CHINMAY AMRUTKAR

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Education

Arizona State University, Tempe, AZ — Aug 2024 – Present
Master of Science, Robotics and Autonomous Systems (AI)
- CGPA: 3.92/4.0 | **Achievements:** NAMU University Scholarship ($10,000), Engineering Fellowship ($1000)
- **Coursework:** Artificial Intelligence, Robotics Systems, Space Robotics and Al, Machine Vision and Pattern Recognition, Natural Language Processing, Mechatronics, Embedded Machine Learning

MIT World Peace University, Pune, India — Aug 2019 – May 2023
Bachelor of Technology, Robotics and Automation
- CGPA: 9.77/10.0 | **Achievements:** Graduated as a Gold Medalist, 3 times merit scholarship holder ($3750)

Skills

Languages: Python, C++, MATLAB, C, Java, JavaScript
AI/CV Frameworks: PyTorch, TensorFlow, OpenCV, Point Cloud Library (PCL), Scikit-learn, Hugging Face
Robotics, Controls & Simulation: ROS 1/2, Gazebo, Simulink, Stateflow, PX4 Autopilot, MoveIt, Control Systems (PID, LQR), System Dynamics, Adams, VTD
Hardware & Embedded: Embedded Systems, Firmware Development, Schematic Design, PX4 Autopilot, Raspberry Pi
Tools & Technologies: Git, Docker, Linux, JIRA, SolidWorks, Agisoft Metashape
Vision Competencies: 3D Object Detection, Neural Radiance Fields (NeRF), SLAM, Image Segmentation, Feature Detection & Matching (SIFT, ORB), Camera Calibration, Epipolar Geometry, Frequency Domain Analysis (FFT)

Publications

Towards Robotic Trash Removal with Autonomous Surface Vessels — 2025
Robots in the Wild Workshop, IEEE International Conference on Robotics and Automation (ICRA) 2025.

A State-of-the-Art Review on Robotics in Waste Sorting — 2023
International Journal on Interactive Design and Manufacturing (IJIDeM), Springer.

Overview of Autonomous Vehicles and Its Challenges — 2022
Techno-Societal 2022. ICATSA 2022, Springer, Cham.

Research Interests: Embodied AI, Sim-to-Real Transfer Learning, Real-Time 3D Perception for Autonomous Navigation, Generative Models for Scene Understanding, Context Engineering Vision-Language Models and Efficient Neural Architectures for Edge Deployment.

Academic Projects

Visual Grounding & Hallucination Mitigation in VLMs on VideoGameBench Benchmark — Dec 2025
- Conducted a failure analysis of Vision-Language Models (VLMs) in dynamic environments of VideoGameBench, identifying critical deficits in spatial awareness and visual hallucination loops.
- Developed a context engineering pipeline to improve perceptual grounding in low-resolution environments, integrating a visual grid overlay strategy to assist the model in spatial localization tasks.
- Deployed a multi-modal agent (Visual Perception + Language Reasoning) that outperformed baseline agents by successfully navigating complex game maps through improved state-tracking and visual context retrieval.

TinyML Audio Classifier for Absolutist Language Detection — Nov 2025
- Designed and trained a Depthwise Separable CNN (DS-CNN) for keyword spotting, achieving 93% test accuracy by engineering a hybrid dataset of 13,000+ samples (custom recordings + Google Speech Commands).
- Optimized the model for deployment on an Arduino Nano 33 BLE Sense by performing INT8 quantization, reducing model size to 18 KB to fit strictly within Flash memory constraints.
- Implemented a robust data preprocessing pipeline including synthetic silence generation and background noise mixing to ensure high model generalization in noisy real-world environments.

TinyML: Real-Time Sensor-Agnostic Posture Detection — Nov 2025
- Developed an end-to-end TinyML pipeline using TensorFlow to train a 1D-CNN for human activity recognition, achieving 99.12% accuracy by implementing orientation-invariant data augmentation.
- Engineered a sensor-agnostic inference engine capable of dynamically normalizing inputs to run predictions using either Accelerometer, Gyroscope, or Magnetometer data at 50Hz.

