# Rasel Ahmed Bhuiyan

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## Research Interest

Human Biometrics, Biometric Security, Computer Vision, Machine Learning, Generative AI, Explainable AI, Medical Image Analysis

## Education

**Ph.D. Computer Science & Eng.** – University of Notre Dame, Notre Dame, IN 05/2027 (expected)
Focus: Iris Recognition at Life Extremes | Advisor: Adam Czajka

**M.Sc. Computer Science & Engineering** – University of Notre Dame, Notre Dame, IN 08/2025
Focus: Forensic Iris Recognition | CGPA: 3.83/4.00

**B.Sc. Computer Science & Engineering** – University of Asia Pacific, Dhaka, BD 03/2018
Graduated with **highest distinction** | CGPA: 3.94/4.00

## Awards & Key Honors

- **Best Paper Award** – IEEE/CVF WACV 2025 Workshop (CV4Smalls) for Infant Iris Recognition System.
- **NSF-Funded Lead Researcher:** Infant Biometric Identification for Healthcare Linkage (Grant 2237880).
- **Vice Chancellor's Award:** Six consecutive semesters of academic distinction during B.Sc.

## Research Experience

**Graduate Research Assistant** 01/2022 - Present
*Computer Vision Research Laboratory (CVRL), University of Notre Dame* *Notre Dame, IN*

- **Forensic Iris Recognition:** Developed a set of computer science tools aiding criminal investigators in analysis of post-mortem iris samples, including methods for multi-spectral (near infrared and visible light) post-mortem interval (PMI) estimation, post-mortem iris image segmentation and matching. GitHub | Related papers: [WACV] [T-BIOM] [JFI]
- **ColdIrisNet — Foundation-Model Adaptation for Forensic Recognition:** Adapted a frozen DINOv3 (ViT-L/16) foundation model using ArcFace metric learning and a saliency-guided multi-task loss, paired with a custom landmark-localization network for feature alignment under extreme rotation. Reduced Equal Error Rate by 68% over prior state-of-the-art post-mortem iris matchers and demonstrated robust cross-dataset and live-to-deceased transfer performance. Related paper: [Information Fusion, Elsevier, under review]
- **Infant Iris Recognition (NSF Funded):** Created an end-to-end universal iris segmentation model and has been the first author of the first ever constructed newborn iris recognition system, to prevent baby swapping, reduce abductions, and improve post-natal health monitoring globally. GitHub | Related paper: [WACVW] (**Best Paper Award**)
- **Synthetic Data Generation:** Designed a PMI-conditioned first of its kind generative AI model synthesizing forensic iris images. GitHub | Related paper: [WACVW]
- **Iris Toolbox:** Developed and delivered a foundation model-based iris image processing toolbox to the NIST IREX-vetted OpenSourceIrisRecognition toolkit, comprising models for iris boundary estimation, eye-canthi localization and alignment, eyelid curve fitting, and projective gaze correction. GitHub
- **Multimodal LLM Reasoning for Forensic Estimation:** Developed a retrieval-augmented, few-shot vision-language framework using a multimodal LLM (LLaMA-3.2-Vision) and semantic retrieval (MPNet embeddings) for post-mortem interval estimation from forensic iris images, benchmarked against ResNet-152 and foundation-model regression baselines.
- **Visualizing Brain-Stimulation-Induced Perceptual Events:** Designed generative computer vision models for in-manifold and out-manifold latent space explorations for a novel neuroscience tool called *perceptographer* to visualize complex perceptual distortions induced by local stimulation of the inferotemporal cortex. Collaboration with National Institute of Mental Health, USA (NIMH). Related paper: [JOV abstract]

**Research Lead (as Lecturer)** 10/2018 - 12/2021
*Uttara University* *Dhaka, Bangladesh*

- **Epileptic Seizure Recognition:** Statistical analysis of EEG signals along with designing and implementing classification strategies for automated seizure diagnosis. Related paper: [ICIEV]
- **Human Activity Recognition:** Designed and implemented frequency-domain models introducing improved feature extraction, dimensionality reduction, and dictionary-based signal representations for wearable patient monitoring. Related papers: [SIVP] [Sensors] [ICKII]

**Research Assistant** 03/2016 - 09/2018
*Computer Vision & Pattern Recognition Lab, University of Asia Pacific* *Dhaka, Bangladesh*

- **Hand Gesture Recognition:** Developed a gesture recognition system utilizing genetic algorithm–based optimization, enabling enhanced communication for deaf and hard-of-hearing users. Related paper: [ICCIT]
- **American Sign Language Recognition:** Built a low-cost, real-time system using deep learning-based feature extraction to support interactive communication for deaf and hard-of-hearing users. Related paper: ICFSP
- **Arrhythmia Diagnosis:** Designed and implemented an ECG-based method for arrhythmia classification. Related paper: [HNICEM]

