

# 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: 3.74/4.00 (Semester 7)

**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*

<b>Field-Oriented Control for Robotic Actuators</b> <i>3-member research team</i>	Ongoing
<ul style="list-style-type: none"> <li>• Implementing FOC algorithms on STM32 microcontrollers for precise torque regulation in BLDC motors</li> <li>• Designed custom drivers with optimized power electronics and integrated actuators into an autonomous mobile platform for competitive high-speed maze navigation</li> </ul>	

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

<b>Pediatric EEG-Based Brain-Computer Interface for Assistive Robotics</b> <i>4-member interdisciplinary team</i>	Ongoing
<ul style="list-style-type: none"> <li>• Designing a pediatric BCI system controlling a 5-DOF robotic arm via real-time EEG processing</li> <li>• Developing custom low-noise PCBs for biopotential amplification and implementing machine learning classification models for robust, non-invasive intention recognition in assistive applications</li> </ul>	

*Focus: Assistive Robotics, Neural Signal Processing, Embedded Systems*

## Technical Projects

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<b>Vision-Guided Robotic Pick-and-Place System</b>  	2024
<i>4-member design team</i>	

- 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*

<b>Autonomous Maze-Solving Micromouse</b> <i>3-members</i>	Ongoing
<ul style="list-style-type: none"> <li>• Engineered high-speed autonomous robot for complex maze navigation using FloodFill algorithm with optimized speed and traversal efficiency</li> <li>• Designed compact mechanical chassis in SolidWorks and custom power distribution PCBs in Altium Designer</li> </ul>	

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

<b>Multi-DOF Robotic Arm: Kinematics and Control</b> 	2024
<i>3-member research team</i>	

- 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*

<b>Autonomous Mobile Robot for Competition</b> 	2024
<i>Sri Lankan Robotics Challenge (SLRC), 5-member team</i>	

- 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*

<b>Multi-Tasking Autonomous Platform</b> 	2023
<i>4-members, EN2533: Robot Design and Competition</i>	

- 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**

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**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

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<b>Introduction to Deep Learning for Computer Vision</b>	2025
<i>MathWork</i>	
<b>Deep Learning for Object Detection</b>	2025
<i>MathWork</i>	
<b>Advanced Deep Learning Techniques for Computer Vision</b>	2025
<i>MathWork</i>	
<b>Teaching Old Motors New Tricks: Field-Oriented Control Implementation</b>	2025
<i>Texas Instruments</i>	
<b>Supervised Machine Learning: Regression and Classification</b>	2025
<i>Stanford University and DeepLearning.AI</i>	
<b>High-Performance C++ Development</b>	2024
<i>LSEG (London Stock Exchange Group)</i>	

## Service & Positions

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<b>Web Manager</b>	Ongoing
<i>IEEE Sri Lanka Section</i>	
<b>Web Manager</b>	Ongoing
<i>IEEE EMBS Sri Lanka Chapter</i>	
<b>Web Master</b>	2024–2025
<i>IEEE EMBS Student Chapter, University of Moratuwa</i>	
<b>Assistant Web Master</b>	2024–2025
<i>IEEE EMBS Student Chapter, University of Moratuwa</i>	
<b>Panelist- Panel Discussion</b>	2024
<i>AXON-IEEE EMBS Sri Lanka Chapter</i>	
<b>Design Team</b>	2022-2024
<i>Electronic Club, ENTC</i>	
<b>Demonstrator</b>	2023
<i>EXMO - University of Moratuwa</i>	
<b>Educational Outreach Volunteer</b>	2022–2024
<i>"Soyuru Sathkara" &amp; "Sasnaka Sansada"</i> and conduct hands-on science workshops for rural students.	
<b>Sports</b>	20114-2015
<i>Prince of Wales College, Moratuwa</i> , : Member of Under-15 Cricket Team Pool and Scrabble Team.	

## Additional Competencies

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**Languages:** Sinhala (Native), English (Fluent)

**Communication:** Technical presentation, scientific writing, research documentation

**Collaboration:** International research collaboration, cross-functional teamwork, mentoring

## References

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**Prof. Rohan Munasinghe, Ph.D. (Saga University)**

Professor, Department of Electronic and Telecommunication Engineering

University of Moratuwa, Sri Lanka

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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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