DESIGN AND SECURITY OF DISTRIBUTED AUTONOMOUS SYSTEMS

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HUNGARY

PROGRAM FINANCED FROM THE NRDI FUND

Overview

- Final publication of the warehouse routing and scheduling optimization method
  - Ács, Botond ; Dóra, László ; Jakab, Olivér ; Jüttner, Alpár ; Madarasi, Péter ; Varga, László Z. "Optimizations of a Multi-Agent System for a Real-World Warehouse Problem" SN Computer Science 3 : 6 Paper: 431 (2022)
- Multi-Agent Programming Contest
  - First prize
  - Miklós Miskolczi ; László Z. Varga "MMD: The Simple Block Building Agent Team with Explainable Intentions" Lect. Notes Computer Challenges (LNCS)
- Submitted EU project proposal
  - AdversarySense – HORIZON-WIDERA-2022-ACCESS-07-01, Hop On Facility
- EuroKnows robot laboratory

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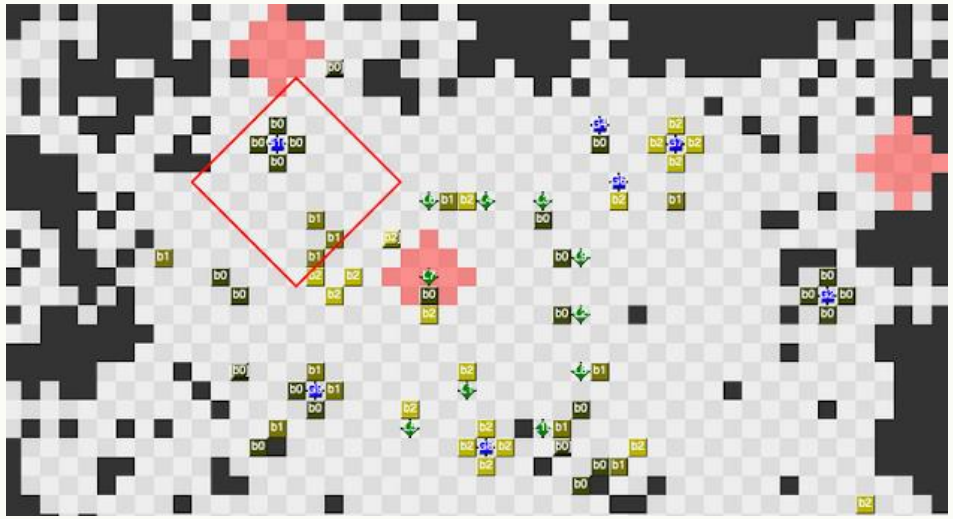
Multi-Agent Programming Contest



- Problem domain
  - Grid world, unknown planet , discrete steps, agent teams
  - Limited vision range, unknown team members,
  - Roles with a set of allowed actions,
  - Obstacles, explosions, block dispensers,
  - Block assembly and submission at goal zones, role zones, norms
  - Goal: collect points given for submitting block structures
- Challenges in the implementation
  - Discovery, pathfinding,
  - Coordination of the team, assembling blocks by a group of agents,
  - Managing norms on the team level
  - Speed of the implementation, real-time response

