Fabiha Bushra

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

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 submitted for publication in a reputable journal.

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 the checkout process in supermarkets by enabling simultaneous, real-time detection and billing of batches of products, contrasting with the traditional one-product-at-a-time barcode scanning.
- A **two-tiered** approach, combining deep learning-based **object detection** with deterministic computer vision techniques for **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.
- For pre-packaged goods, the product is directly detected by YOLO and consequently billed with a predetermined price. Conversely, for weight-based items, the system first categorizes the product as weight-dependent and then employs a **decoding strategy**. This second stage decodes **hybrid ArUco markers** present in the product packaging for extracting the encoded product ID and weight to dynamically compute the price.
- 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**.
- Instructed freshmen students for basic training in the operation of fabrication tools

Projects

AVR-Microcontroller Based Obstacle Avoiding and Line Follower Robot *2018*
Independent Project

- An **AVR-Microcontroller (Atmega32A)** based robot that can follow a line on a surface and avoid obstacles in its path. The primary circuit board and IR sensor module of the robot was custom-designed using **Proteus** and the CAD model was developed on **SOLIDWORKS** which was further built by laser cutting. It was programmed using **C**.

Object Pick-and-Place Robot *2018*
Independent Project

- A robot that can detect the color of the cube passing through a conveyor belt using the **TCS3200** sensor. The manipulator was calibrated to pick and place the cubes in the corresponding colored zones. The system was programmed using the **Arduino IDE** platform.

Teleoperated Robot *2018*
Independent Project

- **Robo Soccer:** A remote-controlled robot was developed for the Robo Soccer Contest. The remote was custom-made using a WiFi module **(NRF24L01)** and two dual-axis joysticks **(KY-023)**. The teleoperation system was programmed in **Arduino**.

Maze Solver Robot *2018*
Independent Project

- The **recursive backtracking algorithm** was deployed on a line follower robot considering the order of left-forward-right directions to solve a line maze.

Relevant Academic Coursework

Intelligent System	Linear Algebra	Statistics and Probability
Differential and Integral Calculus	Control System	Signals and Systems

Certifications

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 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 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*
Graphic Designer, Executive Member

- As an executive member, the key responsibilities included formulating workshop training, seminars and talks.
- As a graphic designer, created 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 for fabrication processes.

Relevant Skills

Programming Languages	Python, C, C++, MATLAB, Arduino, MySQL, HTML
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, 2022 FORMULA STUDENT ARTIFICIAL INTELLIGENCE (FS-AI), IMechE	*Northamptonshire, UK*
2019	Finalist, LFR Challenge, Techsurgence 2019, Bangladesh University of Professionals	*Dhaka, Bangladesh*
2019	Participant, Industrial Automation Challenge, ROBO CARNIVAL 2019, ECE Building, BUET	*Dhaka, Bangladesh*
2018	Participant, LFR Challenge, Mecceleration 2018, Islamic University of Technology	*Gazipur, Bangladesh*
2018	2nd Runner Up, Death Race Contest, ROBO FIESTA, ECE Building, BUET	*Dhaka, Bangladesh*
2018	Finalist, SeeGuider Contest, ROBOLUTION-2018, MIST	*Dhaka, Bangladesh*
2018	Champion, Robo F1 Contest, Technovation 2018, North South University	*Dhaka, Bangladesh*
2018	Champion, Robotics Contest, 11th National Science Carnival-2018, DRMC	*Dhaka, Bangladesh*
2018	Finalist, ROBORACE Contest, Engenius'18, Ahsanullah University of Science and Technology	*Dhaka, Bangladesh*
2017	Participant, PathFinder Contest, ROBO CARNIVAL 2017, ECE Building, BUET	*Dhaka, Bangladesh*
2017	Finalist, LFR Challenge, Mecceleration 2017, Islamic University of Technology	*Gazipur, Bangladesh*
2017	Participant , Robomania V4.0, ESONANCE 2017, Islamic University of Technology	*Gazipur, Bangladesh*
2017	Finalist, THE FURY ROAD Contest, Robofest 2017, University of Dhaka	*Dhaka, Bangladesh*
2017	Participant, Robo soccer/Robo wrestling Contest, Bit Arena V.2 2017, North South University	*Dhaka, Bangladesh*
2017	Champion, Robo-Race Contest, DUSS Science Festival 2017, TSC, University of Dhaka	*Dhaka, Bangladesh*
2017	Participant, Speed Battle Contest, DUET-TECHFEST-2K17, DUET	*Dhaka, Bangladesh*
2017	Participant, Poster Presentation, ROBOLUTION - 2017, MIST	*Dhaka, Bangladesh*
2017	Participant, 2nd Bangladesh Electronics Olympiad 2017, University of Dhaka	*Dhaka, Bangladesh*