Kshitij Sharma

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WORK EXPERIENCE

C++ Software Engineer Mar. 2025 – May 2025

Path Robotics (Contract) (OH, USA)

C++17, ROS1, MoveIt, pluginlib, Boost, GMock, GTest, Multithreading(std::thread/mutex, condition variables), Smart Pointers, Git, CMake, JIRA

- Collaborated on architecture refactoring of legacy C++ code to orchestrate multi-arm welding, scaling from a single robot to a four-arm cell
- Designed and developed a modular resource management system using modern C++ (templates, smart pointers, std::optional, lambdas) to allocate and synchronize the resources across multiple robots.
- Built test infrastructure using GMock with inheritance-based mocking and prototyped dependency injection for robust controller testing.
- Collaborate cross-functionally with robotics and software teams to align system architecture with evolving manufacturing requirements.
- Utilized Git for version control, ensuring code integrity and facilitating seamless collaboration within the development team.

Robotics Software Quality Engineer Jul. 2024 – Mar. 2025

Berkshire Grey via Vuedata (Contract) (MA, USA)

C++, Python, networking, Git, JIRA, multithreading, std::thread, async I/O

- Developed Python-based automation tools for the Cubiscan 325 machine, reducing warehouse management time by 30% and enhancing product dimensioning accuracy for warehouse induction and packing systems.
- Collaborated with development teams on system evaluation to optimize robotic motion planning, perception algorithms, and application software, ensuring systems met design specifications.

Robotics Software Engineer Sept. 2023 – June 2024

Void Robotics (FL, USA)

C++, Python, Arduino, Docker, Git, CI/CD, ROS2, Nav2, Rviz, Google Test, Blynk, Isaac ROS Buildfarm, micro-ROS

- Developed C++ software modules and automated Google Test suites within a Linux environment, enhancing an autonomous mobile robot's functionality through Nav2 implementation within a ROS2 environment, and facilitating team collaboration via Git in a CI/CD pipeline.
- Engineered a sophisticated mapping package, to precisely localize an AMR in outdoor environments, by integration and fusion of high precision data streams from Real-Time Kinematic (RTK) GPS, Zed2 Camera-based visual odometry, and Inertial Measurement Unit (IMU).
- Integrated ROS2 for autonomous navigation, optimized Rviz C++ nodes for enhanced reliability through Google tests in localization and mapping, and seamlessly merged custom localization strategies with Nav2 and Rviz visualization.
- Developed Arduino sketch to integrate Blynk with micro-ROS, facilitating advanced robotic functionalities; transitioned from Docker to Isaac ROS Buildfarm for ROS2 Humble installation, enhancing stability in agent-client connections on Jetson Orin and streamlining the communication process.

Research Engineer Aug. 2022 – Dec. 2022

Manipulation and Environmental Robotics Lab, WPI (Paper)

Python, C++, ROS, OpenCV, PyTorch, ResNet, GGCNN, Gazebo, RealSense RGBD Camera, Franka Panda Robot (7-DoF)

- Implemented vision-based grasp detection algorithms (GGCNN, ResNet) using deep learning within the ROS framework and integrated these algorithms with a robotic manipulator arm equipped with a real-sense RGBD camera on the end-effector for robust grasp planning and execution
- Developed a benchmarking pipeline to evaluate grasp algorithms on the 7-DoF Franka Panda Robot in real-world tests and ROS Gazebo
- Introduced a novel evaluation metric and used the benchmarking protocol (link) for comparing the grasp of various algorithms

Team Lead, Design Engineer Jan. 2017 – June 2021

Nagarro Software (Gurugram, India)

C++, Python, Raspberry Pi, Arduino, OpenCV

- Developed a Minimum Viable Product (MVP) utilizing a 6-DOF robot arm with a camera-end effector for inspecting car chassis on a rotating platform, leveraging C++ and Python to achieve precise automation and high-accuracy defect detection in automotive manufacturing processes.
- Designed and implemented IoT systems for smart homes, integrating PIR, ultrasonic, infrared, photodiode, and thermostat sensors

Research Design Engineer Aug. 2014 – Jan. 2017

Automation Systems and Solution (New Delhi, India)

C++, Python, Cognex Vision Systems, OpenCV

- Developed an automated defect detection system for conveyor belts using Cognex Vision Systems, OpenCV, C++, and Python, enhancing quality control and reducing errors by 40%.
- Designed an automated product sorting system for 1D and 2D barcodes integrated with electric actuators using C++ and Python, boosting sorting efficiency by 60%.

