Fabiha Bushra

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Research Interests: AI Robotics, Computer Vision, Human-Robot Interaction, Deep Reinforcement Learning, Inverse Reinforcement Learning, Meta Learning

Education

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

- **Cumulative CGPA:** 3.50/4.00
- **Major:** Computer , **Minor:** Communication

Research Experience

Classifier-guided Detection using Deep Learning *Feb-Jul 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 adeptly optimized the precision-recall trade-off, fine-tuning detection performance based on adaptive confidence thresholds.
- The research is currently under review for publication in a reputable peer-reviewed journal with my role as the **first author**.

Detection of Supermarket Products for a Batch-Billing Infrastructure *Sep 2021-Feb 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 were trained on our custom-made dataset comprising 26 distinct product categories. This dataset was curated via **web scraping** and manually annotated with **LabelImg**. The performance of the detection framework was further improved by **augmenting** with synthetic images, using genetic algorithm-based **hyperparameter evolution**, and employing **ensembling** techniques. 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 *April-Dec 2021*
IoT Engineer, Research and Development Department

- **Telemedicine Project:** Developed the prototype of an **IoT-based** Blood Pressure Monitor and integrated it into the telemedicine platform for real-time monitoring. The project was developed in response to the COVID-19 pandemic to enable doctors to virtually monitor patient's health data using distance technology.
- **Pisciculture Project:** Worked on developing an **IoT-based** infrastructure to monitor and analyze the water parameters of the pond to ensure the optimum health of fishes.

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

- **Pet Robot:** Developed the **CAD model** for **robot locomotion** and **manipulation** using **SOLIDWORKS**. The **manipulator end effector** was designed in conjunction with the base chassis to enable the pet robot to fetch a ball.
- **Bipedal Robot:** Developed the **CAD model** and **simulation** of a **bipedal robot**.

Projects

AVR-Microcontroller Based Obstacle Avoiding and Line Follower Robot *2019*
Pre-programmed Robot, Independent Project

- 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. **Sensorimotor skills** were developed by integrating IR sensors for environmental detection, enabling the robot with **autonomous navigation**.
- The primary circuit board and IR sensor module of the robot was simulated and custom-designed using **Proteus** and the CAD model was developed on **SOLIDWORKS**.

Object Pick-and-Place Robot *2019*
Pre-programmed Robot, Independent Project

- 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 precise **object sorting** by color.

Teleoperated Robot *2018*
Pre-programmed Robot, Independent Project

- 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 *2018*
Pre-programmed Robot, Independent Project

- 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.

Relevant Academic Coursework

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

Online Coursework

Coursera Platform	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

Research Grants

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

- The grant supports my research on the development of deep learning-based algorithms for segmentations of brain tumors in medical images to enhance diagnostic precision and treatment planning.

High Impact Grant (HIG)# QUHI-CENG-22/23-548 *2022-23*
Qatar University

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

Mentorship & Volunteering Experience

IEEE Student Branch University of Dhaka *2018-19*
Executive Member

- As an executive member, the key responsibilities included formulating and organizing workshop training, seminars and talks.
- Created web contents for the educational events with an attempt to inspire students for active participation and growing their interests.

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

- Conducted foundational training workshops for mentoring students in the use of essential software and tools related to fabrication processes.

Relevant Skills

Programming Languages	Python, C, C++, MATLAB, MySQL, HTML, Arduino
Software & Tools	PyTorch, Tensorflow, SOLIDWORKS, Proteus (Circuit Simulation and Prototyping, PCB Design)
Development Boards	NodeMCU - ESP32,ESP8266; AVR MCU - ATmega328, ATmega328P, ATmega2560

Honors & Awards

2022

- Participant, ADS Class, FORMULA STUDENT ARTIFICIAL INTELLIGENCE (FS-AI), IMechE — Northamptonshire, UK

2019

- Finalist, LFR Challenge, Techsurgence, Bangladesh University of Professionals — Dhaka, Bangladesh
- Participant, Industrial Automation Challenge, ROBO CARNIVAL, BUET — Dhaka, Bangladesh

2018

- **Champion**, Robo F1 Contest, Technovation, North South University — Dhaka, Bangladesh
- **Champion**, Robotics Contest, National Science Carnival, DRMC — Dhaka, Bangladesh
- 2nd Runner Up, Death Race Contest, ROBO FIESTA, BUET — Dhaka, Bangladesh
- Finalist, SeeGuider Contest, ROBOLUTION, MIST — Dhaka, Bangladesh
- Participant, LFR Challenge, Mecceleration, Islamic University of Technology — Gazipur, Bangladesh

2017

- **Champion**, Robo-Race Contest, DUSS Science Festival, University of Dhaka — Dhaka, Bangladesh
- Finalist, THE FURY ROAD Contest, Robofest, University of Dhaka — Dhaka, Bangladesh
- Finalist, LFR Challenge, Mecceleration, Islamic University of Technology — Gazipur, Bangladesh
- Participant, PathFinder Contest, ROBO CARNIVAL, BUET — Dhaka, Bangladesh
- Participant, Robomania V4.0, ESONANCE, Islamic University of Technology — Gazipur, Bangladesh
- Participant, Robo soccer/Robo wrestling Contest, Bit Arena V.2, North South University — Dhaka, Bangladesh
- Participant, Speed Battle Contest, DUET-TECHFEST, DUET — Dhaka, Bangladesh
- Participant, Poster Presentation, ROBOLUTION, MIST — Dhaka, Bangladesh
- Participant, Bangladesh Electronics Olympiad, University of Dhaka — Dhaka, Bangladesh