Multi-robot AI based Explosive Detection Demonstration

Grant Agreement PADR-FDDT-EMERGING-03-2019 884866 - AIDED,

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I. Objectives

AIDED Background

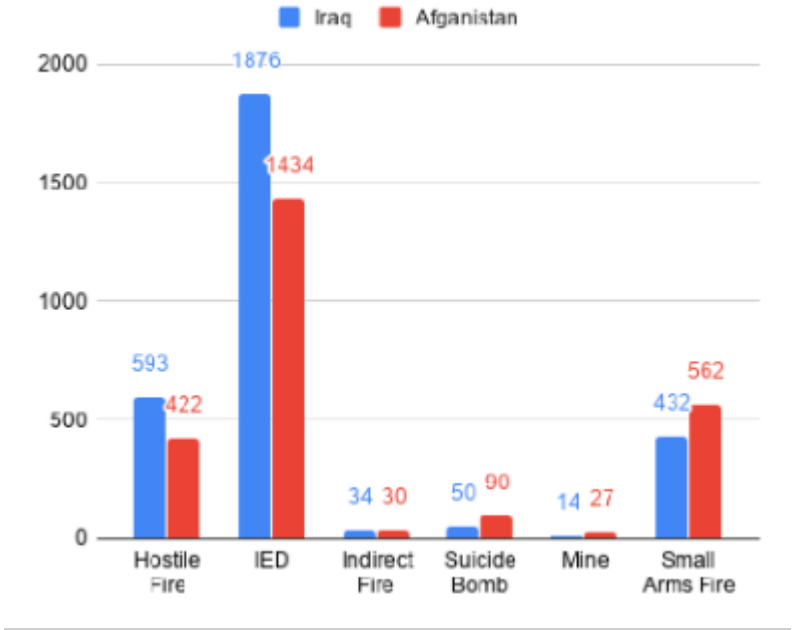
In modern warfare operations, consistently **50% of all soldier deaths** in action are directly related to **IED**s (**I**mprovised **E**xplosive **D**evice).

- Afghanistan 2872 NATO troops were killed in action in total. 1434 of those were killed by IEDs.
- In Iraq, 3801 soldiers were killed in action and 1876 of those were killed by IEDs.

