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Bekink, Mitchel and Liu, Pengcheng orcid.org/0000-0003-0677-4421 (Accepted: 2025)

Machine Learning-Enhanced Adaptive Navigation for Dynamic Environments With ROS.

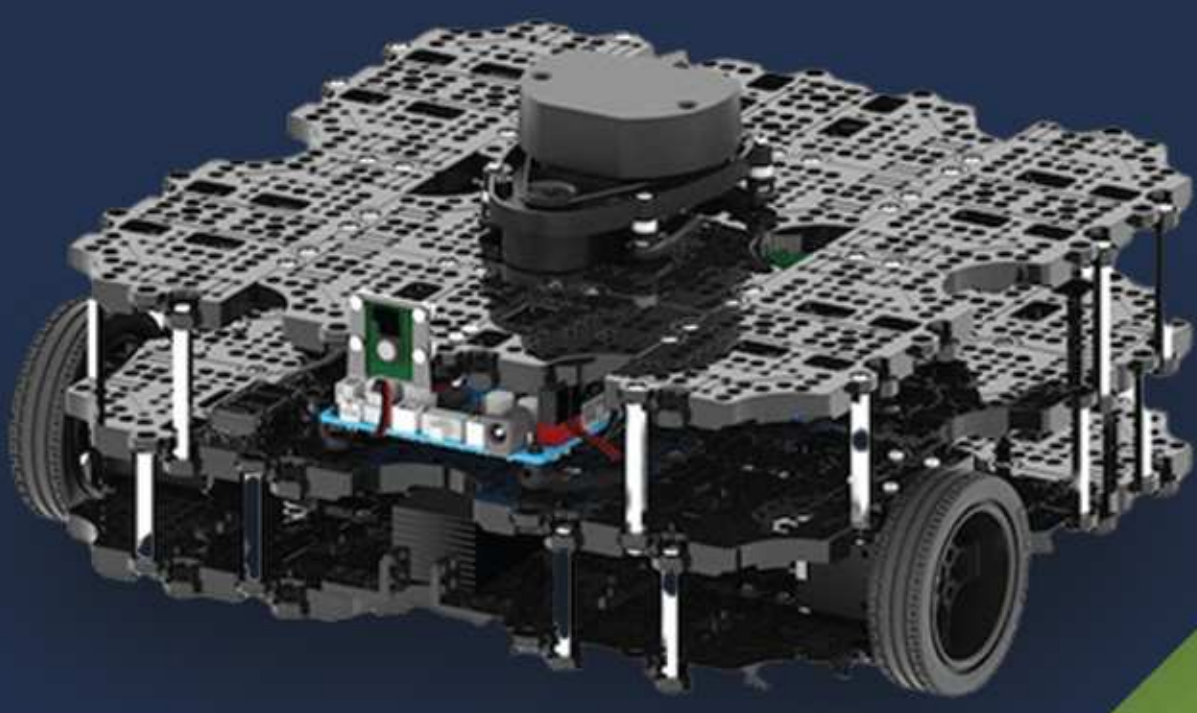
In: 26th TAROS Conference, 20 Aug 2025. (In Press)

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Machine Learning-Enhanced Adaptive Navigation for Dynamic Environments With ROS

