

# M SHIFAT HOSSAIN

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## Education

### UNIVERSITY OF CENTRAL FLORIDA

Ph.D. Candidate in Computer Engineering; CGPA: 4.0/4.0

ORLANDO, FL, USA

Aug. 2022 – Present

**Dissertation Title:** Towards Trustworthy AI Systems: Efficiency, Reliability, and Robustness

**Thesis Supervisor:** Dr. Hao Zheng and Dr. Rickard Ewetz

### KOOKMIN UNIVERSITY

M.Sc. In Electronics Engineering; CGPA: 4.5/4.5

SEOUL, SOUTH KOREA

Mar. 2019 – Feb. 2021

### KHULNA UNIVERSITY OF ENGINEERING AND TECHNOLOGY

B.Sc. In Electrical and Electronic Engineering

KHULNA, BANGLADESH

Mar. 2013 – May 2017

## Research Overview

I have published a total of **15 Journal articles** that includes *IEEE Transactions on Biomedical Engineering*, *IEEE Transactions on Consumer Electronics*, *Expert Systems with Applications*, *Biomedical Signal Processing and Control*, and *Nature Portfolio Scientific Reports*. I have also published **16 Conference articles** in leading peer-reviewed venues, including WACV and AAAI. I am named as an **inventor** in **11 patents** where 7 of them are South Korean patents (KIPO), 2 US patents (USPTO), and 2 are PCT patents (WIPO). A number of my research works are currently being **adopted by health industries** to develop wearable devices. My research interests lie within the following broad areas:

### Research Interests:

- Trustworthy AI Systems
- Biomedical AI / Bio-Signal Processing
- Wearable Devices
- Autonomous Systems
- Applications of ML in Signal and Image Processing

## Publications [Google Scholar

### Journals (15)

- [J15] T.-H. Kwon, **S. Hossain**, M. S. Turja, and K.-D. Kim, "Design and Validation of a Monte Carlo Method for the Implementation of Noninvasive Wearable Devices for HbA1c Estimation Considering the Skin Effect," *Micromachines*, vol. 15, no. 9, Art. no. 9, Sep. 2024, doi: 10.3390/mi15091067. (Link)
- [J14] C. A. Haque, **S. Hossain**, T.-H. Kwon, H. Kim, and K.-D. Kim, Noninvasive In-Vivo Estimation of Blood-Glucose Concentration Using Beer-Lambert-Based Model, *The Korean Institutes of Communications and Information Sciences*, vol. 48 (7), pp. 852-867, Jul. 2023. (Link)
- [J13] **S. Hossain** and K.-D. Kim, Non-Invasive In Vivo Estimation of HbA1c Using Monte Carlo Photon Propagation Simulation: Application of Tissue-Segmented 3D MRI Stacks of the Fingertip and Wrist for Wearable Systems, *Sensors*, vol. 23, no. 1, Art. no. 1, Jan. 2023, doi: 10.3390/s23010540. (Link)
- [J12] **S. Hossain**, S. Satter, T.-H. Kwon, and K.-D. Kim, "Optical Measurement of Molar Absorption Coefficient of HbA1c: Comparison of Theoretical and Experimental Results," *Sensors*, vol. 22, no. 21, Art. no. 21, Jan. 2022, doi: 10.3390/s22218179. (Link)
- [J11] **S. Hossain** and K.-D. Kim, "Noninvasive Estimation of Glycated Hemoglobin In-Vivo Based on Photon Diffusion Theory and Genetic Symbolic Regression Models," *IEEE Transactions on Biomedical Engineering*, vol. 69, no. 6, pp. 2053–2064, Jun. 2022, doi: 10.1109/TBME.2021.3135305. (Link)
- [J10] S. Sen Gupta, **S. Hossain**, and K.-D. Kim, "Recognize the surrounding: Development and evaluation of convolutional deep networks using gammatone spectrograms and raw audio signals," *Expert Systems with Applications*, vol. 200, p. 116998, Aug. 2022, doi: 10.1016/j.eswa.2022.116998. (Link)
- [J9] M. S. H. Sunny, **S. Hossain**, N. Afroze, M. K. Hasan, E. Hossain, and M. H. Rahman, "Understanding the nonlinear behavior of EEG with advanced machine learning in artifact elimination," *Biomed. Phys. Eng. Express*, vol. 8, no. 1, p. 015017, Dec. 2021, doi: 10.1088/2057-1976/ac3f17. (Link)
- [J8] **S. Hossain** and K.-D. Kim, "Comparison of Different Wavelengths for Estimating HbA1c and SpO<sub>2</sub> Noninvasively Using Beer-Lambert Law and Photon Diffusion Theory Derived Models," *The Journal of Korean Institute of Communications and Information Sciences*, vol. 46, no. 8, pp. 1301–1308, Aug. 2021, doi: 10.7840/kics.2021.46.8.1301. (Link)

