

Arafat Rahman

Applied ML Researcher | Digital Biomarkers, Wearable Sensing, Fair AI in Healthcare
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EXPERTISE IN

Applied Machine Learning (Deep Learning, Time Series Representation Learning)
Biomedical Signal and Image Processing (ECG, EEG, EMG, Ultrasound, IMU, MoCap)
Wearable Sensing, Digital Biomarkers, Fairness-Aware Modeling
Biometrics, Ubiquitous Computing, Healthcare Systems

EXPERIENCE

UNIVERSITY OF VIRGINIA | RESEARCH ASSISTANT

Jan 2023 - Present | Charlottesville, Virginia, USA

Digital Biomarkers for Neuromuscular Disorders

- Built a multimodal ML pipeline combining skeletal kinematics and ultrasound to model disease progression in Spinal Muscular Atrophy (SMA) and Duchenne Muscular Dystrophy (DMD), achieving **3-7% higher accuracy** than unimodal baselines.
- Contributed to an NSF Smart and Connected Health proposal on digital biomarker-based evaluation of upper extremity function in neuromuscular disorders (under review).
- Developed a Riemannian Shape Variational Autoencoder (VAE) for stroke severity prediction from motion capture, reaching **0.72-0.78 Spearman correlation** with clinical scores.
- Designed a Transformer model for MS progression from wearable gait data, improving AUC from **0.64 to 0.81**.

Fair and Adaptive Framework for WMSDs

- Developed a Disentangled Variational Autoencoder (DVAE) for hand-load estimation from IMU data with fairness regularization, reducing performance disparities across sex significantly ($p < 0.01$) compared to classical models.
- Contributed to the implementation of TimeSets, a real-time adaptive time-series model for multivariate sensor streams, enabling **sub-100 ms inference** and **30-40% lower error** compared to other classical and deep learning models.

QATAR UNIVERSITY | RESEARCH ASSISTANT

Apr 2021 - Jun 2022 | Remote

Biomedical Signal Processing and Biometrics

- Designed a deep learning model (LinkNet++) for fetal ECG extraction from maternal abdominal ECG, achieving **Pearson correlation of 0.85-0.87**.
- Built a multimodal EEG and keystroke biometric system using Self-ONNs, achieving **98% accuracy** under session-invariant testing.

UNIVERSITY OF DHAKA | RESEARCH ASSISTANT

Jul 2018 - Jul 2019 | Dhaka, Bangladesh

3D-Printed Myoelectric Prosthetic Hand

- Designed and fabricated a low-cost prosthetic hand and EMG-based controller, achieving **>90% accuracy** across 10 gestures.

EDUCATION

UNIVERSITY OF VIRGINIA

PHD, SYSTEMS AND INFORMATION
ENGINEERING

Jan 2023 - April 2027 | Charlottesville,
Virginia, USA

UNIVERSITY OF DHAKA

MS, BIOMEDICAL PHYSICS AND
TECHNOLOGY

2021 | Dhaka, Bangladesh

UNIVERSITY OF DHAKA

BS, ELECTRICAL AND ELECTRONIC
ENGINEERING

2018 | Dhaka, Bangladesh

GRADUATE

COURSEWORK

Workshop on Building AI Agents
Natural Language Processing,
Geometry of Data,
Signal Processing, Machine Learning
and Control,
Data Mining,
Human Factors,
Cyber-Physical System Safety and
Security

