S M Taslim Uddin Raju

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Research Interests

My research focuses on developing multimodal machine learning systems for healthcare by integrating Graph Neural Networks, Vision Transformers, and Large Language Models. I specialize in digital pathology, non-invasive physiological monitoring using smartphone-based PPG, and medical signal processing. I aim to build intelligent, scalable solutions for clinical diagnostics, decision support, and automated reporting. My work emphasizes real-world applicability, bridging advanced AI techniques with practical healthcare needs.

Education

09/2023 – 04/2025 **University of Waterloo, Waterloo, ON N2L 3G1, Canada**
MASc. in Electrical and Computer Engineering (ECE) – Research | CGPA: - 85%
Thesis: Advanced AI for Histopathological Whole Slide Image Classification and Captioning
Specialized: Pattern Analysis and Machine Intelligence (Now Artificial intelligence)
Supervisor: Prof. Fakhri Karray
Core Courses: Introduction to Machine Learning, Advance Deep Learning, Data and Knowledge Modelling and Analysis

06/2019 – 12/2022 **Khulna University of Engineering & Technology, Khulna, Bangladesh**
Master of Science in Computer Science and Engineering (CSE) – Research | CGPA: - 4.00/4.00
Thesis: Hemoglobin and Glucose Levels Estimation Techniques Using Optimal PPG Characteristic Features of Smartphone Videos
Supervisor: Prof. M.M.A Hashem
Core Courses: Advance Deep Learning, Bioinformatics, Soft Computing, Advance Natural Language Processing

04/2015 – 02/2019 **Khulna University of Engineering & Technology, Khulna, Bangladesh**
Bachelor of Science in Computer Science and Engineering (CSE) | CGPA: - 3.85/4.00 (3rd Position)
Thesis: A Study on Non-Invasive Hemoglobin Measurement Techniques
Supervisor: Prof. M.M.A Hashem
Core Courses: Machine Learning, Artificial Intelligence, Natural Language Processing, Biomedical Engineering

Professional Appointments/Experiences

09/2023 – 04/2025 **University of Waterloo, Waterloo, ON**
Machine Learning Graduate Researcher, Pattern Analysis and Machine Intelligence (Now AI) Lab

- Advanced research in caption generation from histopathological whole slide image (WSI) through Transformer and UNet-Based Adversarial Autoencoder architectures.
- Specialized in microscopic WSI analysis, developing Vision Transformers and Graph Neural Networks for advanced digital pathology tasks, such as classification and caption generation with LLMs

01/2024 – 04/2025 ***Teaching Assistant, Department of Electrical and Computer Engineering***

- Courses: MTE 241 – Introduction to Computer Structures and Real-Time Systems, ECE 459 – Programming for Performance, and ECE 222 – Digital Computers
- Contributed to course delivery by leading labs, grading assignments and exams, and offering academic support through office hours

12/2020 – 07/2023 (study leave) **Khulna University of Engineering & Technology, Khulna, Bangladesh**
Lecturer, Department of Computer Science and Engineering (CSE)

- Courses: CSE 1101 – Structure Programming, CSE 1102 – Structure Programming Laboratory, CSE 2113 – Computer Architecture and CSE 4112 – Machine Learning
- Taught undergraduate courses, supervised student projects, and mentored students through academic and technical guidance to support their learning and development

01/2020 – 11/2020 ***Graduate Researcher, Department of Computer Science and Engineering (CSE)***

- Pioneered a non-invasive 850 nm NIR-LED wearable device integrated with a smartphone to capture fingertip videos dataset and PPG signal extraction.
- Engineered advanced ML pipelines – leveraging Deep Neural Networks (DNNs) and Multigene Genetic Programming (MGGP) – to estimate blood glucose, and hemoglobin levels from PPG extracted features

03/2019 – 01/2020 **Eastern University, Dhaka, Bangladesh**
Lecturer, Department of Computer Science and Engineering

