

SMARTBOT

Development of an Intelligent Autonomous Mobile
Robotic System for Smart Manufacturing





ORGANISATION PROFILE

Sistematik Atölye™ is an innovative technology and consultancy SME located in the ULUTEK Technology Development Zone of Bursa Uludağ University.

We develop autonomous mobile robotics technology, artificial intelligence, custom machine technologies, and provides consultancy on Horizon Europe and Eureka projects.



ULUTEK Technology Development Zone, Bursa Uludağ University / Türkiye

PARTNERS



One of Türkiye's Leading Diversified Business Groups

RETAIL | TEXTILE & MANUFACTURING | TOURISM | FOOD & AGRICULTURE | REAL ESTATE & SERVICES

Since 1967 | 3 Core Sectors | 17 Business Lines | ~8,000 Employees

PILOT PROVIDER

ÖZDİLEK TEXTILE

One of Türkiye's textile manufacturer

- 122.000 m² manufacturing area
- 14.000 ton/year cotton yarn manufacturing
- 7.500 ton/year towel manufacturing
- 18.000.000 meters/year home textile manufacturing
- Large-scale real-world pilot environment

TECHNOLOGY DEVELOPER

ÖZVERİ

Özdilek R&D Center certified by TC Ministry of Industry

- Focus on digitalisation.
- Designing the motherboard that will provide high processing capacity to the robot, using NVIDIA and AT253 chips.
- Development, training, and validation of Edge Generative AI algorithms.

PARTNERS

PROTEL

Protel provides end-to-end hotel and restaurant management solutions to Turkey's leading hospitality businesses with Oracle technologies and Protel products. With AI-powered solutions, cloud technology, and comprehensive digital tools, managing hotel and restaurant operations.

TECHNOLOGY DEVELOPER

Protel R&D Center certified by TC Ministry of Industry

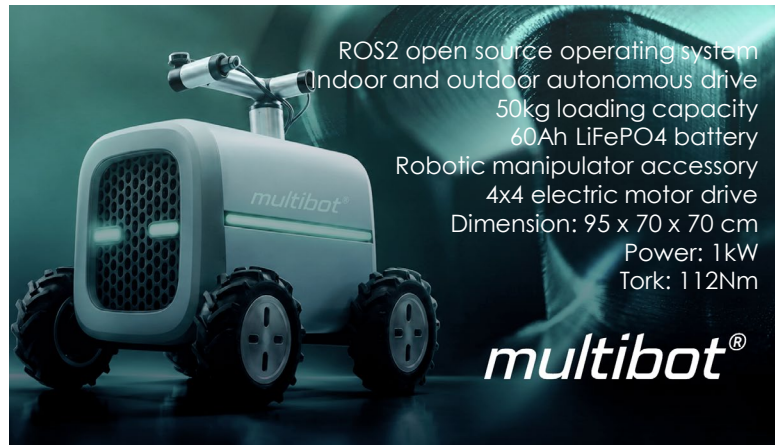
- Computer Vision (YOLO/OCR),
- Edge Vision-Language Models (Edge VLM))



SİSTEMATİK ATÖLYE
Technology & Consultancy

TECHNOLOGY DEVELOPER

- Compact high-torque outrunner / axial-flux drive for lightweight autonomous mobile robot prototyping
- Navigation design for autonomous driving in crowded places

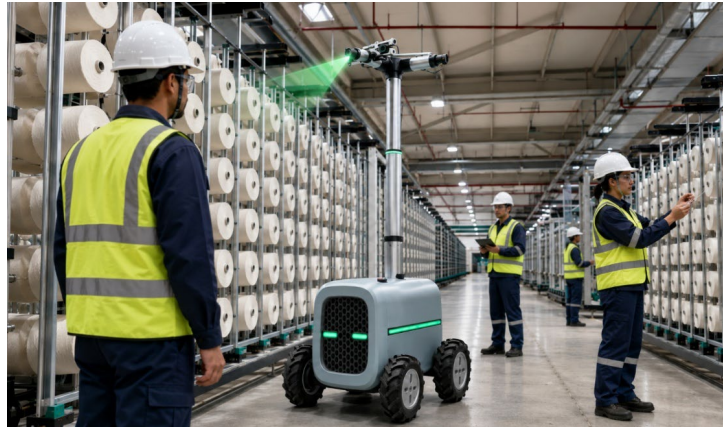


VISION



The autonomous mobile robot will take over the task of arranging bobbins on warping machines, accelerating manual operations while reducing physically demanding work and the associated risk of occupational disorders.