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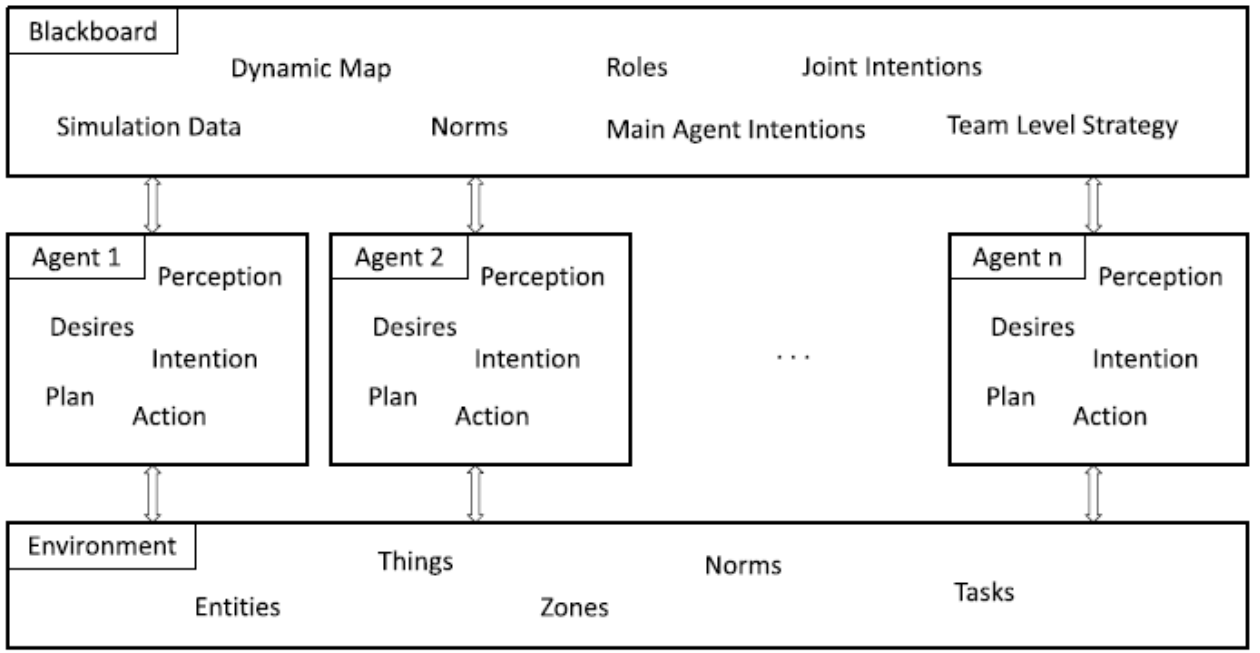
Multi-Agent Programming Contest – implementation

- Agent-oriented programming language vs. general programming language
- Multi-agent concepts
  - Cooperative distributed problem solving
  - Practical reasoning agent architecture
  - Blackboard architecture
- Agent team architecture



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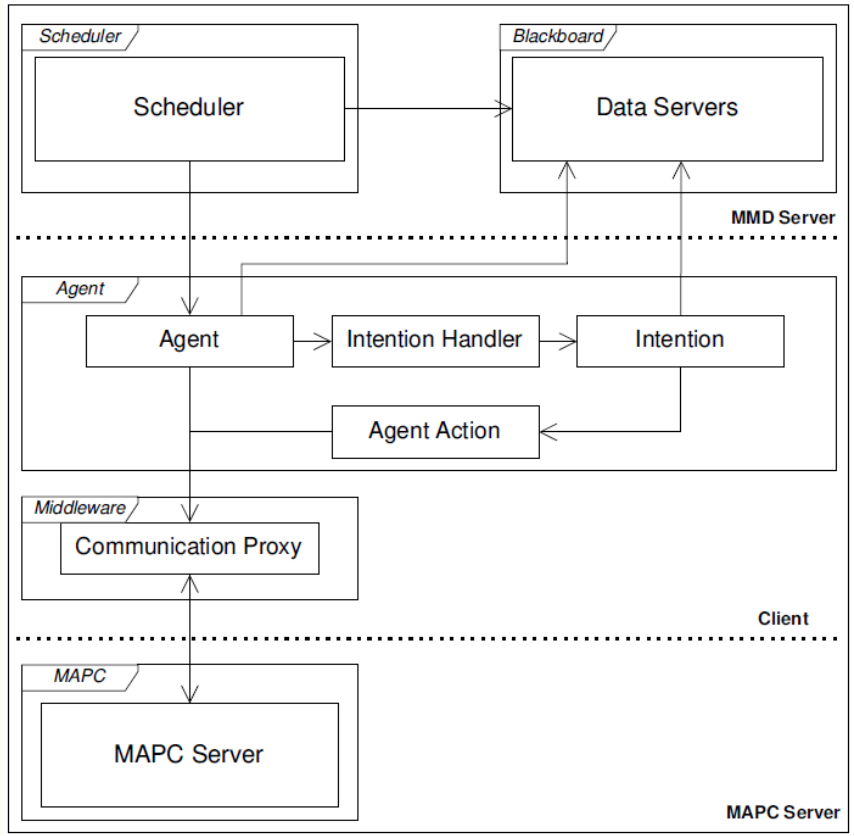
Multi-Agent Programming Contest – implementation

- Software architecture
  - Python
  - Implementation of typical structures
  - No generic planner
  - Specific path planner
  - Behavior logic coded
- Competitive or even better than AOSE



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Multi-Agent Programming Contest – explainable intentions

- Debugging is difficult
  - Dynamic and random environment
  - Impossible to recreate situations
  - Complex data structures
- Explainable intentions

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Multi-Agent Programming Contest

Start MAPC 2022 Publications MASSim in Teaching History

		LI(A)RA	GOALdigger	MMD	FIT BUT	GOAL-DTU	Paula
LI(A)RA	Sim1		350	760	60	120	600
	Sim2		410	750	540	160	120
	Sim3		310	1600	780	0	1000
GOALdigger	Sim1	130		500	220	0	160
	Sim2	0		200	320	0	220
	Sim3	80		840	490	520	1270
MMD	Sim1	120	370		80	480	770
	Sim2	10	300		760	150	500
	Sim3	150	720		170	0	450
FIT BUT	Sim1	220	120	770		230	480
	Sim2	60	320	680		630	360
	Sim3	120	520	1140		0	250
GOAL-DTU	Sim1	310	180	910	0		710
	Sim2	80	370	780	670		610
	Sim3	270	410	1520	1640		570
Paula	Sim1	110	330	580	0	320	
	Sim2	60	700	790	330	280	
	Sim3	90	320	1690	60	0	
Total points:		**1810**	**5730**	**13510**	**6120**	**2610**	**8070**
Total score		9	22	30	19	9	N/A
Placement		4	2	1	3	4	N/A

Participants

In order of registration:

Team	Affiliation	Members	Using	Status
LI(A)RA	UFSC (Brazil)	5	Jason	Q. Passed 22.8.2022
GOALdigger-AIG-Hagen	University of Hagen (Germany)	4	GOAL	Q. Passed 16.8.2022
MMD	ELTE (Hungary)	2	Python	Q. Passed 19.8.2022
FIT BUT	BUT (Czech Republic)	3	Java	Q. Passed 22.8.2022
GOAL-DTU	DTU (Denmark)	3	GOAL	Q. Passed 8.8.2022

Contest

Results

Placement	Team	Total Score	Sources
1	MMD	30	Zip Git mirror
2	GOALdigger	22	Git
3	FIT BUT	19	Git
4	GOAL-DTU	9	Zip Git mirror
	LI(A)RA	9	Git

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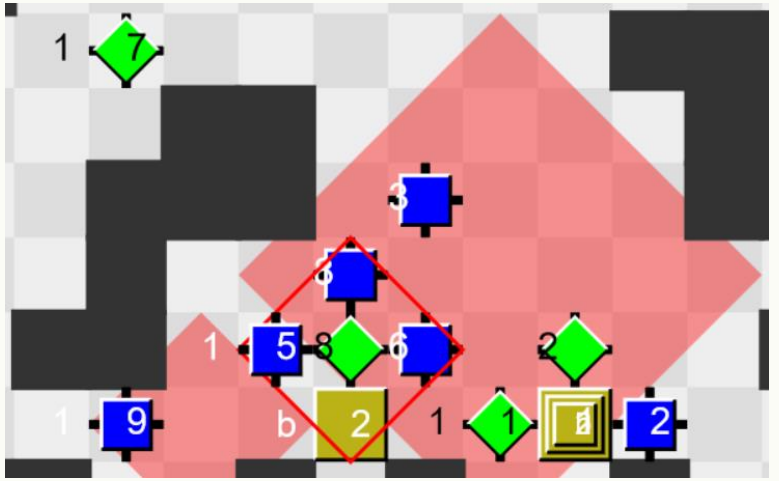
Multi-Agent Programming Contest

- Unexpected adversary behavior
  - Saboteur agents



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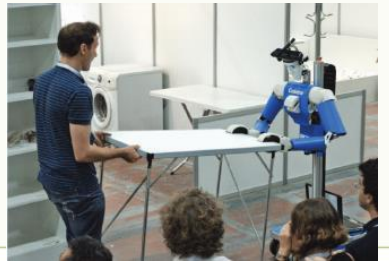
CoreSense: A Hybrid Cognitive Architecture for Deep Understanding

- robots suffering from a lack of understanding of what is going on and a lack of awareness of their role in it
- a problem that artificial intelligence approaches based on machine learning are not addressing well
- solution to this need in the form of
  - 1) a theory of understanding,
  - 2) a theory of awareness,
  - 3) reusable software assets to apply these theories in real robots, and
  - 4) three demonstrations of its capability to
    - a) augment resilience of drone teams,
    - b) augment flexibility of manufacturing robots, and
    - c) augment human alignment of social robots



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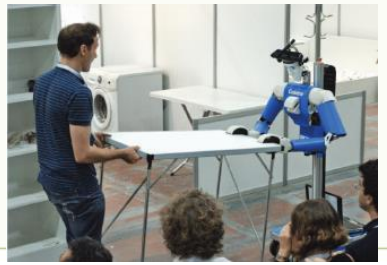
PROGRAM FINANCED FROM THE NRDI FUND

CoreSense: A Hybrid Cognitive Architecture for Deep Understanding

- Universidad Politécnica de Madrid - ES – Coordinator
- Delft University of Technology - NL
- Fraunhofer IPA - DE
- Universidad Rey Juan Carlos - ES
- PAL Robotics - ES
- Irish Manufacturing Research – IR

- Timespan: 2022-2026



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AdversarySense – Hop On

- multi-agent systems design and geometry-based vision perception
- adversary modelling to make the operation of autonomous robots safer
  - For example, autonomous vehicles cannot differentiate between normal or adversarial environment. Currently humans find this behaviour irritating, and they often try to exploit the excessive cautiousness of autonomous vehicles.
- the new widening partner will bring its multi-agent system development knowledge into the project in order to extend the project's current knowledge in this field
- novel geometric 3D image recognition methodology which is a geometry-based computer vision method instead of the currently popular machine learning methods, and hence this will add to the autonomous robots capabilities of understanding and building a geometric model of their environment

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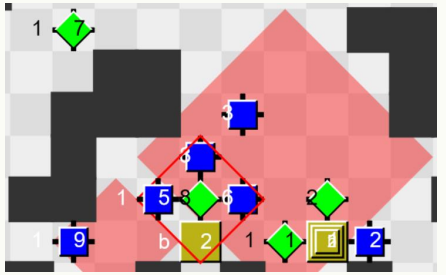
AdversarySense – Hop On

- demonstrated through two scenarios:
  - a simulated scenario
    - MMD system with adversary understanding is measured against the GOALdigger multi-agent system which includes autonomous agents with adversary behaviour
  - a real-world scenario
    - build on the data collected by the ELTECar and ELTEKart systems
    - evaluated within the collaboration with industrial partner Robert Bosch GmbH
    - drone-technology will also be used as bird eye's view is better to overview the traffic situations



- maximising impact:
  - introducing the project results in the MSc courses of the Intelligent Field Robotic Systems (IFRoS) ERASMUS Mundus joint master's degree
    - "Security of Autonomous Systems", or "Methods and tools for AI Applications" and advising MSc thesis

ERASMUS MUNDUS JOINT MASTER in Intelligent Field Robotic Systems
Universitat de Girona
National Research, Development and Innovation Office Hungary
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EuroKnows robot laboratory

- Competency assessment in a demo application
  - European Knowledge Centre Ltd.,
  - Artificial intelligence,
  - Intelligent Field Robotic Systems
  - Multi-agent systems
  - Geometry-based computer vision method
- Demo application
  - Construction field
  - Robots with sensors
  - Collective construction
- Software technology course practice classes: virtual demo

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Results

- Published publication
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- Submitted publication
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