- Courses: 06131205 – Structure Programming, 06131206 – Structure Programming Laboratory, 07142213 – Computer Architecture, 05413109 – Numerical Methods
- Delivered undergraduate lectures, designed course materials and assessments, and guided students through academic support

Projects (Only Major Project*)

09/2024 – 05/2025 **GNN-ViTCap: Microscopic Whole Slide Image Classification and Captioning**
University of Waterloo, Pattern Analysis and Machine Intelligence Lab
- Designed integrated framework combining graph neural networks and LLMs for whole slide images classification and captioning
- Achieved high accuracy with BLEU-4 = 81.1% and METEOR = 56.7%, with BioMedGPT in image captioning

05/2024 – 08/2024 **LLM-Q&A: Automated Medical Q & A Systems Using Fine-Tuned Large Language Models**
University of Waterloo, Pattern Analysis and Machine Intelligence Lab
- Implemented an automated medical Q&A system by fine-tuning LLM models such as GPT-2, Llama2, Bloom, and T5
- Evaluated using BLEU and ROUGE metrics, with T5 showing superior performance in generating accurate medical answers

09/2023 – 04/2024 **TransUAAE-CapGen: Caption Generation from Histopathological Whole Slide Images**
University of Waterloo, Pattern Analysis and Machine Intelligence Lab
- Developed a hybrid UNet-based Adversarial Autoencoder and transformer to generate captions for histopathological images.
- Achieved high accuracy with BLEU-4 = 86.8% and ROUGE = 89.3%, outperforming traditional LSTM-based models

05/2022 – 05/2023 **DNN-BP: A Deep Learning Framework for Blood Pressure Estimation using Optimized PPG Features**
Khulna University of Engineering & Technology
- Developed a DNN-based algorithm to estimate systolic and diastolic blood pressure (BP) using only Photoplethysmography (PPG) signals from 125 subjects with 218 records
- Applied ensemble feature selection on time-domain, frequency-domain, and statistical PPG features, achieving MAE = 2.48 mmHg (SBP) and 1.499 mmHg (DBP), meeting AAMI and BHS standards

01/2020 – 02/2023 **Non-Invasive Blood Component Levels Estimation Using Smartphone Fingertip Video**
Khulna University of Engineering & Technology
- Introduced a non-invasive method for monitoring Glucose and Hemoglobin levels using Smartphone video and NIR LED device
- Generated PPG signal, extracted the PPG features and fed the features to DNN-based models to estimate blood component levels

06/2019 – 08/2020 **Dermo-DOCTOR**
Khulna University of Engineering & Technology, Artificial Intelligence in Medical Image Computing Lab
- Engineered a CNN-based network with class rebalancing for state-of-the-art lesion detection on ISIC-2016 and ISIC-2017 datasets
- Integrated segmented lesions and dual-encoder CNN features to enhance lesion detection across varied conditions

Publications

Published/Accepted Manuscripts

(C1) Md Rezwanul Haque, Md. Milon Islam, **S M Taslim Uddin Raju**, and Fakhri Karray, "A Signer-Invariant Conformer and Multi-Scale Fusion Transformer for Continuous Sign Language Recognition", *Multimodal Sign Language Recognition,* IEEE/CVF ICCV 2025 Workshop, Honolulu, Hawaii, USA, October 20th, 2025 [**Accepted**]

(C2) Md Rezwanul Haque, Md. Milon Islam, **S M Taslim Uddin Raju**, and Fakhri Karray, "FusionEnsemble-Net: An Attention-Based Ensemble of Spatiotemporal Networks for Multimodal Sign Language Recognition", *Multimodal Sign Language Recognition,* IEEE/CVF ICCV 2025 Workshop, Honolulu, Hawaii, USA, October 20th, 2025 **[Accepted**]

