Arjun Pushpalatha Subramanian

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Portfolio: https://rjnps.github.io/

EDUCATION

IIT ISM Dhanbad   Jharkhand, India
Bachelor of Technology in Electronics and communication engineering; CGPA: 8.66   *OCT 2020 - JULY 2024*

VSSC Central School   Kerala, India
class 12 : 2018-2019 97.6 percentage, Class 10 : 2016-2017 10 CGPA

EXPERIENCE

Research Intern   India
*under **Prof. Gora Chand Nandi and Dr. Andrew Melnik***   *October 2023 - December 2024*

- Open Vocabulary Mobile Manipulation - **Won Home Robot Open Vocabulary Mobile manipulation Challenge at NeurIPS 2023 and CVPR 2024**
- Experience Goal Visual Rearrangement
- 3D Gaussian Splatting
- Foundational models for navigation - https://www.youtube.com/watch?v=pvr1uaObL9M

Texmin   Dhanbad, India
Robotics project assistant   *October 2022 - January 2023*

- Successfully built a locomotion controller for a quadruped robot, used for surveying mines.

Artificial Intelligence and Space Robotics Lab, ISRO   Trivandrum, Kerala, India
Research Internship   *May 2022 - August 2022*

- Worked on designing a whole body control framework for a quadruped robot, intended for interplanetary missions
- Completed 2 versions of the controller: Control with synchronized predefined gait trajectory for each leg and an inverse dynamics based whole body control framework to follow velocity commands
- Integrated with ROS, Simulted on Gazebo

PUBLICATIONS

- **SplatR : Experience Goal Visual Rearrangement with 3D Gaussian Splatting and Dense Feature Matching**
  Arjun P S, Andrew Melnik, Gora Chand Nandi
  (CORL 2024 workshop on Lifelong Learning for Home Robots)
  https://splat-r.github.io/

- **Cognitive Planning for Object Goal Navigation using Generative AI Models.**
  Arjun P S, Andrew Melnik, Gora Chand Nandi
  (NEURIPS 2024 workshop on Open-World Agents and CORL 2024 workshop on Lifelong Learning for Home Robots)
  https://arxiv.org/abs/2404.00318v2

- **Towards Open-World Mobile Manipulation in Homes: Lessons from the Neurips 2023 HomeRobot Open Vocabulary Mobile Manipulation Challenge.**
  (Open Vocabulary Mobile Manipulation Challenge, arxiv preprint)
  https://arxiv.org/abs/2407.06939

- **UniTeam: Open Vocabulary Mobile Manipulation Challenge**
  (Open Vocabulary Mobile Manipulation Challenge, arxiv preprint)
  https://arxiv.org/abs/2312.08611

PROJECTS

- **ENERGY BASED MODEL, MAXIMUM ENTROPY REINFORCEMENT LEARNING FOR ROBUST HUMANOID LOCOMOTION**:
  code : https://github.com/rjnps/EBM_Humanoid_locomotion

- **ENERGY BASED MODEL FOR MANIPULATION WITH DYNAMIC MOVEMENT PRIMITIVES (IMITATION LEARNING)**:
  code : https://github.com/rjnps/ebm

- **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. The controller used synchronized Gait trajectories for each leg, providing torque commands at each actuator using an inverse kinematics based PID controller. The locomotion controller was tested in Gazebo simulation environment using ROS. Improved the stability of this controller with an inverse dynamics based whole body controller which provided torque commands by optimizing the dynamic equation of a floating base system in quadratic format, subjected to constraints.
Documentation : https://drive.google.com/file/d/1pdtvqoksGbVI6cOc2eBPsbr2qq-a_cNZ/view?usp=share_link

version−2 : **RL based Controller for robust rough terrain locomotion**. 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, slope and gap terrains.
Demonstration : https://rjnps.github.io/projects/1_project/

- **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 entire stack was tested on Gazebo.
Demonstration : https://rjnps.github.io/projects/2_project/

- **GREENHOUSE MANAGEMENT ROBOT**: Developed a greenhouse management robot for harvesting tomatoes. The robot had a mobile base with a UR5 arm mounted on top of it. 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 color 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.
Demonstration : https://rjnps.github.io/projects/4_project/

- **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.
Presentation: https://mcmsaps.my.canva.site/

SKILLS SUMMARY

- **Programming Languages**: Python, C++, C
- **Frameworks**: ROS (robot operating system), Gazebo, RVIZ, MuJoCo, pytorch, Tensorflow, OpenAI gym, Nvidia Isaacgym, IsaacSIM, Habitat lab, AI2THOR
- **Hardware**: Quadrupeds, HomeRobot Strech Mobile Manipulator, Baxter robot, NVIDIA Jetson, NVIDIA Orin, Raspberry pi, ESP32, Arduino

RELATED COURSEWORK

- **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

- **Won CVPR 2024 Home Robot : Open Vocabulary Mobile Manipulation Challenge, Embodied AI Workshop**:
- **Won the NeurIPS 2023 HomeRobot: Open Vocabulary Mobile Manipulation (OVMM) Challenge**:
- 8291st rank in JEE Advanced-2020 among 1.4 million candidates
- Takshak 2021 (Annual robotics competition of IIT (ISM) Dhanbad): 2nd place in Ishana (computer vision competition), 3rd place in Kruthak (electronics and IoT based competition), 3rd place in Navyantra (open innovation competition)
- Achieved 1st place in Mazerunner event of petrichor 22 hosted by IIT Palakkad