

Assisted Explosive Ordnance Disposal: Teleoperated Robotic Systems with AI, Virtual Reality, and Semi-Autonomous Manipulation for Safer Demining Operations



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Table of Contents

- I. Introduction
- II. System Architecture
- III. Methodology
- IV. Conclusions

Table of Contents

- I Introduction
- II System Architecture
- III Methodology
- IV Conclusions

Introduction

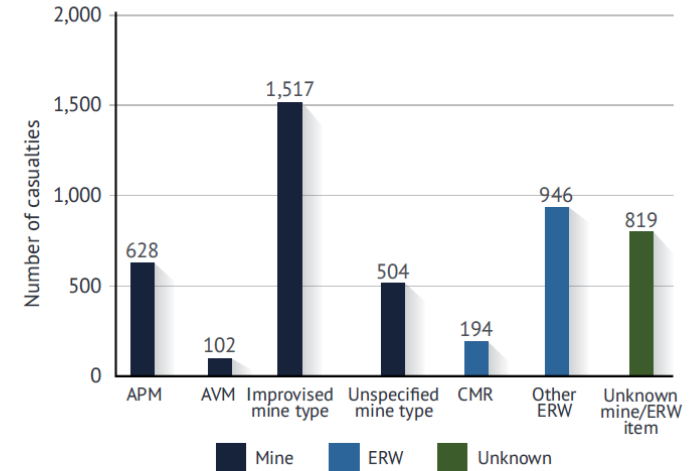
- 4,710 people were injured or killed by landmines across 49 states in 2022
- Civilians accounted for 85% of landmine casualties recorded in 2022, with half of them being children (1,171)
- Syria and Ukraine reported the highest number of annual casualties



Source: https://reliefweb.int/attachments/cd8949c8-13e4-4b24-9f78-ee1b980305f4/landmine-monitor-2023_embargoed.pdf

Introduction

- The majority of casualties reported in 2022 is to be addressed to the usage of **Improvised Explosive Devices (IEDs)**

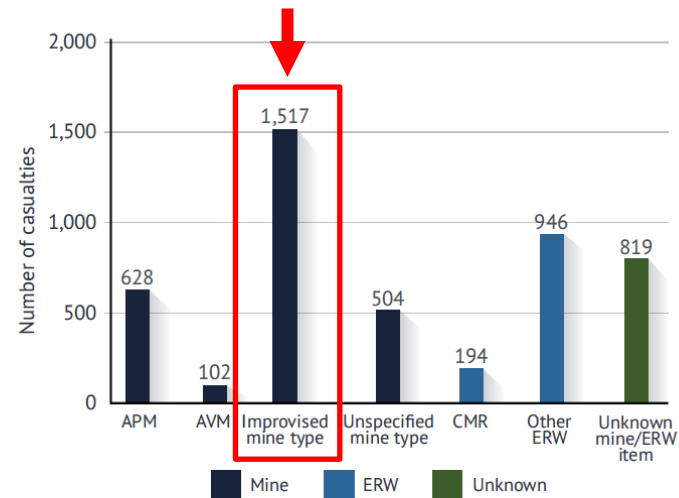


Note: APM=antipersonnel mines; AVM=antivehicle mines; CMR=cluster munition remnants; ERW=explosive remnants of war.

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Introduction

- In this context, **Belgian Defence** funded the BELGIAN project
- The project has a duration of 4 years (Jan 2024 – Dec 2027)
- The goal consists in developing an Unmanned Ground Vehicle with semi-autonomous capabilities for precise manipulation of dangerous objects (EOs, IEDs.).

Introduction

- The **Belgian EOD Group** is a partner of the project, thus allowing to have a direct feedback from the end users as well as a validation of the proposed solution
- Different field trials are foreseen in the years of the project to collect data and validate developed algorithms in real case scenarios (Meerdaal Military Base, BE)

Table of Contents

- I. Introduction
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- III. Methodology
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System Architecture

- State of the art platform in UGV research
- High payload to support different sensors integration