The AIDED Project 2021-2023

AIDED

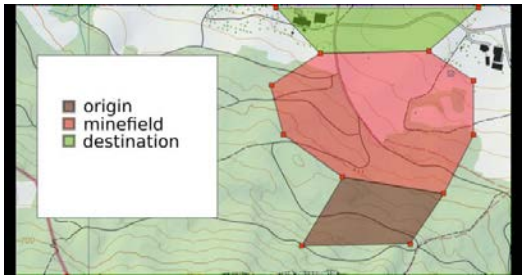
source: icasualties.org

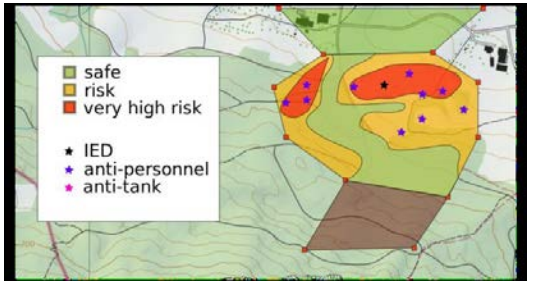


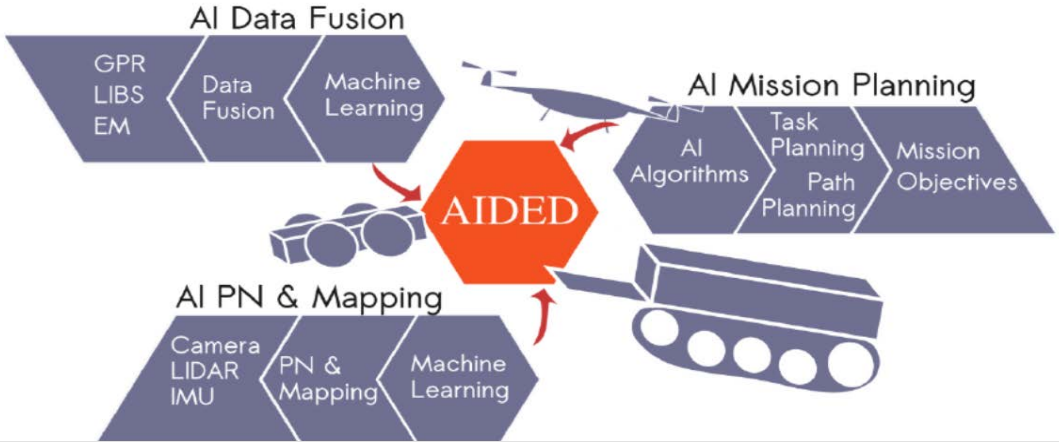
I. Objectives

Technical Objective

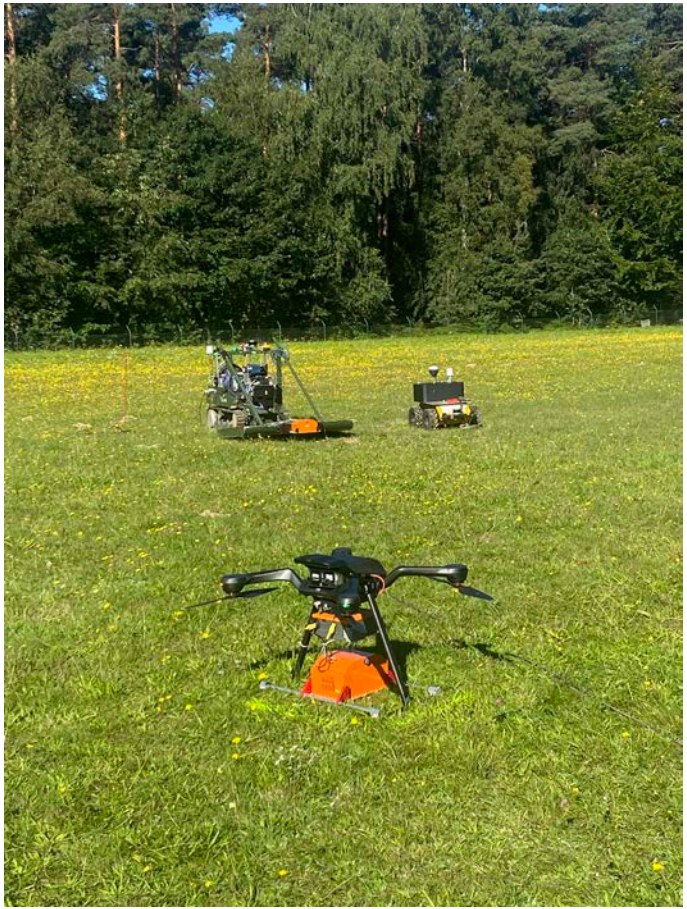
- AI-enabled heterogeneous robotic fleet
- Advanced ML based IED/UxO detection
- Automated mission planning capabilities
- Sent out in advance to detect and classify IED/UxOs in the terrain
- Keeping the human soldiers out of harm's way
- Humanitarian applications – demining

