Fatima Naweed

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Education

Lahore University of Management Sciences (LUMS) 09/19 – 06/23
Bachelor of Science in Computer Science Minor in Mathematics
GPA: 3.74/4.0

- Graduated with Distinction
- Placed on Dean's Honor List 2019 – 2022
- Relevant Coursework: Machine Learning, Deep Learning, Computer Vision, Computer Graphics, Distributed Systems, Mathematical Foundations in Machine Learning and Data Science, Statistics, Ordinary Differential Equations, Complex Variables, Introduction to Analysis

Publications

Cartesian: Variance and Gaussian-Based Attention for Urban Green Space Detection Using Generative Adversarial Networks [Under Submission]
Fatima Naweed, Zubair Khalid, Muhammad Tahir, Momin Uppal*
*Principal Author

Geographically Generalisable Urban Green Space Segmentation for Developing Countries IGARSS 2025
[github] [poster]
Mohtashim Butt, Nawaal Siddique, Fatima Naweed, Zubair Khalid

Work Experience

Obvio, Inc. Lahore, Pakistan
Computer Vision Engineer 07/24 – Present

- Contributed to vision systems for traffic analysis, visual evidence-quality improvement, embedded perception, and currently serve as Engineering Lead for the Trials – Research and Development team.

Center for Urban Informatics and Technology (CITY), LUMS Lahore, Pakistan
Research Assistant 08/23 – 06/24

- Initiated a research thread on urban green space mapping in developing-country contexts, developing geo-spatial datasets and exploring generalizable segmentation methods across diverse urban terrains.

Computer Vision and Graphics Lab (CVGL), LUMS Lahore, Pakistan
Research Assistant 06/22 – 06/23

- Worked on a collaborative initiative between the World Wide Fund and LUMS to build an early-warning forest fire detection system, contributing to real-time vision module development and edge-based deployment.

Punjab Information and Technology Board (PITB) Lahore, Pakistan
Software Development Intern 12/21 – 01/22

- Trained deep learning models in Google Earth Engine to classify crop varieties using Sentinel-2A satellite imagery.

Teaching Experience

Undergraduate Teaching Assistant 2021 – 2024
Lahore University of Management Sciences Lahore, Pakistan

- **EE240**: Circuits I (Teaching Assistant) Fall 2021
- **EE514/CS535**: Machine Learning (Head Teaching Assistant) Spring 2022
- **CS436/CS5310/EE513**: Computer Vision Fundamentals (Teaching Assistant) Fall 2022
- **CS437/CS5317/EE414/EE517**: Deep Learning (Teaching Assistant) Fall 2022
- **EE514/CS535**: Machine Learning (Head Teaching Assistant) Spring 2023
- **CS437/CS5317/EE414/EE517**: Deep Learning (Head Teaching Assistant) Spring 2024

Game Development Workshop Instruction 2023
Girls Make Games, Learn District Lahore, Pakistan

- **Pak Turk High School** — Workshop on Game Design using **Unreal Engine** (35+ students)
- **Mindstorm Studios** — Workshop on Game Design using **Unity** (20+ students)

Projects

Urban Green Space Mapping for Developing Countries (CITY, LUMS)

Zubair Khalid (LUMS)

Developing a Public Geospatial Dataset for Lahore's Green Spaces [dataset]

- Constructed a labelled geospatial dataset of Lahore's urban green spaces by integrating open-source layers, including Google Maps vegetation masks, OpenStreetMap land-use polygons, and ESA WorldCover classifications.
- Used QGIS and Google Earth Engine to extract, align, and fuse raster–vector layers, applying segmentation thresholds and inter-dataset consistency criteria.
- Produced a high-accuracy dataset (>90% confidence) along with a fully replicable open-source workflow, enabling consistent green-space mapping across diverse geographic contexts.

