JAYAMADU GAMMUNE

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Research Interests

My research focuses on developing autonomous robotic systems that interact safely and efficiently with humans in dynamic environments. I work on learning-based control for robot manipulation, computer vision and deep learning for perception, and vision-language models for task understanding. My interests span mechatronic system design including UAVs, unmanned vehicles, and soft robotics, with emphasis on developing novel robotic structures and mechanisms.

Education

B.Sc. Engineering (Honours) in Biomedical Engineering 2022–Present
University of Moratuwa, Sri Lanka
Specialization: Robotics & Automation Pathway
Cumulative GPA: 3.71/4.00

Relevant Coursework: Autonomous Systems, Deep Learning for Computer Vision, Robotics, Electronic Control Systems, Embedded Systems, Signals and Systems, Data Structures and Algorithms, Analog Circuit Design, Electronic Instrumentation, Modeling and Analysis of Physiological Systems

General Certificate of Education Advanced Level 2020
Physical Science Stream (English Medium)
3 Distinctions — Z-Score: 2.3214

Experience

Intern Research Affiliate 2024–2025
Intelligent Robotics Laboratory, Swinburne University of Technology, Australia
Advisor: Assoc. Prof. Mats Isaksson

- Developed GPU-accelerated computer vision algorithms for autonomous robotic ultrasound imaging, achieving 40% reduction in processing latency for real-time anatomical landmark detection using PyTorch and CUDA

Instructor August–December 2025
Department of Electronic and Telecommunication Engineering, University of Moratuwa, Sri Lanka

- Instructed laboratory sessions for undergraduate students in embedded systems, electronic circuits, and robotics applications with hands-on guidance in hardware integration and system design

Research Projects

RoboBrain 2.0: Vision-Language Models for Robotic Manipulation Ongoing
2-member research collaboration

- Augmented the CVPR 2025 RoboBrain 3M baseline by integrating a dedicated LLM layer for complex hierarchical task decomposition
- Developed hybrid architecture that decouples high-level planning from low-level control, boosting accuracy on long-horizon tasks
- Engineered an 8-bit quantization pipeline to **reduce memory usage by 50%**, enabling real-time deployment on consumer hardware

Stack: PyTorch, Transformers, CUDA, bitsandbytes, Flask, React

GPU-Accelerated Autonomous Robotic Ultrasound System 2024–2025
Intelligent Robotics Laboratory, Swinburne University of Technology

- Developed CUDA-accelerated image processing algorithms achieving 40% latency improvement in lumbar spine landmark detection
- Optimized ROS control architectures integrating OpenCV pipelines for closed-loop medical imaging feedback and safe clinical human-robot interaction

Stack: ROS, PyTorch, CUDA, OpenCV, Python

Field-Oriented Control for Robotic Actuators Ongoing
3-member research team

- Implementing FOC algorithms on STM32 microcontrollers for precise torque regulation in BLDC motors
- Designed custom drivers with optimized power electronics and integrated actuators into an autonomous mobile platform for competitive high-speed maze navigation

Focus: Motor Control Theory, Power Electronics, Real-Time Systems

Pediatric EEG-Based Brain-Computer Interface for Assistive Robotics Ongoing
4-member interdisciplinary team

- Designing a pediatric BCI system controlling a 5-DOF robotic arm via real-time EEG processing
- Developing custom low-noise PCBs for biopotential amplification and implementing machine learning classification models for robust, non-invasive intention recognition in assistive applications

Focus: Assistive Robotics, Neural Signal Processing, Embedded Systems

Technical Projects

Vision-Guided Robotic Pick-and-Place System 2024
4-member design team

- Integrated mechatronic system combining mechanical design (SolidWorks), custom electronics (Altium PCB), and computer vision (OpenCV) for precision object manipulation
- Implemented real-time visual servoing with cross-hair overlay for accurate hole alignment and autonomous placement control

Technical Stack: Altium, SolidWorks, OpenCV, Python, C++, Hardware Integration

Autonomous Maze-Solving Micromouse Ongoing
3-members

- Engineered high-speed autonomous robot for complex maze navigation using FloodFill algorithm with optimized speed and traversal efficiency
- Designed compact mechanical chassis in SolidWorks and custom power distribution PCBs in Altium Designer

Technical Stack: STM32 (CubeIDE), Altium Designer, SolidWorks, FloodFill Algorithm, Gazebo, Webots

Multi-DOF Robotic Arm: Kinematics and Control 2024
3-member research team

- Implemented forward and inverse kinematics algorithms with trajectory planning for multi-DOF manipulator using MATLAB Robotics Toolbox
- Developed real-time control interface with emphasis on precision positioning and motion stability for manipulation tasks

Technical Stack: MATLAB Robotics Toolbox, Python, C++, Control Systems

Autonomous Mobile Robot for Competition 2024
Sri Lankan Robotics Challenge (SLRC), 5-member team

- Designed and implemented autonomous mobile robot for national robotics competition with integrated embedded control systems
- Developed sensor fusion and navigation algorithms for competitive performance in dynamic environments

Technical Stack: Arduino, C++, Sensor Integration, Path Planning

Multi-Tasking Autonomous Platform 2023
4-members, EN2533: Robot Design and Competition

