Ahmed Waqar Rao

Date of birth: 17/11/1998

Nationality: Pakistani

Gender: Male

CONTACT

📍 School of Computer Science, Northwestern Polytechnical University,, 1 Dongxiang Road, Chang'an District, Shaanxi 710072 Xi'an, China **(Work)**

✉ ahmedwaqar261@mail.nwpu.edu.cn

💼 (+86) 17792251931

🏠 (+92) 3064922957

🌐 https://www.linkedin.com/in/ahmed-waqar-b1b700183

🌐 https://github.com/AhmedWaqarRao

💬 +8617792251931 **(WeChat)**

ABOUT ME

I am passionate about applying Deep Learning, Machine Learning, and Computer Vi... agriculture, urban environments, and surveillance through Edge AI and Edge C... developing lightweight and efficient deep neural networks specifically optimized for e... detection, segmentation, and target tracking within UAV-based applications. The... spraying, traffic analysis, and automated security systems. I aim to integrate Robot... efficient, and adaptive solutions that address resource optimization and environn... safety and decision-making in real-world deployments. Committed to continuous le... and problem-solving, I strive to contribute impactful innovations in Edge Intelligence... across diverse operational domains.

EDUCATION AND TRAINING

01/09/2023 – CURRENT Xi'an, China

Master's in Computer Science | Student Researcher Northweste...

Website https://en.nwpu.edu.cn/

01/10/2018 – 17/09/2022 Pakistan

Bachelor's in Mechatronics Engineering National University of Sc...

Address Islamabad, Pakistan | **Website** https://nust.edu.pk/

SKILLS

Python | C++ | Matlab | Numpy | Pandas | Keras | OpenCV | PyTorch | Tensorflow | Learning - AI - ANN - DNN | Edge AI, Edge Computing & AIot Edge Device | Data Scien... Regression, NN,Segmentation, Classification, | Computer vision: Object detection, obj... Statistics | Image Processing, Image Analysis, Image Segmentation | Object detection... FasterRCNN, MaskRCNN, Yolov3 | Feature Extraction | MongoDB, SQL, Flask, Docker | mulink | Proteus | CHINESE (HSK-3)

WORK EXPERIENCE

Northwestern Polytechnical University Xi'an, China

Lab Researcher
01/09/2023 – Current
- Leading an ongoing research project as part of my **master's thesis**, develo... **techniques** aimed at optimizing **target detection models** for **Unmanned**...
- Currently engaged in research on an edge-based adaptive selection metho... This research emphasized lightweight model edge computing, enhancing t... deploying quantitative models. Key areas included UAV technology, sensor... of embedded AI to enhance operational efficiency, optimize storage, and n...
- Employed **entropy-based pruning** and **channel importance scoring** to a... optimizing for **low-latency, high-accuracy performance** on **resource-cor**... **VIDIA Jetson AGX**).
- Applied advanced **model compression** techniques, including **weight prun**... ensure that models remain efficient and scalable for edge deployment in U... challenging environments.

Skills: Dynamic Pruning, YOLOv5, YOLOv6, LeYolo, YOLOv8seg, TensorRT, NVIDIA... Compression, PyTorch, Real-Time Inference, Object Detection, Feature Engineerin... Edge AI, Real-Time Target Detection, UAV Systems, Model Pruning, Model Compre... Embedded AI.

DataVision Lahore, Pakistan

Link https://github.com/AhmedWaqarRao/Data-Annotaion-Projects

Senior Data/ Image Annotation Specialist
25/02/2023 – 06/06/2023
Focused on tagging and labeling datasets for machine learning using techniques... segmentation, structuring datasets for coherence and accessibility, and collabora... ensure high-quality annotations. Utilized V7 Darwin Software for 2D/3D bounding... categorization, lines, splines, and semantic segmentation.

Skills: Team Work, Image Annotation, Time Management, Quality Assurance, Project Management, Leadership Development.

Simplicity Concept Nigeria Lagos, Nigeria

Project Manager
01/09/2021 – 01/09/2023
Project Manager - Website and Mobile Development, Oyato. ng
Managed the development of the Oyato Shopping Application, including handling resources, coordinating team efforts, communicating with stakeholders, and making decisions about technology, design, and quality assurance.

