

# Arjun P S

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## EDUCATION

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- **IIT ISM Dhanbad** Jharkhand, India  
*Bachelor of Technology in Electronics and communication engineering; CGPA: 8.56* OCT 2020 - JULY 2024
- **VSSC Central School** Kerala, India  
*class 12 : 2018-2019 97.6 percentage, Class 10 : 2016-2017 10 CGPA*

## SKILLS SUMMARY

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- **Languages:** Python, C++, C
- **Frameworks:** ROS (robot operating system), Gazebo, RVIZ, MuJoCo, pytorch, OpenAI gym, Nvidia Isaacgym, Habitat lab
- **Hardware:** NVIDIA Jetson, NVIDIA Orin, Raspberry pi, ESP32, Arduino

## EXPERIENCE

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- **ARTIFICIAL INTELLIGENCE AND SPACE ROBOTICS DIVISION, ISRO** Trivandrum, Kerala, India  
*Research Internship* May 2022 - August 2022
  - Worked on a project entitled Study on quadruped robot dynamics and design of locomotion controller.
  - The work involved designing a controller for a quadruped robot from scratch for an in-house model.
  - The stack was tested on ROS, a Gazebo simulation environment.
  - A whole-body controller with inverse dynamics-based control was designed from scratch.

## PUBLICATIONS

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- Exploring Unseen Environments with Robots using Large Language and Vision Models through a Procedurally Generated 3D Scene Representation <https://arxiv.org/abs/2404.00318>

## ACADEMIC PROJECTS

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- **OPEN VOCABULARY MOBILE MANIPULATION:**  
Developed an embodied AI agent that is capable of navigating unfamiliar environments, recognizing open vocabulary classes and manipulating novel objects. <https://arxiv.org/abs/2312.08611> This was part of the HomeRobot Open Vocabulary Mobile Manipulation (OVMM) Challenge.
- **LOCOMOTION CONTROLLER FOR A QUADRUPED ROBOT:**
  - version-1** : Developed a control algorithm for tele-operation of a quadruped robot with velocity and yaw rate as input. Gait controller, Swing trajectory generator, Inverse kinematics and PID controller were used here. The locomotion controller was tested in Gazebo simulation environment using ROS. Inverse dynamics-based whole body controller was also designed for the quadruped robot from scratch. The whole body controller uses a quadratic cost function to optimize a set of prioritized task, subjected to constraints.  
documentation – [https://drive.google.com/file/d/1pdtvqoksGbVI6cOc2eBPsbr2qq-a\\_cNZ/view?usp=share\\_link](https://drive.google.com/file/d/1pdtvqoksGbVI6cOc2eBPsbr2qq-a_cNZ/view?usp=share_link)
  - version-2** : Used Quad-sdk, an open source, Nonlinear model predictive control based locomotion controller to control quadruped robots. The underlying process used and the libraries used like Ipopt and RBDL were analyzed in detail from the source code. The locomotion platform was tested on Gazebo, the hardware implementation of the same is in the process.
  - version-3** : A custom implementation of proximal policy optimization to train a quadruped robot to traverse a challenging terrain by following the velocity commands given by a high level entity. The robot was designed ergonomically to walk on different kinds of terrain; also keeping in mind the ease of manufacture of each of its parts. The robot was trained on Nvidia's Isaacgym physics simulation engine with domain randomization (random mass for robot's base, random values of friction, random external force to the base of the robot, noise to observations) to facilitate the sim to real transfer of policy. The robots were trained to walk on both flat and rugged terrains including stairs, slopes and gap terrains.  
documentation – [https://drive.google.com/file/d/1\\_hiMFDw3OtJkTnZP7KVopyB2OUeVSmws/view?usp=sharing](https://drive.google.com/file/d/1_hiMFDw3OtJkTnZP7KVopyB2OUeVSmws/view?usp=sharing)
- **REINFORCEMENT LEARNING:**
  - Algorithms from scratch:** Implemented PPO, A3C and SAC algorithm for reinforcement learning from scratch using pytorch. The algorithm was tested successfully in openAI GYM CartPole environment (discrete action space) and BipedalWalker environment (continuous action space).
  - Quadruped Robot:** Developed a Proximal policy optimization based reinforcement learning algorithm for robust rough terrain locomotion controller for a quadruped robot.

- **DUAL ARM CONTROLLER:** Developed a dual arm controller for parallel operation of two UR5 arm attached to a torso from scratch. The control stack involved planning trajectories using Moveit planning framework and executing it on the robot simultaneously. The primary workspace of the robot is constrained to avoid collision, for tasks where we need to cross the workspace, a novel 3.5-D based collision avoidance system is being developed. The entire stack was tested on Gazebo.
- **GREENHOUSE MANAGEMENT ROBOT:** Developed a greenhouse management robot for harvesting tomatoes. The robot had a mobile base with a UR5 arm mounted on the base. The robot was fully automated, from navigation around the greenhouse to picking and placing ripened tomatoes in a basket. Computer vision based algorithms were used to segregate tomatoes based on their colour and extract their position in the world using an RGB-D camera. Moveit planning framework was used to manipulate the UR5 arm and the gripper. The stack was tested on Gazebo physics simulator with ROS.
- **MOORE – COW MONITORING SYSTEM:** Developed an IoT-based solution for monitoring farm livestock health. An intelligent belt was designed to go around the neck of the cow, which has IMU and ESP32. The data collected was sent to the cloud, and the analyzed version was available to the user through a mobile app. Machine learning was used to classify livestock that showed abnormal characteristics.

## RELATED COURSEWORK

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- **MOOC:** Machine learning - Stanford, Deep learning - deeplearning.ai
- **ROBOTICS:** Upenn robotics course, Northwestern university robotics course, CS287 Advanced robotics UC Berkeley (YouTube), Reinforcement learning by Barto Sutton(textbook)

## HONORS AND AWARDS

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- **Won the NeurIPS 2023 HomeRobot: Open Vocabulary Mobile Manipulation (OVMM) Challenge**
- 8291st rank in JEE Advanced-2020 among 1.4 million candidates
- Achieved 1st place in Mazerunner event of petrchor 22 hosted by IIT Palakkad
- Achieved 2nd place in Ishana (computer vision competition) at Takshak 2021 (Annual robotics competition of IIT (ISM) Dhanbad)
- Achieved 3rd place in Kruthak (electronics and IoT based competition) at Takshak 2021 (Annual robotics competition of IIT (ISM) Dhanbad)
- Achieved 3rd place in Navyantra (open innovation competition) at Takshak 2021 (Annual robotics competition of IIT (ISM) Dhanbad)

## POSITION OF RESPONSIBILITY

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- Member of RoboISM, Robotics and AI club of IIT (ISM) Dhanbad
- Organized robotics fest of IIT (ISM) Dhanbad 2021 and 2022 edition.

## EXTRACURRICULARS

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- Magic - Performed at various stages
- Sketching
- Represented VSSC central school in competitions like Aerolympics, IISER quiz (3rd place regionally), IIM quiz and camp at Kalpakam nuclear power plant.