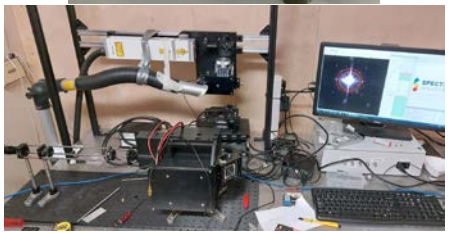


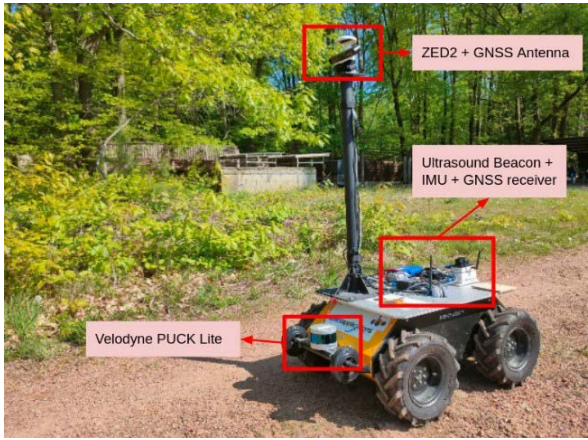




Robots & Sensors



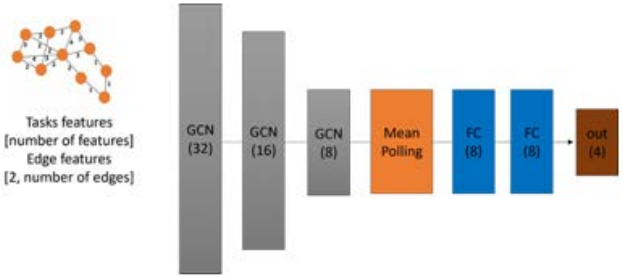




II. Why AI-ML for demining ?

II. Why AI-Machine Learning for C-IED and demining?

Adaptative to **non-conventional IED's**



Sensor fusion → { **Increased detection probability**
Reduced false positive rate

Automated **multi-agent** tasks & path planning – coordination & cooperation

Robustness in **localization & mapping** in case of **jamming** and loss of **communications**

Optimal use of available **resources**

Multi-agent system

Multi-agent systems are :

- Share mission objectives
- More efficient area coverage
- Cooperative behaviour
- Optimize the capacities of each agent

Added value to AIDED

- Decrease the time of area coverage
- **Reduce the false detection by sensor fusion**
- Challenge the state of art for localisation and mapping

