Fabiha Bushra

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Research Interests: Robotics; Interactive Perception; Long-horizon Reasoning; Dynamic Planning; Manipulation; Autonomous Navigation; Human-Robot Interaction; Computer Vision; Natural Language Processing; Multimodal Learning; Continual Learning; Imitation Learning; Reinforcement Learning (Deep RL, Inverse RL, Meta RL, Hierarchical RL).

EDUCATION

Bachelor of Science in Electrical and Electronic Engineering *Dhaka, Bangladesh*
University of Dhaka *2022*

- **Cumulative CGPA:** 3.50/4.00

PUBLICATIONS

- **Bushra, F.**, Chowdhury, M. E. H., Sarmun, R., Kabir, S., Said, M., Zoghoul, S. B., Mushtak, A., Al-Hashimi, I., Alqahtani, A., Hasan, A., 2024. Deep learning in computed tomography pulmonary angiography imaging: a dual-pronged approach for pulmonary embolism detection. *Expert Systems With Applications, 245,* p.123029.
  DOI: [10.1016/j.eswa.2023.123029]

- [Under Review] Baray, S. B., Chowdhury M. E. H., Sarmun, R., Prithula, J., **Bushra, F.**, Islam, M. S., Khandakar, A., Khan M. M., Sayem F. R., Sumon, M. S. I., Mushtak, A., Alqahtani, A., Hasan, A., 2023. Atherosclerosis Diagnosis from Magnetic Resonance Images: An Empirical Approach to Automate Carotid Vessel Wall Segmentation and Feature-Based Prediction. *Biomedical Signal Processing & Control.*

- [Under Review] Saha, P., Majid, M. E., Nashbat, M., Hasan-Zia, M., Kashem, S. B. A., Khandakar, A., Ashraf, A., Kunju, A. K. A., **Bushra, F.**, Sarmun, R., Hossen, M. M., Chowdhury M. E. H., 2023. UAVNet: A Novel Network for Waste Localization and Classification using Images from Unmanned Aerial Vehicles. *Journal of Material Cycles and Waste Management.*

RESEARCH EXPERIENCE

Research Assistant *2023-Present*
Qatar University ML Group, Supervised by Dr. Muhammad E. H. Chowdhury

- **Multimodal Semantic Segmentation with Hybrid CNN-Transformer Encoder, Lead Investigator**

  ○ In this study, the **U-net** architecture was utilized as baseline for segmenting brain tumor from different MRI modalities, focusing on the integration of Vision Transformer (ViT) with CNN in the encoder design.

  ○ The transformer was utilized to encode tokenized image patches from CNN feature maps to capture long-range contextual information, while the decoder was designed to integrate upsampled features with CNN feature maps for leveraging low-level details.

  ○ To enhance the model's learning from different hierarchical levels, a feature fusion technique was implemented to integrate outputs from the decoder stages.

- **Classifier-guided Detection using Deep Learning, Lead Investigator**

  ○ For the classifier, a deep learning-based approach was proposed that leveraged local context alongside global information by utilizing a spatial attention mechanism for Pulmonary Embolism diagnosis. This framework emulated a human expert's attention.

  ○ The attention-based classifier demonstrated major improvements over baseline models (*DenseNet, ResNet, MobileNet, Inception*) **improving AUROC by 8.1%.**

  ○ For the detection framework, *EfficientDet*, *Faster R-CNN*, and *YOLO* models were employed to localize PE. The mAP was further improved by a 4.7% increase through the implementation of model ensembling.

  ○ Utilizing the classifier's probabilistic inference, the detection outcomes were refined based on adaptive confidence thresholds to optimize precision. **Published in Expert Systems With Applications.**

Senior Thesis
University of Dhaka
2022

- **Detection of Supermarket Products for a Batch-Billing Infrastructure**

○ A Computer Vision-based billing system was proposed to reduce congestion at the supermarket's cash register. A two-tiered approach, combining deep learning-based object detection with deterministic pattern recognition was implemented.

○ Standard pre-packaged goods were immediately detected and billed at fixed prices, while weight-based products underwent two-phase processing: initial detection by *YOLO* followed by hybrid ArUco marker decoding step for dynamic price calculation.

○ The detection models, trained on our custom dataset sourced through web scraping, were optimized with synthetic image augmentation, genetic algorithm-based hyperparameter evolution, and ensembling methods. **Code:** GitHub Repository

IoT Engineer
Research and Development Department, Datasoft Manufacturing & Assembly Inc. Limited
2021

- **IoT-based Aquaculture Monitoring System, Part-time Engineer**

○ Worked on developing an IoT infrastructure for continuous monitoring and data analysis of aquaculture parameters, facilitating real-time data-driven decisions for pond management and worker notifications.

- **Telemedicine Platform, Summer Intern**

○ Developed a cloud-based system to integrate health data with a telemedicine platform for remote patient monitoring by physicians during the COVID-19 pandemic.

Undergraduate Research Assistant
Fabrication Laboratory, University of Dhaka
2018-19

- **Pet Robot**

○ Collaborated with a senior student. My contribution was in developing the robot's locomotion system through on-board sensing and computation.

- **Bipedal Robot**

○ Collaborated with a senior student. My contribution was in developing the simulation of a bipedal robot.

