LLM-Enabled Voice-Command of Multi-Robot Systems

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NAMUR Project: **N**atural-language **A**ssisted **Mu**lti-**R**obot Interaction and Planning
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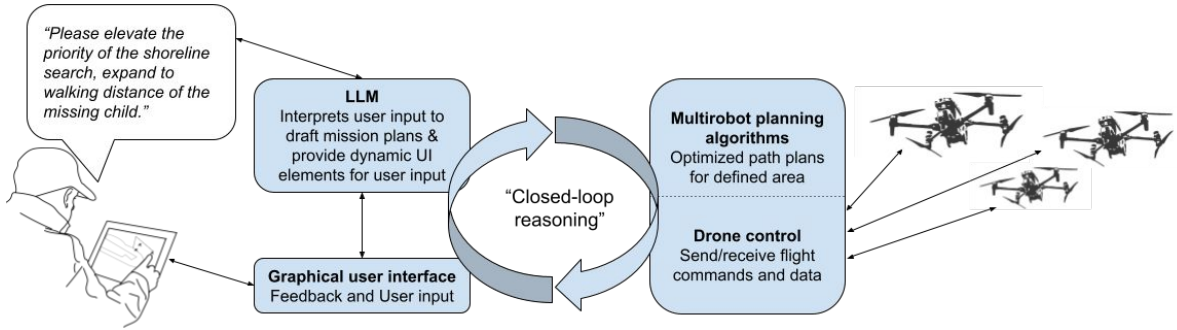
Challenge: Complexity of controlling multi-robot systems by operators in SAR missions.

Opportunity: LLMs enable flexible, natural command-and-control.

Vision: Operators speak; robots intelligently plan, coordinate, and execute missions.



Real-World Deployment of an LLM-Enabled Voice-Commanded UGV for Logistics in SAR Missions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Motivation

Disaster response - chaotic and high-pressure, requiring rapid, accurate coordination

SAR teams use multiple robots but face limited integration with command structures

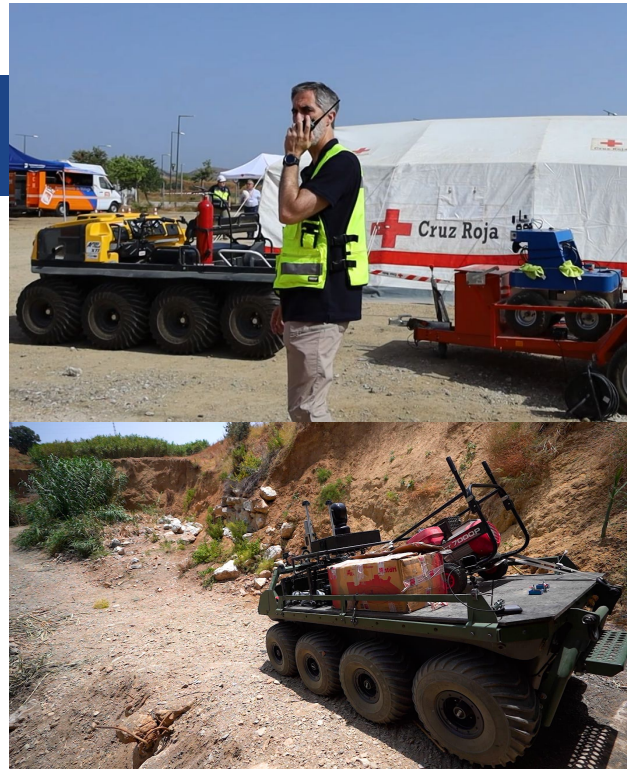
Traditional GUIs for robot control require specialized training

Voice commands enable intuitive, hands-free control for non-expert operators

LLM agents provide real-time, context-aware understanding of natural language

Combining LLMs and UGVs supports efficient, safe logistics in live SAR missions

Contribution



Deployment of voice-controlled UGV (Rover J8)
in realistic SAR scenarios:

- 150+ first responders
- 3 real missions

Non-expert operator control with natural language:

