Tharun V Puthanveettil

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Education

University of Maryland Aug. 2022 – May 2024
Master of Engineering in Robotics (3.88/4.0) *Maryland, USA*

Vellore Institute of Technology Jul. 2014 – Apr 2018
Bachelor of Technology in Electronics and Communication (GPA:8.59/10.0) *Vellore, India*

Experience

Robotics Intern Feb 2023 – Present
CATT Labs *Maryland, USA*

- Developing anomaly detection models to identify and report behaviors that deviate from the robot's normal baseline nature.
- Formulating functional and behavioral attacks to model the baseline behavior of the autonomy stack.
- Designed targeted Data Flooding attacks on ROS-based autonomy stacks running on Lidar input.
- Implemented an LSTM-based anomaly detection model with 86% accuracy to detect abnormal behaviour.
- Orchestrated a MITM attack, effectively disabling and intercepting ROS node communication with minimal traceability.
- Established a dynamic web interface for real-time tracking and control of robot in the global map.
- Engineered a robust Flask-based web app for seamless waypoint navigation for a autonomy stack.

Graduate Research Assistant Nov 2022 – Jan 2023
Perception and Robotics Group, UMD *Maryland, USA*

- Worked on *"Human-Robot Interaction using Multi-Modal interaction schemes"* under **Dr.Yiannis Aloimonos**
- Implemented an Imitation Learning-based policy to learn robot action space from human demonstration, speech, and gestures.

Robotics Research Intern June 2021 – Dec 2021
Indian Institute of Science *Banglore, India*

- Implemented a robotic manipulator based *Precision Weeding Robot* to optimize pesticide usage in indoor farms.
- Developed YoloR-based crack detection algorithm with 94% accuracy for asset inspection challenge at IROS21.
- Developed a UNet-based Monocular Depth Estimation model using the NYU Dataset with 94% accuracy.
- Conceptualized a poster on "Event-based Dynamic Obstacle Avoidance in Outdoor Environments" for IROS21.

Project Engineer Jul. 2018 – May 2021
CTO Office, Wipro Digital *Banglore, India*

- Served as the **AI Team Lead** and designed the yearly project lineup for the Innovation team of Wipro.
- Implemented a 2D CNN-based real-time tool tracking and detection system using a Leap Motion controller to identify and track tools in the user's hand and provide real-time assistance with hardware assembly.
- Developed a Transfer Learning based car model detection module with 96% accuracy using Tflite for an insurance solution targeted for mobile apps.
- Implemented vision and learning-based algorithms for *My Style*, Wipro's top 2 retail solutions for the year 2020.

Publications

[1] "Application of Mobile Collaborative Robot using Deep Learning in Precision Weed Control of Large Farms". Elsevier 2021 [`manuscript`]
[2] "A Univariate Data Analysis Approach for Rainfall Forecasting". ICCIS 2020 [`manuscript`] [`link`]
[3] "Prediction of Rainfall Using Data Mining Techniques". ICICCT 2018 [`link`]
[4] "Wall climbing robot using soft robotics". ICPCSI 2017 [`link`]

Patents

AGGRIP *(In Progress)* [`link`] Oct 2021 – Present

- Developed an innovative gripper for manipulators to perform precision weeding(plucking and spraying) catering to the detected weed type.
- The unique design ensures minimal contact with non-weeds using an adaptive vision-based control mechanism.

Technical Stack

Programming: Python, C/C++, SQL (mysql), JavaScript, HTML/CSS, Matlab, Labview, Docker
AI/ML/Data Science: Tensorflow, Pytorch, OpenCV, Keras, Tableau
UI/UX/AR/VR/MR/Simulation: Unity, Three.js, A-frame, AR.js, Vuforia, Gazebo, Rviz
Embedded/IOT/Robotics: ROS, ROS2, MQTT, HTTP, Socket, Softrobotics
Robotic Platforms: Turtlebot 2, Turtlebot 3, Delta, OpenManipulator-X, Husky

Projects

PoseFusion - Multi-view Action Recognition | *Python, Pytorch, OpenCV* [link] Nov 2023 – Dec 2023
- Developed a pipeline for view-based pose aggregation for action recognition in partial/no occlusion scenarios.
- GCN+Transformer multi-view aggregation model acheived an accuracy of 96% for multi-class action recognition.
- Implemented a custom data loader to enable batch training that improved training speed by 4 times.