Skills: Project Management, Resource Allocation, Team Coordination, Stakeholder Communication, Technical Expertise, Technology Decision-Making, Design, Quality Assurance, Innovative Development, High-Quality Work, Deadline Management.

Volunteer Rawalpindi, Pakistan

NERC Managed AERO & LEGO Event under NERC

10/07/2019 – 23/07/2019
This event serves as a platform for enthusiasts and experts to explore innovations in robot design, development, and application, fostering collaboration and advancement within the robotics community.

Internee Rawalpindi, Pakistan

Manufacturing engineer in automation
07/08/2021 – 13/09/2022
As a volunteer intern at Robot Makers Labs, I honed my skills in 3D modeling and hardware design, contributing to the development of the olive processing project. Furthermore, my experience at the National Centre of Robotics and Automation (NCRA) deepened my understanding of industrial automation techniques, providing valuable insights into robotics applications in commercial settings.

PROJECTS

15/10/2024 – CURRENT

Efficient Real Time Dynamic Pruning Techniques for Optimizing Target Detection Models in UAVs

- Leading an ongoing research project as part of my **master's thesis**, developing **real-time dynamic pruning techniques** aimed at optimizing **target detection models** for **Unmanned Aerial Vehicles (UAVs)**.
- Currently engaged in research on an edge-based adaptive selection method for efficient UAV target detection. This research emphasized lightweight model edge computing, enhancing target detection capabilities, and deploying quantitative models. Key areas included UAV technology, sensor group selection, and the integration of embedded AI to improve operational efficiency, optimize storage, and minimize delays.
- Employed **entropy-based pruning** and **channel importance scoring** to adaptively reduce model size, optimizing for **low-latency, high-accuracy performance** on **resource-constrained UAV edge devices** (e.g., **NVIDIA Jetson AGX**).
- Applied advanced **model compression** techniques, including **weight pruning** and **activation sparsification**, to ensure that models remain efficient and scalable for edge deployment in UAVs operating in dynamic and challenging environments.

Skills: Dynamic Pruning, YOLOv5, YOLOv6, LeYolo, YOLOv8seg, TensorRT, NVIDIA Jetson, UAV Systems, Model Compression, PyTorch, Real-Time Inference, Object Detection, Feature Engineering, Feature Selection, Classification, Edge AI, Real-Time Target Detection, UAV Systems, Model Pruning, Model Compression, Deep Learning Optimization, Embedded AI.

Link https://github.com/AhmedWaqarRao/Efficient-Real-Time-Dynamic-Pruning-Techniques-for-Optimizing-Target-Detection-Models-in-UAVs

15/10/2024 – CURRENT

Adaptive Precision Spraying Tasks on Edge Device Using Real-Time Crop Segmentation for Smart Agriculture

- Developed an **autonomous precision spraying system** for **Unmanned Aerial Vehicles (UAVs)**, leveraging the **YOLOv8-Seg** and **LE-YOLO** models for high-resolution, **real-time crop segmentation**.
- Applied **dynamic pruning (F2Zip)** to compress the segmentation models for deployment on **NVIDIA Jetson AGX Xavier**, achieving **low-latency inference** while preserving segmentation accuracy on edge devices.
- Achieved up to **40% reduction in pesticide usage** by adapting spraying actions in real time based on segmented crop and weed areas, minimizing over-spraying and environmental impact.
- Incorporated **sensor fusion** (RGB, multispectral, and thermal imagery) to enhance segmentation under varying field conditions, enabling robust operation across multiple crop stages.
- Demonstrated a scalable and environmentally sustainable **AIoT solution** for **smart agriculture**, combining adaptive deep learning with real-time autonomous actuation.

Skills: YOLOv8 Segmentation, LE-YOLO Integration, Precision Spraying Automation, Dynamic Model Pruning (F2Zip), Edge AI Deployment, Real-Time Inference, AIoT-based Smart Agriculture, Deep Learning Optimization, Agricultural Robotics, Edge Computing, Latency and Fast Inference Application.