## Teaching Experience

**Graduate Teaching Assistant** 01/2022 - Present
*Department of Computer Science and Engineering, University of Notre Dame* *Notre Dame, IN*

- Contributed to course development, including designing assignments, labs, and project materials.
- Conducted office hours and facilitated class discussions to support student learning.
- Assessed student work, providing constructive feedback to enhance understanding and performance.
- Mentored two undergraduate students (Summer and Fall 2023) in building an iris presentation attack detection dataset, with weekly meetings on iris recognition fundamentals and presentation attack detection.
- Invited to represent the Computer Vision Research Lab at the annual CSE Lab Day (Fall 2025), introducing first-year students to computer vision research with live demonstrations.
- Courses Assisted:
  - CSE 30332: Programming Paradigms (Spring 2022)
  - CSE 20312: Data Structures (Fall 2022)
  - CSE 40868: Neural Networks (Spring 2023, Spring 2024)
  - CSE 40535: Special Studies: Computer Vision (Fall 2023, Fall 2024)
  - CSE 60868: Graduate Neural Networks (Spring 2025)
  - CSE 60535: Graduate Computer Vision (Fall 2025)

**Lecturer** 10/2018 - 12/2021
*Department of Computer Science and Engineering, Uttara University* *Dhaka, Bangladesh*

- Served as the primary instructor for undergraduate engineering courses including:
  - Algorithms
  - Digital Logic Design
  - Machine Learning
  - Artificial Intelligence
- Actively designed course materials, assignments, and exam questions to support student learning outcomes.
- Supervised undergraduate final year projects, providing guidance on project development and research methodology.
- Taught courses online over Zoom during the COVID-19 period.
- Contributed to departmental service including Routine Committee, Accreditation Committee, and Faculty Recruitment Committee.

## Publications

Google Scholar: https://scholar.google.com/citations?user=LvUO52oAAAAJ&hl=en

**Journal Publications:**

1. **Rasel Ahmed Bhuiyan** and Adam Czajka, "ColdIrisNet: Biology-Guided Fusion for Forensic Iris Recognition," *Information Fusion, Elsevier*, 2026. (Under Review)

2. Elia Shahbazi, Drew Nguyen, **Rasel Ahmed Bhuiyan**, Adam Czajka, Arash Afraz, "Perceptographer: AI-powered framework for controlled navigation of high-dimensional stimulus spaces," manuscript submitted to *Journal of Vision*, 2026.
3. **Rasel Ahmed Bhuiyan**, Parisa Farmanifard, Renu Sharma, Andrey Kuehlkamp, Aidan Boyd, Patrick J. Flynn, Kevin W. Bowyer, Arun Ross, Dennis Chute, and Adam Czajka, "Beyond Mortality: Advancements in Post-Mortem Iris Recognition through Data Collection and Computer-Aided Forensic Examination," *IEEE Transactions on Biometrics, Behavior, and Identity Science (T-BIOM)*, 2025.
4. Elia Shahbazi, Drew Nguyen, **Rasel Ahmed Bhuiyan**, Adam Czajka, Arash Afraz, "Visualizing the Unseen: Perceptographer, an AI Engine for Visualizing Brain-Stimulation-Induced Perceptual Events," *Journal of Vision*, Vol. 25, 2855, July 2025.
5. **Rasel Ahmed Bhuiyan** and Adam Czajka, "Forensic Iris Recognition: A Survey," *Journal of Forensic Identification*, vol. 74, no. 1, pp. 38, 2024.
6. **Rasel Ahmed Bhuiyan**, Shams Tarek, and Hongda Tian, "Enhanced Bag-of-Words Representation for Human Activity Recognition using Mobile Sensor Data," *Signal, Image and Video Processing (SIViP)*, Springer Nature, pp. 1–8, 2021.
7. **Rasel Ahmed Bhuiyan**, A.K. Kundu, S.R. Shafi, and A. Matin, "A Bag-of-Words Based Feature Extraction Scheme for American Sign Language Number Recognition from Hand Gesture Images," *International Journal of Machine Learning and Computing (IJMLC)*, vol. 11, no. 1, pp. 85–91, 2021.
8. **Rasel Ahmed Bhuiyan**, N. Ahmed, Md. Amiruzzaman, and M.R. Islam, "A Robust Feature Extraction Model for Human Activity Characterization using 3-Axis Accelerometer and Gyroscope Data," *Sensors*, MDPI, 20(23):6990, 2020.

