ENHANCING LANDMINE DETECTION USING UAVS WITH THERMAL IMAGING AND SIMULATIONS

UNIVERSITY OF TWENTE.

VU

LMAC

ALBERTO MARTINETTI, FRANCESCO NEX, SVEN ASKES

UT-VU COALITION PANEL DISCUSSION
OCTOBER 3RD, 2024

Humanitarian engineering
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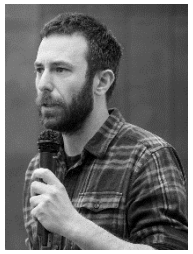
Team

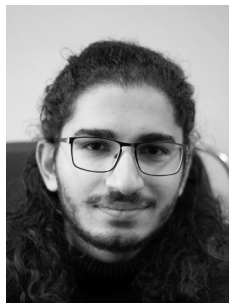


Dr. Alberto Martinetti
ET, UT

Prof. Dr. Francesco Nex
ITC, UT

Dr. Sven Askes
VU-Physics & Astronomy

Ben O'regan and Reinis Jaunarājs, Students B-ME, Drone Team members



Amir Shah
Student B-Natuur- en Sterrenkunde, VU-UvA

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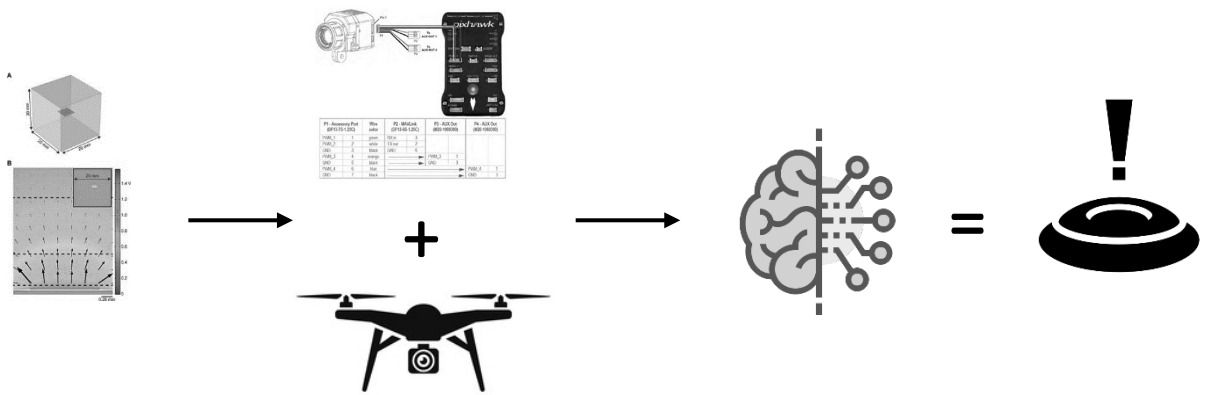
Aim, methods and timeline

AIM:

How can novel technology such as UAVs in combination with thermal cameras be used to modernise the detection of landmines?

METHODS:



May-June 2024 – initial study; July-August 2024 – Simulation and Design of the system; Sep-Nov 2024 – Data Acquisition; Dec-March 2024 –Final Test and Dissemination Phase; April 2025 – Closing and Reporting

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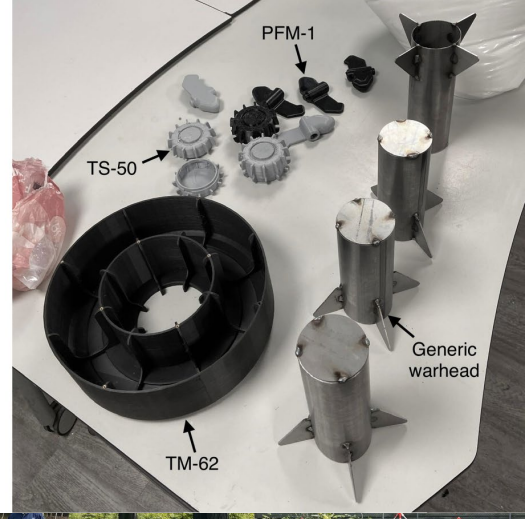
Activities so far

- *3D Manufactured 12 landmine replicas*
- *Run 25 field campaigns on different soils and collected around 850 images*
- *Used 3 different drones and 2 thermal cameras*
- *COMSOL simulation to mimic the different thermal capacities of soil and land mines*
- *Compared 3 CNNs algorithms (ResNet50, MobileNetV2 and DenseNet201)*

Prusa MK3s

Elegoo Neptune 4 Plus

?