- [J7] **S. Hossain**, C. A. Haque, and K.-D. Kim, "Quantitative Analysis of Different Multi-Wavelength PPG Devices and Methods for Noninvasive In-Vivo Estimation of Glycated Hemoglobin," *Applied Sciences*, vol. 11, no. 15, Art. no. 15, Jul. 2021, doi: 10.3390/app11156867. (Link)
- [J6] C. A. Haque, **S. Hossain**, T.-H. Kwon, and K.-D. Kim, "Noninvasive In Vivo Estimation of Blood-Glucose Concentration by Monte Carlo Simulation," *Sensors*, vol. 21, no. 14, Art. no. 14, Jan. 2021, doi: 10.3390/s21144918. (Link)
- [J5] S. S. Gupta, T.-H. Kwon, **S. Hossain**, and K.-D. Kim, "Towards non-invasive blood glucose measurement using machine learning: An all-purpose PPG system design," *Biomedical Signal Processing and Control*, vol. 68, p. 102706, Jul. 2021, doi: 10.1016/j.bspc.2021.102706. (Link)
- [J4] **S. Hossain** and K.-D. Kim, "Estimation of Molar Absorption Coefficients of HbA1c in Near UV-Vis-SW NIR Light Spectrum," *The Korean Institutes of Communications and Information Sciences*, Jun. 2020. (Link)
- [J3] S. S. Gupta, **S. Hossain**, and K.-D. Kim, "HDR-Like Image from Pseudo-Exposure Image Fusion: A Genetic Algorithm Approach," *IEEE Transactions on Consumer Electronics*, vol. 67, no. 2, pp. 119–128, May 2021, doi: 10.1109/TCE.2021.3066431. (Link)
- [J2] **S. Hossain**, S. S. Gupta, T.-H. Kwon, and K.-D. Kim, "Derivation and Validation of Gray-Box Models to Estimate Noninvasive In-vivo Percentage Glycated Hemoglobin Using Digital Volume Pulse Waveform," *Scientific Reports*, Jun. 2021, doi: 10.1038/s41598-021-91527-2. (Link)
- [J1] P. P. Banik, **S. Hossain**, T.-H. Kwon, H. Kim, and K.-D. Kim, "Development of a Wearable Reflection-Type Pulse Oximeter System to Acquire Clean PPG Signals and Measure Pulse Rate and SpO2 with and without Finger Motion," *Electronics*, vol. 9, no. 11, Art. no. 11, Nov. 2020, doi: 10.3390/electronics9111905. (Link)

