SHURENDHER KUMAR SAMPATHKUMAR

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SUMMARY

Engineer with multidisciplinary experience at the intersection of robotics, mechanical systems, and embedded development. Skilled in designing and prototyping mechatronic systems, developing control algorithms, and integrating hardware and software for real-world applications. Experienced in low-level programming, motor control, CAD modeling, and system-level problem solving. Focused on building reliable, modular, and scalable solutions for intelligent machines and automated systems.

TECHNICAL SKILLS

- **Robotics:** ROS, ROS2, Gazebo, Rviz, SLAM, sensor fusion, path planning, OpenCV, camera calibration, Simulink.
- **Embedded Systems:** C++, Python, Embedded C, Embedded Linux, Git/GitHub, UART, SPI, I2C, CAN, Arduino, Raspberry Pi.
- **Sensors & Actuators:** IMU, LiDAR, cameras, time-of-flight sensors, RFID, BLDC, stepper, and servo motor control.
- **Mechanical Design & Analysis:** SolidWorks, CATIA, Fusion 360, PTC Creo, ANSYS, Abaqus, GD&T (ASME Y14.5), tolerance stack-up analysis, MATLAB.
- **Prototyping & Manufacturing**: Design for Manufacturing & Assembly (DFMA), 3D printing, CNC machining, laser cutting, vacuum forming, injection molding, root cause analysis, FMEA.

EXPERIENCE

Mechanical and Embedded Systems Intern – *Meteora3D, Cincinnati, OH*   **Apr 2025 – Present**
- Designed a calibration and homing routine that eliminated the need for additional hardware, enabling scaling across machines.
- Structured firmware for robust startup, modularity, and diagnostic logging to support future OTA-style updates and maintenance.
- Developed and tested firmware for stepper motors for stall detection and current control with a focus on reliability.
- Integrating camera and time-of-flight sensors into the embedded stack; configured vision system for ArUco marker tracking using OpenCV.

Graduate & Research Assistant - IASRL *University of Cincinnati, Cincinnati,* OH   **Jan 2022 – Apr 2025**

Research Assistant
- Led the development of control algorithms and real-time calibration for a Control Moment Gyroscope (CMG)-based platform.
- Designed and implemented software-in-the-loop (SIL) testing to validate strategies under dynamic operational constraints.
- Defined system architecture and drove component selection for a high-torque motion device, ensuring alignment with both functional and manufacturability requirements.
- Collaborated with stakeholders to track project milestones and recommended operational strategies for demos, leading to clearer communication and stronger technical presentations.
- Diagnosed and resolved hardware-software integration issues; optimized IMU feedback loops to mitigate sensor drift caused by BLDC motor interference.
- Performed system characterization tests to evaluate performance and identify ideal applications for CMG-based systems.
- Maintained detailed Bills of Materials (BOMs) for multiple prototypes, streamlining procurement and vendor coordination.

Graduate Assistant
- Partnered with Gimbal Innovations to prototype a flight simulator, integrating mechanical, electrical, and software subsystems.
- Led embedded system development using Arduino and Raspberry Pi, including real-time motor control and sensor interfacing.
- Implemented IMU-based feedback into a PID control loop for driving BLDC and servo motors with responsive dynamics.
- Established communication between Microsoft Flight Simulator and the physical prototype to enable closed-loop testing.
- Contributed to the SMART platform by integrating mechanical and electrical systems and analyzing behavior in SolidWorks.
- Designed and built custom test rigs to evaluate component performance and system-level responses.
- Coordinated with vendors for pricing, sourcing, and timely procurement of prototype parts, ensuring continuity in iterative development.

Graduate Researcher
- Designed and developed a Human-Aware Navigation (HAN) framework for Autonomous Mobile Robots (AMRs) operating in human-rich environments such as airports and malls.
  - Integrated Fuzzy Inference Systems (FIS) with an Enhanced Potential Field (EPF) method to adapt robot behavior based on dynamic human positions and contextual factors.
  - Focused on improving human safety, comfort, and social acceptance in robot interactions by modeling proxemics and navigation intent.
  - Demonstrated promising results in simulation, showcasing the framework's robustness as a local planner in cluttered, human-centric spaces.
- Publications:
  - *S. Sampathkumar*, D. Choi, and D. Kim, "Fuzzy Inference System-assisted Human-Aware Navigation Framework based on Enhanced Potential Field," Complex Engineering Systems, Vol. 4, No. 1, Jan. 12, 2024. (Link)
  - *S. Sampathkumar*, A. Chhabra, D. Choi, and D. Kim, "Optimization of Artificial Potential Field using Genetic Algorithm for Human-aware Navigation of Autonomous Mobile Robots," 2023 North American Fuzzy Information Processing Society Conference, Cincinnati, OH, May 31-Jun. 2, 2023 (Best Student Paper award). (Link)

Mechanical Engineer Intern- *SmartX Connected Products Pvt. Ltd., Chennai, India* **Dec 2019 – Dec 2020**
- Led 5 projects focused on smart medical products, and pet health tracking systems.
  - Reduced weight (47.5%) and volume (72%) of a smart blood transportation device through structural optimization.
  - Designed and validated sealed electromechanical enclosures using FEA simulations in ANSYS.
  - Innovated cost-effective, in-house magnetic power connectors, reducing dependency on costly imports.
  - Transitioned product designs smoothly from early prototypes to full-scale production with scalable manufacturing.
- Developed and analyzed a 3-DOF robotic manipulator with a compliant soft-pneumatic gripper using Abaqus.

EDUCATION

Master of Science *(MS)***, Mechanical Engineering** *(GPA: 3.74/4)* **Aug 2025***
University of Cincinnati, Cincinnati, OH, USA
Bachelor of Engineering *(B.E.)***, Mechanical Engineering** *(GPA: 8.8/10)* **May 2019**
Anna University, Chennai, India

RESEARCH & ACADEMIC PROJECTS

Flight Simulator Platform – IMU Filtering & Real-Time Calibration: Tuned IMU filtering and compensated for magnetic interference, reducing heading drift in real-time dynamical testing.

Autonomous Navigation & Obstacle Avoidance – TurtleBot3 SLAM: Implemented LiDAR-based SLAM and autonomous navigation using the ROS Navigation Stack on TurtleBot3 in an unknown indoor environment. Achieved consistent start-to-goal path planning with full obstacle avoidance, tested on real hardware with static obstacles.

Real-Time Data Plotting Tool for Embedded Linux Systems: Developing a modular plotting framework for embedded Linux devices to visualize real-time system data via command-line or remote interfaces. Designing for flexibility across projects, with support for local CLI visualization, headless CSV logging, and TCP-based streaming to remote dashboards. *(ONGOING)*

Fault Detection and Diagnosis of Failure Modes in Tapered Roller Bearings: Detected and diagnosed outer race, inner race, and cage failures for performing predictive maintenance to avoid downtime using self-organizing maps and principal component analysis.

RFID Reader Integration with RC522 Module: Developed low-level C++ firmware to configure the MFRC522, enabling card detection and interrupt-based filtering for noise suppression.

Heat Transfer Optimization of Internal Combustion (IC) Engine Fins: Optimized fin geometries achieving a 48% increase in heat transfer efficiency and a 54% reduction in material usage via thermal analysis.