**Conference Publications:**

1. **Rasel Ahmed Bhuiyan** and Adam Czajka, "Forensic Iris Image-Based Post-Mortem Interval Estimation," *Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)*, Tucson, Arizona, 2025.
2. **Rasel Ahmed Bhuiyan**, Md. Amiruzzaman, Nadeem Ahmed, Md. Rashedul Islam, "Efficient Frequency Domain Feature Extraction Model using EPS and LDA for Human Activity Recognition," *3rd IEEE International Conference on Knowledge Innovation and Invention (ICKII)*, Kaohsiung, Taiwan, 2020, pp. 344–347.
3. A. Matin, **Rasel Ahmed Bhuiyan**, S.R. Shafi, A.K. Kundu, and M.U. Islam, "A Hybrid Scheme Using PCA and ICA Based Statistical Feature for Epileptic Seizure Recognition from EEG Signal," *Joint 2019 IEEE 8th International Conference on Informatics, Electronics, and Vision (ICIEV) and 3rd International Conference on Imaging, Vision, and Pattern Recognition (IVPR)*, Eastern Washington University, USA, 2019.
4. Md. Rashedul Islam, **Rasel Ahmed Bhuiyan**, Nadeem Ahmed, Md. Rajibul Islam, "PCA and ICA Based Hybrid Dimension Reduction Model for Cardiac Arrhythmia Disease Diagnosis," *2018 IEEE 10th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM)*, Baguio City, Philippines, 2018, pp. 1–7.
5. Md. Rashedul Islam, Ummey Kulsum Mitu, **Rasel Ahmed Bhuiyan**, Jungpil Shin, "Hand Gesture Feature Extraction Using Deep Convolutional Neural Network for Recognizing American Sign Language," *4th International Conference on Frontiers of Signal Processing (ICFSP)*, Poitiers, France, 2018, pp. 115–119.
6. **Rasel Ahmed Bhuiyan**, Abdul Kawsar Tushar, Akm Ashiquzzaman, Jungpil Shin, Md. Rashedul Islam, "Reduction of Gesture Feature Dimension for Improving the Hand Gesture Recognition Performance of Numerical Sign Language," *20th International Conference of Computer and Information Technology (ICCIT)*, Dhaka, Bangladesh, 2017, pp. 1–6.

**Workshop Publications:**

1. **Rasel Ahmed Bhuiyan**, Mateusz Trokielewicz, Piotr Maciejewicz, Sherri Bucher, Adam Czajka, "Iris Recognition for Infants," *Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (WACV) Workshops*, 2025, pp. 83–92. **(Best Paper Award)**
2. **Rasel Ahmed Bhuiyan**, Adam Czajka, "Forensic Iris Image Synthesis," *Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (WACV) Workshops*, 2024, pp. 1015–1023.

## Technical Skills

- **Core Research:** Computer Vision, Generative AI (GANs/Diffusion), Vision Transformers (ViT), Foundation Models (DINOv3), Biometrics, Classification, Object Detection, Segmentation, Domain Adaptation, Explainable AI (XAI).
- **Languages:** Python, MATLAB, Bash, SQL
- **ML Frameworks:** PyTorch, TensorFlow, Scikit-learn, OpenCV, Hugging Face, NumPy, Pandas.
- **Development & Infrastructure:** Git, Linux, HPC Clusters, Multi-GPU Training, Large-scale Data Processing.

## Conference Presentations

- Paper Presenter, IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), Tucson, Arizona, 2025.
- Paper Presenter, IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), Waikoloa Beach Marriott Resort, Waikoloa, Hawaii, 2024.
- Paper Presenter, IEEE International Conference of Computer and Information Technology (ICCIT), University of Asia Pacific, Dhaka, Bangladesh, 2017.

## Review Activities

- IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), 2027.
- IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), 2025.
- International Conference on Science and Contemporary Technologies (ICSCT), 2021.

## Participation in Skills Development Workshops

- Workshop on "Creating High-Quality Images for Publications," Lucy Family Institute for Data & Society, University of Notre Dame, Notre Dame, IN, USA, 2022.
- Workshop on "Machine Learning and Human-Computer Interaction," University of Asia Pacific, Dhaka, Bangladesh, 2019.
- Workshop on "Research Methodology and Thesis Writing," Uttara University, Dhaka, Bangladesh, 2019.
- Workshop on "LaTeX," University of Asia Pacific, Dhaka, Bangladesh, 2017.
- Workshop on "Microsoft Word," University of Asia Pacific, Dhaka, Bangladesh, 2017.

## Extra-curricular Activities

- Volunteered at IEEE 20$^{\text{th}}$ International Conference on Computer and Information Technology (ICCIT), 2017, Dhaka, Bangladesh.
- Volunteered at ACM International Collegiate Programming Contest (ACM-ICPC), 2017 and 2016, Dhaka, Bangladesh.
- Voluntary Blood Donor from 2017 to 2021 at Quantum Method, Dhaka, Bangladesh.

## Leadership & Service

- Social Chair, Bangladeshi Student Association, Notre Dame, 2023-2024.
- President, CSE Student Association, University of Asia Pacific, 2016-2017.