## Conferences (16)

- [C16] [**SaTC'26**] M. M. H. Gazi, **S. Hossain**, A. Hussain, S. K. Jha, and M. R. Ahmed, "SecureHLSMem: Memory-Safety Enforcement for High-Level Synthesis of Accelerators", *IEEE Conference on Secure and Trustworthy CyberInfrastructure for IoT and Microelectronics (SaTC)*, 2026.
- [C15] [**ICMLA'25**] **S. Hossain**, S. Jha, H. Zheng, and R. Ewetz, "Multitask Contrastive Learning using Task-Wise Training and Partitioned Embedding Space", *International Conference on Machine Learning and Applications (ICMLA)*, 2025.
- [C14] [**ICMLA'25**] F. Rahat, **S. Hossain**, A. Ramanathan, S. Jha, H. Zheng, and R. Ewetz, "Attr-RAG: Attribution-Guided Retrieval-Augmented Generation for Scientific Experiment Design", *International Conference on Machine Learning and Applications (ICMLA)*, 2025.
- [C13] [**ICMLA'25**] M. R. Ahmed, F. Rahat, **S. Hossain**, S. Jha, and R. Ewetz, "Street2Air: A Framework for Synthesizing Aerial Vehicle Views from Ground Images", *International Conference on Machine Learning and Applications (ICMLA)*, 2025.
- [C12] [**WACV'25**] F. Rahat, **S. Hossain**, R. Ahmed, S. Jha, and R. Ewetz, "Data Augmentation for Image Classification using Generative AI", *Winter Conference on Applications of Computer Vision (WACV)*, 2025.
- [C11] [**ICMLA'24**] **S. Hossain**, C. Walker, S. Jha, and R. Ewetz, "Out-of-Distribution Detection for Contrastive Models using Angular Distance Measures", *International Conference on Machine Learning and Applications (ICMLA)*, 2024.
- [C10] [**ICMLA'24**] F. Rahat, **S. Hossain**, R. Ahmed, and R. Ewetz, "CLE: Context-Aware Local Explanations for High Dimensional Tabular Data", *International Conference on Machine Learning and Applications (ICMLA)*, 2024.
- [C9] [**AAAI Workshop'23**] **M. S. Hossain**, M. R. Ahmed, L. Pullum, S. Jha, and R. Ewetz, "Neuro-Symbolic Representations of 3D Scenes using Universal Scene Description Language," in *Neuro-Symbolic Learning and Reasoning in the era of Large Language Models (NuCLeaR)*, AAAI, 2023.
- [C8] [**ICTC'21**] C. A. Haque, **S. Hossain**, T.-H. Kwon, and K.-D. Kim, "Comparison of Different Methods to Estimate Blood Oxygen Saturation using PPG," in *2021 International Conference on Information and Communication Technology Convergence (ICTC)*, Oct. 2021, pp. 792–794. doi: 10.1109/ICTC52510.2021.9621142.
- [C7] [**ICTC'20**] S. S. Gupta, **S. Hossain**, C. A. Haque, and K.-D. Kim, "In-Vivo Estimation of Glucose Level Using PPG Signal," in *2020 International Conference on Information and Communication Technology Convergence (ICTC)*, Oct. 2020, pp. 733–736.
- [C6] [**ICTC'19**] **S. Hossain**, T.-H. Kwon, and K.-D. Kim, "Comparison of Different Wavelengths for Estimating SpO2 Using Beer-Lambert Law and Photon Diffusion in PPG," in *2019 International Conference on Information and Communication Technology Convergence (ICTC)*, Oct. 2019, pp. 1377–1379. doi: 10.1109/ICTC46691.2019.8939849.
- [C5] [**ICASERT'19**] Md. S. Haque Sunny, D. Roy Dipta, **S. Hossain**, H. M. Resalat Faruque, and E. Hossain, "Design of a Convolutional Neural Network Based Smart Waste Disposal System," in *2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT)*, May 2019, pp. 1–5. doi: 10.1109/ICASERT.2019.8934633.
- [C4] [**EICT'17**] S. S. Khan, Md. S. H. Sunny, **M. S. Hossain**, E. Hossain, and M. Ahmad, "Nose tracking cursor control for the people with disabilities: An improved HCI," in *2017 3rd International Conference on Electrical Information and Communication Technology (EICT)*, Dec. 2017, pp. 1–5. doi: 10.1109/EICT.2017.8275178.