(C3) Md Rezwanul Haque, Md. Milon Islam, **S M Taslim Uddin Raju**, Hamdi Altaheri, Lobna Nassar, and Fakhri Karray, "MMFformer: Multimodal Fusion Transformer Network for Depression Detection", *IEEE International Conference on Systems, Man, and Cybernetics (SMC),* IEEE, Austria Center Vienna, Austria, 5 - 8 October 2025. [**Accepted, Tier B1 Conference**]

(C4) Md Rezwanul Haque, Md. Milon Islam, **S M Taslim Uddin Raju**, Hamdi Altaheri, Lobna Nassar, and Fakhri Karray, "Multimodal Depression Detection through Mutual Transformer", IEEE, Austria Center Vienna, Austria, 5 - 8 October 2025. [**Accepted, Tier B1 Conference**]

(C5) **S M Taslim Uddin Raju,** Md Rezwanul Haque, Md. Milon Islam, Hamdi Altaheri, and Fakhri Karray, "GNN-ViTCap: GNN-Enhanced Multiple Instance Learning with Vision Transformers for Whole Slide Image Classification and Captioning", *International Joint Conference on Neural Networks (IJCNN 2025),* 30 June - 5 July 2025, IEEE, Rome, Italy **[Tier A*] [Thesis Work]**

(C6) **S M Taslim Uddin Raju,** Abdul Raqeeb Mohammad, Md. Milon Islam, and Fakhri Karray, "TransUAAE-CapGen: Caption Generation from Histopathological Patches through Transformer and UNet-Based Adversarial Autoencoder", ***IEEE***

International Conference on Systems, Man, and Cybernetics (IEEE SMC), IEEE, Borneo Convention Centre Kuching, Sarawak, Malaysia, 6 - 10 October 2024 [**Tier B1 Conference**] **[Thesis Work]**

(J1) **S M Taslim Uddin Raju,** Safin Ahmed Dipto, Md Imran Hossain, Md. Abu Shahid Chowdhury, Fabliha Haque, Ayesha Tun Nashrah, Araf Nishan, Ashfaq Ahmad, and M. M. A. Hashem, "DNN-BP: A Novel Framework for Cuffless Blood Pressure Measurement from Optimal PPG Features using Deep Learning Model," ***Medical & Biological Engineering & Computing***, Springer, pp. 1–22, 2024.

(J2) Araf Nishan, **S M Taslim Uddin Raju,** Md Imran Hossain, Safin Ahmed Dipto, Asif Sijan, S M Tanvir Uddin, Md. Abu Shahid Chowdhury, and Md Mahamudul Hasan Khan, "A Continuous Cuffless Blood Pressure Measurement from Optimal PPG Characteristic Features using Machine Learning Algorithms," ***Heliyon,*** Elsevier, vol. 10, no. 6, 2024.

(C7) MD Jamil, Saimoon Oman, **S M Taslim Uddin Raju,** Fatema Soshi, "A Novel Framework for Enhancing Sensor Data Analysis: Label-Preserving Augmentation and Probabilistic Balancing", *26th International Conference on Computer and Information Technology (ICCIT),* IEEE, Cox's Bazar, Bangladesh, 13-15 December, 2023

(C8) Humaira Neha, Sadman Sakib, Farhan Sadaf, **S M Taslim Uddin Raju**, "Mobile Application to Collect Data and Measure Blood Component Level in a Non-Invasive Way", *26th International Conference on Computer and Information Technology (ICCIT),* IEEE, Cox's Bazar, Bangladesh, 13-15 December, 2023

(C9) Lamia Hossain, Ilma Hossain, **S M Taslim Uddin Raju,** Md. Shahidul Salim and Joy Saha**,** "A Novel Technique for Classification of Motor Imagery EEG Signal Based on Deep Learning Approaches," *2nd International Conference on Big Data, IoT and Machine Learning (BIM 2023),* Springer, Dhaka, Bangladesh, 6-8 September, 2023