Link https://github.com/AhmedWaqarRao/Adaptive-Precision-Spraying-Tasks-on-Edge-Device-Using-Real-Time-Crop-Segmentation

15/09/2024 – 15/07/2025

Real-Time License Plate Detection and Vehicle Speed Estimation Using Deep Learning

- Developed a **real-time automatic license plate recognition (ALPR)** system using **YOLOv8** for vehicle and plate detection, **EasyOCR** for optical character recognition, and **SORT** for real-time multi-frame vehicle tracking.
- Implemented a **speed estimation module** by calculating object displacement between consecutive video frames, utilizing calibrated camera parameters for accurate measurements under varying real-world traffic conditions.
- The system was developed and tested on **Google Colab**, allowing seamless model training and inference using **GPU-accelerated computing**, suitable for cloud-based or scalable edge deployments.
- Achieved **95%+ detection accuracy**, with robust performance under challenges such as **occlusion**, **illumination variance**, and **high vehicle velocity**.
- Designed for integration into **smart city infrastructure**, supporting applications like **automated tolling**, **speed monitoring**, and **traffic law enforcement**.

Skills: YOLOv8 Detection, EasyOCR-based Character Recognition, Real-Time Vehicle Tracking with SORT, Speed Estimation via Frame Displacement, ALPR System Development, Deep Learning for Intelligent Transportation, Google Colab GPU Utilization, Video-Based Computer Vision, Smart Traffic Analytics.

Link https://github.com/AhmedWaqarRao/Real-Time-License-Plate-Detection-and-Vehicle-Speed-Estimation-Using-Deep-Learning-

15/11/2024 – 15/05/2025

Time-Aware Deep Reinforcement Learning Framework for Dynamic Multi-Agent Interception

- Developed a **time-aware deep reinforcement learning (DRL)** system integrating **Soft Actor-Critic (SAC)**, **LSTM**, and a novel **Time-Constrained Neural Network (TCNN)** for cooperative UAV-based interception in dynamic, adversarial environments.
- Introduced a **temporal decision-making mechanism** that prioritizes interception actions based on time-to-target and threat level, enabling UAV defenders to anticipate attacker trajectories in real time.
- Evaluated the system in **reach-avoid multi-agent scenarios** with variable attacker-defender ratios, achieving **99.89% interception success** and generalizing effectively to unseen configurations.
- Achieved **low-latency real-time inference** with adaptive policy learning and trajectory forecasting, making the system deployable on embedded UAV platforms.
- Designed to support **autonomous swarm defense applications**, removing the need for explicit inter-agent communication while maintaining optimal cooperation.

Skills: Soft Actor-Critic Optimization, LSTM-Based Temporal Modeling, Time-Constrained Neural Network (TCNN), Multi-Agent Interception Strategy, Deep Reinforcement Learning, Real-Time UAV Defense Systems, Reach-Avoid Game Simulation, Autonomous Decision Making, AI for Swarm Robotics.

Link https://github.com/AhmedWaqarRao/Time-Aware-Deep-Reinforcement-Learning-Framework-for-Dynamic-Multi-Agent-Interception

Passive Two-Phase Flow Regime Identification Based on Wavelet Transform Scalogram and Deep Learning

- Developed a deep learning-based framework for **passive identification of two-phase flow regimes** by analyzing acoustic signals using **wavelet transform scalograms** and image-based classification techniques.
- Designed an experimental setup for capturing **acoustic signals from gas-liquid flows**, followed by signal pre-processing using **Continuous Wavelet Transform (CWT)** to generate time-frequency scalograms as visual input data.
- Trained a custom **Convolutional Neural Network (CNN)** on scalogram images representing distinct flow regimes such as bubbly, slug, and annular, achieving high classification accuracy and robustness across operating conditions.
- Employed **data augmentation and batch normalization** to improve model generalization and reduce overfitting, enabling **real-time flow monitoring** in industrial pipeline systems without intrusive sensors.
- This work provides a non-invasive, cost-effective, and scalable solution for **flow pattern recognition**, advancing intelligent pipeline diagnostics and smart monitoring systems using deep learning.

Skills: Continuous Wavelet Transform (CWT), Signal Processing, Flow Regime Classification, CNN-Based Scalogram Analysis, Acoustic Signal Interpretation, Two-Phase Flow Monitoring, Deep Learning for Industrial Diagnostics, Passive Sensing for Pipeline Systems.

Link https://github.com/AhmedWaqarRao/Passive-Two-Phase-Flow-Regime-Identification-based-on-Wavelet-Transform-Scalogram-and-Deep-Learning.

01/01/2024 – 05/06/2024

Precision Agriculture Application Development using Deep Learning & Computer Vision Techniques

Developed a precision agriculture application using YOLOv5 and YOLOv6 for real-time detection and segmentation of tobacco plants to optimize chemical usage and enhance farmer safety.