TECHNICAL SKILLS

Programming Languages: Python, R,
MATLAB, C++

Software Frameworks: PyTorch,
scikit-learn

Software: SolidWorks, Proteus

Hardware: AVR and Arduino-based
system design

Machine Operation: Laser Cutter, CNC,
3D printer

SOCIETIES

Treasurer: ABS UVA

Member: ACM, IEEE

INTERESTS

Traveling, Sports, Reading, Fishing

SELECTED JOURNAL ARTICLES

- **Rahman, A.**, Lim, S. and Chung, S., 2025. Fairness in Machine Learning-Based Hand Load Estimation: A Case Study on Load Carriage Tasks. *Applied Ergonomics*, 130, p.104642.
- Kumar, S., **Rahman, A.**, Gutierrez, R., Livermon, S., McCrady, A.N., Blemker, S., Scharf, R., Srivastava, A. and Barnes, L.E., 2025. A Shape-Based Functional Index for Objective Assessment of Pediatric Motor Function. *PLOS ONE*, 20(10), p.e0332383.
- **Rahman, A.**, Nahid, N., Schuller, B. and Ahad, M.A.R., 2024. A Stacked CNN and Random Forest Ensemble Architecture for Complex Nursing Activity Recognition and Nurse Identification. *Scientific Reports*, 14(1), p.31667.
- **Rahman, A.**, Mahmud, S., Chowdhury, M.E., Yalcin, H.C., Khandakar, A., Mutlu, O., Mahbub, Z.B., Kamal, R.Y. and Pedersen, S., 2023. Fetal ECG Extraction from Maternal ECG Using Deeply Supervised LinkNet++ Model. *Engineering Applications of Artificial Intelligence*, 123, p.106414.
- **Rahman, A.**, Chowdhury, M.E., Khandakar, A., Tahir, A.M., Ibtehaz, N., Hossain, M.S., Kiranyaz, S., Malik, J., Monawwar, H. and Kadir, M.A., 2022. Robust Biometric System Using Session Invariant Multimodal EEG and Keystroke Dynamics by the Ensemble of Self-ONNs. *Computers in Biology and Medicine*, 142, p.105238.

MANUSCRIPTS IN PROCESS / UNDER REVIEW

- Multimodal Skeleton and Ultrasound-Based Modeling for Predicting Upper Limb Disease Severity Progression in Neuro-muscular Disorders. (**Major revision, IEEE International Conference on Healthcare Informatics**)
- Riemannian Shape Variational Autoencoder (VAE) for predicting disease severity of stroke patients using motion-capture (mo-cap) data. (**In preparation, IEEE Transactions on Biomedical Engineering**)
- Transformer-Based Disease Severity Progression Prediction in Multiple Sclerosis. (**In preparation, Nature Digital Medicine**)

SELECTED CONFERENCE PROCEEDINGS

- Ahmed, M.S., **Rahman, A.**, Rucker, M. and Barnes, L.E., 2025. SocialPulse: An On-Smartwatch System for Detecting Real-World Social Interactions. In Companion of the 2025 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp Companion '25).
- Nahid, N., **Rahman, A.** and Ahad, M.A., 2020. Deep Learning-Based Surface EMG Hand Gesture Classification for Low-Cost Myoelectric Prosthetic Hand. In 2020 Joint 9th International Conference on Informatics, Electronics & Vision (ICIEV) and 2020 4th International Conference on Imaging, Vision & Pattern Recognition (icIVPR) (pp. 1-8). [**Excellent Paper Award**]
- Nahid, N., **Rahman, A.**, Das, T.K., Khabir, K.M., Islam, A. and Alam, M.S., 2019, May. Design and Implementation of DUFAB Hand, a Low-Cost Myoelectric Prosthetic Hand. In 2019 Joint 8th International Conference on Informatics, Electronics & Vision (ICIEV) and 2019 3rd International Conference on Imaging, Vision & Pattern Recognition (icIVPR) (pp. 206-211).

WORKSHOP ARTICLES

- **Rahman, A.**, Hassan, I. and Ahad, M.A.R., 2021, September. Nurse Care Activity Recognition: A Cost-Sensitive Ensemble Approach to Handle Imbalanced Class Problem in the Wild. In Adjunct Proceedings of the 2021 ACM UbiComp and ISWC (pp. 440-445).
- **Rahman, A.**, Nahid, N., Hassan, I. and Ahad, M.A.R., 2020, September. Nurse Care Activity Recognition: Using Random Forest to Handle Imbalanced Class Problem. In Adjunct Proceedings of the 2020 ACM UbiComp and ISWC (pp. 419-424). [**3rd Place Award**]

AWARDS

- 3rd Place at the 2nd Nurse Care Activity Recognition Challenge (ACM UbiComp/ISWC) 2020
- IAPR travel grant to attend IAPR/IEEE Winter School on Biometrics 2020, 2021
- NASA Space Apps Challenge Runner-up (Dhaka Region) 2019