Navlika Singh

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Education

- **Imperial College London** — London, United Kingdom
  MSc in Computing (Artificial Intelligence & Machine Learning — *September 2025 - September 2026*
- **Indian Institute of Technology Jodhpur** — Jodhpur, India
  Bachelor of Technology - Artificial Intelligence & Data Science; CGPA: 8.42 — *November 2020 - May 2024*

Publications

- **When Big Models Train Small Ones: Label-Free Model Parity Alignment for Efficient Visual Question Answering using Small VLMs**: (Accepted)
  N. Singh, P. Arora, A.S. Penamakuri, A. Mishra
  2025. In EMNLP Main
- **Dataset Selection is Critical for Effective Pre-Training of Fish Detection Models for Underwater Video**: (Accepted - paper)
  D. Ayyagari, T. Wasi Alavi, **N. Singh**, J. Barnes, C. Morris, C. Whidden
  2025. In ICES Journal of Marine Science
- **UniPreCIS: A data pre-processing solution for collocated services on shared IoT**: (Accepted - paper)
  A. Das, **N. Singh**, S. Chakraborty
  2024. In Journal of Future Generation Computer Systems

Work Experience

- **Metafusion** — Noida, India
  Computer Vision Research Engineer - Computer Vision Department — *May 2024 - August 2025*

Lightweight VLMs for Surveillance

- Built an end-to-end pipeline to analyze vehicle and person images from CCTV footage, predicting pre-defined attributes (e.g., vehicle type, color, orientation; clothing, age, gender) and generating natural language summaries with text recognition from objects (e.g., license plates, T-shirts).
- Curated training data by localizing and cropping vehicles/people using YOLOv11, then leveraging Qwen2.5VL-7B with tailored prompts to generate high-quality attribute labels and summaries, enabling reliable downstream model training.
- Researched and optimized lightweight VLMs ($\leq$ 256M parameters), achieving real-time inference under $\sim$1s with RTX 4000 Ada.

Safe-City Applications

- Researched and optimized Vision-Language Models (VLMs) for real-time, low-resource surveillance, designing preprocessing and prompt-engineering strategies that achieved a 90% F1 score with Qwen2.5VL on action-based applications.
- Developed a scalable violence detection framework incorporating severity-level classification, FoV-based adaptability, and incident description generation to improve interpretability for law-enforcement monitoring.
- Enhanced person collapse detection by introducing temporal action-recognition and localization via the YOWO model, curating and annotating large-scale surveillance datasets, and deploying fine-tuned models in C++ and Python applications.

Intelligent Traffic Management Systems (ITMS) Applications

- Built a helmet and triple-riding violation detection system, addressing class imbalance via synthetic sample generation for rare triple-riding cases and benchmarking YOLO models (v3–v8), achieving +12% overall accuracy and +17.5% for triple-riding detection.
- Optimized violation logic and processing pipeline, reducing computational load and enabling real-time deployment.
- Extended the system to License Plate Detection (LPD) by redesigning the pipeline from bounding-box to keypoint-based detection, improving robustness on angled/occluded plates, eliminating compute-heavy post-processing, and deploying across ITMS applications with enhanced speed and reliability.

Research Internships

- **Dalhousie University** — Halifax, Canada
  Visiting Student Researcher, Supervisor: Prof. Christopher Whidden — *May 2023 - Aug 2023*
  - Researched machine learning for marine ecosystem monitoring, evaluating the effectiveness of pre-trained models for fish detection across diverse underwater datasets.
  - Analyzed multiple datasets and demonstrated that pre-training with OzFish led to faster convergence and comparable accuracy, while other datasets sometimes degraded performance.
  - Highlighted the importance of dataset diversity and quality in improving model generalization for real-world marine ML applications.

- **Bosch Global Software Technologies** — Remote
  ML Engineering Intern - Research & Development Department — *May 2022 - Aug 2022*
  - Studied Bosch's diverse dataset of real-world traffic sign images, nearly 90 classes, addressing significant skewness (0.5% in certain classes).
  - Utilized StarGAN for synthetic image generation and advanced data augmentation techniques to mitigate class imbalance issues.
  - Enhanced recall metrics by 1.2% through tailored ConvNeXt-L variations, outperforming EfficientNet-B2.

- **Pingala AI** — Remote
  Industrial AI Fellow - Research & Development Department — *Sep 2021 - Feb 2022*
  - Refined warehouse CCTV footage by isolating repeating patterns, zooming into worker activities, and augmentation.
  - Developed a customized 3D action classifier, drawing inspiration from YOLOv3, tailored to meet project needs.
  - The model, in its beta phase, was set for deployment in multiple warehouse environments.