TOOLS USED
Jupyter, PyTorch, LabelImg, TensorFlow, OpenCV, Keras, Roboflow, Matplotlib
Skills: Precision Agriculture, Deep Learning, YOLO, Object Detection, Segmentation, UAV Path Planning, Chemical Usage Optimization, Data Visualization, and Model Evaluation.

05/05/2024 – 15/06/2024

Automatic License Plate Recognition(ALPR) Using Transfer Learning

Developed an ALPR system for Pakistani cars: license plate detection and character recognition. Annotated a custom dataset using YOLO format and configured YOLOv3 for training. Achieved high accuracy in detecting and recognizing license plate characters.

Skills: Automatic License Plate Recognition, Transfer Learning, YOLOv3, Object Detection, Character Recognition, Data Annotation, Python, Darknet, and Model Training.

Link https://github.com/AhmedWaqarRao/Automatic-License-Plate-Recognition-ALPR-Using-Transfer-Learning

01/03/2024 – 25/03/2024

Fruits Classification Using Convolution Neural Networks(CNN)

Developed a CNN model for classifying 21 different fruit classes using the Fruits 360 dataset from Kaggle. Trained on 5605 images and implemented a Sequential CNN model with 4 Conv2D and MaxPool2D layers, followed by Flattening and Dense layers. Achieved accurate predictions on the test dataset.

Skills: Convolutional Neural Networks, Image Classification, Machine Learning, Deep Learning, Data Preprocessing, Model Training, Python, TensorFlow, Keras.

Link https://github.com/AhmedWaqarRao/Fruits-Classsification-Project

15/04/2024 – 10/05/2024

Face Mask Detection Using YOLOv3

Implemented YOLOv3 for face mask detection using the Kaggle dataset and AlexeyAB's Darknet repo. Labeled images with LabelImg, modified Darknet cfg file, and trained on the dataset. Achieved over 90% accuracy in detecting masked and not_masked classes.

Skills: YOLOv3, Object Detection, Machine Learning, Deep Learning, Data Labeling, Image Annotation, Python, Darknet, Model Training...

Link https://github.com/AhmedWaqarRao/Face-Mask-Detection-Project

05/08/2024 – 25/08/2024

Enigma Cipher Machine

Developed an Enigma machine simulator in C++ for encoding and decoding messages. Implemented using electromechanical rotor mechanisms, keyboard, lamp board, and plug board to mimic the historical encryption device used during World War II.

Skills: C++, Object-Oriented Programming, Encryption, Simulation, Data Encoding, Historical Algorithms.

Link https://github.com/AhmedWaqarRao/Enigma-Machine-Project

15/09/2024 – 15/10/2024

Searching Heuristically Optimal Path Using a New Technique of Bug0 Algorithm in Swarm Robotics

Developed a heuristic path planning method using swarm robotics to enhance conventional bug algorithms in cluttered environments. Introduced a parent-child bug algorithm where a parent bug sends two child bugs to search in different directions, using tactile sensors to follow obstacle perimeters. The parent bug then follows the heuristically optimal path determined by the child bugs. Simulation results demonstrate the effectiveness of this method compared to the bug0 algorithm in various scenarios.

Skills: Mobile Robotics, Swarm Robotics, Heuristics, Path Planning, Bug Algorithm.

15/06/2021 – 30/06/2022

Design and Development of Olive Grading Mechanism & Pitting Machine (Bachelor Degree Final Year Project)

Developer - Olive Grading and Pitting Machine, Jan 2023-present
Designed and developed a 3D model and hardware for a semi-automated machine to grade and pit various varieties of olives cultivated in Pakistan. The project focuses on creating a grading mechanism to separate olives based on quality and a 3D CAD model for the pitting machine. The machine utilizes a Geneva mechanism and a slider crank mechanism to efficiently remove olive pits. This innovation aims to reduce the dependency on imported olive oil by enhancing domestic olive processing capabilities and providing an industrial and commercial solution.

Skills: 3D Modeling, CAD, Mechanical Design, Olive Grading, Geneva Mechanism, Slider Crank Mechanism, Semi-Automation, Industrial Design.