Human Pose Estimation based Fall Recognition | *Python, Tensorflow* [link] Nov 2023 – Dec 2023
- Developed a Human Pose Keypoints based dynamic Fall Detection model.
- The custom Graph CNN + Transformer based Fall Detection model performs with 98% accuracy.

Maze Runner | *C++, ROS2, Gazebo, RViz* [link1] [link2] Nov 2023 – Dec 2023
- Implemented autonomous navigation in a maze based on the realtime cues recieved from Aruco markers.
- Implemented NAV2-based autonomous waypoint navigation to detect and trace coloured parts in Gazebo world.

Leonardo - Autonomous Retrieval UGV | *Python, Arduino, OpenCV* [video] Feb 2023 – May 2023
- Constructed a Barron robot equipped with an integrated IMU, Encoder, and Rpi camera.
- Developed a tailored software stack encompassing robotic controls, object detection, motion planning, object manipulation, localization, and mapping.

Auto Platoon | *Python, Matlab, OpenCV, Tensorflow, Pytorch, Flask* [video] [link] Apr 2023 – May 2023
- Deployed a bio-inspired multi-agent leader-follower system for energy-efficient transportation.
- Created a YoloV7-based custom agent tracking algorithm incorporating dynamic obstacle avoidance.
- Developed a connected-vehicle communication strategy featuring a customized motion planner and low-level controller.

Autonomous Weeding Robot | *Python, Matlab, OpenCV, Tensorflow, Pytorch* [video] June 2021 – Present
- Implemented a robotic manipulator-based precision weeding robot for optimizing pesticide usage in indoor farms.
- Created a YOLOR object detection model trained on augmented synthetic data for weed localization.
- Implemented an Inverse Kinematics solver based on a feed-forward neural network for precise manipulation.

my Style | *Python, OpenCV, Tensorflow, Pytorch, Mysql, Flask* [link] [video] Jun 2019 – Sep 2019
- An end-to-end AI-powered shopping app.
- Implemented a human body measurement extraction module based on 2D photogrammetry & Body Pose Estimation that enables real-time 3D human body reconstruction(Customer Digital Twin).
- Modelled a Content-based recommendation engine for apparel recommendation.
- Developed a GAN-based product customization model for dynamic apparel styling.
- Implemented a fit analyzer model that evaluates the fit of the chosen apparel in terms of a 'Fit %' metric.

Other Robotic Projects: | [Pizzaro] | [ACO - RRT*] | [Irona] | [Robobutler] Aug 2022 – May 2023
Other AI/ML Projects: | [Virtual Try-On] | [RL Cricket Simulation Engine] July 2018 – Aug 2019

Achievements

RAMI Cascade Campaign - IEEE/RSJ IROS 2021 [link]
- Secured 3rd place for providing an aerial robotic solution for asset Inspection and Management (I&M).

Late Breaking Results - IEEE/RSJ IROS 2021 [link]
- Poster on " Event-based Dynamic Obstacle Avoidance in Outdoor Environments" accepted amongst the top 25 posters for a presentation.

Winter School Projects - IEEE RAS 2021 [link]
- Finished as one of the Top 2 teams to complete 4/4 tasks with a presentation for a challenge on "SLAM in Deformable Environments"

National Retail Federation 2020 - Top 2 Solution [link]
- Led a team into developing and designing a retail solution that was shortlisted for a showcase at NRF 2020, a retail-based exhibition held at New York inaugurated by Satya Nadella, CEO of Microsoft.