- [C3] **[EICT'17] S. Hossain**, S. S. Khan, M. S. H. Sunny, and M. Ahmad, "Frequency component grouping based sound source extraction from mixed audio signals using spectral analysis," in 2017 3rd International Conference on Electrical Information and Communication Technology (EICT), Dec. 2017, pp. 1–6. doi: 10.1109/EICT.2017.8275145.
- [C2] **[ICAEE'17] Md. S. H. Sunny**, E. Hossain, T. N. Mimma, and **S. Hossain**, "An autonomous robot: Using ANN to navigate in a static path," in 2017 4th International Conference on Advances in Electrical Engineering (ICAEE), Sep. 2017, pp. 291–296. doi: 10.1109/ICAEE.2017.8255369.
- [C1] **[IC2IT'17] Md. K. Hasan**, Md. S. H. Sunny, **S. Hossain**, and M. Ahmad, "User Independency of SSVEP Based Brain Computer Interface Using ANN Classifier: Statistical Approach," in Recent Advances in Information and Communication Technology (IC2IT) 2017, 2018, pp. 58–68. doi: 10.1007/978-3-319-60663-7\_6.

## Patents

- [IP8] Ki-Doo Kim, Tae-Ho Kwon, and **Shifat Hossain**, "Non-invasive biosignal measurement device and method based on skin effect removal," KR Patent: KR102595803B1. Issued: October 30, 2023. [Online]
- [IP7] Ki-Doo Kim, Tae-Ho Kwon, and **Shifat Hossain**, "Non-invasive biosignal measurement device based on skin effect removal," KR Patent: KR102591405B1. Issued: October 19, 2023. [Online]
- [IP6] Ki-Doo Kim, Tae-Ho Kwon, and **Shifat Hossain**, "Method and Apparatus for Non-Invasive Measurement of Glycated Hemoglobin using Monte Carlo Simulation," KR Patent: KR102439240B1. Issued: September 2, 2022. [Online]
- [IP5] Ki-Doo Kim and **Shifat Hossain**, "Noninvasive HbA1c Measurement System and Method using Monte-Carlo Simulation,"
- KR patent: KR102403577B1, Issued: May 31, 2022 [Online]
  - PCT application: WO2022045822A1, Published: March 03, 2022 [Online]
  - US patent: US12412667B2, Issued: September 09, 2025 [Online]
- [IP4] Ki-Doo Kim and **Shifat Hossain**, "Noninvasive HbA1c Measurement System and Method Thereof," KR Patent: KR102482459B1, Issued: December 29, 2022. [Online]
- [IP3] Ki-Doo Kim and **Shifat Hossain**, "Noninvasive HbA1c Measurement System using Photon-Diffusion Theory and Method Thereof," KR Patent: KR102402263B1, Issued: May 27, 2022. [Online].
- [IP2] Ki-Doo Kim and **Shifat Hossain**, "System and Method for Non-Invasive Measurement of Glycated Hemoglobin,"
- PCT Application: WO2021210724A1, Published: October 21, 2021. [Online]
  - US Application: US20240225495A1, Published: July 11, 2024. [Online]
- [IP1] Ki-Doo Kim and **Shifat Hossain**, "Noninvasive HbA1c Measurement System using the Beer-Lambert law and Method Thereof," KR Patent: KR102356154B1, Issued: January 28, 2022. [Online].

## Preprints/Under Review

- [U3] Localizing LLM Knowledge by Tracing Information Flow
- [U2] LLM token optimization for data oriented applications
- [U1] Leveraging Inter-Anchor Spatial Reasoning for Autonomous UAV-Assisted Search and Rescue

