NIRAJ BASNET

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TECHNICAL SKILLS

Robotics: AI, VLM/VLA/LLMs, Motion planning, Trajectory Optimization, Controls, Data structures and algorithms, Optimization, Mapping, Localization, Sensor Fusion, Machine learning, Deep learning, Reinforcement Learning
Programming Languages: C/C++, Python, MATLAB, Latex
Software Tools: ROS/ROS2, Gazebo, CARLA, OMPL, Pytorch, Tensorflow, OpenCV, Git, Linux, Gitlab, Docker

EXPERIENCE

Senior Software Engineer(Robotics), *Volkswagen IECC, Belmont, CA* Mar 2023 – Present

- Designed AI decision-making modules that integrated multi-modal interior and exterior perception data (e.g., camera, radar, occupant monitoring) to support safety-critical features and context-aware in-cabin experiences.
- Engineered an in-vehicle video intelligence pipeline leveraging Vision-Language Models (VLMs), aesthetic quality scoring, and unsupervised clustering to automatically detect and highlight significant trip events from multi-camera footage.
- Applied state-of-the-art VLMs (e.g., CLIP, BLIP variants) to perform semantic scene understanding for real-time use cases, including object left-behind alerts and adaptive 360° situational awareness for enhanced security.
- Contributed to the system design and architecture of a modular, ROS2-based robotic vehicle platform for automotive service robotics applications, including autonomous valet parking, EV charging, and automated inspection. Focused on designing flexible interfaces and reusable components to support diverse task workflows and hardware configurations.
- Developed and integrated motion planning and control modules tailored for precise navigation in constrained environments. Collaborated with cross-functional teams to bring up and validate the complete autonomy stack, including perception, localization, and actuation subsystems.

Robotics Software Engineer II, *Dorabot Inc., Peachtree Corners, GA* May 2022 – Feb 2023

- Designed and optimized system architecture for AI-powered logistics robots deployed in FedEx and DHL warehouses, enabling high-throughput palletizing, depalletizing, and autonomous box transport at industrial scale.
- Designed and deployed a containerized robotics pipeline for palletizing robots, integrating perception (YOLOv7-based object detection), motion planning, and control modules with ROS2 framework. System optimizations including GPU inference tuning, task scheduling, and architectural refinements improved cycle time and throughput by 40 percent.
- Implemented contingency MPC for AGVs enabling real-time safe route re-planning under uncertainty.
- Built CI/CD-enabled deployment pipelines and real-time ROS2 visualization tools to monitor system diagnostics, inference latencies, and control behaviors, accelerating safe field deployment and debugging.
- Developed learning-based load planning algorithms for palletizing robots handling mixed SKU packages.

Robotics Software Engineer I, *Dorabot Inc., Peachtree Corners, GA* May 2021 – Apr 2022

- Enhanced grasping and motion planning logic for palletizing and depalletizing workflows, reducing placement error and eliminating collisions through improved path generation and stacking heuristics.
- Developed Gazebo-based simulation environments to validate robotic behaviors in high-fidelity warehouse scenarios, enabling rapid iteration and safety testing for new planning and control features.
- Built automated test cases to simulate robot platform behaviors and edge conditions, ensuring software reliability under functional and safety-critical requirements.
- Designed and implemented automated and manual recovery protocols to handle operational anomalies such as package drops, unexpected human presence, and system reboots.

Graduate Research Assistant, *Oregon State University* Sept 2018 – Dec 2020

- Developed motion planning and controls stack of the university team for autonomous F1/10 cars racing competition.
- Engineered a real-time(40Hz) model predictive contouring controller for generating and tracking dynamically feasible high speed racing trajectories while avoiding obstacles and opponents in the race track.
- Developed a real-time hierarchical planner comprising state lattice planner and Nonlinear MPC(for tracking) for generating high quality plans for self-driving racecar.
- Automated racetrack mapping and its relevant data extraction and pre-processing for autonomous cars racing, thereby slashing preparation time before the race, by almost half.
- Adapted an evolutionary algorithm(CMA-ES) for raceline-optimization of a given racetrack.
- Benchmarked and implemented control strategies like PID, LQR, MPC and Pure Pursuit.

