBN: 9781450398862. [DOI: 10.1145/3560905.3568091](https://doi.org/10.1145/3560905.3568091).
- 4 M. S. I. Siam and **Biswas, Subrata**, "A deep learning based person detection and heatmap generation technique with a multi-camera system," in *2022 12th International Conference on Electrical and Computer Engineering (ICECE)*, 2022, pp. 260–263. [DOI: 10.1109/ICECE57408.2022.10089044](https://doi.org/10.1109/ICECE57408.2022.10089044).
- 5 **Biswas, Subrata**, A. M. Nasir, and M. F. Hossain, "A deep learning based energy efficient downlink power control mechanism for cellular networks," in *2020 11th International Conference on Electrical and Computer Engineering (ICECE)*, 2020, pp. 343–346. [DOI: 10.1109/ICECE51571.2020.9393086](https://doi.org/10.1109/ICECE51571.2020.9393086).
- 6 K. M. Naimul Hassan, **Biswas, Subrata Kumar**, M. S. Anwar, M. S. Iman Siam, and C. Shahnaz, "A dual-purpose refreshable braille display based on real time object detection and optical character

recognition," in 2019 *IEEE International Conference on Signal Processing, Information, Communication Systems (SPICSCON)*, 2019, pp. 78–81. [DOI: 10.1109/SPICSCON48833.2019.9065110](https://doi.org/10.1109/SPICSCON48833.2019.9065110).

Honors & Awards

- Aug' 22 📌 **1st Runner-up, Robi Datathon 2.0.**
- Oct'20 📌 **5th, of IEEE Video & Image processing Cup.**
- Apr'20 📌 **5th, of IEEE Signal Processing Cup.**
- Jul'19 📌 **Champion, of of Bangladesh Section at IEEE YESIST12 Innovation Challenge.**

Skills

- Programming Language 📌 Python, C/C++, Assembly.
- Tools & Framework 📌 PyTorch, Tensorflow, Huggiface, Keras, MATLAB.
- Operating System 📌 Linux, Windows, Unix.
- Web Dev 📌 Django, React, Flask, Nginx, Selenium, BeautifulSoup, Request, HTML5, CSS.
- Mobile Platform. 📌 Flutter.

References

Available on Request