- Developed ATmega2560-based mobile robot with custom chassis and mechanical arm featuring PID control for line following and wall avoidance
- Integrated sensor logic for color detection, sound frequency sensitivity, and ramp navigation to solve dynamic obstacle courses

Technical Stack: ATmega2560, C/C++, PID Control, SolidWorks, Mechanical Design, Sensor Fusion

Computer Vision Human Tracking System 2024

- Developed real-time human detection and tracking system using OpenCV with GUI for visualization and monitoring
- Demonstrated computer vision capabilities applicable to surveillance and mobile robotics applications

Technical Stack: Python, OpenCV, Tkinter

Wearable Fall Detection System for Elderly Care 2023

- Created IoT-enabled wearable device with machine vision-based fall detection algorithm using OpenCV for assistive technology applications
- Implemented MQTT wireless communication for real-time caregiver notification with custom PCB for sensor integration

Technical Stack: Arduino, Altium, C++, MQTT, OpenCV

Analog Biosignal Acquisition Systems 2024

- Designed and fabricated low-noise analog front-end circuits for ECG and EMG biosignal acquisition using instrumentation amplifiers
- Conducted noise analysis and implemented active filtering to achieve sub-microvolt noise floors for assistive robotic systems integration

Technical Stack: Altium, Analog Circuit Design, Signal Processing

Analog Five-Band Audio Equalizer 2023
3-member design team

- Designed multi-channel analog equalizer using active filter topologies with frequency response simulation in Proteus, Multisim, and FilterPro
- Created custom PCB layout in Altium Designer and mechanical enclosure in SolidWorks, integrating Arduino for control

Technical Stack: Altium Designer, SolidWorks, Proteus, Multisim, FilterPro, Arduino

Technical Competencies

Robotics & Control: Robot Operating System (ROS), Kinematics and Dynamics, Trajectory Planning, Motion Control, Model-Based Control, Field-Oriented Control, Gazebo Simulation, MATLAB Robotics Toolbox, Path Planning, Mobile Robotics

Computer Vision & Perception: OpenCV, Real-time Object Detection and Tracking, Visual Servoing, GPU-Accelerated Vision, CUDA Programming, Image Processing, Deep Learning for Perception

Machine Learning & AI: PyTorch, Transformers, Vision-Language Models, Deep Learning, Neural Networks, Model Optimization and Quantization, GPU Acceleration, Supervised/Unsupervised Learning

Embedded Systems: STM32, AVR/ARM Microcontrollers, Real-Time Operating Systems, Firmware Development (C/C++), Motor Control, Sensor Integration, Embedded Signal Processing

Electronics Design: Altium Designer (PCB Layout), Analog Circuit Design, Power Electronics, Motor Driver Design, Biopotential Amplifiers, SPICE Simulation, EMI/EMC Design

Programming: Python (Scientific Computing, Robotics, Web), C/C++ (Embedded/Systems), CUDA (Parallel Computing), JavaScript/React, MATLAB, SystemVerilog

Signal Processing: Biosignal Acquisition (EEG/EMG/ECG), Digital Filter Design, Frequency Domain Analysis, Real-time Processing

Development Tools: Flask (REST API), React, Git, Linux/Ubuntu, SolidWorks (CAD), Proteus, Multisim

Professional Development

Introduction to Deep Learning for Computer Vision 2025
MathWork

Deep Learning for Object Detection 2025
MathWork

Advanced Deep Learning Techniques for Computer Vision 2025
MathWork

Teaching Old Motors New Tricks: Field-Oriented Control Implementation 2025
Texas Instruments

Supervised Machine Learning: Regression and Classification 2025
Stanford University and DeepLearning.AI

High-Performance C++ Development 2024
LSEG (London Stock Exchange Group)

Service & Positions

Web Manager Ongoing
IEEE Sri Lanka Section

Web Manager Ongoing
IEEE EMBS Sri Lanka Chapter

Web Master 2024–2025
IEEE EMBS Student Chapter, University of Moratuwa

Assistant Web Master 2024–2025
IEEE EMBS Student Chapter, University of Moratuwa

Panelist- Panel Discussion 2024
AXON-IEEE EMBS Sri Lanka Chapter

Design Team 2022-2024
Electronic Club, ENTC

Demonstrator 2023
EXMO - University of Moratuwa

Educational Outreach Volunteer 2022–2024
"Soyuru Sathkara" & "Sasnaka Sansada" and conduct hands-on science workshops for rural students.

Sports 20114-2015
Prince of Wales College, Moratuwa, : Member of Under-15 Cricket Team Pool and Scrabble Team.

Additional Competencies

Languages: Sinhala (Native), English (Fluent)
Communication: Technical presentation, scientific writing, research documentation
Collaboration: International research collaboration, cross-functional teamwork, mentoring

References

Prof. Rohan Munasinghe, Ph.D. (Saga University)
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Assoc. Prof. Mats Isaksson, Ph.D. (Deakin University)
Associate Professor, Intelligent Robotics Laboratory
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Dr. Peshala Jayasekara, Ph.D. (University of Tokyo)
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