

Fabiha Bushra

Dhaka, Bangladesh

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Research Interests: AI Robotics, Deep Reinforcement Learning, Human-Robot Interaction, Computer Vision, Natural Language Processing

EDUCATION

Bachelor of Science in Electrical and Electronic Engineering
University of Dhaka

Dhaka, Bangladesh
2022

- **Cumulative CGPA:** 3.50/4.00

MANUSCRIPTS

- [Under Review] **Bushra, F.**, Chowdhury, M. E. H., Sarmun, R., Kabir, S., Said, M., Zoghoul, S. B., Mushtak, A., Al-Hashimi, I., Alqahtani, A., Hasan, A. *Deep Learning in Computed Tomography Pulmonary Angiography Imaging: A Dual-Pronged Approach for Pulmonary Embolism Detection*. Expert Systems With Applications. [Submitted: 13 Sep 2023]
Preprint: [\[arXiv:2311.05197\]](https://arxiv.org/abs/2311.05197)
- [In Preparation] 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. *Atherosclerosis Diagnosis from Magnetic Resonance Images: An Empirical Approach to Automate Carotid Vessel Wall Segmentation and Feature-Based Prediction*.

SKILLS

Programming Languages	Python, C, C++, MATLAB, Assembly Language, HTML, MySQL
Libraries & Frameworks	PyTorch, TensorFlow, Keras, scikit-learn, OpenCV, NumPy, pandas, Matplotlib
Software & Tools	Git, LaTeX, SOLIDWORKS, Proteus (Circuit Simulation and Prototyping, PCB Design)

RESEARCH EXPERIENCE

Multimodal Semantic Image Segmentation with Hybrid CNN-Transformer Encoder

2023

Continuing Research, In collaboration with Dr. Muhammad E. H. Chowdhury, Funded by Qatar University

- In this study, the **U-net** architecture is utilized as baseline for segmenting multimodal brain tumor MRI images. Our research direction focuses on the integration of transformer with CNN in the encoder design.
- The transformer-based encoder, with its innate global self-attention mechanisms, encodes tokenized image patches from CNN feature maps to capture **long-range contextual information**, while the decoder upsamples these features and integrates them with high-resolution CNN feature maps for leveraging low-level details.
- To further enhance the model's feature learning capability, intermediate outputs are extracted from the top three decoder stages, achieved through the addition of auxiliary convolution layers. These intermediate outputs are strategically combined with the terminal output, thereby infusing the model with deep supervision.

Classifier-guided Detection using Deep Learning

2023

In collaboration with Dr. Muhammad E. H. Chowdhury, Funded by Qatar University

- For the classification framework, a deep learning-based approach was proposed that leverages **local context** by utilizing an **attention mechanism** for improved diagnosis of Pulmonary Embolism (PE). This framework emulates the attention of a human expert by considering both global appearances and local lesion regions before forming a conclusive decision.
- Demonstrated major improvements over baseline models by incorporating the attention method on the classification framework; **improving AUROC by 8.1%** on a publicly available CTA dataset of PE.
- 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.

- To mitigate the false positives associated with the detection framework's high sensitivity, a post-processing step was employed utilizing the classifier's probabilistic inference to direct the detection outcomes. This approach optimized the precision-recall trade-off, fine-tuning detection performance based on adaptive confidence thresholds.

Preprint: [[arXiv:2311.05197](https://arxiv.org/abs/2311.05197)]

Detection of Supermarket Products for a Batch-Billing Infrastructure

2022

Senior Thesis

- A computer vision-based billing system was proposed to expedite supermarket's checkout process by detecting and processing multiple products in real-time, contrasting with the traditional barcode scanning.
- A two-tiered approach, combining deep learning-based **object detection** with deterministic **pattern recognition**, was implemented to handle both weight-independent and weight-based products. To achieve real-time performance with an emphasis on minimizing billing latency, the YOLO architecture was chosen for its single-stage detection.
- Standard pre-packaged goods are immediately detected and billed at fixed prices, while weight-based products undergo a two-phase processing: initial detection by YOLO followed by hybrid ArUco marker decoding step to extract product ID and weight for dynamic price calculation.
- The detection models, trained on our custom-made dataset of 26 product categories sourced through web scraping were optimized with synthetic image augmentation, genetic algorithm-based hyperparameter evolution, and ensembling methods. The PyQt5 framework was used to create a GUI-based interface for the billing system.

Github Repository: github.com/fabihabushra/Computer_vision_based_check_out_system

Datasoft Manufacturing & Assembly Inc. Limited - DMA

2021

IoT Engineer, Research and Development Department

- **Telemedicine Project:** Developed the prototype of an **IoT-enabled** Blood Pressure Monitor that interfaces with a telemedicine platform, allowing for remote patient health monitoring by physicians during the COVID-19 pandemic.
- **Pisciculture Project:** Worked on developing an **IoT infrastructure** to continuously monitor and report aquaculture pond parameters, facilitating real-time data-driven decisions for pond management and worker notification.

Fabrication Laboratory, University of Dhaka (FAB LAB DU)

2018-19

Undergraduate Research Assistant

- **Pet Robot:** Collaborated with a senior student. My contribution was on designing the **manipulator end effector** and developing the CAD model for **robot locomotion** and **manipulation** using SOLIDWORKS.
- **Bipedal Robot:** Collaborated with a senior student. My contribution was on developing the CAD model and simulation of a bipedal robot.

INDEPENDENT PROJECTS

AVR-Microcontroller Based Obstacle Avoiding and Line Follower Robot

2019

Pre-programmed Robot

- An AVR-Microcontroller (Atmega32A) based robot was developed capable of following a black line on a white ground (or inverted colors) and avoiding obstacles in its path.
- The primary circuit board and IR sensor module of the robot were simulated and custom-designed using Proteus and the CAD model was developed on SOLIDWORKS.

Object Pick-and-Place Robot

2019

Pre-programmed Robot

- A pick-and-place robot was developed capable of detecting the color of the cube passing over a conveyor belt using the TCS3200 color sensor. The manipulator was finely tuned for **sensorimotor coordination**, allowing for object sorting by color.

Teleoperated Robot
Pre-programmed Robot

2018

- A remote-controlled robot, tailored for the Robo Soccer contest, incorporated a NRF24L01 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
Pre-programmed Robot

2018

- Implemented the **recursive backtracking algorithm** on a line-following robot to solve mazes. The algorithm prioritized left-forward-right directional moves, enabling the robot to navigate mazes while incorporating **sensorimotor feedback** for decision-making processes.

RESEARCH GRANTS

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

2023

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

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

2023

- 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.

RELEVANT ACADEMIC COURSEWORK

Intelligent System	Linear Algebra	Statistics and Probability
Differential and Integral Calculus	Vector Analysis	Computer Programming
Control System	Signals and Systems	Numerical Technique Lab

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)
Executive Member

2018-19

- Co-led the "Workshop and Hands-on Training on Microcontrollers", 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.

- Served in the organizing committee of [Fab Fest 2018](#), Nov 2018.
- Formulated and conducted a foundational training workshop on SOLIDWORKS and fabrication tools, Sep 2018.

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)