- Specifies missions for the UGV
- Multi-Agent LLM identifies where the robot should go
- Plans a safe route to reach that location, and makes UGV move
- Provides visual feedback on the completion status

Experimental Setup

Location: Málaga, Spain – JEMERG 2025

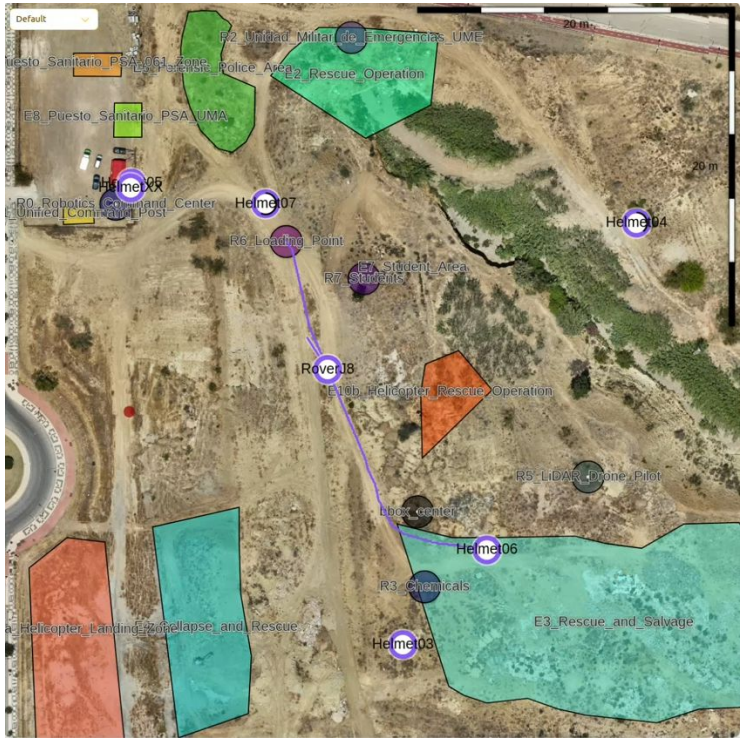
Participants:

150+ first responders across 6 missions

Equipment:

- UGV (RoverJ8)
- Smart helmets with GNSS live tracking

Monitoring: Real-time GUI and Chat Interface

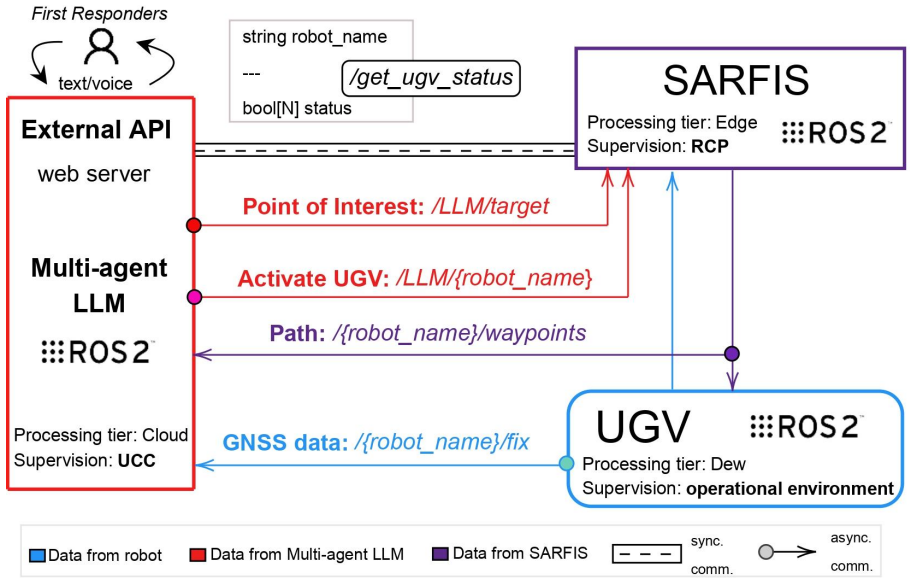


System Architecture

Multi-Agent LLM: Generates Point of Interest

SARFIS: monitoring + global path planning

UGV: Local execution + sensors



Key point: High-level reasoning combined with low-level robustness

Commands Interpretation - Multi-Agent LLM

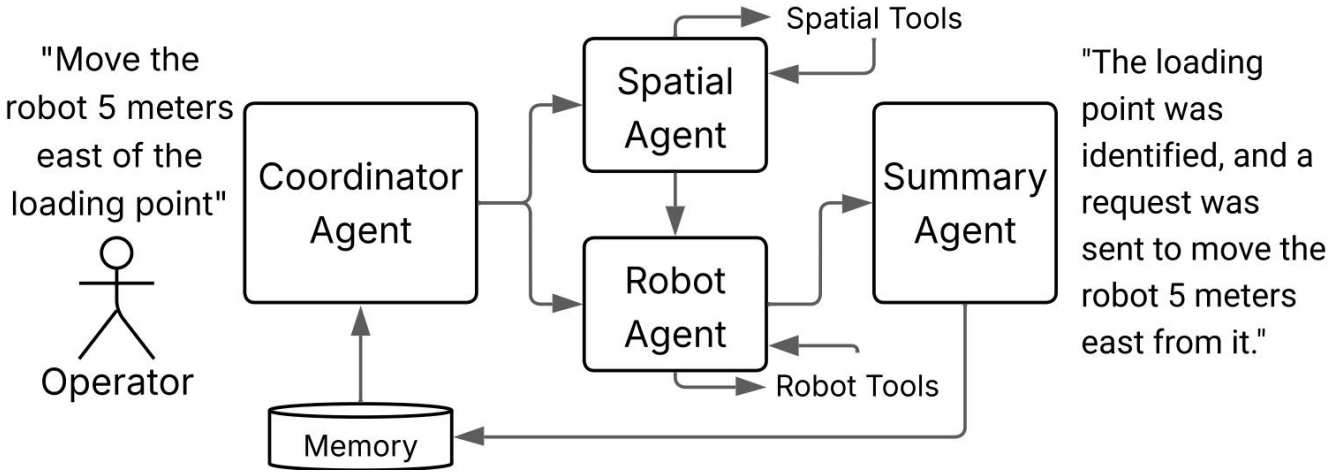
Coordinator → decomposes tasks

Spatial agent → spatial awareness

Robot agent → movement requests

Summary agent → conversational memory

Operator preview before confirmation = safety and correctness



Missions & Results

TABLE I: Summary of operator commands, execution times, and outcomes for each mission.

Mission	Operator Command (Spanish / English)	Command Time	Arrival Time	Total Time	Notes
#1a	*Envía J8 al casco 6* / Send J8 to helmet 6	10:37:00	10:39:46	2m 46s	Successful
#1b	*Envía J8 a R6* / Send J8 to R6	10:39:50	10:42:08	2m 18s	Successful
#2a	*Envía J8 a 5 metros al Oeste del casco 3* / Send J8 five meters west of helmet 3	11:18:45	11:21:10	2m 25s	Successful
#2b	*Envía J8 a R6* / Send J8 to R6	11:21:34	11:24:05	2m 31s	Successful
#3	*Envía J8 a 5 metros al Noroeste del casco 8* / Send J8 five meters northwest of helmet 8	13:41:27	13:46:50	5m 23s	Successful. Close supervision due to hazardous slope.

(a) Requesting batteries.

(b) UGV following route autonomously.

(c) Battery pickup.

Fig. 6: Sequence from Mission #1 showing the delivery workflow: (a) the drone pilot requests additional batteries, (b) the UGV autonomously navigates to the delivery point, and (c) the pilot retrieves the batteries from the robot in the field.