Robotics Software Engineer, Co-founder, *Paaila Technology, Nepal* Dec 2016 – Sep 2018

- Designed and developed robotics products like waiter and banking service robots in-house for the first time in Nepal.
- Co-led a team of 4 engineers for development of motion planning and control stack, collaborated with mechanical and electrical hardware teams, to create initial prototypes for waiter and service robots within 9 months.
- Deployed a multi-robot global path planner to plan collision-free paths for waiter robots.
- Evaluated EKF and UKF, and implemented UKF for more precise indoor pedestrian tracking with lidar and radar.

PUBLICATION

- **A. Momtaz, N. Basnet**, H. Abbas, B. Bonakdarpour, "Predicate Monitoring in Distributed Cyber-Physical Systems ". In: Feng L., Fisman D. (eds) *Runtime Verification. RV 2021*, Lecture Notes in Computer Science, vol 12974. Springer, Cham. **(Best paper Award)**
- **N. Basnet** and H. Abbas, "Logical signal processing: A fourier analysis of temporal logic," in *Runtime Verification*, (Cham),pp. 359–382, Springer International Publishing, 2020. **(Best paper nominee)**

PROJECTS

Trip Planner Agent - Agentic AI Hackathon Winner | *TEAM LEAD* | *Python, LangGraph, Fal.ai, ElevenLabs* Apr 2025

- Built a multi-agent system for personalized road trip planning using LLMs for preference extraction, POI selection, and itinerary generation, integrating real-time APIs (Google Maps, Playwright) with custom aesthetic ranking and clustering for scenic stopover recommendations.
- Designed and implemented the agent orchestration layer using LangGraph, modeling reactive task agents within a directed computation graph and developing a FastAPI backend to support asynchronous workflows, stateful planning, and real-time streaming interactions.

Semantic Spatial Memory for Robot Navigation | *Python, PyTorch, VLM* Jan 2025

- Developed a long-term spatial memory system for indoor robots by associating CLIP-based visual embeddings and natural language descriptions with pose data from SLAM.
- Enabled semantic querying and goal-directed navigation using language prompts such as "Go to the room with the whiteboard" or "Where was the toolbox last seen?"

Learning-Based Latent Space Motion Planner (TD-MPC Inspired) | *PyTorch, CARLA, MPC* Mar 2024

- Implemented a model-based reinforcement learning planner inspired by TD-MPC for autonomous urban navigation in CARLA, leveraging learned latent dynamics and value functions for predictive planning and real-time control.
- Built a modular pipeline for latent-space rollouts and value-driven control, enabling efficient and generalizable trajectory planning without explicit trajectory optimization across diverse driving scenarios.

Imitation Learning-Based Motion Planner for Autonomous Driving | *Python, Pytorch, nuScenes* Dec 2023

- Explored and implemented a deep imitation learning pipeline from scratch, using transformer encoders and map-conditioned decoders to learn driving trajectories from expert demonstrations.
- Leveraged the nuScenes dataset to train and evaluate the model on complex urban scenarios, achieving strong performance in terms of trajectory accuracy, safety, and compliance with traffic semantics.

Motion planning for Self-driving cars in city traffic using CARLA simulator | *Python, CARLA* Oct 2020

- Integrated finite state machine(FSM) based behaviour planner and conformal lattice planner to plan collision-free trajectories for self-driving car in city traffic. Learnt CARLA to simulate planning in realistic driving scenarios.

Mapping, Localization and Motion planning algorithms | *C++, Python, ROS* Feb 2019 – Jun 2020

- Coded planning algorithms like Hybrid A*, PRM, RRT, RRT*, BIT*, and potential fields for learning.
- Implemented occupancy grid mapping and particle filter(Monte Carlo Localization(MCL)) on simulated vehicles.

Deep Cross-Entropy Method based planner | *Python, Pytorch* Jan 2020

- Trained a Deep Cross-Entropy Method-based planner that uses the learnt state-space model of the environment to get feasible motion plans for a car driving in a track.

EDUCATION

Oregon State University(OSU) Corvallis, OR
Masters of Science in Computer Science *Sep 2018 – Dec 2020*

Pulchowk Campus, Institute of Engineering, Tribhuvan University Lalitpur, Nepal
Bachelors in Electronics and Communication Engineering *Sep 2012 – Sep 2016*