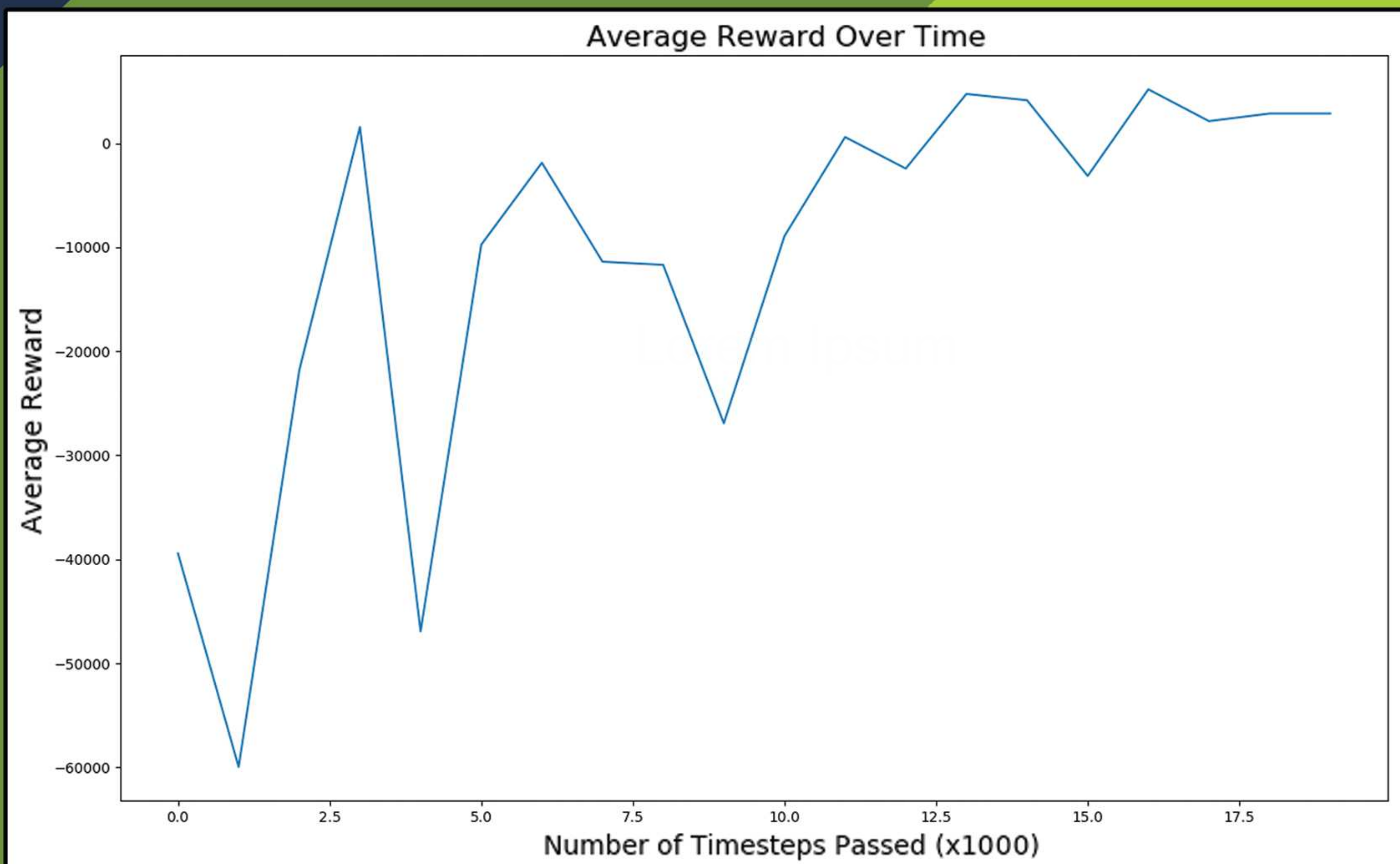
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Overview:

This project focuses on the synergy between the ROS aspects of robotics, the combination of machine learning algorithms, and self-learning neural networks that power these packages capable of continual adaptation to evolving environments.



The Problem:

Traditional SLAM and pathfinding algorithms are limited to known, static environments.

They struggle in dynamic, partially known spaces common in real-world environments.

Machine learning offers a solution but integrating with ROS is complex.