INDEPENDENT PROJECTS

Object Pick-and-Place Robot
Pre-programmed Robot
2019

○ A pick-and-place robot was developed capable of detecting the color of moving cubes passing over a conveyor belt. The manipulator was finely tuned for sensorimotor coordination, allowing for object sorting by color.

AVR-Microcontroller Based Obstacle Avoiding and Line Follower Robot
Pre-programmed Robot
2017-18

○ An AVR-microcontroller-based robot was developed that navigated by following a black line on white ground (or inverted colors). Additionally, a dynamic obstacle avoidance system was implemented with proximity sensor-based detection.

○ For precise maneuvering, a finely tuned Proportional-Integral-Derivative (PID) control system was implemented.

○ The use of sensor fusion and adaptive control algorithms enabled the robot to dynamically adjust its path and speed, efficiently navigating around moving obstacles.

Teleoperated Robot
Pre-programmed Robot
2018

○ A remote-controlled robot was developed for the Robo Soccer contest, incorporating a WiFi module for wireless communication. The robot's control mechanism was developed with a dual-axis locomotion system, integrating sensorimotor synchronization for real-time maneuvering.

Maze Solver Robot   *2018*
Pre-programmed Robot

○ Implemented the recursive backtracking algorithm on a line-following robot to solve mazes. The algorithm enabled the robot to navigate mazes while incorporating sensorimotor feedback for decision-making processes.

Research Grants

High Impact Grant (HIG)# QUHI-CENG-22/23-548   *2023*
Qatar University

○ The grant supports my research on the development of deep learning-based algorithms for the segmentation of brain tumors in medical images with the objective of enhanced treatment planning.

High Impact Grant (HIG)# QUHI-CENG-23/24-216   *2023*
Qatar University

○ The grant was conferred for my research on the development of innovative AI algorithms aimed at enhancing the diagnosis of Pulmonary Embolism through medical image analysis.

Online Coursework

Coursera	Institution
Unsupervised Learning, Recommenders, Reinforcement Learning	Stanford University & DeepLearning.AI
DeepLearning.AI TensorFlow Developer Specialization	DeepLearning.AI
Introduction to TensorFlow for Artificial Intelligence, Machine Learning, and Deep Learning	DeepLearning.AI
Convolutional Neural Networks in TensorFlow	DeepLearning.AI
Natural Language Processing in TensorFlow	DeepLearning.AI
Sequences, Time Series and Prediction	DeepLearning.AI

Mentorship & Volunteering Experience

IEEE Student Branch University of Dhaka (IEEE SB DU)   *2018-19*
Executive Member

○ Co-led a workshop on microcontroller programming focused on embedded system development, Apr 2018.

○ As an executive member, I was actively involved in organizing workshops, seminars, and talks hosted by IEEE SB DU in more than 10 events throughout my tenure.

Fabrication Laboratory, University of Dhaka (FAB LAB DU)   *2018-19*
Undergraduate Research Assistant

○ Served in the organizing committee of Fab Fest 2018, Nov 2018.

○ Formulated and conducted a foundational training workshop on CAD simulation, Sep 2018.

Skills

Programming Languages	Python, C/C++, MATLAB, LaTeX, Assembly Language
Libraries & Frameworks	PyTorch, TensorFlow, Keras, scikit-learn, OpenCV, NumPy, pandas, Matplotlib, PyQt5
Software & Tools	Git, SOLIDWORKS, Proteus, Arduino, AVR Microcontrollers
Webs & Databases	HTML/CSS, MySQL, Django

Honors & Awards

2019

- Finalist, LFR Challenge, Techsurgence, Bangladesh University of Professionals (BUP)

- Participant, Industrial Automation Challenge, ROBO CARNIVAL, Bangladesh University of Engineering and Technology (BUET)

2018

- **Champion**, Robo F1 Contest, Technovation, North South University (NSU)

- **Champion**, Robotics Contest, National Science Carnival, Dhaka Residential Model College (DRMC)

- 2nd Runner Up, Death Race Contest, ROBO FIESTA, Bangladesh University of Engineering and Technology (BUET)

- Finalist, SeeGuider Contest, ROBOLUTION, Military Institute of Science and Technology (MIST)

- Participant, LFR Challenge, Mecceleration, Islamic University of Technology (IUT)

2017

- **Champion**, Robo-Race Contest, DUSS Science Festival, University of Dhaka (DU)

- Finalist, THE FURY ROAD Contest, Robofest, University of Dhaka (DU)

- Finalist, LFR Challenge, Mecceleration, Islamic University of Technology (IUT)

- Participant, PathFinder Contest, ROBO CARNIVAL, Bangladesh University of Engineering and Technology (BUET)

- Participant, Robomania V4.0, ESONANCE, Islamic University of Technology (IUT)

- Participant, Robo soccer Contest, Bit Arena V.2, North South University (NSU)

- Participant, Speed Battle Contest, DUET-TECHFEST, Dhaka University of Engineering & Technology (DUET)

- Participant, Poster Presentation, ROBOLUTION, Military Institute of Science and Technology (MIST)

- Participant, Bangladesh Electronics Olympiad, University of Dhaka (DU)