Research Projects

- **Indian Institute of Technology Jodhpur** — Jodhpur, India
  Researcher - VL2G Labs, Supervisor: Prof. Anand Mishra — *Dec 2024 - August 2025*
  - Developed Model Parity Aligner (MPA) to enhance Small Vision-Language Models (S-VLMs) by systematically identifying and addressing knowledge gaps relative to Large Vision-Language Models (L-VLMs).
  - Designed three key modules (PA, PI, PL) to generate pseudo-annotations, isolate failure cases, and fine-tune S-VLMs on targeted samples, improving efficiency while reducing computational overhead.
  - Achieved notable performance improvements on VQA benchmarks, including +6.4% (TextVQA), +12.0% (ChartQA), and +4.0% (ST-VQA) on TinyLLaVA-2B.

- **Indian Institute of Technology Jodhpur** — Jodhpur, India
  Researcher, Supervisor: Prof. Pratik Mazumder — *April 2024 - Nov 2024*
  - Developed a bias translation approach to mitigate spurious correlations in neural networks without requiring explicit bias labels or bias-conflicting samples.
  - Designed an adaptive multi-level latent feature interpolation strategy, dynamically adjusting feature mixup based on an image's bias level to enhance generalization.
  - Achieved a 20% absolute improvement over state-of-the-art methods on Corrupted CIFAR-10 and other benchmark datasets in bias-heavy settings.

- **Indian Institute of Technology Jodhpur** — Jodhpur, India
  Undergraduate Student Researcher -IAB Lab, Supervisor: Prof. Mayank Vatsa — *Aug 2023 - Feb 2024*
  - Developed a novel bias mitigation framework to reduce neural networks' reliance on spurious correlations, in multiple-unknown-bias settings, using a two-step training strategy with modified KL divergence-based optimization.
  - Trained parallel biased and debiased models, leveraging Generalized and Reweighted Cross-Entropy to amplify bias-aligned gradients and dynamically adjust loss weights. Introduced feature swapping to improve generalization.

- Refined the final model using a dual-teacher distillation approach, achieving a 2% improvement over SOTA on Multi-Colored MNIST and Corrupted CIFAR-10, setting a new benchmark in fair and robust deep learning.

- **Indian Institute of Technology Jodhpur** Jodhpur, India
  Undergraduate Student Researcher, Supervisor: Prof. Pratik Mazumder *April 2023 - Sep 2023*
  - Developed a novel framework to enhance few-shot learning by leveraging multi-view knowledge consolidation, improving generalization in low-data settings.
  - Introduced a multi-path encoding strategy, where transformed views of an image are processed separately and selectively fused, forming a highly discriminative composite feature.
  - Achieved significant performance gains on few-shot classification benchmarks, advancing AI models' ability to learn efficiently with minimal supervision.

- **University of Central Florida** Florida, USA
  Research Intern - CRCV Lab, Supervisors: Prof. Yogesh Singh Rawat & Vibhav Vineet *May 2022 - Feb 2023*
  - Conducted an in-depth assessment of self-supervised learning models' performance under diverse distribution shifts - natural and adversarial variations.
  - Investigated the hypothesis suggesting superior resilience of self-supervised learning methods compared to supervised approaches amidst distributional shifts.

- **Worcester Polytechnic Institute** Worcester, USA
  Research Intern - The Cake Lab, Supervisor: Prof. Tian Guo *May 2022 - Aug 2022*
  - Developed a Facial Expression Recognition pipeline for VTubing.
  - Utilized deep learning for refined facial expression recognition, aiming to integrate expressive avatars seamlessly onto major social platforms like YouTube, elevating user interaction and immersion.

- **Indian Institute of Technology** Jodhpur, India
  Undergraduate Student Researcher - UbiSys Lab, Supervisor: Prof. Suchetana Chakraborty *Sep 2021 - Jan 2022*
  - Developed UniPreCIS, an innovative edge-based data pre-processing solution for shared sensing infrastructure in smart city applications.
  - Engineered it to dynamically select high-quality data sources through sensor ranking, optimizing resource consumption while meeting varied application QoS needs at the network edge.
  - Successfully deployed it on a campus testbed, demonstrating remarkable reductions in processing time and memory utilization for stakeholder services. Achieved up to 90% accuracy, surpassing existing sensing techniques.

Honors and Awards

- Awarded the prestigious J.N. TATA Endowment Scholarship 2025 for the higher education of Indians overseas.
- Awarded the MITACS GRI 2023 Research Internship.
- Second Position in Computer Vision Hackathon 2021 conducted by TIH iHub Drishti.
- Ranked in top 0.1 percentile in IIT-JEE Joint Entrance Examination 2020 out of 1.3 million applicants.

Teaching and Volunteering Experience

- **Reviewer Experience:** Served as a reviewer for the prestigious ICES Journal of Marine Science 2024.
- **Teaching Assistant-ship:** Served as a teaching assistant at IIT Jodhpur for 250+ sophomore students, conducting weekly lab and viva sessions, preparing assessments, and grading them for the following course: Principles of Computer Systems and Pattern Recognition & Machine Learning.
- **Head of Student Wellbeing Committee:** Orchestrated a passionate team of 55 students, spearheading comprehensive student mental health initiatives. Through dynamic collaboration with college counselors and administration, championed an environment prioritizing student wellbeing, fostering a resilient and supportive community.