MININDU PASAN

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EDUCATION

SLIIT Malabe
BSc (Hons) in Computer Systems Engineering Expected May 2027

INDUSTRY EXPERIENCE

ASSOCIATE EMBEDDED SYSTEMS ENGINEER 2026 March-Present
Vega Innovations (Pvt) Ltd

TRAINEE SOFTWARE ENGINEER 2025 September - 2026 March
Vega Innovations (Pvt) Ltd

PROJECT: Unitree GO2 Autonomous Navigation & Frontier Exploration Framework

1. **Autonomous Navigation & Frontier Exploration Stack:** Developed a comprehensive navigation framework for the Unitree GO2 using **ROS2 Nav2 and AMCL**, featuring autonomous frontier-based mapping, 360-degree localization sequences, and intelligent "Return to Base" (RTB) logic.
2. **Precision Visual Marker Tracking & Docking:** Engineered an **AprilTag and ArUco detection system** using TF2 and RealSense cameras, enabling the robot to perform autonomous precision docking and sub-meter alignment through stable 3D pose estimation and visual servoing.
3. **Real-Time Systems Monitoring Dashboard:** Architected a high-performance **Rust-based Text User Interface** optimized for Jetson Orin, implementing a custom FIFO-based logging architecture that reduced CPU overhead by 90% while providing real-time telemetry and system health monitoring.
4. **3D Perception & Advanced Obstacle Avoidance:** Implemented a **depth-based obstacle detection system** by fusing RealSense point-cloud data with 2D LIDAR scans, significantly improving robot safety and maneuverability in dynamic, high-traffic environments.
5. **Autonomous Mission & Recovery Management:** Developed a dedicated **Nav2 health monitor and exploration coordinator** to handle automatic system recovery, mission state transitions, and post-exploration automation, ensuring high reliability during extended autonomous operations.

PROJECTS

VECTOR NAV - OFFLINE VOICE-CONTROLLED AUTONOMOUS NAVIGATION ROBOT 2026
github.com/minindupasan/Vector-NAV

1. **Fully Offline Voice-to-Action Pipeline**: Built a chained wake-word → STT → LLM → tool-call → TTS pipeline (openwakeword → faster-whisper base.en int8 → Llama-3.2-1B via NanoLLM → Kokoro 82M TensorRT) that turns spoken commands into real navigation goals with zero cloud dependency. Justification: a warehouse robot can't depend on internet connectivity or a cloud round-trip for latency-sensitive voice control; running the full stack on-device (wake word ~10ms/frame, always-on) keeps response times low and operation fully autonomous.
2. **Real-Time Barge-In Interruption**: Implemented mid-response interruption where saying the wake word during TTS playback (at a lowered 0.4 detection threshold) immediately halts the LLM stream and drains the TTS queue via dedicated /llm/interrupt and /tts/input signals. Justification: a robot mid-speech or mid-navigation still needs to respond instantly to "stop" - queuing new commands behind an unfinished utterance isn't acceptable for real-time control.
3. **Distributed Compute Architecture (Jetson + Raspberry Pi)**: Split the system across a Jetson Orin Nano Super (LLM, STT, TTS, Nav2, SLAM, object detection, web dashboard) and a Raspberry Pi 5 (motor PWM/encoder ISR, IMU sampling, EKF fusion, LiDAR driver, camera capture), bridged over CycloneDDS multicast on a shared ROS

domain, no custom bridge code. Justification: hard real-time motor control needs deterministic GPIO latency on the Pi, while GPU-accelerated AI workloads need the Jetson's compute; separating them avoids resource contention between the two.

4. **Sensor Fusion & Autonomous Navigation Stack**: Integrated SLAM Toolbox (async online SLAM), Nav2 (AMCL localization, NavFn planner, DWB controller, behavior server, BT navigator), and a robot_localization EKF fusing wheel odometry and IMU data at 15Hz to produce the sole odom→base_link transform.
5. **Custom ROS2 Interfaces & System Health Monitoring**: Authored 5 custom message types and 9 services (location management, mode switching, map saving) plus a status-aggregation node publishing consolidated robot health (navigation/LLM/STT/TTS state, battery, CPU/GPU temps on both boards) at 2Hz with automatic warning/critical thresholds.

