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Task-level Collaborative Ad-hoc Autonomous Guided Vehicles (AGV) for Efficient Warehouse Logistics

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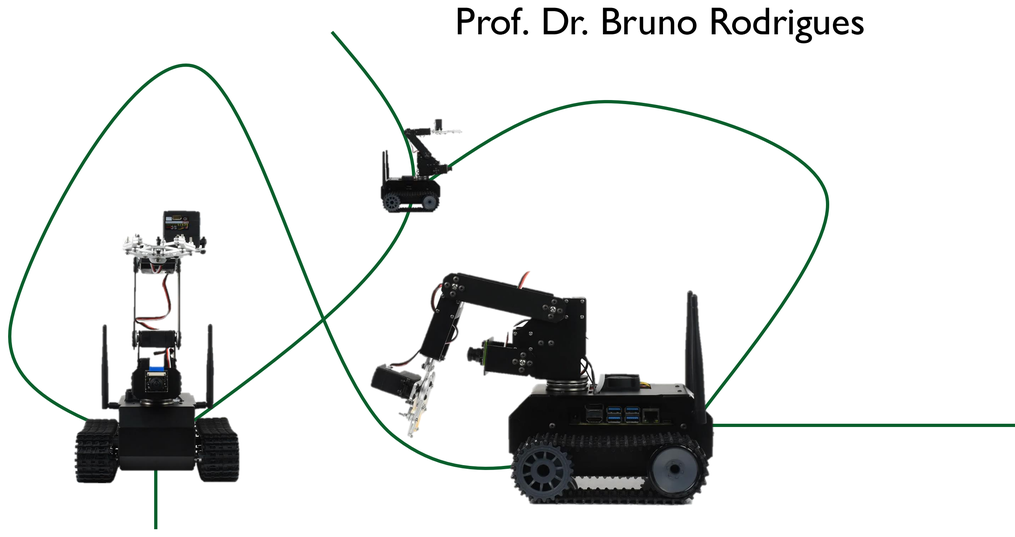
Motivation

- The global logistics market size is expected to expand at a CAGR of 7.2% from 2024 to 2030
- Warehouses which operate in an efficient matter consume less electricity, require a lower building footprint and accomplish task faster
- Improve the efficiency of an AGV system in a task-saturated environment with a collaborative approach on task-level.



Study Design

We evaluated the performance of the JETANK robots in two environments:

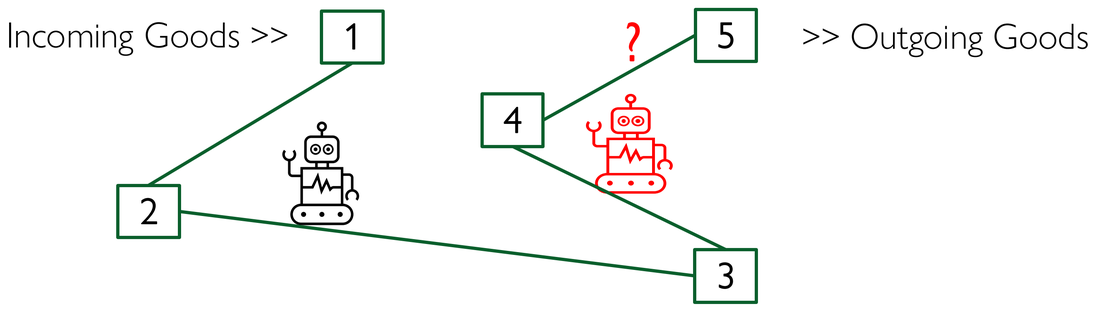
- **Conventional**: a single robot accomplishes one task by itself, and
- **Collaborative**: a robot is assigned a task and is able to coordinate subtasks to available robots within the current environment.

The same task was repeatedly performed and the execution time was measured per individual task for both approaches.

Hardware: „JETANK“ Robots

- Highly versatile robotics platform designed for advanced edge AI applications
- With real-time AI capabilities and sensor integration, it provides a highly realistic environment to test algorithms and scenarios
- 8MP with 160° field of view
- 128-core GPU, Quad-core ARM CPU, 4 GB memory

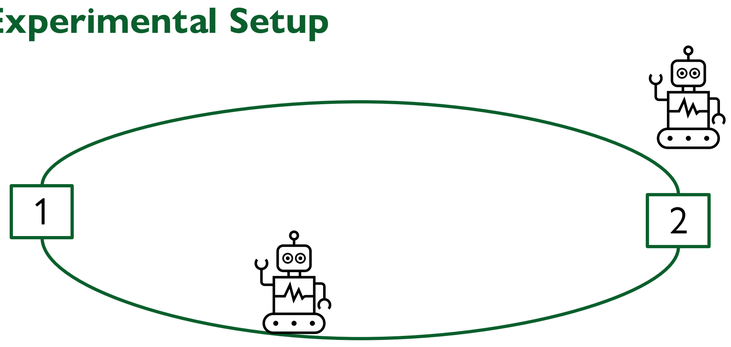
Baseline Setup



Baseline Results

	Conventional	Collaborative
Single Task Execution	1x Baseline	75% slower
Consecutive Task Execution	2x Baseline	4.5% slower
Consecutive Task Execution	3x Baseline	2% slower

Further Experimental Setup



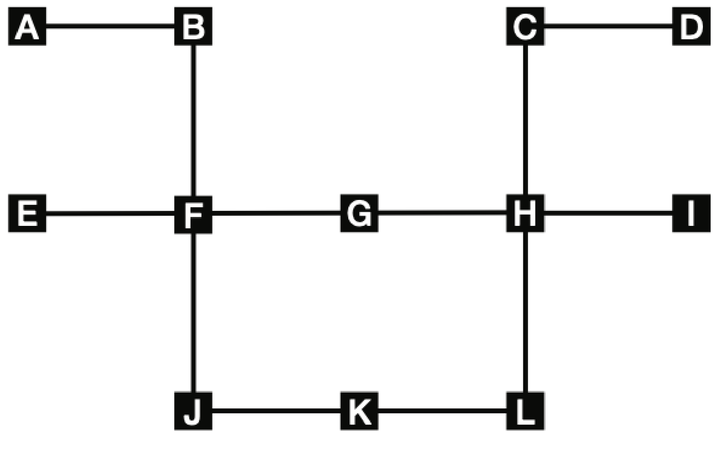
Experimental Results

	Conventional	Collaborative
Single Task Execution	1x Experiment	n.A.
Consecutive Task Execution	2x Experiment	100% faster

→ These results demonstrate the promising potential of a collaborative approach for AGVs on a task-level.

Experimental Setup

A more complex environment can simulating a Warehouse scenario is the baseline for experiments. Such an environment gives us a chance to integrate up **eight robots** and simulate many different tasks and possible pathways. Instead of colors, we are going to use ArUco markers to detect waypoints.



Future work

Our research shows that depending on the task and the environment the difference between the conventional and collaborative approach can become very small. Thus, further research could be conducted regarding:

- *Does the uniformity of path lenghts influence the efficiency of any approach?*
- *Are there any path environments which are more suitable towards AGV systems which collaboratively operate on task-level?*

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Access our Github repo and the paper

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Check out the demo video