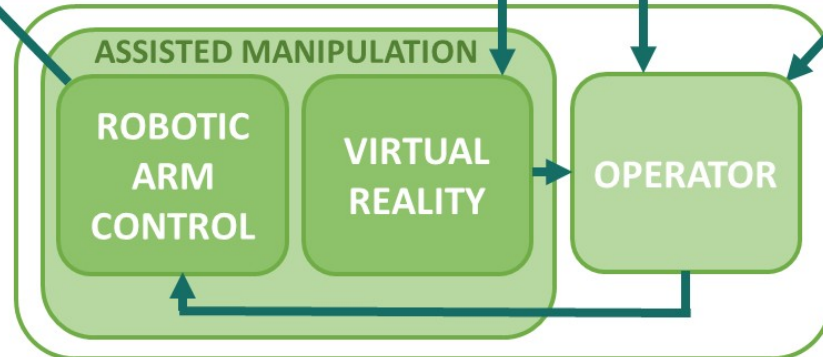
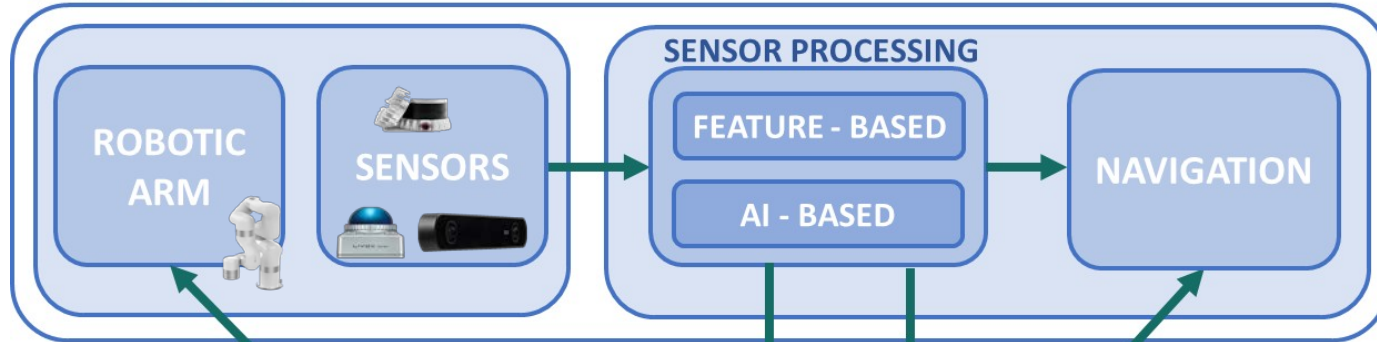


Clearpath Robotics Husky AV200 UGV



System Architecture

UGV PLATFORM



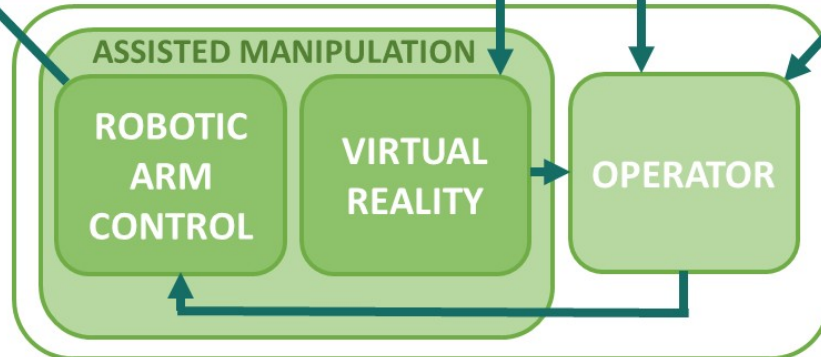
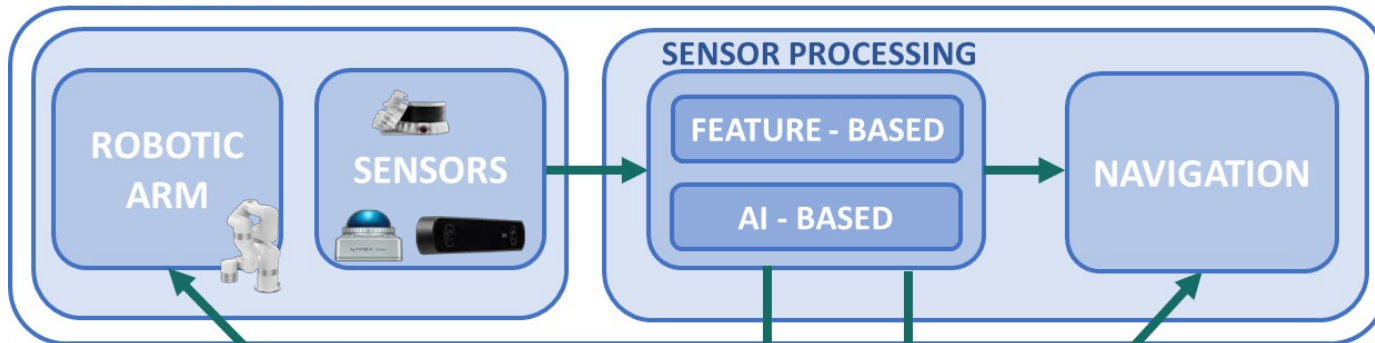
BASE STATION

