Stage 3 Checklist: Raspberry Pi Integration (RPi 3 B+ Prototype)

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■ Objective

- Integrate Raspberry Pi 3 B+ as high-level control node.

- Run ROS 2 Humble on Pi 3 B+ to test serial communication, teleoperation, and odometry bridge.

- Prepare for seamless migration to Raspberry Pi 5 in future.

■ Preparation & Hardware Inventory

- [ ] Raspberry Pi 3 B+ available and tested

- [ ] MicroSD card (16–32■GB recommended)

- [ ] USB cable for Arduino Nano 33 IoT connection

- [ ] Stable power supply for Raspberry Pi (5V 2.5–3A)

- [ ] Optional: Wi-Fi/Ethernet setup for SSH access

■ OS & Software Setup

- [ ] Flash and install Ubuntu 22.04 Server (ARM64) or Raspberry Pi OS 64-bit Lite

- [ ] Update packages (sudo apt update && sudo apt upgrade)

- [ ] Install ROS 2 Humble (using official repo)

- [ ] Set up ROS 2 workspace

- [ ] Test core commands:

- ros2 topic list

- ros2 run demo_nodes_py talker

- ros2 topic echo /chatter

■ Arduino Integration

- [ ] Connect Arduino Nano 33 IoT via USB

- [ ] Verify serial port on Pi (ls /dev/ttyACM* or /dev/ttyUSB*)

- [ ] Test serial connection with minicom, screen, or cat

- [ ] Ensure Arduino firmware:

- Streams odometry data over serial

- Accepts velocity commands over serial

■ ROS 2 Node Development (RPi 3 B+)

- [ ] Create ros2_serial_bridge package

- [ ] Node functions:

- Open serial port to Arduino

- Parse odometry messages

- Publish /odom topic

- Subscribe to /cmd_vel

- Send velocity commands to Arduino

- [ ] Test node end-to-end:
- Simulate /cmd_vel inputs
- Validate /odom outputs

■ Communication Protocol Design
- [ ] Define message format:
- From Arduino ➜ Pi: odometry (ticks, speed)
- From Pi ➜ Arduino: velocity commands
- [ ] Include header/checksum if needed
- [ ] Document protocol for future upgrades

■ Teleoperation Testing
- [ ] Install teleop package:
- ros2 run teleop_twist_keyboard teleop_twist_keyboard
- [ ] Control robot via /cmd_vel
- [ ] Observe robot response

■ Visualization and Logging
- [ ] Install and test ros2 bag recording
- [ ] Record /odom and /cmd_vel topics during runs
- [ ] Transfer bag files for analysis on laptop
- [ ] Optional:
- Plot odometry with PlotJuggler
- Remote RViz on laptop for visualization

■■ Documentation
- [ ] Record OS and ROS 2 installation steps
- [ ] Save bridge node code with comments
- [ ] Document serial message formats
- [ ] Archive test logs and plots
- [ ] Note all working configurations for migration to Pi 5

■ Future Upgrades (RPi 5 Ready)
- [ ] Install ROS 2 Humble on Raspberry Pi 5
- [ ] Move serial bridge node seamlessly
- [ ] Add ROS 2 Nav2 stack for autonomous navigation
- [ ] Integrate SLAM Toolbox or Cartographer
- [ ] Add camera node for vision tasks
- [ ] Enable full teleop, mapping, and planning over Wi-Fi

■ Milestone

Completion of Stage 3 means your robot is integrated with ROS 2, supports teleoperation and odometry monitoring, and is ready for advanced autonomy on Raspberry Pi 5.