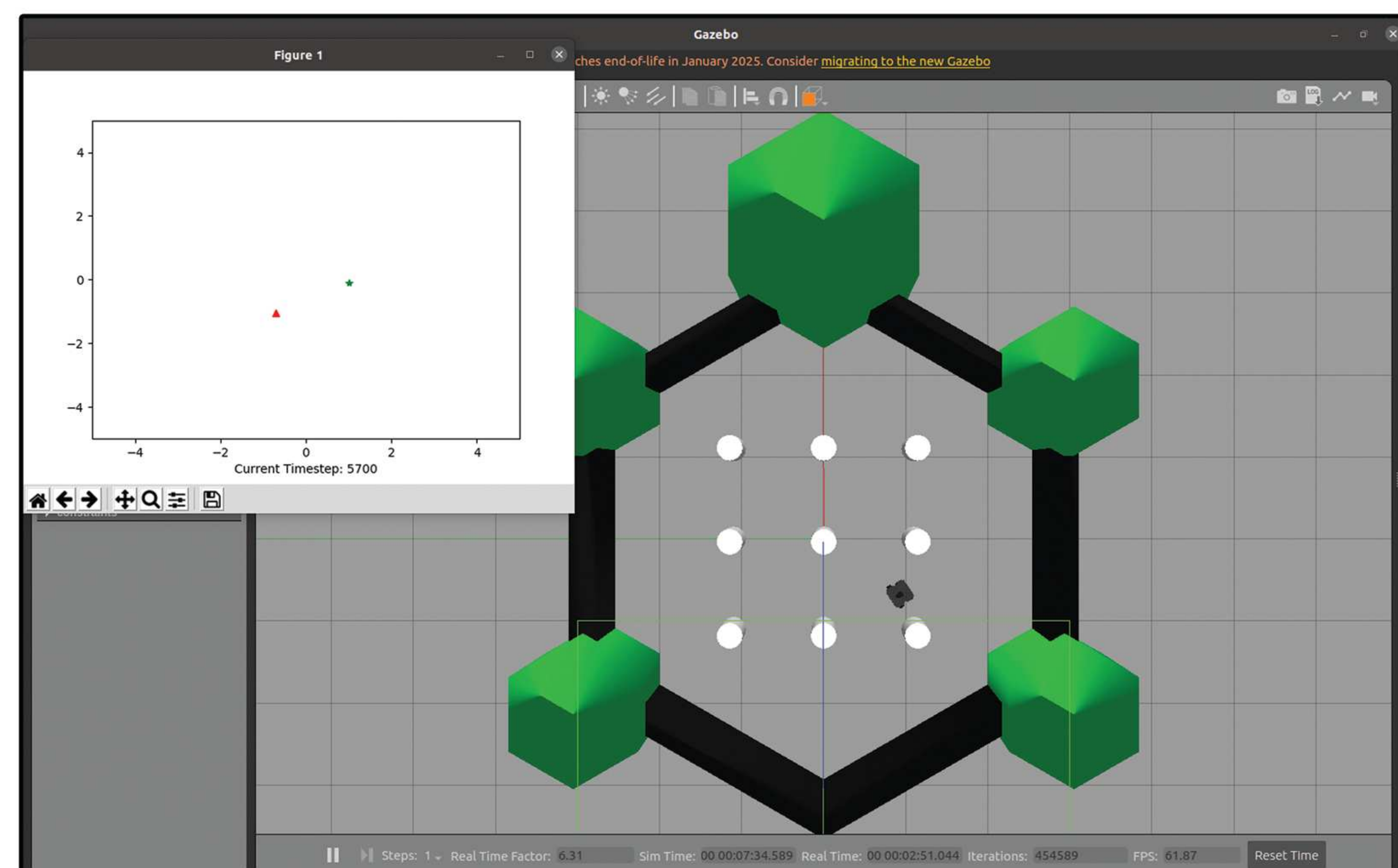
This project proposes a simplified framework to bridge ROS inputs with ML-powered decision making for adaptive navigation

Positive preliminary results when run in Gazebo.

