Abstract

PROJECT TITLE:

Design and Development of Autonomous Mobile Robot (AMR) and Unmanned Ground Vehicle (UGV) for Industrial Surveillance and Smart Logistics Applications

Industrial sectors in Tamil Nadu, particularly manufacturing, logistics, warehousing, and heavy process industries, are increasingly adopting automation to improve operational efficiency, safety, and productivity. However, many small and medium industries still rely on manual inspection, material transport, and surveillance processes due to the high cost of imported autonomous robotic systems and limited availability of indigenous solutions tailored for Indian industrial environments. Existing systems often lack adaptability to unstructured industrial terrains, dynamic obstacles, and low-light operating conditions.

This proposal aims to develop an intelligent LiDAR-SLAM based Autonomous Mobile Robot (AMR) and Unmanned Ground Vehicle (UGV) platform designed specifically for industrial surveillance and smart logistics applications. The proposed system will integrate LiDAR sensing, visual perception, and AI-based navigation algorithms using ROS framework to enable real-time mapping, localization, obstacle avoidance, and autonomous path planning. The AMR will be optimized for indoor material handling and warehouse navigation, while the UGV will be designed for outdoor industrial inspection and surveillance across uneven terrains.

The project will focus on robust sensor fusion, real-time SLAM implementation, industrial safety compliance, and field validation in collaboration with an industry partner. The developed system aims to operate in dynamic environments with minimal human intervention and provide scalable architecture for future deployment. Indigenous development will significantly reduce dependency on imported robotic platforms and improve affordability for MSMEs.

Currently, the system is at Technology Readiness Level (TRL) 3–4 (proof-of-concept and laboratory validation). Through this project, it is proposed to achieve TRL 6–7 by developing fully functional prototypes and validating them in relevant industrial environments. Expected deliverables include two working prototypes (AMR and UGV), validated navigation software stack, industrial testing report, and potential intellectual property generation.

The project has strong commercialization potential through industry adoption in logistics hubs, manufacturing units, smart factories, and security applications. The proposed research aligns with the objectives of TNRPF-URP in promoting industry-academia collaboration and translating research into deployable industrial technology.

Problem Statement:

Industries in Tamil Nadu face challenges in automating internal logistics, inspection, and surveillance tasks due to the high cost of imported robotic systems and limited availability of robust indigenous solutions. Manual material handling and inspection processes lead to inefficiencies, safety risks, and increased operational costs. Existing robotic systems are often not optimized for dynamic industrial conditions such as narrow pathways, uneven terrain, poor lighting, and unpredictable obstacles. There is a need for a cost-effective, scalable, and industry-validated autonomous robotic platform capable of real-time mapping, localization, and intelligent navigation suitable for Indian industrial environments. Developing an indigenous LiDAR-SLAM based AMR and UGV platform will address these challenges by enabling safe, autonomous operation for logistics and surveillance applications.

Advanced Autonomous Mobile Robots (AMRs) available globally use LiDAR-based Simultaneous Localization and Mapping (SLAM) for dynamic navigation but are largely imported and priced between INR 25–60 lakhs per unit, making them inaccessible to MSMEs.

Key Objectives:

- ✓ Design and develop LiDAR-based SLAM navigation architecture for autonomous mobility.
- ✓ Develop AMR platform for indoor smart logistics applications.
- ✓ Develop UGV platform for outdoor industrial inspection and surveillance.
- ✓ Integrate AI-based obstacle detection and adaptive path planning.
- ✓ Validate prototypes in real industrial environment to achieve TRL 6–7 readiness.

The research will follow a structured methodology: We may get the project supported by EDII – Anna Business Incubation Research Foundation- Tiruchirappalli as Knowledge Partner to facilitate commercialization strategy, startup incubation, and industry outreach

- ✓ Phase 1: System design, simulation, and algorithm validation
- ✓ Phase 2: Prototype development and integration
- ✓ Phase 3: Controlled laboratory validation
- ✓ Phase 4: Industrial pilot deployment and performance benchmarking

Expected Outcomes:

The project includes a defined Intellectual Property strategy targeting patent filing for indigenous navigation architecture and integrated robotic platform design

- ✓ Two functional industrial-grade robotic prototypes (AMR & UGV)
- ✓ Validated SLAM and navigation software stack
- ✓ Industry field validation report
- ✓ At least one patent filing
- ✓ One high-quality journal publication
- ✓ Technology transfer readiness

Total estimated Project Cost: INR 36 to 38 Lakhs

TNRPF Requested: INR 18 Lakhs

Industry Contribution: INR 18 to 20 Lakhs

Planned Model Images of the Miniature proto for your reference