Feedback & Lessons Learned

Feedback from first responders:

Praised intuitive voice interface (low training required)

Reported reduced cognitive load

Valued seamless integration with standard protocols

Lessons learned:

Robust but still with limitations in how commands can be given

Human oversight remains essential for unpredictable terrain / events

Progress so far

Real-World Deployment on Realistic SAR Logistics Missions with a UGV

“Deliver the materials to the firefighter #6”

Simulation with 8 drones and complex voice commands

“Split in 4 groups and send each to a different building”

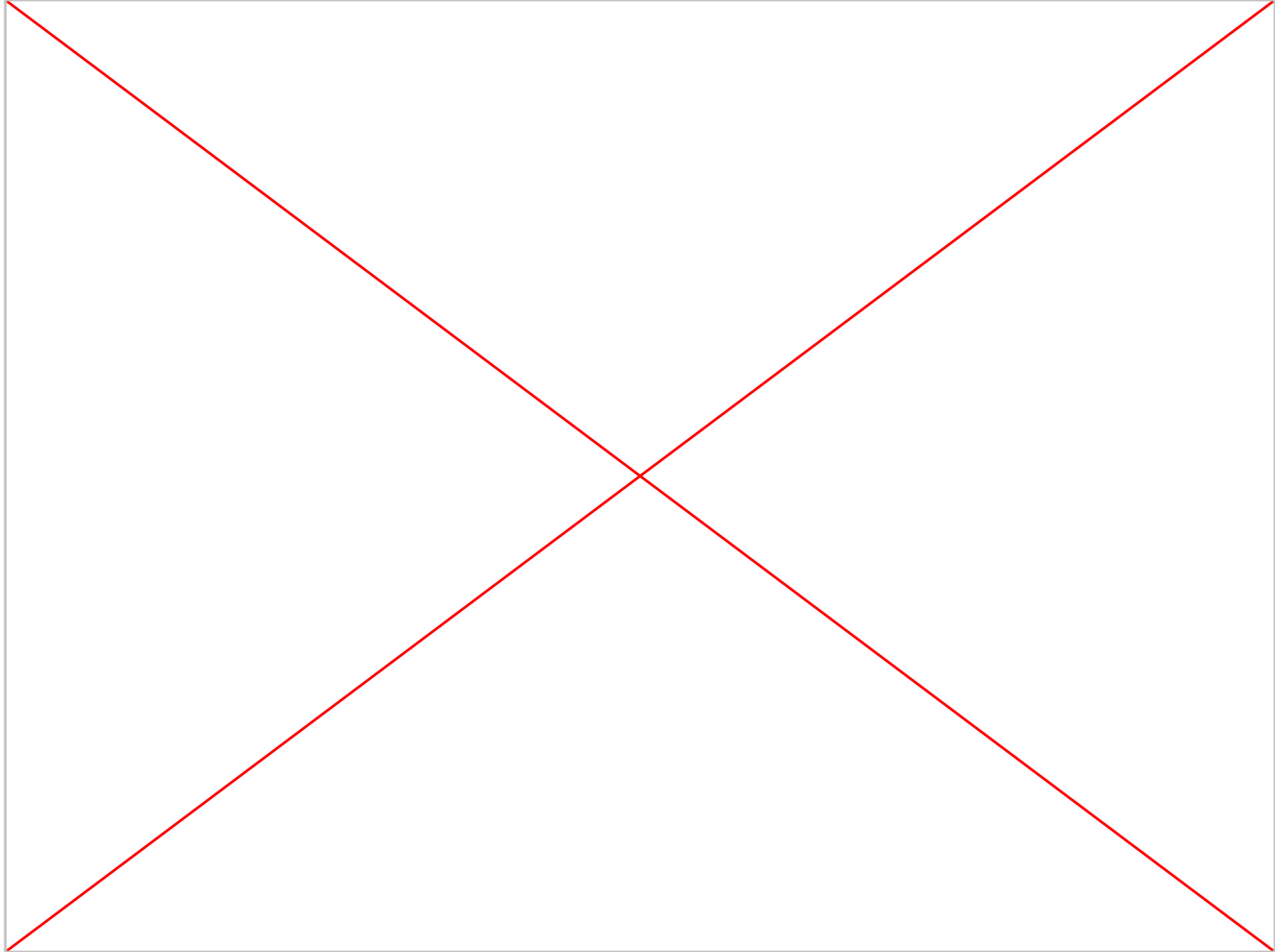
“Scan the area next to the river with group Bravo”