Enhanced Real-Time 3D Object Detection from LiDAR Point Clouds — Apr 2025
- Integrated a CBAM attention module into an SFA3D (PyTorch) backbone to enhance 3D object detection of occluded

pedestrians and cyclists in sparse LiDAR point clouds from the KITTI dataset.
- Validated that the lightweight attention mechanism qualitatively improved detection of challenging objects with a key factor for autonomous system safety while maintaining real-time inference speeds.

3D Volumetric Reconstruction of Meteorite using NeRF Variants Apr 2025
- Reconstructed a high-fidelity 3D model of a real-world object by training multiple Neural Radiance Field (NeRF) variants (Instant-NGP, Nerfacto) on a custom 55-image dataset with poses estimated via Metashape.

Perception-Driven Autonomous Trash Collection with a Robotic Boat May 2025
- Designed a ROS-Gazebo simulation pipeline on the Heron USV to perform boustrophedon (lawnmower-style) surveys with constraint-aware detours for opportunistic trash interception, ensuring scientific sampling integrity was preserved through bounded lateral deviation.
- Validated the perception-driven control logic in 10 Monte Carlo simulation trials with 100% waypoint recovery and 54% collection rate and separately deployed YOLOv8 on the R/V Karin Valentine ASV to confirm real-time trash detection feasibility under natural lighting.

Autonomous Drone for Vision Based Geological Mapping and Landing Apr 2025 - May 2025
- Developed a ROS 2 node for autonomous lawnmower (boustrophedon) survey using PX4 SITL and onboard RGB-D input which performed real-time environment mapping via RTAB-Map and logged 3D terrain data for post-analysis.
- Detected cylindrical as geological features using ArUco markers and executed a controlled landing sequence using altitude-based selection and velocity-smooth descent.

Autonomous Moving Platform Tracking and Landing with a Drone Apr 2025
- Implemented a robust visual servoing system in Simulink for a Parrot Mambo drone, using classical computer vision to generate real-time control commands for tracking a moving target.
- Designed and tuned Stateflow logic for reliable state transitions (e.g., tracking, aligning, landing), enabling robust target locking and velocity compensation based on visual feedback.

Autonomous Maze-Solving Robot with Digital Twin (MyCobot Pro 600) Dec 2025
- Designed a complete vision-to-motion pipeline by solving a physical maze using OpenCV (Python), mapping the path to robot coordinates, and converting waypoints to joint angles via MATLAB-based inverse kinematics.
- Simulated and visualized robot motion in a digital twin using URDF and animated execution paths; prepared TCP-ready joint commands with >95% execution accuracy.

Design and Prototyping of Robotic Arm for Waste Sorting using Computer Vision Sep 2022-Nov 2022
- Built a 4 DOF robotic arm with Arduino control for robotic manipulation, capable of sorting recyclables (glass, paper, cardboard, tin cans) with a payload capacity of 200 grams, addressing real-world sustainability challenges.
- Trained a deep learning model (YOLOv7) on 2000+ images for object detection.

Quadcopter Flight Control System (Simulink) Apr 2025
- Designed and simulated a full 6-DOF flight controller for a quadrotor using model-based design in Simulink, implementing nested PID loops for stable attitude and position control.
- Developed motor mixing logic to translate controller outputs into individual rotor commands and validated the system's stability and responsiveness by tracking its trajectory in a 3D visualization.

Low-Level Admittance Controller for Risky Teleoperation (Ongoing) May 2025
- Developed a shared autonomy framework for the Fetch robot, using admittance control to ensure stable 2D locomotion and responsive grasping via Novint Falcon under high-latency conditions.
- Architected a comprehensive data collection pipeline to record synchronized state-action pairs, serving as the foundation for expert demonstration learning.
- Engineered the system to transition from manual teleoperation to Inverse Reinforcement Learning (IRL) to model operator cost functions for improved safety and stability.

STaR: Self-Taught Reasoner for Enhanced LLM Reasoning Oct 2025
- Implemented the Self-Taught Reasoner (STaR) methodology to fine-tune a Llama-3.2-3B model, boosting its mathematical reasoning accuracy on the GSM8k benchmark to 63.38%.
- Engineered a data bootstrapping pipeline using PyTorch and the Hugging Face ecosystem to programmatically generate a high-quality training set by having the model create, verify, and self-correct its own reasoning paths.
- Validated that the STaR approach successfully overcame the *catastrophic forgetting* observed in standard fine-tuning, outperforming both the SFT baseline (57.32%) and the original pre-trained model with zero-shot CoT (59.89%).