PROWLER NAV - HEXAPOD ROBOT SIMULATION & CONTROL May 2025
github.com/minindupasan/Prowler-NAV

1. **Custom 18-DOF Inverse Kinematics (IK) Gait Engine**: Developed a specialized motion controller from scratch to coordinate 18 independent joints. Justification: ROS2 lacks a standard, out-of-the-box controller for hexapod locomotion like diff_drive and ackermann_steering. Developed this engine to bridge the gap between high-level navigation and synchronized 18-joint trajectory execution.
2. **Geometric Asymmetry & Drift Compensation**: Engineered a mathematical correction layer within the gait generator to balance non-uniform leg mounting angles. Justification: Physical hexapods often exhibit "crabbing" (unintentional sideways drift) during forward motion; this compensation ensures precise linear and angular accuracy by equalizing the net force vectors across tripod groups.
3. **Distributed micro-ROS Hardware Architecture**: Architected a hybrid system using a Jetson Orin Nano for high-level logic and an ESP32 for low-level servo timing via micro-ROS (XRCE-DDS), backed by a custom PCB design for the drive electronics.
4. **Kinematic Modeling & Dual-Simulation Validation**: Authored a complete URDF with 18 joints and high-quality STL meshes, integrated into a modern Gazebo environment, and cross-validated gait behavior in a separate MuJoCo simulation for physics-accuracy comparison.
5. **Custom RViz Tooling**: Built dedicated RViz plugins for hexapod-specific visualization and debugging beyond RViz's default robot-model tooling.
6. **Navigation Stack & SLAM Integration**: Integrated SLAM Toolbox and Nav2 to provide the robot with spatial awareness and autonomous capabilities.

LOW-POWER FM TRANSMITTER May 2025

- Designed and implemented a low-power FM transmitter for rural broadcasting applications.
- Captured audio input via microphone and modulated signal using a LC tank oscillator.
- Broadcasted real-time FM transmission across 88–108 MHz with PCB-integrated telescopic antenna.

INDUSTRY SPECIFIC SKILLS

ROBOTICS & AUTOMATION

- Robotics Operating System (ROS 2)
- URDF & Robot Modeling
- SLAM and Navigation with Nav2
- Sensor Integration (LiDAR, IMU)
- PID Control and Tuning
- Sensor Calibration and Actuator Control

EMBEDDED SYSTEMS & FIRMWARE DEVELOPMENT

- C/C++ Embedded Firmware Development
- Worked with NVIDIA Orin platforms (AGX, NX, Nano)
- Microcontroller Programming (ESP32, STM32, Atmel AVR, Raspberry Pi)
- Bare-metal AVR MCU Development with Assembly
- Peripheral Communication (I2C, SPI, UART)

COMPUTER VISION & EDGE AI

- Optimized AI models using TensorRT.
- Object Detection & Landmark Tracking
- Depth Estimation and Visual Language Model integration with Robotics

HARDWARE & IOT DEVELOPMENT
- PCB Design & Prototyping (KiCad)
- IoT Protocols & Cloud Integration (MQTT, LoRa, Zigbee, AWS)
- 3D CAD Modeling (Fusion 360)

CERTIFICATIONS

MACHINE LEARNING
Stanford University

ROS 2 FOR BEGINNERS LEVEL 2 - TF, URDF, RVIZ, GAZEBO
Udemy

ROS 2: BASICS LEVEL 1
Udemy

ROS 2 NAV2: SLAM & NAVIGATION
Udemy

LEADERSHIP SKILLS

COMPUTER SYSTEMS ENGINEERING STUDENT COMMUNITY SLIIT
President Aug 2025 – March 2026
- Elected as president, leading and coordinating activities for a community of 100+ students.
- Organize industry collaborated events for improving engagement between students and the industry.

IEEE WIE SLIIT - PERPETUAL 5.0 SLIIT
Lead Editor May 2025 – July 2025
- Lead the editorial team for the Perpetual 5.0 charity event

KEY ACHIEVEMENTS

IEEE R10 ROBOTICS COMPETITION 2024
Top 10 Finalists. Presented a concept for an advanced hydroponic system.

IIT IEEE MICROMAZE COMPETITION 2024
Secured a top 10 position in the Micromouse robotics competition.

REFERENCES

Prof. Anuradha Jayakody
Ph.D. (Curtin) (Australia), M.Phil. (UOP)(SL), MSc in IS (SLIIT)(SL), BSc (Computing) Hons (Greenwich)(UK), MBCS CITP, CEng (EC-UK), MIET, MIEEE, CCAI, MCSSL, MCP
Head - Department of Computer Systems Engineering SLIIT
Consultant