## Posters/Presentations

- [P8] **[ICMLA'24] S. Hossain**, C. Walker, S. Jha, and R. Ewetz, "Out-of-Distribution Detection for Contrastive Models using Angular Distance Measures", International Conference on Machine Learning and Applications (ICMLA), 2024.
- [P7] **[AAAI Workshop'23] M. S. Hossain**, M. R. Ahmed, L. Pullum, S. Jha, and R. Ewetz, "Neuro-Symbolic Representations of 3D Scenes using Universal Scene Description Language," in Neuro-Symbolic Learning and Reasoning in the era of Large Language Models (NuCLear), AAAI, 2023.
- [P6] **[ICTC'20] S. S. Gupta**, **S. Hossain**, C. A. Haque, and K.-D. Kim, "In-Vivo Estimation of Glucose Level Using PPG Signal," in 2020 International Conference on Information and Communication Technology Convergence (ICTC), Oct. 2020, pp. 733–736.
- [P5] **[ICTC'19] S. Hossain**, T.-H. Kwon, and K.-D. Kim, "Comparison of Different Wavelengths for Estimating SpO2 Using Beer-Lambert Law and Photon Diffusion in PPG," in 2019 International Conference on Information and Communication Technology Convergence (ICTC), Oct. 2019, pp. 1377–1379. doi: 10.1109/ICTC46691.2019.8939849.
- [P4] **[KOSIPER'20] S. Hossain**, K. D. Kim, "Analysis of national patent statistics for Visual-MIMO", The Korean Society of Intellectual Property Education & Research (KOSIPER), 2020
- [P3] **[KOSIPER'19] S. Hossain**, K. D. Kim, "Statistical Analysis of IP Documents on "Artificial Neural Network" from Google Patents Database", The Korean Society of Intellectual Property Education & Research (KOSIPER), 2019

- [P2] **[EICT'17] S. Hossain**, S. S. Khan, M. S. H. Sunny, and M. Ahmad, "Frequency component grouping based sound source extraction from mixed audio signals using spectral analysis," in 2017 3rd International Conference on Electrical Information and Communication Technology (EICT), Dec. 2017, pp. 1–6. doi: 10.1109/EICT.2017.8275145.
- [P1] **[ICAEE'17] Md. S. H. Sunny**, E. Hossain, T. N. Mimma, and **S. Hossain**, "An autonomous robot: Using ANN to navigate in a static path," in 2017 4th International Conference on Advances in Electrical Engineering (ICAEE), Sep. 2017, pp. 291–296.

## Professional Experiences

### GRADUATE RESEARCH ASSISTANT

**AUG. 2022 – PRESENT**

AI and Emerging Computing Lab, University of Central Florida

Orlando, FL, USA

- Developed machine learning models and frameworks for trustworthy AI
- Developed synthetic data generation system using generative AI
- Developed hybrid neuro-symbolic algorithms for the DARPA ANSR program
- Facilitated and mentored undergrad and grad students in their research plan development and execution

### RESEARCHER

**MAR. 2021 – JUL. 2022**

Kookmin University

Seoul, South Korea

- Derived theories and performed experiments on Beer-Lambert law, photon diffusion model, and Monte Carlo photon propagation based HbA1c estimation
- Performed experiments on HbA1c estimation with PPG signals.
- Designed and developed smart watch using FreeCad and KiCad to record PPG signal.
- Developed firmware for the ESP32 smart watch.

### GRADUATE RESEARCH ASSISTANT

**MAR. 2019 – FEB. 2021**

Multimedia, Communication, and Signal Processing Lab, Kookmin University

Seoul, South Korea

- Derived theories for estimating SpO2, and heart rate using PPG signal.
- Developed PPG signal acquisition application using mobile phone camera.
- Developed wristband hardware solutions for PPG signal acquisition.

### LECTURER

**SEP. 2018 – FEB. 2019**

Department of Electrical and Electronics Engineering, Daffodil International University

Dhaka, Bangladesh,

- Microprocessors and Interfacing
- Control Systems
- Electronics I
- Random Signals and Processes
- Power System Protection

### SOFTWARE DEVELOPER

**MAY 2015 – MAY 2016**

Bangladesh Institute of ICT in Development (BIID)

Dhaka, Bangladesh

- Developed a web based agricultural data repository for the Bangladesh Institute of ICT in Development (BIID) in ASP.NET.
- Maintained the web data repository.