EDUCATION

Worcester Polytechnic Institute (MA, USA) | MS in Robotics Engineering Department **| GPA: 3.9** Aug. 2021 – May 2023

I.T.S. Engineering College (U.P, India) | B.Tech. in Mechanical Engineering **| GPA: 3.3** Aug. 2010 – June 2014

SKILLS

Languages and Platforms: C++, Python, Linux, ROS 2, Docker, Git, JIRA

Libraries and Frameworks: Nav2, MoveIt, OMPL, Eigen, CASADi, OpenCV, PCL, Pytorch, TensorFlow, CUDA, gtest, pytest, std::thread, std::async, coroutines, asyncio, CUDA

Coursework: Motion Planning, Robot Controls, Computer Vision, Robot Dynamics, Reinforcement Learning, Deep Learning, Artificial Intelligence, Machine Learning, Data Structures and Algorithms

PROJECTS

Autonomous Crown Preparation

- Modelled a 6-DOF manipulator arm, utilizing MATLAB's Robotics Toolbox and generated waypoints around a tooth, using Solidworks
- Resolved inverse kinematics to generate waypoints for motion planning using algorithms like RRT, RRT*, Bidirectional RRT, and D*
- Implemented a bidirectional RRT algorithm and designed an advanced clearance algorithm to simulate a collision-free crowning procedure

Einstein Vision (CLRNet, YOLOv7, MiDaS, Blender)

- Designed and implemented a comprehensive perception pipeline using CLRNet for lane detection, YOLOv7 for object recognition, and MiDaS for depth estimation, achieving accurate 3D scene mapping and high-quality Blender visualizations of complex road environments.
- Improved detection accuracy and robustness under varied lighting by integrating HSV filtering for traffic signals and customizing 3D vehicle pose estimation through refined camera matrix and bounding box adjustments, ensuring reliable object recognition and scene depth consistency.

Joint Space Control of 3-DOF Robot Manipulator

- Designed and simulated joint space PID control for an RRP 3-DOF robot manipulator arm in Gazebo, enabling precise trajectory tracking.
- Developed an advanced verification module using Linear Quadratic Regulator (LQR), solving the Riccati equation for optimal feedback control, and compared its robustness and energy efficiency with PID control.
- Implemented trajectory generation algorithms with cubic polynomial interpolation and visualized control responses to evaluate stability and response characteristics.

3D Scene Reconstruction (SfM, NeRF, Multi-view Geometry, Pose Estimation)

- Developed a full pipeline for Structure from Motion (SfM) using SIFT keypoints, RANSAC for outlier rejection, Fundamental and Essential matrix estimation, camera pose extraction, triangulation, Perspective-n-Point (PnP), and Bundle Adjustment, successfully reconstructing 3D scenes from 2D images.
- Implemented the Neural Radiance Fields (NeRF) method to synthesize novel views of complex 3D scenes, creating a continuous volumetric scene function optimized through deep learning, and achieved photorealistic renderings from sparse input views.

Urban Scene Reconstruction (Semantic Segmentation and ICP)

- Designed a robust pipeline to align LiDAR point clouds using ICP and integrate RGB camera data with semantic segmentation for accurate 3D urban reconstructions.
- Enhanced 3D point clouds with semantic labels, significantly improving object recognition and scene understanding in complex environments.

One-Shot Basketball Detection (YOLOv5, PyTorch) (GitHub) (Video)

- Developed an end-to-end basketball detection model using YOLOv5 algorithm in PyTorch achieving more than 90% accuracy
- Implemented transfer learning, the pre-trained model approach, as initial layers of the network, to improve accuracy
- Adapted this system for use on a mobile robot, forming an extensive perception system for immediate basketball detection on the court

Semantic Segmentation using CARLA Dataset (ENet, ERFNet, CARLA)

- Implemented ENet and ERFNet on the CARLA dataset for semantic segmentation, achieving 72% mean IoU on the validation set and 69.8% on the test set, enabling accurate object classification for self-driving modules.

AutoCalib (Camera Autocalibration)

- Applied Z. Zhang's camera autocalibration technique enhanced with non-linear optimization algorithms to achieve high-precision intrinsic parameter estimation.

Face Recognition/Verification Using Siamese Network

- Developed an end-to-end face recognition system using the Siamese Network in TensorFlow and achieved at least 85% accuracy
- Implemented Google's FaceNet and a pre-trained random forest classification to compare accuracy with the results achieved with the Siamese Network

Multi-Robot Path Planning in a Dynamic Environment

- Developed an integrated synchronous system of 3 mobile robots utilizing multi-processing to represent the restaurant service paradigm
- Compared various grid-based and sampling-based path planning algorithms like A*, D*, LPA*, D* Lite, Sampling-Based A*, Informed RRT*
- Executed comprehensive collision testing and optimization path analysis for the 3 mobile robots across all path planning algorithms

Autonomous Parallel Parking

- Designed a motion planner with Hybrid A* for trajectory planning and an MPC controller for parallel parking and navigating obstacles
- Successfully executed a parallel parking maneuver for a truck and trailer setup utilizing a kinodynamic RRT motion planner in MATLAB

Autonomous Vehicle Control and State Estimation

- Utilized Model Predictive Control (MPC) to guide the vehicle along a predefined racetrack using preset waypoints
- Implemented the Error State Extended Kalman Filter for accurate vehicle localization within the CARLA environment
- Addressed sensor miscalibrations and evaluated the impact of noise variances on pose estimates

CERTIFICATIONS

Deep Learning by DeepLearning.AI on Coursera (Link)

- Neural Networks and Deep Learning
- Structuring Machine Learning Projects
- Convolutional Neural Networks
- Sequence Models
- Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization

Machine Learning Course by Stanford University on Coursera (Link)

VOLUNTEER

Volunteer Work on Worcester Campaign October 2021

Worcester, Massachusetts, USA

- Collaborated with 100 volunteers across 10 groups to clean and beautify the Worcester community, collecting over 300 pounds of recyclable waste and trash, showcasing strong teamwork, collaboration, and commitment to community service.