Link https://www.linkedin.com/in/ahmed-waqar-b1b700183

Fruit Plucking Robot At National Engineering Robotics Competition (Software Based)

The Project contains two robots in which one is moveable and the other is a static
- Master Robot (Fully Autonomous and can move on the base of the static robot)
- Sub-Robot (Wirelessly controlled) Fabrication, Assembly of electronic circuitry, and Programming using Arduino.

PUBLICATIONS

2025

Adaptive Precision Spraying Tasks on Edge Device Using Real Time Crop Segmentation for Smart Agriculture

Under Review

Journal Name IEEE Access | **Publisher** IEEE

2025

Time Aware Deep Reinforcement Learning Framework for Dynamic Multi Agent Interception

Under Review

Journal Name Frontier Information Technology | **Publisher** IEEE

2025

Passive Two-Phase Flow Regime Identification Based on Wavelet Transform Scalogram and Deep Learning

(Under Review)

Journal Name International Journal of Multiphase Flow

HONOURS AND AWARDS

15/05/2024 Northwestern Polytechnical University, Xi'an , Shaanxi, China

First "Belt & Road" International Academic Forum of Engineering, Science and Technology

28/05/2024 Northwestern Polytechnical University, Xi'an , Shaanxi, China

8th International Culture Festival of Northwestern Polytechnical University, "Beauty in Harmony, Walking for Dreams".

10/07/2024 Northwestern Polytechnical University, Xi'an , Shaanxi, China

Course Completion Certificate on Introduction to Image Processing & Computer Vision (IPCV)

Gained valuable insights and skills in image processing and computer vision through a 24-hour course at the School of Software, Northwestern Polytechnical University, completed with a Certificate of Completion in July 2024.

15/07/2024 Northwestern Polytechnical University, Xi'an , Shaanxi, China

Course Completion Certificate on Energy Efficient Computing of Deep Neural Networks

Gained valuable insights and skills in image processing and computer vision through a 16-hour course at the School of Software, Northwestern Polytechnical University, completed with a Certificate of Completion in July 2024.

15/07/2024 Northwestern Polytechnical University, Xi'an , Shaanxi, China

Course Completion Certificate on Data Analysis with AI

Gained valuable insights and skills in image processing and computer vision through a 24-hour course at the School of Software, Northwestern Polytechnical University, completed with a Certificate of Completion in July 2024.

Coursera

Advanced Certifications in Data Science, Deep Learning , Computer Vision , Image Processing ,Machine Learning and Edge AI

Completed **27+ online courses** and **6 full specializations** from **DeepLearning.AI, Stanford University, IBM, Illinois Tech, and Edge Impulse** via Coursera. Topics covered include **Neural Networks, Convolutional Networks, GANs, PyTorch, TensorFlow, Computer Vision, SQL, ML Mathematics (Linear Algebra, Calculus, Probability & Statistics), and Data Science Methodologies**. Gained hands-on experience through practical labs and projects focused on **image segmentation and optimization techniques**.

20/12/2012 Army Public School Mehfooz Shaheed Garrison, Lahore, Pakistan

1st Position in Relay Race and also a cricket player at School & College

RECOMMENDATIONS

Yu Zhang Professor

Professor at the Department of AI Computing System, School of Computer Science, Northwestern Polytechnical University, 1 Dongxiang Road, Chang'an District, Xi'an, Shaanxi, 710129, P.R. China.

Email zhangyu@nwpu.edu.cn | **Phone** (+86) 13891997511
Link https://yuzhang-nwpu.github.io/yuzhang/

Dr. Umar Shahbaz Khan Tenured Associate Prof/Project Director NCRA

Tenured Assoc. Prof./Project Director, NCRA Department of Mechatronics Engineering College of Electrical & Mechanical Engineering National University of Sciences and Technology (NUST), Peshawar Road, Rawalpindi 46000, Pakistan

Email u.shahbaz@ceme.nust.edu.pk ⎮ **Phone** (+92) 3005533775

Dr. Hamid Jabbar Associate Professor

Head of Department & Associate Professor at Mechatronics Engineering Department, College of Electrical & Mechanical Engineering, National University of Sciences and Technology (NUST), Peshawar Road, Rawalpindi 46000, Pakistan.

Email hamid.jabbar@ceme.nust.edu.pk ⎮ **Phone** (+92) 3005274026

HOBBIES AND INTERESTS

- **Cricket**

- **Athletics & Physical Exercises**

- **Current Affairs News**