

COMRADES (COoperative Multi-Robot Autonomous DEtection System) for Humanitarian Demining

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Objective: Develop novel coordination techniques between multiple low-cost, autonomous, mobile robots which enable them to collaboratively detect landmines with high accuracy in post-conflict regions

Existing Robot Technologies for Humanitarian Demining

Robots can navigate in a variety of terrain - more focused on mechanical construction of robots

- High cost
- Heavy weight, limited maneuverability
- Logistical/maintenance care
- Limited testing
- Mine detection is very sensitive to moisture, ground cover, solar loading, burial depth, etc.
- Sensor data is very prone to false-positives

Proposed Solution

A multi-robot system consisting of relatively inexpensive, off-the-shelf robots, where each robot is equipped with a different type of sensor, can be used to perform automated landmine detection in an efficient manner while **reducing the number of false positives.**

COMRADES Project Robots



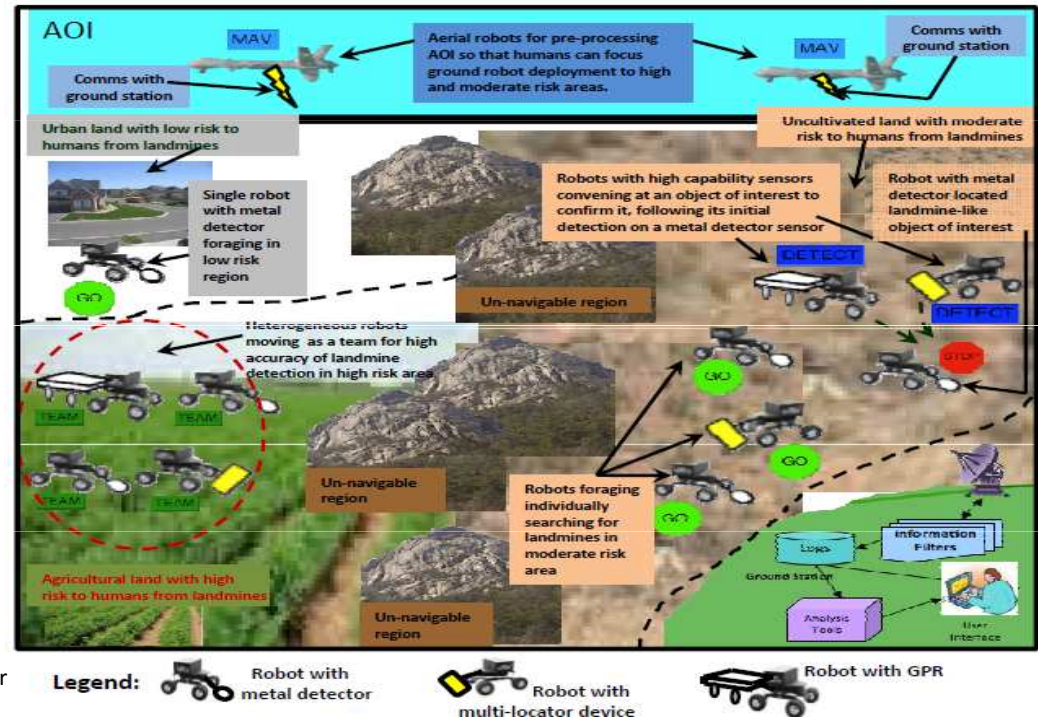
- Sensors:
- IR range sensor
 - Camera
 - Indoor localization

Corobot: \$5, 500



Explorer: \$13, 000+

- Sensors:
- Laser range sensor
 - Camera
 - GPS
 - Metal detector (custom)



COMRADES System Architecture

Robot Operational Features

- Explore an initially unknown region while searching for landmines
- Recognize landmine-like objects on its sensors (metal detectors, ground penetrating radar, IR sensors)
- Coordinate actions with other robots so that multiple robots with different types sensors can converge on the object to analyze it
- Confirm object as landmine using sensor data fusion techniques

Expanded Applications of COMRADES Technology

Agricultural : Automated crop harvesting, virtual fences for cattle herding

Engineering: Checking turbines, bridges for cracks and fissures

Basic Research Focus Areas

Terrain Coverage with multiple robots

Current/Proposed Solutions: Complete coverage algorithms with very limited comm. overhead, game theory for dynamically forming robot teams and flocks for efficient coverage

Multi-robot Task Allocation

Current/Proposed Solution: Swarming-based and market-based algorithms for efficient task allocation that guarantees rapid yet accurate task completion within the system

Space and Extra-terrestrial exploration

Homeland security: Perimeter protection and surveillance of high security areas