(C10) Saimoon Al Farshi Oman, Md. Nafis Jamil, and **S M Taslim Uddin Raju,** "BCL: A Branched CNN-LSTM Architecture for Human Activity Recognition Using Smartphone Sensors," *International Conference on Next-Generation Computing, IoT and Machine Learning (NCIM 2023),* IEEE, DUET Gazipur, Bangladesh, 16-17 June, 2023

(C11) Rifah Tasnim Haque Promi, Rezwana Akter Nazri, Md. Shahidul Salim, and **S M Taslim Uddin Raju,** "A Deep Learning Approach for Non-Invasive Hypertension Classification from PPG Signal" *International Conference on Next-Generation Computing, IoT and Machine Learning (NCIM 2023),* IEEE, DUET Gazipur, Bangladesh, 16-17 June, 2023

(C12) **S M Taslim Uddin Raju**, and M. M.M.A. Hashem, "Real-Time Hemoglobin Measurement Using Smartphone Video and Artificial Neural Network," *International Conference on Electrical, Computer & Telecommunication Engineering (ICECTE 2022),* IEEE, RUET, Rajshahi, Bangladesh, 29 – 31 Dec., 2022

(C13) **S M Taslim Uddin Raju** and M. M. A. Hashem, "DNN Based Blood Glucose Level Estimation Using PPG Characteristic Features of Smartphone Videos," *25th International Conference on Computer and Information Technology (ICCIT 2022)*, IEEE, Cox's Bazar, Bangladesh, 17-19 Dec., 2022

(C14) Towsif Ahamed Labib, Md. Nazrul Islam, **S M Taslim Uddin Raju** and M. M. A. Hashem, "Blood Donor Arrival Forecasting Using Regression Model and Analysis of Donor Behavioural Pattern," *25th International Conference on Computer and Information Technology (ICCIT 2022)*, IEEE, Cox's Bazar, Bangladesh, 17-19 Dec., 2022

(J3) **S M Taslim Uddin Raju**, Amlan Sarker, Apurba Das, Md. Milon Islam, Mabrook S. Al-Rakhami, Atif M. Al-Amri, and Tasniah Mohiuddin , Fahad R. Albogamy, "An Approach for Demand Forecasting in Steel Industries Using Ensemble Learning," ***Complexity*****, Hindawi**, vol. 2022, Feb. 2022

(C15) Farhan Sadaf, **S M Taslim Uddin Raju**, and Abdul Muntakim, "Offline Bangla Handwritten Text Recognition: A Comprehensive Study of Various Deep Learning Approaches" *2021 3rd International Conference on Electrical & Electronic Engineering (ICEEE 2021),* IEEE, RUET, Rajshahi, Bangladesh, 22 – 24 Dec., 2021

(C16) Anik Ghosh, A. B. M. Aowlad Hossain and **S M Taslim Uddin Raju**, "Classification of Diabetic Retinopathy Using Few-Shot Transfer Learning from Imbalanced Data" *2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS)*, IEEE, Tamilnadu, India, 19 – 20 Mar., 2021

(J4) Md. Kamrul Hasan, Shidhartho Roy, Chayan Mondal, Md. Ashraful Alam, Md. Toufick E Elahi, Aishwariya Dutta, **S M Taslim Uddin Raju**, Md. Tasnim Jawad, Mohiuddin Ahmad, "Dermo-DOCTOR: A framework for concurrent skin lesion detection and recognition using a deep convolutional neural network with end-to-end dual encoders," ***Biomedical Signal Processing and Control***, **Elsevier**, vol. 68, Mar. 2021

(J5) Md. Rezwanul Haque, **S M Taslim Uddin Raju**, Md. Asaf-uddowla Golap, M. M. A. Hashem, "A Novel Technique for Non-Invasive Measurement of Human Blood Component Levels from Fingertip Video Using DNN Based Models," ***IEEE Access,*** vol. 9, pp. 19025 – 19042, IEEE, Jan. 2021