## Major Project Highlights

### INSTA-AI: Integrating Neural Representation and their Symbolic Twins for Assured AI

2022 - present

The INSTA-AI project, part of DARPA's initiative, focuses on developing hybrid AI algorithms that combine neuro-symbolic reasoning with data-driven learning to create trustworthy autonomous systems. My work centers on enhancing the perception capabilities of autonomous drones in tightly resource-constrained situations. It also includes integration with the maneuver component, using ROS2 and Docker multi-container setups. As a researcher, I developed neuro-symbolic perception algorithms, mentored students, and co-authored papers for top AI conferences. [C9, U2]

### XAI for Improving Scientific Workflows using Multi-Modal Explanations

2022 - present

This project is from the U.S. Department of Defense to develop novel multi-modal trustworthy AI models and frameworks in the scope of neuro-symbolic AI. Designed novel methods to improve AI model efficiency and reliability. [C10, C11, C12, U1, U3]

### Embedded Wearable Device for Noninvasive Glycated Hemoglobin Estimation

2020 - 2022

This project was initiated by Kookmin University Industry-Academic Cooperation Foundation. The goals of this project include development of theoretical proofs of the feasibility of wearable devices for diabetes diagnosis and monitoring, development of novel algorithms to compute the diabetes detection factors from biosignals, design of wearable tech, and make those human compliant. I have published multiple conferences and journals in top venues and publishers. We have also published multiple intellectual properties. [C6~C8, J3~J15, IP1~IP8]

## Mobile Camera Based Fingertip DVP Signal Acquisition System

2019

Developed an mobile applications to record 3-wavelength digital volume pulse (DVP) signals directly from the mobile camera sensor. We have published a journal paper reporting our findings. [J1]

## Review Activities

IEEE Access – 1 paper	2019
Lasers in Medical Science – 1 paper	2025

## Honors and Awards

<b>UCF Grad Presentation Fellowship</b> , University of Central Florida	2024
<b>ORCGS Doctoral Fellowship</b> , University of Central Florida	2022
<b>Academic Excellence Award</b> , Kookmin University	2021
<b>Best Presenter Award Nomination</b> , "Analysis of national patent statistics for Visual-MIMO", The Korean Society of Intellectual Property Education & Research (KOSIPER)	2020
<b>Best Presenter Award Nomination</b> , "Statistical Analysis of IP Documents on "Artificial Neural Network" from Google Patents Database", The Korean Society of Intellectual Property Education & Research (KOSIPER)	2019
<b>Dr. Fatima Rashid Best Paper Award</b> , "An autonomous robot: Using ANN to navigate in a static path", International Conference on Advances in Electrical Engineering (ICAEE)	2017
<b>Technical Scholarship</b> , Khulna University of Engineering and Technology	2014-2017
<b>Award of Excellence</b> , EEE Association, Khulna University of Engineering and Technology	2015

## Professional Activities

<b>Assistant General Secretary</b> , EEE Association, Khulna University of Engineering and Technology (KUET)	2016
<b>Volunteer Mentor</b> , Line-Follower robot competition, IEEE Student Branch, Khulna University of Engineering & Technology (KUET)	Dec. 2016
<b>Graphics Designer and Technical Core</b> , Inter-University Tech Fiesta (IUTF), Khulna University of Engineering & Technology (KUET)	Jan. 2016
<b>Volunteer</b> , International Conference on Electrical Information and Communication Technology (EICT), Khulna, Bangladesh	Dec. 2015
<b>C/C++ Trainer</b> , Human Enlightenment and Researching Technical Zone (HERTZ), Khulna University of Engineering & Technology (KUET)	Jun. 2014 ~Jun. 2015

## Professional Training

• UCF Institutional Review Board (IRB) and Human Research Protection Program (HRPP) Awareness Training, UCF	2025
• UCF Active Threat Response Training	2025
• Fraud Awareness Training, UCF	2023
• Kognito at-risk for Faculty & Staff, UCF	2023
• IRB training, Kookmin University	2020
• Annual Lab Safety Training, Kookmin University	2019~2021

## Talks

• AI and Emerging Computing Lab Research talk	2023
• A Method and System for Measuring Noninvasive Glycated Hemoglobin (HbA1c) using PPG signals	2022
• Talk on wearable HbA1c estimation device, K-OLLABO Industry-Academic Day – KES	2021

## Mentoring

<b>University of Central Florida</b>	2023-2024
Jaden Jeudy (B.S. Student, UCF)	
Jose Porta (B.S. Student, UCF)	
Scott Schimpf (B.S. Student, UCF)	
Oliver Fritsche (B.S. Student, UCF)	