MayBot-Personal Portfolio Al Agent Jul 2025
- Developed and deployed a conversational Al agent designed to provide interactive information about my skills and experience.
- Engineered a secure backend utilizing a Netlify Function and environment variables to protect the Gemini API key. And built the user-facing chat widget with HTML, Tailwind CSS, and JavaScript, including state management, API calls, and Markdown rendering.

Pitch Perfet - Real-Time Feedback Tool for Job Seekers (24-Hour Hackathon Project) Apr 2025

- Built a Gradio-based NLP tool in 24 hours using whisper.cpp, Vander, and Olama to transcribe interview videos, analyze sentiment and relevance, and deliver real-time feedback for job seekers.

AI Scheduling Assistant Sept 2025

- Built a cloud-native full-stack application integrating Google Gemini API, Google Calendar API, and Google Cloud Functions with secure IAM authentication for conversational event management.
- Designed and deployed LLM-powered prompt engineering to classify user intent and parse unstructured, multi-day text into structured JSON, enabling seamless chatbot-driven scheduling.

Work Experience

Graduate Student Assistant, Center for Hydrologic Innovations, ASU – AZ, USA Jan 2026 – Present

- Developing a predictive machine learning framework to estimate snow depth and snow water equivalent, facilitating data-driven water resource management.
- Architecting an end-to-end ML pipeline, including large-scale dataset curation, model training, and the development of custom data visualization functions.
- Collaborating with the Salt River Project (SRP) to deliver monthly technical reports and progress updates, ensuring model outputs align with regional hydrologic requirements.
- Implementing robust data analysis workflows to translate complex environmental sensor data into actionable insights for snowpack monitoring.

Graduate Engineer Trainee, Jabil Circuit India Private – Pune, India Jan 2024 – Jul 2024

- Engineered a Wrist Band Monitoring System for ESD compliance by integrating fault-tolerant hardware with critical manufacturing lines, ensuring zero added downtime through a hot-swappable, automation-ready design; collaborated with stakeholders to understand requirements and align system features accordingly.
- Identified and proposed automation opportunities across the production line, presenting actionable improvements to enhance efficiency, safety, and compliance within the electronics manufacturing workflow.
- Communicated effectively with cross-functional teams in test, production, and quality to align system behavior with factory workflow requirements, reinforcing operator accountability and audit compliance.

Automation Engineer, Flexible Softwares – Pune, India Aug 2023 – Jan 2024

- Architected and developed a Python-based data pipeline to automate the extraction and structuring of critical information from multiple unstructured technical documents.
- Worked directly with the client to define data requirements and validation criteria, delivering a robust software solution that significantly reduced manual data processing and improved workflow productivity.

R&D Intern, Hexagon Manufacturing Intelligence – Pune, India Feb 2023 – Aug 2023

- Designed and automated over 1000 end-to-end test cases using Sikuli (an OCR-based tool), thereby accelerating regression testing workflows across Virtual Test Drive and MSC Adams environments.
- Developed a Python-based script generation tool to empower non-technical users in test automation, enhancing cross-functional productivity by 40% and reducing manual scripting overhead.

Leadership and Volunteer Work

Research Volunteer, CHART Lab (Center for Human, Al, and Robot Teaming), ASU Jan 2025-Present

- Supporting research in human-Al-robot teaming for mission-critical applications; gaining hands-on experience with platforms like FETCH, Husky, UR5, ABB YuMi, and TurtleBot.

Volunteer, Southwest Robotics Symposium - Arizona State University Oct 2024

- Welcomed attendees, managed guest check-ins, and led guided tours across ASU's robotics labs to showcase ongoing research and foster community engagement.

Team Captain, Electric Vehicle Design & Manufacturing Team Jan 2020-Jan 2023

- Led a 14-member interdisciplinary team in designing a competition-grade electric vehicle; secured 1st place in acceleration through bold system-level innovation and cross-functional coordination.