Geographically Generalisable Urban Green Space Segmentation [github] (Published - IGARSS 2025)

- Investigated geographically generalisable methods for urban green-space segmentation, addressing the need for scalable, data-driven environmental mapping in regions with limited annotated geospatial resources.
- Constructed two labelled datasets for Islamabad from high-resolution Google Earth imagery using a SAM-based annotation workflow with manual refinement, and fine-tuned the YOLOv11n-seg model on them.
- Demonstrated best performance relative to SOTA segmentation models (U-Net, HRNet, DeepLabv3+), with YOLOv11n-seg achieving IoU 0.803, F1 0.912, and Accuracy 0.871, indicating high delineation accuracy and low pixel-wise error.
- Assessed geographic generalisability by evaluating the model on satellite imagery from Karachi (coastal region) and Swat (mountainous region), where YOLOv11n-seg maintained stable segmentation across contrasting landscapes.

Cartesian: Variance and Gaussian-Based Attention for Urban Green Space Detection Using GANs (Under Submission)

- Developed Cartesian, a GAN-based semantic segmentation framework introducing novel attention modules to improve fine-grained UGS detection in VHR 1 m imagery.
- Designed global-variance-pooling and Gaussian distribution–based attention mechanisms to replace Coordinate Attention within the generator, enhancing feature discrimination and improving fine-grained UGS segmentation.
- Benchmarked attention variants and reported best metrics with multiplicative variance attention (F1 0.752, IoU 0.598) and Gaussian attention (Accuracy 0.849), demonstrating improved boundary delineation and feature discrimination.
- Leveraged the UGS-1m Beijing benchmark's high-quality annotations for adversarial domain adaptation, enabling robust cross-domain transfer to Pakistan's aerial imagery.

WWF - Early-warning Forest Fire Detection System (CVGL, LUMS)

Murtaza Taj (LUMS)

WWF Early-Warning Forest Fire Vision System [github]

- Developed a real-time remote forest monitoring system combining a distributed setup of PTZ cameras with edge-based AI detection to provide early fire–smoke alerts.
- Implemented a remote-control system for PTZ, featuring an automated coverage algorithm spanning 180° pan and 90° tilt, manual pan–tilt–zoom control, and integrated support for camera calibration.
- Constructed an 8,386-image fire–smoke dataset by integrating published benchmark datasets, and incorporating synthetic imagery to improve early-smoke generalization across diverse environmental conditions.
- Fine-tuned and benchmarked YOLOv7, YOLOv7-tiny, DETR, and Deformable DETR for early fire–smoke localization, evaluating accuracy, recall, F1-score, mAP, and inference latency on NVIDIA Jetson Nano devices.
- Deployed YOLOv7-tiny on edge in Mansehra due to its highest accuracy (0.88) and F1-score (0.88), compact parameter size (6M), and lowest inference time (0.2s), enabling reliable real-time monitoring.

PTZ Camera Tracking Model [github]

- Implemented a PTZ tracking system to zoom in on localized detections and re-run inference at higher resolution to improve precision and reduce false positives.
- Designed a geometric transformation model that maps 2D image-plane detections to real-world pan–tilt actuation using inverse camera mapping, spherical coordinate transforms, and field-of-view–derived angular offsets.
- Validated the model in simulation, yielding near-zero transformation error (10^{-33}–10^{-34}) and <1% angular deviation.

Haze Removal via Dark Channel Prior [github]

- Designed to mitigate fog and atmospheric haze for improved image visibility in downstream detection tasks.
- Implemented Dark Channel Prior (DCP)–based dehazing for atmospheric light estimation, transmission recovery, and radiance reconstruction, with parameters optimised for stable performance.
- Evaluated the method on the Dense-Haze (NTIRE 2019) dataset by benchmarking reconstructed outputs against ground-truth images.

Industry Projects (Obvio, Inc.)

Washington, D.C. Citywide Traffic Violation Study

- Conducted a comprehensive citywide study in collaboration with DDOT across 30+ high-traffic corridors in Washington, D.C., to assess the severity and scale of distracted driving.
- Developed an application for real-time multimodal data capturing on Thundercomm edge devices, managed on-site hardware deployments, and handled storage and organization of datasets on AWS S3.
- Built vision-based detection and identity-obfuscation pipelines for distracted driving and other traffic violations, and validated system performance through a custom data-review interface.
- Analyzed datasets to quantify distracted driving prevalence (identifying rates +10% in residential areas and up to 20% at major intersections) and examined their correlation with other violations to support broader safety insights.