Equipped with intelligent vision systems, the robot will also continuously monitor personnel locations and the use of personal protective equipment within the working area, enabling autonomous occupational health and safety monitoring across the factory floor.



Figures generated by AI.

MOTIVATION

To enable smart and adaptive manufacturing, autonomous mobile robots need to evolve beyond their traditional role in material logistics and take on more interactive functions, supported by AI-enabled human-machine interaction. Furthermore, flexible manufacturing requires production lines to autonomously adapt and prepare for rapidly changing production demands.

Warping processes (see fig.1) in textile manufacturing require the handling and precise placement of a large number of yarn bobbins (see fig. 2). These operations are largely performed manually and involve repetitive movements, frequent material handling, and physically demanding tasks. This creates a significant labor workload, limits operational efficiency, and increases ergonomic and occupational health risks for operators.



Figure 1. Warping process



Figure 2. Yarn bobbin

CONTENT

The project will develop and integrate three key technologies:

1. Agentic AI for Autonomous Decision and Task Management

R&D Objective: Move beyond classical machine learning toward agentic AI architectures that enable robots to plan, prioritize, and adapt tasks based on factory data.

Technical Innovation:

- Large Action Models (LAM) and multi-agent reinforcement learning
- Integration with MES/ERP systems for adaptive task planning

2. Crowd-Aware Navigation and Human Activity Intent Estimation

R&D Objective: Ensure safe navigation in environments with dense human presence.

Technical Innovation:

- Crowd navigation algorithms (social force models, deep RL-based crowd-aware path planning)
- Human activity intent estimation to predict workers' movement intentions (walking, turning, stopping) and proactively adjust robot behavior (braking, maneuvering, accelerating)

3. Swarm Algorithms for Multi-UGV Coordination

R&D Objective: Enable multiple UGVs to collaborate through distributed intelligence.

Technical Innovation:

- Decentralized swarm intelligence (Boids, ant colony optimization)
- Continuity of communication protocols ensuring sustained, reliable data exchange
- Dynamic task allocation and fault tolerance mechanisms

EXPECTED OUTCOME

The project will deliver three core technological solutions:

- **A self-learning robotic ecosystem capable of detecting bottlenecks and autonomously re-planning its tasks.**
- **Robots that adapt their motion before becoming hazardous, enabling safe coexistence with human workers.**
- **A collective intelligence system where UGVs share tasks, optimize routes, and increase factory efficiency by 25% or more.**
- **Automated coil identification integrated with proactive occupational safety checks.**

IMPACTS

Project Schedule:

Start Date : 01 January 2028
End Date : 31 December 2029
Duration : 24 months

The implementation of these technical outcomes will generate:

Dimension	Current UGVs	Proposed Project
Intelligence Level	Pre-programmed tasks	Agentic AI with autonomous task planning
Navigation	Basic obstacle avoidance	Crowd-aware navigation with human intent prediction
Coordination	Centralized control	Swarm intelligence with distributed task sharing
Perception	Standard camera systems	VLLM-enabled coil recognition and safety monitoring
Efficiency Impact	Limited gains (mostly routing optimization)	- Zero human errors in coil arrangement and placement - 50% reduction in machine setup and production preparation time - Improved worker safety through proactive intent estimation - Higher throughput with dynamic task allocation and minimized downtime

PARTNERS

#		Partners	Type	Country	Contribution
1	 ÖZDİLEK HOLDİNG	Özdilek	Large Scale Company	Türkiye	Coordinator, Use case provider, Edge AI model development
2	 PROTEL	Protel	Large Scale Company	Türkiye	Advanced Perception for Coil Recognition and Safety Monitoring (VLLM, YOLO/CNN)
3	 SİSTEMATİK ATÖLYE Technology & Consultancy	Sistematik Atölye	SME	Türkiye	UGV Prototyping, Navigation Development

Seeking partners for;

- Agentic AI,
- Human activity intent estimation,
- Swarm algorithms,
- Continuity of communication protocols development
- Motor driver developer, manufacturer
- End effector design
- Collaborative robotic manipulator (arm) design
- Pilot providers

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