Table of Contents

- I. Introduction
- II. System Architecture
- III. Methodology
- IV. Conclusions

Methodology

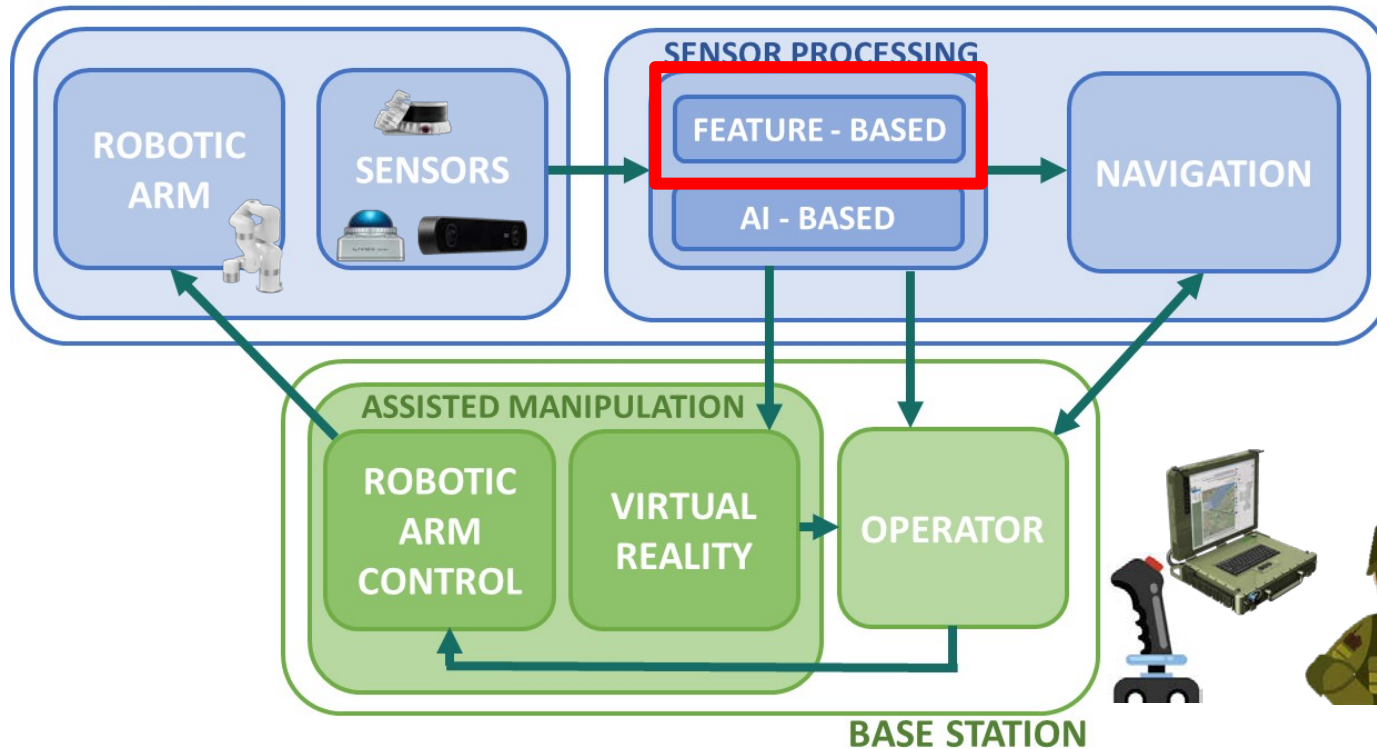
UGV PLATFORM



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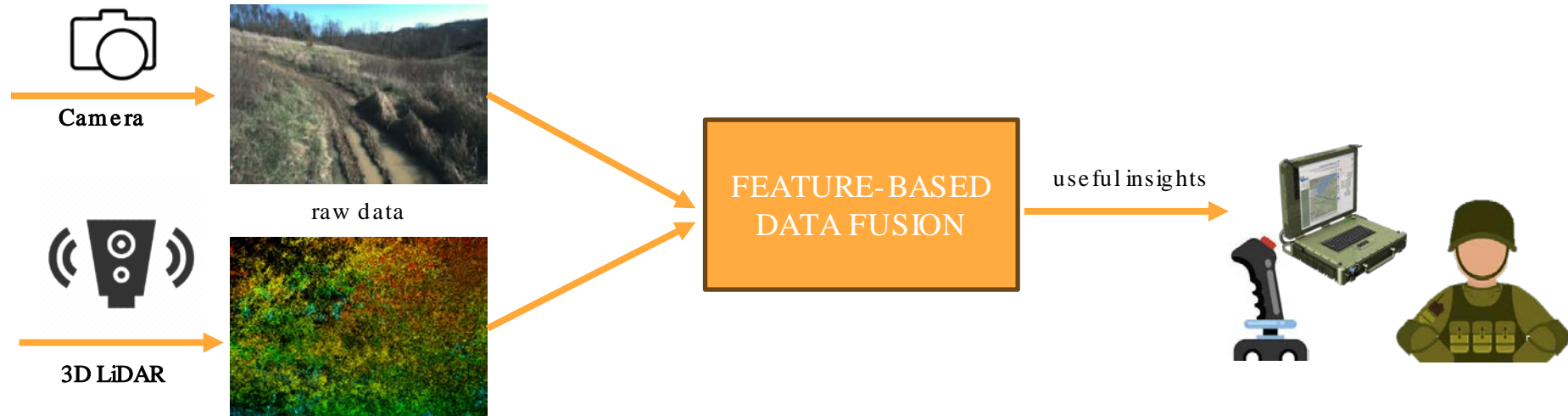
Methodology

UGV PLATFORM



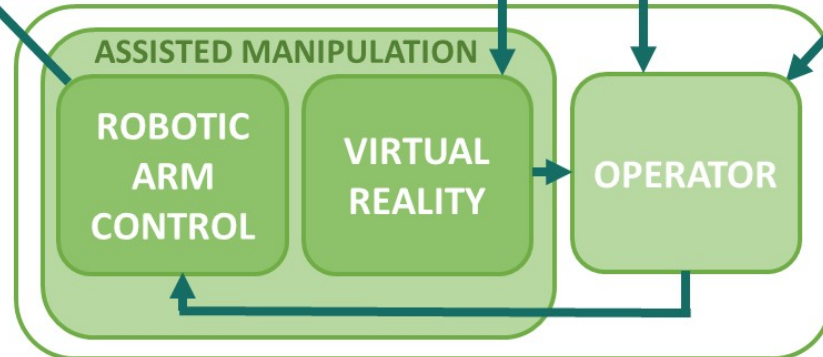
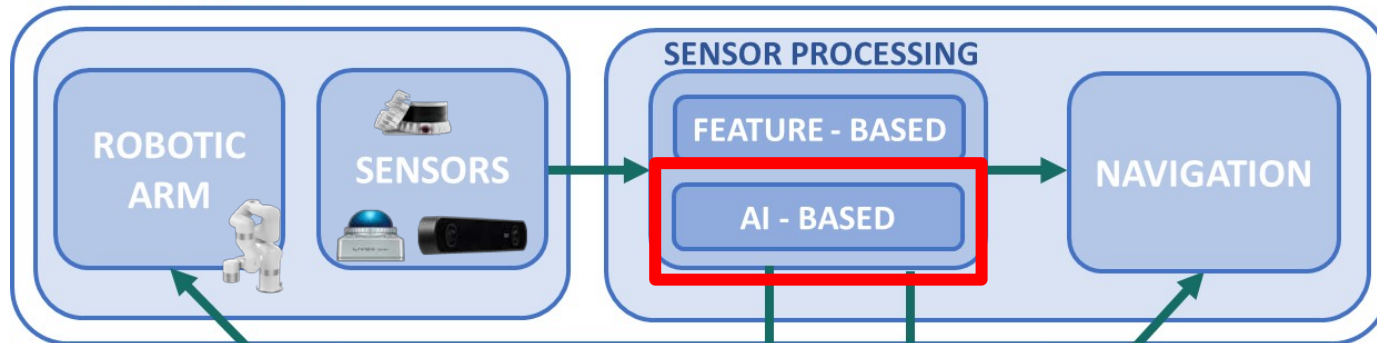
Methodology | Feature-Based Sensor Processing

- Extracts specific features or characteristics from sensor data
- Algorithms are designed to detect and use these predefined features for various tasks



Methodology

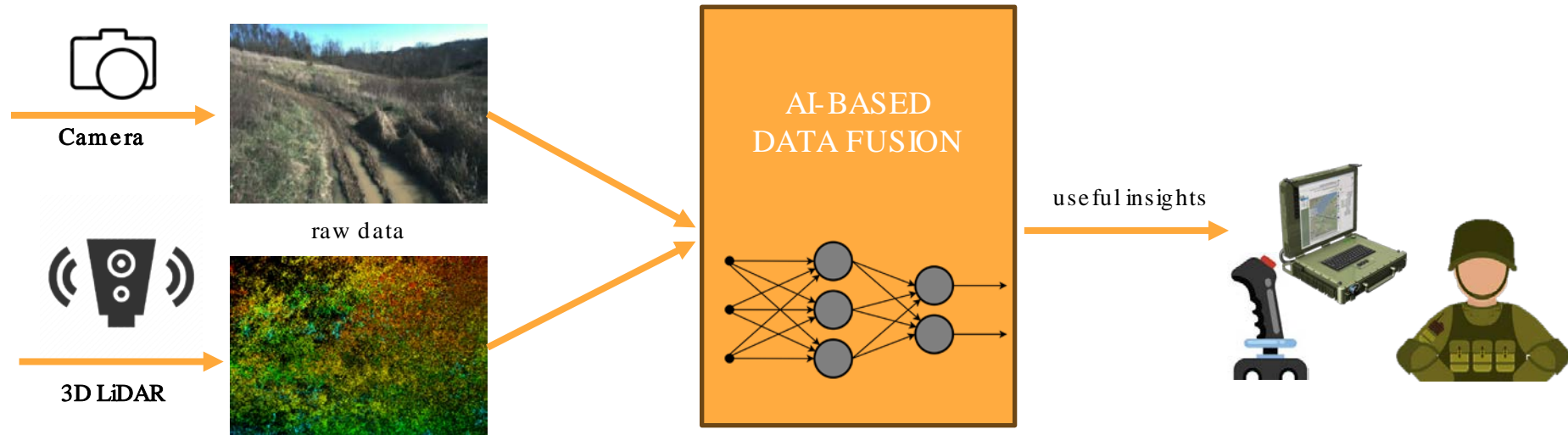
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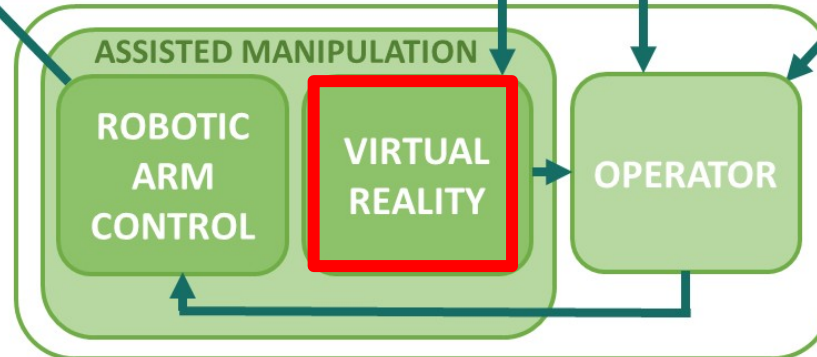
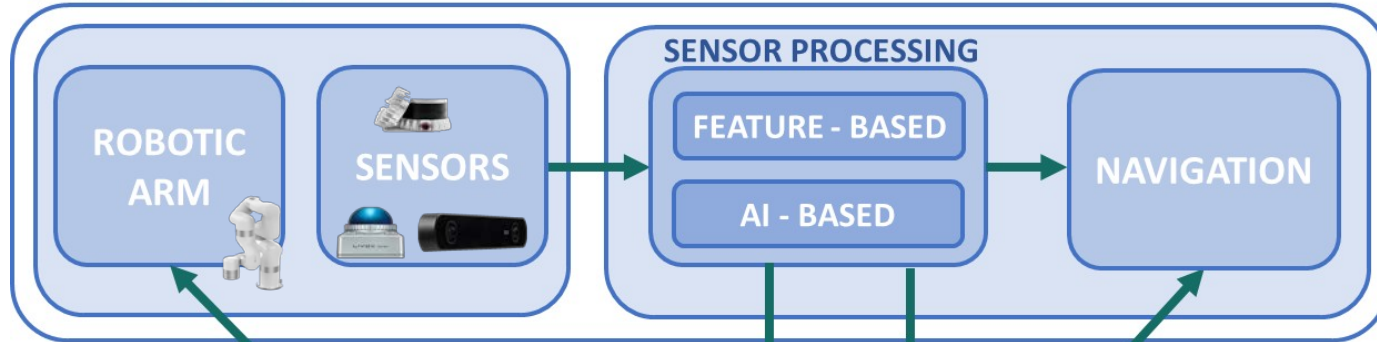
Methodology | AI-Based Sensor Processing

- Uses machine learning to process sensor data
- Learns patterns and representations directly from raw sensor data without predefined features



System Architecture

UGV PLATFORM

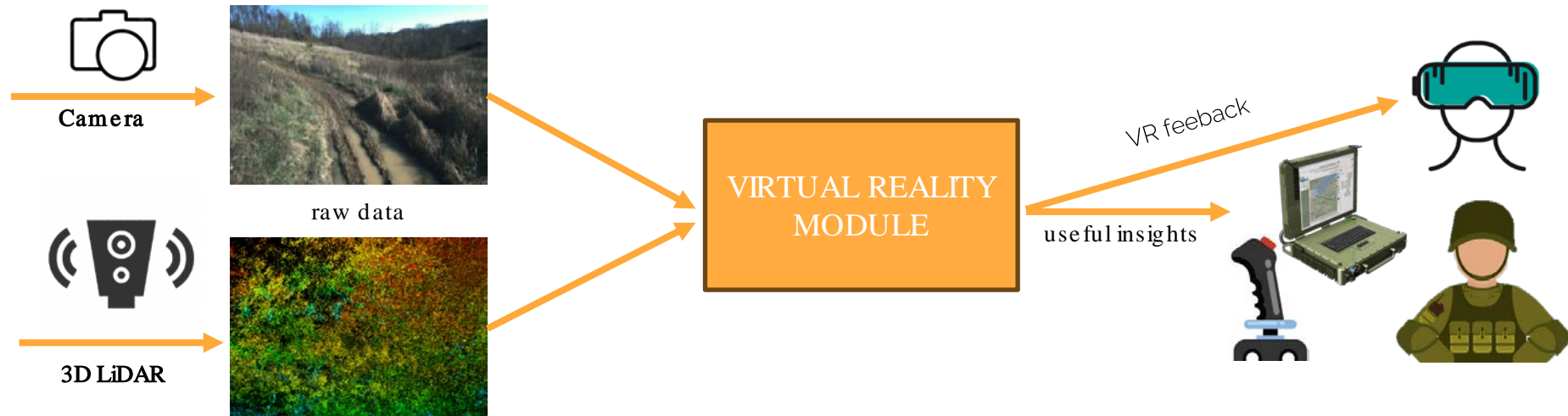


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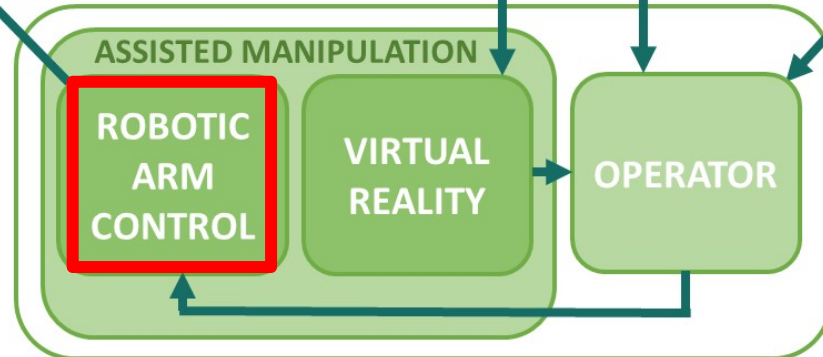
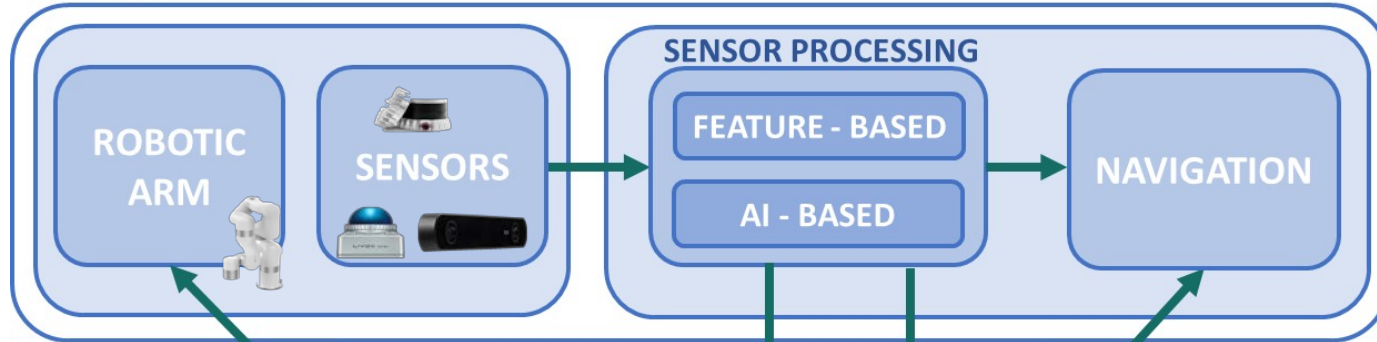
Methodology | Real-Time Virtual Reality Streaming

- Provides operators with immersive visual feedback through VR headsets, enhancing their situational awareness and control precision
- Process sensor data to create real-time 3D models, offering operators comprehensive situational awareness



System Architecture

UGV PLATFORM



BASE STATION

Methodology | Assisted Robotic Manipulation

- Corrects operator commands for precision and safety in real-time
- Enhances operator's control inputs to coordinate robotic arm / UGV movements

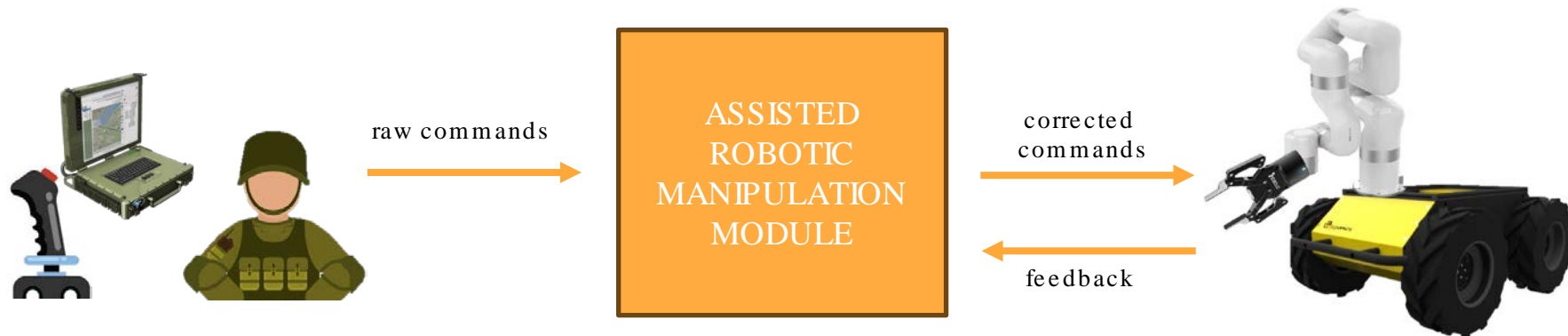


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Conclusions

- The objective of this project is to advance the state of the art in AI-based assisted robotic manipulation of EODs and IEDs
- Within the 4 years of the project, we will conduct field tests to validate our approach in real-world scenarios
- The main challenge resides in the safe and precise manipulation of IEDs and associated data fusion generating useful insights for EOD experts

Thank you for your attention!