License Plate Visibility & Exposure Management

- Addressed high evidence-rejection rates by establishing a system to monitor license-plate visibility across deployments and improve evidence quality, ultimately reducing rejection rates from 15% to 5%.
- Engineered two exposure metrics, readability (OCR-based) and visibility (Laplace-based), to evaluate manual exposure schedules and the automated exposure service across 40+ diverse production deployments.
- Developed a Retool annotation interface to validate metrics against ground-truth evidence, and a Redash dashboard to track performance across deployments and assess the impact of exposure adjustments on evidence quality.

Sentinel: C++ Embedded Vision Stack

- Contributed to the system architecture design for Sentinel by resolving bottlenecks in video quality, inference speed, and event throughput through optimized refactored modular design and efficient memory management.
- Implemented the complete vision stack on Thundercomm, integrating SNPE inference, BYTE Tracker, and a behavior-classification module to detect different traffic behaviors derived from object-centric trajectories in real time.
- Achieved stable real-time processing throughput of 30 fps, and deployed the system across 20+ production sites, now operating on 50+ live installations supporting evidence generation for automated traffic enforcement.

Trials: Research and Development

- Coordinating a cross-functional team of 20+ engineers, annotators, and technicians across hardware validation, embedded system testing, and field deployment operations, while overseeing backend infrastructure optimization, data-collection pipelines, and traffic violation analytics.
- **Scout** – an Android-based multi-modal data collection application that captures synchronized, deep-learning–triggered vehicle datasets using UVC cameras and 1D radars, with backend integration for registering site locations, initializing sensor sessions, and real-time data ingestion to AWS S3.
- **Vision-Based Speeding** – designed a speed-estimation system capable of bi-directional and multi-lane vehicle measurement using monocular 3D scene reconstruction and object-centric linear regression to compute velocities from vehicle trajectories, with a patent application submitted and validated performance across 30+ field sites.

Other Projects

- **Adventure Hike** (Computer Graphics Course Project) Developed a third-person 3D adventure game in Unity featuring custom terrains, collectibles, and NPCs with interactive dialogues and animations. [github]
- **Talba** (Software Engineering Course Project) Built a MERN-stack e-learning platform enabling personalized course sharing and hosting 10+ courses to broaden accessibility. [github]
- **Raft Consensus Protocol** (Distributed Systems Course Project) Implemented a from-scratch Go version of the Raft consensus protocol, focusing on distributed coordination and fault tolerance.
- **Real-time SOP Surveillance System** (Computer Vision Course Project) Created a real-time surveillance system using fine-tuned YOLOv3 and multi-camera homography to detect mask compliance and proximity violations.
- **Urban Call Center Data Classification** (CITY, LUMS) Developed a bilingual call-center speech-processing tool, assessing Google/IBM STT APIs and real-time libraries for accurate, low-latency classification and rerouting.

Skills

Programming Languages: C++, C, Python, Go, R, Swift, MATLAB, SQL, LaTeX

Modules & Frameworks: TensorFlow, Keras, PyTorch, Detectron2, ONNX, SNPE, OpenCV, OpenGL, scikit-learn, matplotlib, seaborn, NumPy, Pandas, Plotly, React, MongoDB, Node.js, CoreML, Eigen

Tools & Platforms: Unity, Unreal Engine, Blender, Roboflow, CVAT, Label Studio, Voxel51, Pixeltable, Redash, Retool, Jupyter Lab, Docker, CMake, GStreamer, GitHub, Figma, GEE, QGIS

Cloud & MLOps: AWS (S3, RDS), MLflow, TensorRT, CUDA, PostgreSQL

Awards and Honors

- **Triple E Awards 2024 (Asia-Pacific)** — Runner-Up, *Impactful Research Team of the Year Award* (Low-Cost Early Warning System for Forest Fires) 2024
- **Dean's Honor List** — Lahore University of Management Sciences 2019 – 2023
- **Girls Make Games Ambassador Award** — PlayStation HQ 2019