(J6) Md. Asaf-uddowla Golap, **S M Taslim Uddin Raju**, Md. Rezwanul Haque, M. M. A. Hashem, "Hemoglobin and Glucose Level Estimation from PPG Characteristics Features of Fingertip Video Using MGGP-Based Model," ***Biomedical Signal Processing and Control,*** **Elsevier**, vol. 67, Jan. 2021

(J7) Shah Muhammad Azmat Ullah, Md. Milon Islam, Saifuddin Mahmud, Sheikh Nooruddin, **S M Taslim Uddin Raju** and Md. Rezwanul Haque, "Scalable Telehealth Services to Combat Novel Coronavirus (COVID-19) Pandemic" ***SN Computer Science,*** **Springer**, vol. 2, no. 1, pp. 18, Jan. 2021

(J8) Md. Milon Islam, Shah Muhammad Azmat Ullah, Saifuddin Mahmud and **S M Taslim Uddin Raju,** "Breathing Aid Devices to Support Novel Coronavirus (COVID-19) Infected Patients," ***SN Computer Science,*** Springer, vol. 1, no. 5, pp. 274, Aug. 2020

(C17) **S M Taslim Uddin Raju**, and Md Shamimur Rahman, "Horizontal Vertical and SuperQueen Parity (HVSQ) Method for Soft Error Tolerance," *2020 IEEE Region 10 Symposium (TENSYMP),* IEEE, Dhaka, Bangladesh, pp. 1734-1737, 5-7 Jun., 2020

Posters/Workshop Publications

(P1) **S M Taslim Uddin Raju,** and M. M. A Hashem, "Development of a Novel Non-invasive Smartphone-Based Blood Components Estimation Technique Using Python," PyCon US 2023, Salt Lake City, USA, 19-27 April 2023

Book Chapter

(B1) Md Milon Islam, **S M Taslim Uddin Raju**, Sheikh Nooruddin, Fakhri Karray, and Ghulam Muhammad. "Internet of Health Things: an introduction." *In Blockchain and Digital Twin for Smart Healthcare*, pp. 19-44. Elsevier, 2025

Submitted Manuscripts

(S1) **S M Taslim Uddin Raju,** Md Rezwanul Haque, Md. Milon Islam, Hamdi Altaheri, and Fakhri Karray, "ClusGNN-ViT: Integrating Deep Embedded Clustering and GNN-MIL for Microscopic Image Captioning and Diagnosis," ***IEEE Transactions on Computational Imaging,*** **IEEE**

(S2) **S M Taslim Uddin Raju**, Apurba Das, Amlan Sarker, Md. Milon Islam, S M Tanvir Uddin, Md. Ismail Hossain, and MD Piyal Mollah, "EwvEn: An Enhancing Weighted Voting Ensemble Algorithm for Demand Forecasting of Steel Industry," ***Array***, **Elsevier**. [Manuscript Number: ARRAY-D-25-01466]

(S3) **S M Taslim Uddin Raju,** and Abdul Raqeeb Mohammad, "Enhancing Automated Medical Question-Answer Systems Using Fine-Tuned Large Language Models" *13th International Conference on Electrical and Computer Engineering (ICECE)*

(S4) Md. Najib Hasan, Sourav Basak Shuvo, Md. Mahadi Hasan Ankon, Souvika Sarkar, **S M Taslim Uddin Raju** and Nazmul Siddique, "TransfusionNet: Framework for Cervical Cancer Detection using Deep Learning with Multi-level Bi-Fusion and Aggregated-Fusion", ***Information Fusion,*** **Elsevier** [Manuscript Number: INFFUS-D-25-00008]

