

EDUCATION

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| MASc in Systems Design Engineering, University of Waterloo, Canada                        | Sep 2022 — Mar 2025 |
| B.Tech in Electronics and Communication, Guru Gobind Singh Indraprastha University, India | Aug 2016 — Sep 2020 |

SKILLS

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| Languages & Platforms  | Python, C++, C, Linux, Git, Docker, SSH, CI/CD   |
| Frameworks & Libraries | PyTorch, LibTorch, CUDA, TensorFlow, Keras, ONNX, Scikit-learn, NumPy, Pandas, OpenCV, Pillow, Jupyter Notebook, Plotly, Seaborn, Matplotlib, Weights & Biases |
| Technologies           | Perception, Computer Vision, Machine Learning, Object Detection, Segmentation  |
| Hardware               | VLP-16 LiDAR, FLIR Pointgrey Cameras, Raspberry Pi 3B, Arduino, NVIDIA Jetson  |

WORK EXPERIENCE

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| <b>Computer Vision Researcher   VIP Lab, University of Waterloo ; ATS Automation   Supervisor: <a href="#">Prof. John Zelek</a></b>  | Jan 2023 — Present  |
| <ul style="list-style-type: none"><li>Leading research on Visual Place Recognition (VPR) for aerial imagery; exploring transformer-based, cross-view, and multimodal architectures (e.g., CNNs, DINOv2, ViTs) to extract robust features for UAV-based geo-localization.</li><li>Designed a novel prediction model integrating Mamba state-space model and self-attention mechanisms with advanced data association strategies and YOLO-X for real-time multi-object tracking, achieving <u>3-7% improvement</u> over other methods on complex motion scenarios.</li><li>Created a novel automatic bounding box annotation pipeline for videos with multiple objects using Point Tracking, Segment Anything, and YOLO-v8, achieving the <u>annotation speed of 10 FPS</u>. (<a href="#">View Paper</a>)</li><li>Developed and containerized a multi-object tracking pipeline to estimate velocities of hundreds of assembly parts in a high-throughput industrial setting, enhancing production efficiency and enabling scalable deployment.</li></ul> |                     |
| <b>Computer Vision Research Engineer   LENS Corporation, India</b>   | Feb 2022 — May 2022 |
| <ul style="list-style-type: none"><li>Migrated a latent fingerprint extraction and matching pipeline from Python to C++ using Libtorch to enable faster GPU and CPU-based deployment, optimizing performance and reducing latency.</li><li>Programmed custom signal processing functions, including Fourier Transforms and Gabor Filtering, in C++ from scratch to process fingerprint data, overcoming constraints in existing matrix and signal processing C++ libraries.</li></ul>  |                     |
| <b>Perception Research Engineer   Autonomous Vehicle Project, IIIT Delhi, India   Supervisor: <a href="#">Dr. Saket Anand</a></b>  | Oct 2020 — Feb 2022 |
| <ul style="list-style-type: none"><li>Built and deployed a multi-sensor calibration system integrating 2 FLIR Pointgrey cameras and 3 VLP-16 LiDARs using a checkerboard target; implemented LiDAR-LiDAR alignment with Iterative Closest Point (ICP), achieving <u>&lt; 4° rotational and &lt;10 cm translational error</u> across modalities using surface normal and Euclidean metrics.</li><li>Developed and optimized a real-time lane detection pipeline in C++ and TorchScript; projected lane boundaries onto HD maps to identify driveable regions, maintaining <u>12+ FPS</u> on NVIDIA Jetson Xavier. (<a href="#">View Project</a>)</li></ul>  |                     |
| <b>Research Intern   Microsoft Research India   Supervisor: <a href="#">Dr. Akshay Nambi</a></b>   | Feb 2020 — Sep 2020 |
| <ul style="list-style-type: none"><li>Redesigned and scaled the Automated Driver License Testing (ALT) project for Regional Transport Offices (RTO) across India. The scaling led to the deployment of the project in <u>10+ cities</u> in India with <u>99% accuracy</u> in automated driving test results. (<a href="#">View Project</a>)</li></ul>  |                     |

PROJECTS

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| <b>Image Enhancement and Object Detection in Rainy Weather Conditions   Deep Learning, GANs, PyTorch</b>   | Jan 2023 — Apr 2023 |
| <ul style="list-style-type: none"><li>Implemented deep learning models for image enhancement in rainy weather, integrating GAN-based denoising with morphological transformations and optimized loss functions, improving visual clarity by increasing PSNR by 5.8%.</li></ul>   |                     |
| <b>Multi-Sensor Calibration and Sensor Fusion for Autonomous vehicle   Photogrammetry, ROS, Sensors (<a href="#">View Project</a>)</b>   | Oct 2020 — Feb 2022 |
| <ul style="list-style-type: none"><li>Created an automated calibration pipeline using ROS for synchronized data capture from multiple sensors; applied RANSAC and DBSCAN for point cloud filtering and visualized alignment in RViz.</li><li>Refined sensor pose estimates using Linear Algebra, 3D geometry, and Statistical ML techniques; integrated calibrated outputs into the autonomous vehicle's perception stack to support tasks like lane detection, HD map projection, and real-time localization.</li></ul> |                     |
| <b>RecipeDB   Pandas, Data Visualizations (<a href="#">View Project</a>)</b>   | Jun 2019 — Sep 2019 |
| <ul style="list-style-type: none"><li>Curated and integrated recipe data from 7 online sources, performed multi-level statistical analysis across 22 regions, and programmed interactive visualizations using Pandas, Matplotlib, and Plotly to present insights on regional dietary and nutritional patterns.</li></ul>   |                     |

PUBLICATIONS

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| <ul style="list-style-type: none"><li><b>SportMamba: Adaptive Non-Linear Multi-Object Tracking with State Space Models for Team Sports</b>, IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW-2025). (<a href="#">View Paper</a>)</li><li><b>Attention-Mamba for Multi-Object Tracking</b>, Conference on Robots and Vision (CRV), 2025. (<a href="#">View Paper</a>)</li><li><b>POPCat: Propagation of Particles for Complex Annotation Tasks</b>, Conference on Robots and Vision (CRV), 2024. (<a href="#">View paper</a>)</li><li><b>Recipedb: A resource for exploring recipes</b>, Database Journal (Oxford), pp. baaa077, Nov 2020. (<a href="#">View Paper</a>)</li><li><b>NTIRE 2019 Challenge on Video Super-Resolution:Methods and Results</b>, Co-author of team paper, IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW-2019). (<a href="#">View paper</a>)</li></ul> |  |
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