Next steps

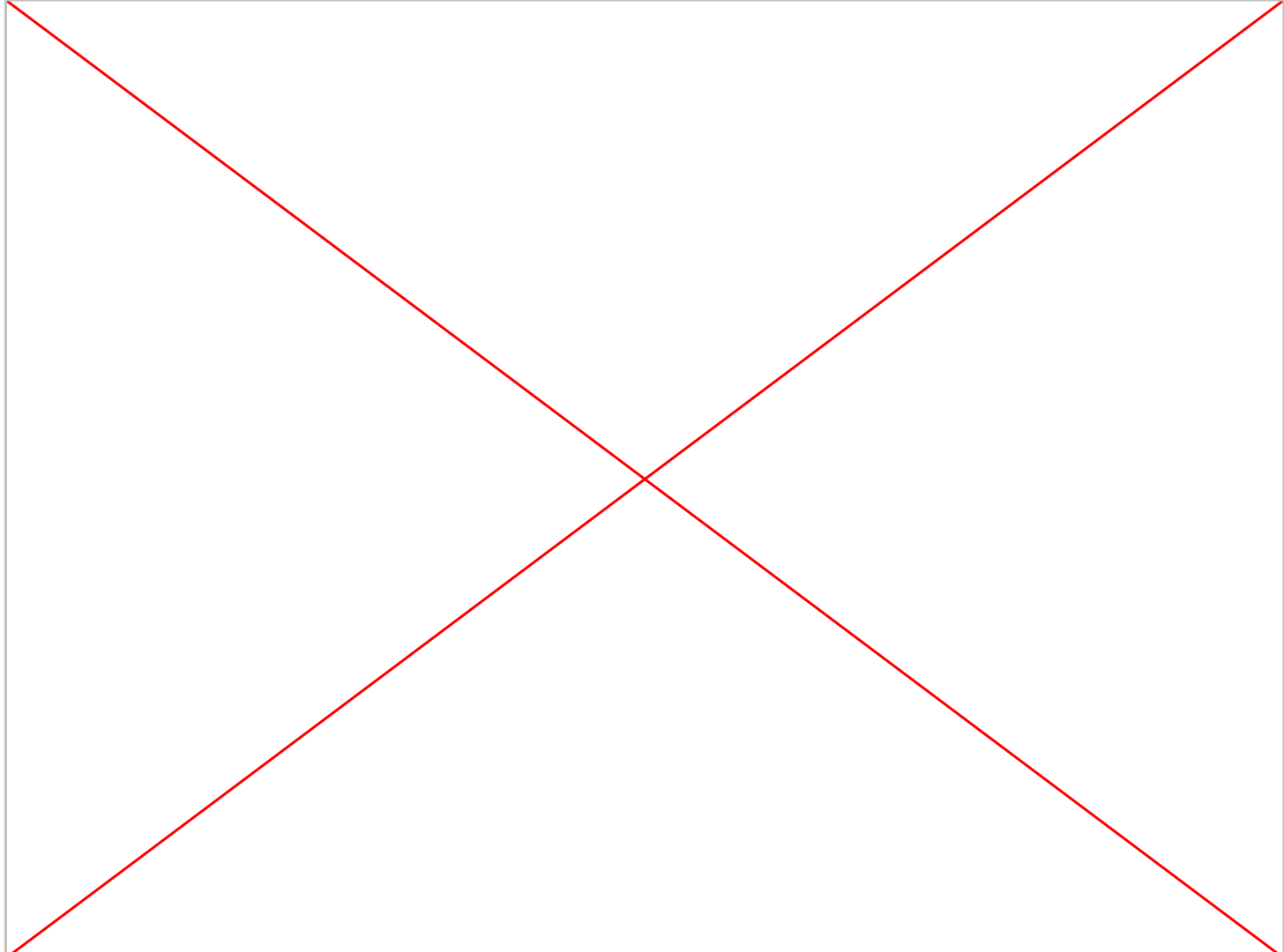
Acquired 10 DJI 4 Minis to perform realistic experiments and validation

Implementation of more complex features like constraints or events

Video
Demo



The best is yet to come…



Thank you :) - Questions?

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