Services and Outreach

Journal Reviews

- Journal of Biomedical and Health Informatics [PDF]
- IEEE Access [PDF]
- IEEE Sensors Letters [PDF]
- One Plus [PDF]
- Journal of Engineering – Wiley [PDF]
- Journal of International Medical Research [PDF]
- Scientific Reports – Nature [PDF]
- Computer Methods in Biomechanics and Biomedical Engineering [PDF]
- Signal, Image and Video Processing – Springer Nature [PDF]
- Biomedical Engineering: Applications, Basis and Communications [PDF]
- Technology and Health Care – Sage Journals [PDF]
- International Journal of Intelligent Systems – Wiley [PDF]

Conferences Reviews

- IEEE SMC 2024: IEEE International Conference on Systems, Man, and Cybernetics: 2024 – 2025 [PDF]
- International Joint Conference on Neural Networks (IJCNN 2025) [PDF]

Leadership & Co-curricular Activities

- Mentor, Graduate Mentorship Program, University of Waterloo – Guided new graduate students through mentorship initiative [PDF]
- Supervisor, Capstone Project, KUET – Advised 4th year students in applying deep learning to biomedical data analysis, supporting project completion and publication 2023 [PDF]
- Research Mentor, KUET – Supervised 3rd year undergraduates on deep learning and sensor-based projects, fostering research skills and teamwork 2022 [PDF]
- Mentor, System Development Project, KUET – Supervised 3rd-year students in developing smartphone-based solutions [2021] [PDF]
- Supervisor, Capstone Project, KUET – Advised 4th year students on EEG signal classification using deep learning [PDF]
- Student Coordinator, Department of CSE, KUET, leading campus tours, and coordinating student volunteers

Voluntary Experiences

- Volunteer Member to assisting with conference logistics, attendee suppor for 5th International Conference on Electrical Information and Communication Technology (EICT) [2021]
- Collaboration work with one blood organization project, Petersburg, Florida 33716, USA [2020-2021] [PDF]
- Collaboration research with **King Saud University**, Saudi Arabia [PDF]
- **Instructor** for introductory workshop on C Programming in SGPIC (Special Group Interested in Programming Contest) [2016]
- Student Motivator and Examiner in **NHSPC** (National High School Programming Contest) [2016- 2017]

Fellowships, Honors, & Awards

2023 – 2025	**Graduate Research Students** (GRS) from University of Waterloo **[Funding: $42000 USD]** [PDF]
2023	Scholar Award, IEEE International Conference on Systems, Man and Cybernetics (IEEE SMC) **[Funding: $500 USD]**
2023	Scholar Award, PyCon US Poster Presentation, Salt Lake City, Utah USA **[Funding: $2000 (USD)]**
2023	**Vice Chancellor Awards** for top researcher, Khulna University of Engineering & Technology **[Funding: $500 (USD)]** [PDF]
2022	Travel Grant, 25th International Conference on Computer and Information Technology (ICCIT 2022), IEEE, Cox's Bazar, Bangladesh **[Funding: $400 USD]**
2021	Travel Grant, 3rd International Conference on Electrical & Electronic Engineering (ICEEE 2021), IEEE, RUET, Rajshahi, Bangladesh **[Funding: $300 USD]**
2017 – 2018	**Dean's List**, outstanding academic performance, KUET [CGPA: 3.93/4.00] [PDF]
2016 – 2017	**Dean's List,** outstanding academic performance, KUET [CGPA: 3.94/4.00] [PDF]
2015 – 2016	**Dean's List,** outstanding academic performance, KUET [CGPA: 3.90/4.00] [PDF]
2016 – 2019	Technical Scholarship, Khulna University of Engineering & Technology [**Funding: $250 (USD)/Year]**

Skill & Tools

Programming Languages	**Python** (Primary), C, C++, Java
ML & DL Frameworks	**Pytorch**, Scikit-learn, Tensorflow, Keras, OpenCV
Development Tools & IDEs	**VS Code, LaTeX/Overleaf**, Jupyter Notebooks, GitHub

References

Prof. Fakhri Karray
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