

Student Internship Scheme – 2024
Cluster Innovation Centre

Project Title: PathFinder: Autonomous Mapping and Navigation System Development for Bots and Drones

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Abstract:

This project provides an improved algorithm approach to enhance the autonomous navigation, and mapping upon existing cost-effective mobile robot platforms using advanced control architecture which is likely more efficient. The study involves the improvement of Proportional-Integral-Derivative (PID) controller performance through Particle Swarm Optimization(PSO), and Gradient Descent algorithms which creates a system with significant improvements in stability, time response and frequency response. We also solve the challenges in traditional Simultaneous Localization and Mapping (SLAM) by improving Extended Kalman Filter(EKF) using user defined fitness function to remove sensor noise, which aids generation of more accurate map. ORB-SLAM2 is integrated for high-resolution 3D mapping and A* path planning algorithm used to ensure optimal navigation in occupied environments of static & dynamic obstacles. To increase mapping accuracy we are using a combination of LiDAR and OAK-D depth camera, which is also integrated into Robot Operating System (ROS) based on data cloud for real time processing & control. The system has been implemented on a novel low-cost mobile robot platform that reduces both the computational overhead and hardware spend compared to standard platforms such as the TurtleBot Waffle. Extensive experimental evaluation-endorses the effectiveness of methods in improving navigation accuracy, reducing localization and mapping error, as well as guaranteeing robustness for complex and dynamic environments. This study takes us a step further toward the realization of autonomous mobile robotics with its proposal to develop scaleable and inexpensive predictive modelling suitable for real-world applicability.