MD SANZID BIN HOSSAIN

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RESEARCH SUMMARY

My research primarily focuses on advanced AI-based approaches, utilizing wearables for more practical, cost-effective, and accurate human gait analysis, while also integrating deep learning for clinical decision-making in digital pathology and radiology. This interdisciplinary work contributes to the development of more personalized, automated, and timely healthcare solutions. I have published several high-impact journals, conferences, and conference abstracts in these fields.

RESEARCH EXPERIENCE

- **Postdoctoral Scholar**, University of Central Florida, Orlando, FL   *August 2024- Present*
  Department of Clinical Science, College of Medicine
  Advisor: Dr. Dexter Hadley

- **Graduate Research Assistant**, University of Central Florida, Orlando, FL   *August 2020- July 2024*
  Department of Electrical and Computer Engineering
  Advisor: Dr. Hwan Choi and Dr. Zhishan Guo

EDUCATION

University of Central Florida, Orlando, FL   *August 2024*
PhD in Computer Engineering, Department of ECE

Bangladesh University of Engineering and Technology   *September 2017*
Bachelor of Science, Department of Electrical and Electronics Engineering

SELECTED AWARDS AND HONORS

- NSF Student Travel Award, IEEE/ACM CHASE   2022
- ORC Doctoral Fellow, University of Central Florida   2019
- UCF Presentation Fellowship   2022, 2024

RESEARCH PAPER PUBLICATIONS

Major Research Topics:

- Wearables
- Artificial Intelligence (AI) and Deep Learning
- Human Gait Monitoring
- Biomechanics
- Digital Pathology and Radiology

PhD Dissertation

Towards Sparse IMU Sensor-Based Estimation of Walking Kinematics, Joint Moments, and Ground Reaction Forces in Multiple Locomotion Modes via Deep Learning

Journal

[J3] Md Moniruzzaman, Zhaozheng Yin, **Md Sanzid Bin Hossain**, Hwan Choi, and Zhishan Guo, "Wearable Motion Capture: Reconstructing and Predicting 3D Human Poses From Wearable Sensors," in *IEEE Journal of Biomedical and Health Informatics*, vol. 27, no. 11, pp. 5345–5356, 2023.

[J2] **Md Sanzid Bin Hossain**, Zhishan Guo, and Hwan Choi, "Estimation of Lower Extremity Joint Moments and 3D Ground Reaction Forces Using IMU Sensors in Multiple Walking Conditions: A Deep Learning Approach," in *IEEE Journal of Biomedical and Health Informatics*, 2023.

[J1] **<u>Md Sanzid Bin Hossain</u>**, Joseph Dranetz, Hwan Choi, and Zhishan Guo, "DeepBBWAENet: A CNN-RNN Based Deep Superlearner for Estimating Lower Extremity Sagittal Plane Joint Kinematics Using Shoe-Mounted IMU Sensors in Daily Living," in *IEEE Journal of Biomedical and Health Informatics*, vol. 26, no. 8, pp. 3906–3917, 2022.

Journal Under Submission and Preparation

[U5] Oliver Fritsche, Steven Camacho, Tyler Halpenny, Carlos Archniegas, **<u>Md Sanzid Bin Hossain</u>**, Joseph Dranetz, and Hwan Choi, "Multimodal IMU and EMG Dataset for Deep Learning in Upper Body Kinematic Analysis," 2024. **Under Preparation**.

[U4] **<u>Md Sanzid Bin Hossain</u>**, Hwan Choi, Zhishan Guo, and Dexter Hadley, "Cross-Model Knowledge Transfer to Fuse Heterogeneous Datasets for Enhanced Kinetics Estimation," 2024. **Under Preparation**.

[U3] **<u>Md Sanzid Bin Hossain</u>**, Yelena Piazza, Jacob Braun, Michael Hsieh, Samir Fouissi, Anthony Bilic, Chen Chen, Liqian Wang, Husain Mujtaba, and Dexter Hadley, "A Public Dataset of Histopathology Images for Deep Learning Model Based Classification," in *Scientific Data*, 2024. **Under submission**.

[U2] **<u>Md Sanzid Bin Hossain</u>**, Hwan Choi, Zhishan Guo, and Dexter Hadley, "Sparse IMU-Based Kinetics Estimation Using Multi-modal Fusion and Sensor Distillation," in *IEEE Journal of Biomedical and Health Informatics*, 2024. **Under submission**.

[U1] **<u>Md Sanzid Bin Hossain</u>**, Hwan Choi, Zhishan Guo, Hyunjun Shin, and Dexter Hadley, "Smartphone Video-Based Kinetics Estimation via Multi-modal Fusion and Knowledge Distillation," in *IEEE Transactions on Neural Systems and Rehabilitation Engineering (TNSRE)*, 2024. **Under submission**.

Conferences

[C7] **<u>Md Sanzid Bin Hossain</u>**, Md Shazid Islam, Md Saad Ul Haque, and Md Saydur Rahman, "Gait Phase Classification from sEMG in Multiple Locomotion Mode Using Deep Learning," in *9th International Congress on Information and Communication Technology*, 2024.

[C6] **<u>Md Sanzid Bin Hossain</u>**, Zhishan Guo, Ning Sui, and Hwan Choi, "Predicting Lower Extremity Joint Kinematics Using Multi-Modal Data in the Lab and Outdoor Environment," in *57th Hawaii International Conference on System Sciences*, 2024.

[C5] Md Shazid Islam, Md Saydur Rahman, Md Saad Ul Haque, Farhana Akter Tumpa, **<u>Md Sanzid Bin Hossain</u>**, and Abul Al Arabi, "Location Agnostic Adaptive Rain Precipitation Prediction Using Deep Learning," in *2023 IEEE 9th International Women in Engineering (WIE) Conference on Electrical and Computer Engineering (WIECON-ECE)*, pp. 148–153, 2023.

[C4] Md Saydur Rahman, Farhana Akter Tumpa, Md Shazid Islam, Abul Al Arabi, **<u>Md Sanzid Bin Hossain</u>**, and Md Saad Ul Haque, "Comparative Evaluation of Weather Forecasting Using Machine Learning Models," in *2023 26th International Conference on Computer and Information Technology (ICCIT)*, pp. 1–6, 2023.

[C3] **<u>Md Sanzid Bin Hossain</u>**, Zhishan Guo, and Hwan Choi, "Estimation of Hip, Knee, and Ankle Joint Moment Using a Single IMU Sensor on Foot Via Deep Learning," in *2022 IEEE/ACM Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE)*, pp. 25–33, 2022.

[C2] **<u>Md Sanzid Bin Hossain</u>**, Hwan Choi, and Zhishan Guo, "Estimating Lower Extremity Joint Angles During Gait Using Reduced Number of Sensors Count Via Deep Learning," in *Fourteenth International Conference on Digital Image Processing (ICDIP 2022)*, vol. 12342, pp. 1116–1123, 2022.

[C1] Jayanta Dey, **<u>Md Sanzid Bin Hossain</u>**, and Mohammad Ariful Haque, "An Ensemble SVM-Based Approach for Voice Activity Detection," in *2018 10th International Conference on Electrical and Computer Engineering (ICECE)*, pp. 297–300, 2018.

Conference Abstract

[CA5] **<u>Md Sanzid Bin Hossain</u>**, Zhishan Guo, and Hwan Choi, "Domain Adaptation Technique to Transfer Knowledge Among Different Datasets for Improved Kinetics Estimation," in *Proceedings of the Gait and Clinical Movement Analysis Society Annual Meeting (GCMAS)*, 2024.

[CA4] **<u>Md Sanzid Bin Hossain</u>** , Zhishan Guo, and Hwan Choi, "Sensor and Cross-Modal Knowledge Distillation for Kinetics Estimation," in *Proceedings of the 46th Meetings of the American Society of Biomechanics (ASB)*, 2023.

[CA3] **Md Sanzid Bin Hossain**, Zhishan Guo, and Hwan Choi, "Estimating Ground Reaction Forces (GRF) and Lower Extremity Joint Moment in Multiple Walking Environments Using Deep Learning," in *Proceedings of the Gait and Clinical Movement Analysis Society Annual Meeting (GCMAS)*, 2022.

[CA2] **Md Sanzid Bin Hossain**, Joseph Dranetz, Hwan Choi, and Zhishan Guo, "An Ensemble Machine Learning Approach for the Estimation of Lower Extremity Kinematics Using Shoe-Mounted IMU Sensors," in *Proceedings of the Gait and Clinical Movement Analysis Society Annual Meeting (GCMAS)*, 2021.

[CA1] **Md Sanzid Bin Hossain**, Youngho Lee, Junghwa Hong, Hwan Choi, and Zhishan Guo, "Predicting Lower Limb 3D Kinematics During Gait Using Reduced Number of Wearable Sensors Via Deep Learning," in *Proceedings of the 44th Meetings of the American Society of Biomechanics (ASB)*, 2020.

TALKS/POSTER PRESENTATIONS

[T8] **[Podium Presentation]** 9th International Congress on Information and Communication Technology 2024
[T7] **[Podium Presentation]** Gait and Clinical Movement Analysis Society Annual Meeting (GCMAS) 2024
[T6] **[Poster Presentation]** 46th Meetings of the American Society of Biomechanics (ASB) 2023
[T5] **[Podium Presentation]** Gait and Clinical Movement Analysis Society Annual Meeting (GCMAS) 2022
[T4] **[Podium Presentation]** IEEE/ACM Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE) 2022
[T3] **[Podium Presentation]** Fourteenth International Conference on Digital Image Processing (ICDIP) 2022
[T2] **[Poster Presentation]** Gait and Clinical Movement Analysis Society Annual Meeting (GCMAS) 2021
[T1] **[Poster Presentation]** 46th Meetings of the American Society of Biomechanics (ASB) 2020

GITHUB REPOSITORIES

[G9] Sparse-IMU-Sensor-based-kinetics-estimation (Under Construction)
[G8] UCF-WSI-Dataset
[G7] Smartphone-Video-based-KAM-KFM-3D-GRFs
[G6] Future-kinematics-prediction-in-multiple-locomotion-modes-using-deep-learning
[G5] Kinetics-FM-DLR-Net-Estimating-Kinetics-in-multiple-locomotion-modes
[G4] DL-Kinetics-FM-Net-Joint-moment-estimation-with-sensor-on-foot
[G3] DeepBBWAE-Net
[G2] Estimating-lower-extremity-joint-angles-during-gait-using-reduced-number-of-sensors-count
[G1] Wearable-Motion-Capture

RESEARCH PROJECTS

[P4] Whole Slide Image (WSI) Cadaver Tissue Patch Preparation and Classification
  - Curated and prepared 1,700 WSIs from various organs for further analysis.
  - Created patches from these WSIs to establish a benchmark dataset for classifying 15 different organs.
[P3] Smartphone-Video Based Human Kinetics Estimation
  - Developed an innovative method for estimating knee adduction moment (KAM), knee flexion moment (KFM), and 3D ground reaction forces (GRFs) using only smartphone video data.
  - The method employs a two-step knowledge distillation and multi-modal fusion technique to achieve high accuracy in kinetics estimation.
[P2] Sparse IMU Sensor-Based Joint Angles, Joint Moments, and GRFs Estimation
  - Proposed novel methods for estimating joint angles, joint moments, and ground reaction forces (GRFs) using a sparse configuration of inertial measurement unit (IMU) sensors.
  - Leveraged a new technique called sensor distillation and multi-modal fusion to enhance the accuracy and reliability of the estimations, significantly outperforming state-of-the-art deep learning models while remaining computationally lightweight.
[P1] Prediction and Reconstruction of 3D Human Pose Using IMUs and Wearable Cameras
  - Collected data from 20 subjects using Vicon Motion Capture, Delsys IMUs, and two shank-mounted egocentric GoPro cameras, with subsequent processing in OpenSim.
  - Introduced an innovative approach that integrates whole-body IMUs with wearable camera features to accurately reconstruct current 3D poses and predict future movements.

TEACHING EXPERIENCE (TA)

- EEL 4768: Computer Architecture   Summer'22
- EEL 4742C: Embedded Systems Lab   Fall'22
- EEL3801C: Computer Organization   Summer'22
- EEL 3021: Introduction to Applied Randomness for Engineers   Fall'22
- EEE 4775/EEL 5862: Real-Time-Systems   Fall'22, Spring'23
- EEL 3552C: Signal Analysis and Analog Communication   Spring'23
- EEE 3307C: Electronics I   Fall'22, Spring'23

PROFESSIONAL SERVICE

- Reviewer, AAAI Conference on Artificial Intelligence (AAAI)   2023
- Reviewer, Real-Time and Network Systems (RTNS)   2022
- Reviewer, IEEE Real-Time and Embedded Technology and Applications Symposium(RTAS)   2021
- Reviewer, IEEE Computer Society Signature Conference on Computers, Software, and Applications (COMP-SAC)   2023
- Reviewer, ACM International Conference on Web Search and Data Mining (WSDM)   2020
- Reviewer, International Conference on Information Society and Technology (ICIST)   2020
- Reviewer, IEEE International Conference on Embedded and Real-Time Computing Systems and Application (RTCSA)   2022
- Reviewer, Computer Methods in Biomechanics and Biomedical Engineering   2023
- Secondary Reviewer, IEEE Transactions on Neural Systems and Rehabilitation Engineering   2024

SKILLS

- *Programming Language*: C, Python, MATLAB.
- *Hardware/Software*: Vicon motion capture system, Delsys EMG and IMU system, OpenSim, AMTI force plate, AMTI instrumented treadmill
- *Operating Systems and Software*: Linux, Windows, Office Software, Latex, Google Cloud Platforms (GCP).

MENTORING EXPERIENCE

- **Carlos Arciniegas, Oliver Fritsche, Steven Camacho, Tyler Halfpenny**, Undergraduate Senior Design Project, University of Central Florida
- **Yi Hong Jong, Pranav Sattiraju, Samir Fouissi**, Undergraduate Research Assistant, University of Central Florida

TRAINING

- Information Security Awareness Training (UCF)   2024
- Fraud Awareness Training (UCF)   2024
- Biomedical Responsible Conduct of Research (UCF)   2023
- Laboratory Hazardous Waste Handling and Processing (UCF)   2023
- EHS203 - Laboratory Safety Annual Refresher   2024
- EHS421 - Think About Your Sink   2024
- EHS 201 - Laboratory Safety Orientation   2019
- Graduate Teaching Assistant Training (UCF)   2021