II. Locations for data gathering & testing

Integration

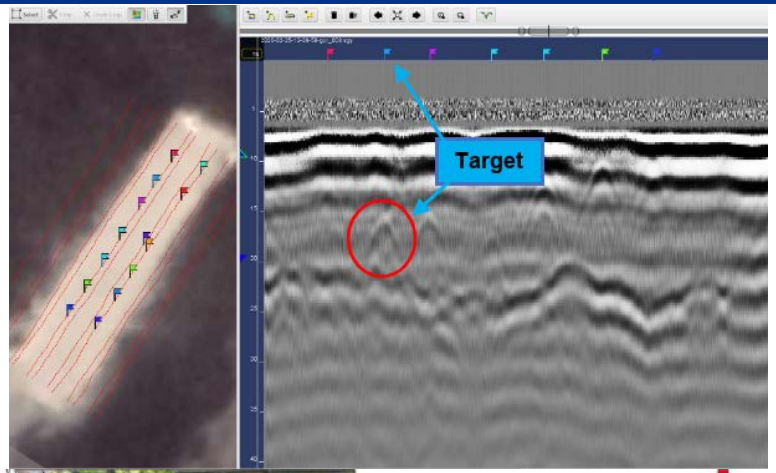
III. Demonstration Outcomes

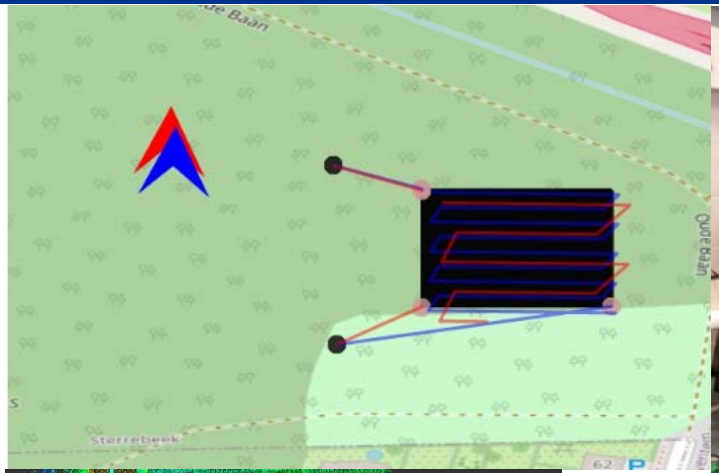
DOVO Collaboration

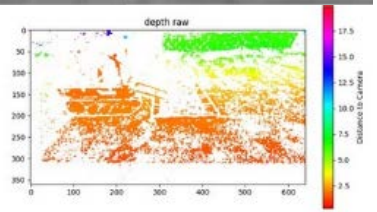
DOVO:

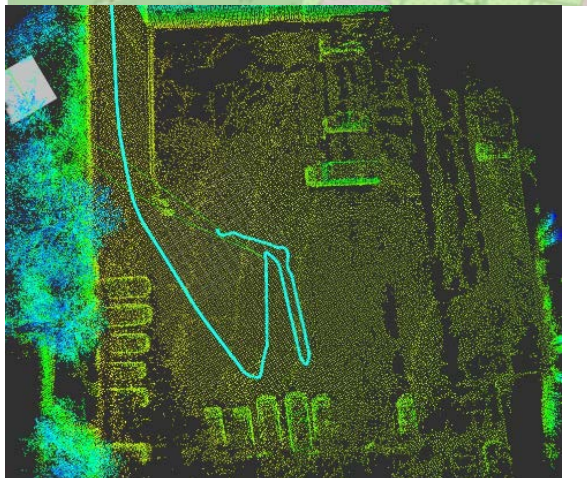
- Provide **test fields** and facilities to collect data to **train AI** and **test** the **robots**
- Develop **mock-up** EOD's / IED's
- Fabricated by **experts**
- Chemicals - Extremely low concentrations of TNT or TATP (to be confirmed)
- Soil conditions where the measurement is taken (humid, dry, clay, sandy, hot, cold)

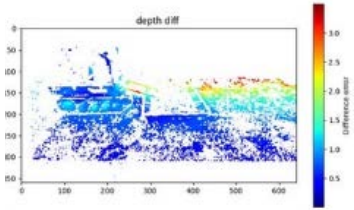
III. Results (Unclassified)

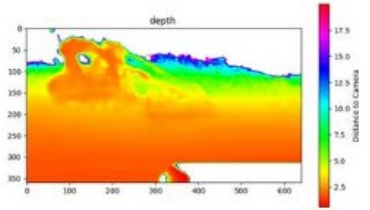












Outcomes of the project

Achievements

- **Sensor integration** on the robots
- Large **labelled data** sets acquired
- **Navigation** tests conducted with **mission** planning
- **ROS Architecture** implemented on the different robots
- **Control centre and communications**
- Deployed and test **trained Neural Networks for detection**
- **Multi-agent planning**
- **Cooperative Navigation**
- **Trial campaign** realized with **DOVO**

IV.Conclusion

IV. Conclusion

Objectives Review:

- AI-ML can generalize detection methods for sensors, terrains and data fusion
- Multi-robot system to clear area faster and more effective
- Application of AI to demining field of study
- AI based:
  - IED detection by sensor fusion
  - Navigation
  - Multi Robot Mission Planning

Challenges

- Data labelling – complex and time consuming
- Classical technique was robust to external noise than trained NN (Ex. GPR on drone)
- Featureless terrain (Grass) – classical navigation worked slightly better
- AI-ML does not solve everything!