The Solution:

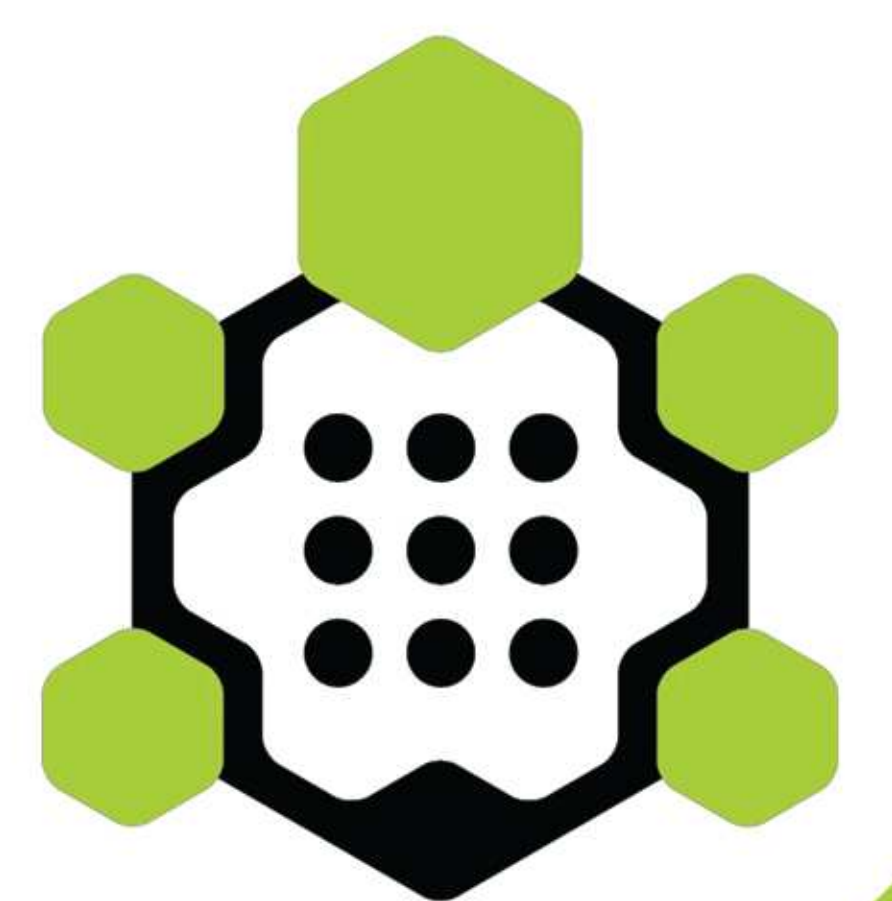
This project aims to develop a general-purpose navigation framework where ROS inputs from various sensors can be seamlessly interpreted by neural networks to generate real-time navigation decisions, even in unpredictable environments.

This is a massively under-represented area of research that we hope to contribute to, as well as to aid other researchers in achieving their robotics goals.

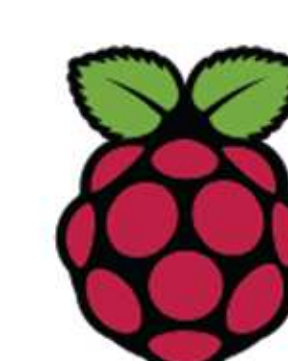


Primary Aims:

- + **Adaptability:** Maintain performance despite environment changes.
- + **Innovation:** Creates a modular, training-from-scratch pipeline.
- + **Scalability:** Supports a variety of robots and sensor inputs.
- + **Reliability:** Operate robustly in unseen environments.



ROS



RaspberryPi

References:

- [1] Taheri, H., Hosseini, S.R. and Nekoui, M.A., 2024. Deep reinforcement learning with enhanced ppo for safe mobile robot navigation. arXiv preprint arXiv:2405.16266.
- [2] PPO Implementation Inspiration: <https://github.com/ericyangyu/PPO-for-Beginners>
- [3] PPO Algorithm Source: <https://www.datacamp.com/tutorial/proximal-policy-optimization>

GitHub Link:

