Perception, Prediction and Planning Techniques in Collaboration Human-Robot Tasks

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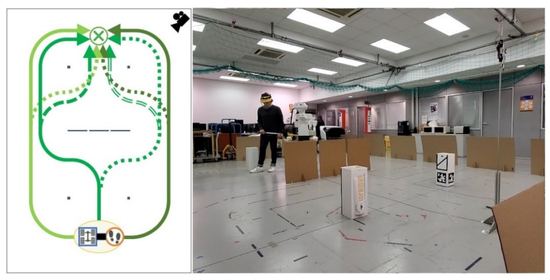
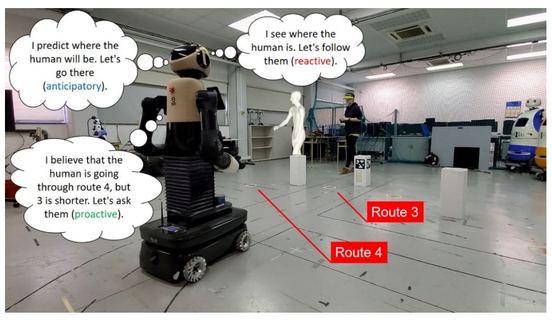
MOTIVATION

- What is intention? Really, what is the definition of intention?
- According to psychology: "**Desire** to achieve a **result** by **believing** that a certain **action** can generate that result" [Malle, 1997].
- In robotics, no clear and general definition of intention.

OBJECTIVES

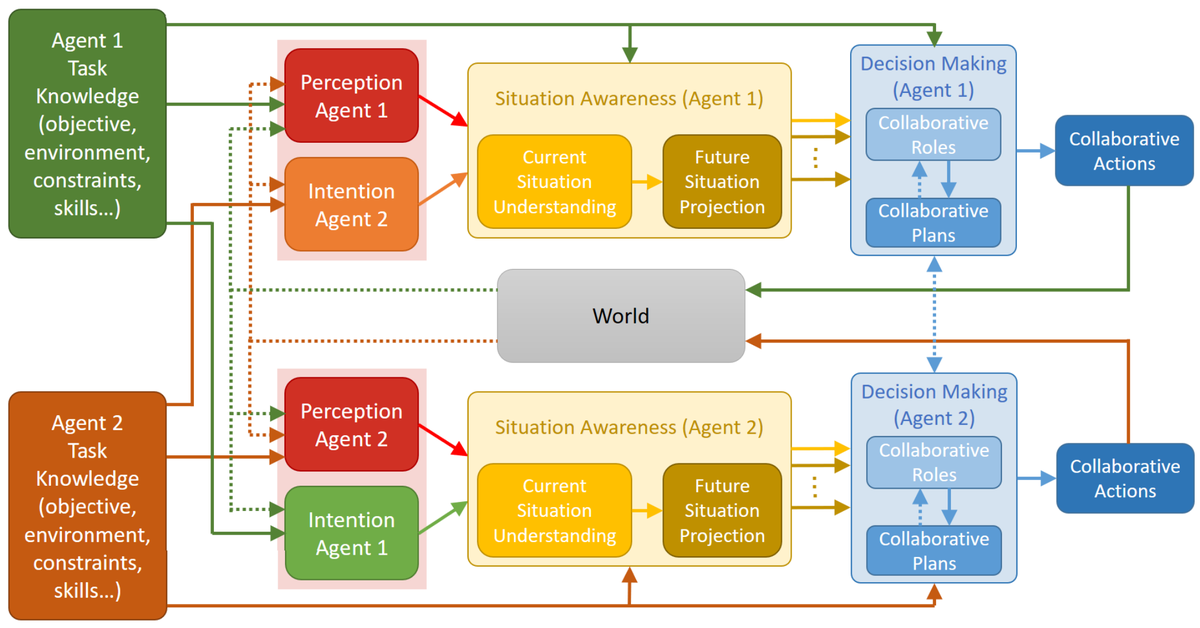
- **Objective 1:** Theoretical **model** relating human's intention with robot's actions and vice versa.
- **Objective 2:** Analysis and **classification** of different types of intention with three use cases:
  a) Collaborative search[1].
  b) Collaborative object transportation[2].
  c) Handover[3].
- **Objective 3:** Explore their implication in the appearance of **proactive** and **anticipatory** behaviors.





RESULTS

- *PIA (Perception-Intention-Action) cycle [5, 9].*



- *Preliminary intention taxonomy (under review).*
- *Implicit vs. explicit intention:*
  a) Different inference methods: force prediction [1, 3, 7] and movement prediction [2].
  b) Explicit intention elicitation through smartphone app [6, 11] and voice commands [4].
  c) We do NOT need the perfect predictor, but a good enough one and allowing the human to communicate with the robot [8].
- *Both types of intentions are necessary to provide the robot with anticipation and proactivity capabilities [2].*

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Research collaborations and research stays

- Participation in the European project CANOPIES, the Japanese project SOCIAL-PIA and the Spanish Project ROCOTRANSP.
- Research stay in 2024 in IIT (Istituto Italiano di Tecnologia), Italy.

Publications

[1] Domínguez-Vidal, J. E. & Sanfeliu, A. (2024). ***Force and Velocity Prediction in Human-Robot Collaborative Transportation Tasks through Video Retentive Networks***. 2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), *to appear*, Abu Dhabi ,UAE.

[2] Domínguez-Vidal, J. E. & Sanfeliu, A. (2024). ***Anticipation and Proactivity. Unraveling Both Concepts in Human-Robot Interaction through a Handover Example***. 33rd IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN), *to appear*, Pasadena, CA, USA.

[3] Domínguez-Vidal, J. E. & Sanfeliu, A. (2024). ***Exploring Transformers and Visual Transformers for Force Prediction in Human-Robot Collaborative Transportation Tasks.*** 2024 IEEE International Conference on Robotics and Automation (ICRA), Yokohama, Japan.

[4] Domínguez-Vidal, J. E. & Sanfeliu, A. (2024). ***Voice Command Recognition for Explicit Intent Elicitation in Collaborative Object Transportation Tasks: a ROS-based Implementation***. 2024 ACM/IEEE International Conference on Human-Robot Interaction (HRI), Boulder, CO, USA.

[5] Domínguez-Vidal, J. E., Rodríguez, N. & Sanfeliu, A. (2024). ***Perception–Intention–Action Cycle in Human–Robot Collaborative Tasks: The Collaborative Lightweight Object Transportation Use-Case***. International Journal of Social Robotics.

[6] Dalmasso, M., Domínguez-Vidal, J. E., Torres-Rodríguez, I. J., Jiménez, P., Garrell, A. & Sanfeliu, A. (2023). ***Shared Task Representation for Human–Robot Collaborative Navigation: The Collaborative Search Case***. International Journal of Social Robotics.

[7] Domínguez-Vidal, J. E. & Sanfeliu, A. (2023). ***Improving Human-Robot Interaction Effectiveness in Human-Robot Collaborative Object Transportation using Force Prediction***. 2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Detroit, MI, USA.

[8] Domínguez-Vidal, J. E. & Sanfeliu, A. (2023). ***Inference VS. Explicitness. Do We Really Need the Perfect Predictor? The Human-Robot Collaborative Object Transportation Case***. 32nd IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN), Busan, South Korea.

[9] Domínguez-Vidal, J. E., Rodríguez, N. & Sanfeliu, A. (2023). ***Perception-Intention-Action Cycle as a Human Acceptable Way for Improving Human-Robot Collaborative Tasks***. 2023 ACM/IEEE International Conference on Human-Robot Interaction (HRI), Stockholm, Sweden.

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[11] Domínguez-Vidal, J. E., Torres-Rodríguez, I.J., Garrell, A. & Sanfeliu, A. (2021). ***User-Friendly Smartphone Interface to Share Knowledge in Human-Robot Collaborative Search Tasks***. 30th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN), Vancouver, Canada.

[12] Dalmasso, M., Garrell, A., Domínguez-Vidal, J. E., Jiménez, P. & Sanfeliu, A. (2021). ***Human-Robot Collaborative Multi-Agent Path Planning using Monte Carlo Tree Search and Social Reward Sources.*** 2021 IEEE International Conference on Robotics and Automation (ICRA), Xian, China.