IV. AIDEDex Follow up – EDF Challenge

- Project Duration: 48M
- Budget: ~5M Eur
- Partners: 6
- Start date: 12/2023
- Funding Scheme: Lump Sum EDF HTDP 03-2022
- Inspired from DARPA challenges

Competition Organised in Sweden
- HitDOC

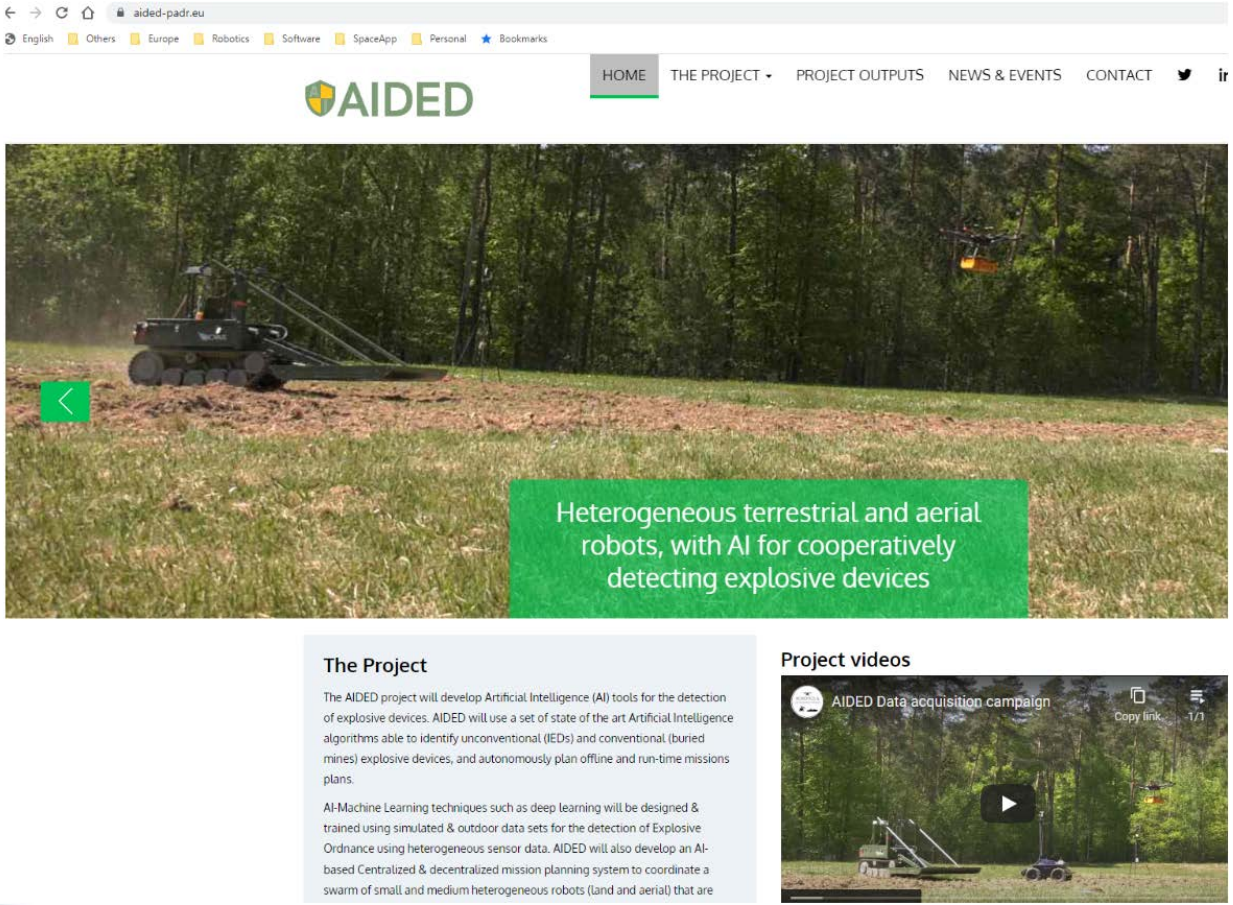
Competition with projects:
- CONVOY
- DeterMine
- TICHE







Thank you



https://aided-padr.eu/