UAV and sensor system comparison

"Free Bird" + FLIR Vue Pro R

- Observe far away locations
- Flexible / customisable
- Very large, difficult transport
- Less efficient hover
- Has to be manufactured (similar off-the-shelf variants very expensive)

Quadcopter + FLIR Vue Pro R

- Compact, easy to transport
- Flexible / customisable
- Efficient hover
- Has to be manufactured

DJI Mavic 3 Thermal

- Whole system fits in one small case
- Very easy setup and use
- Off-the-shelf (plug and play)
- Difficult to customize

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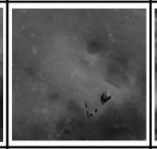
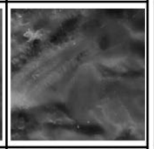
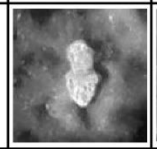
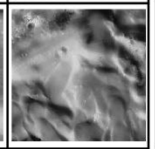
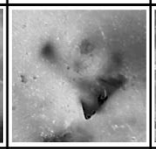
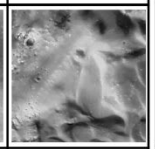
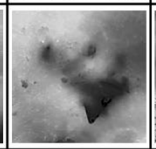
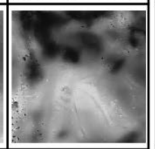
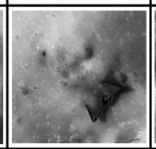
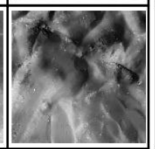
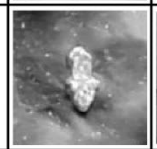
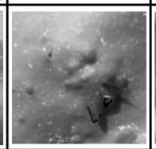
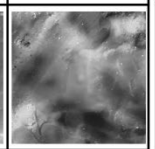
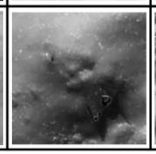
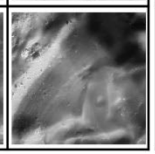
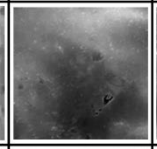
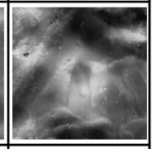
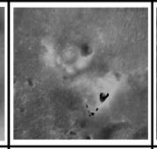
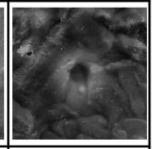
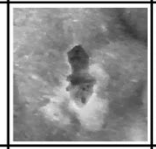
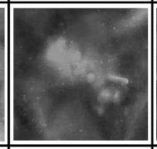
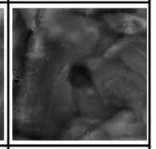
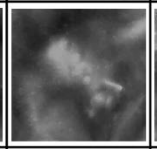
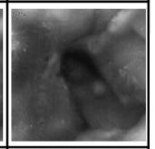
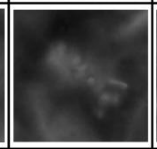
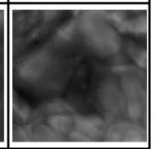
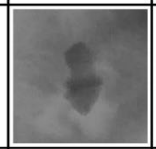
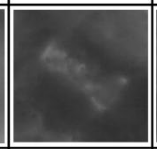
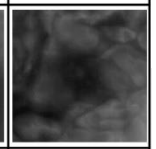
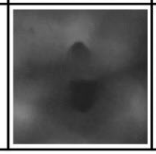
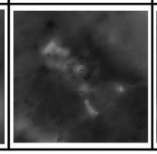
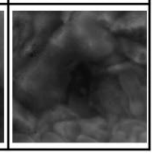
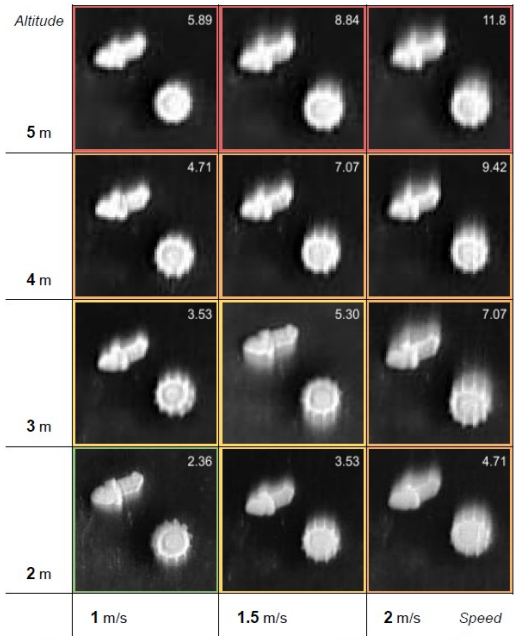
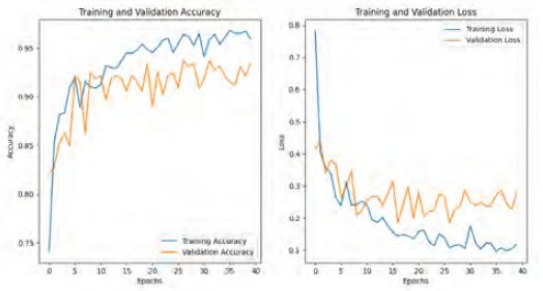
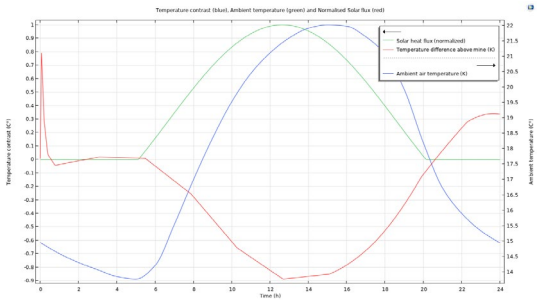
Results so far

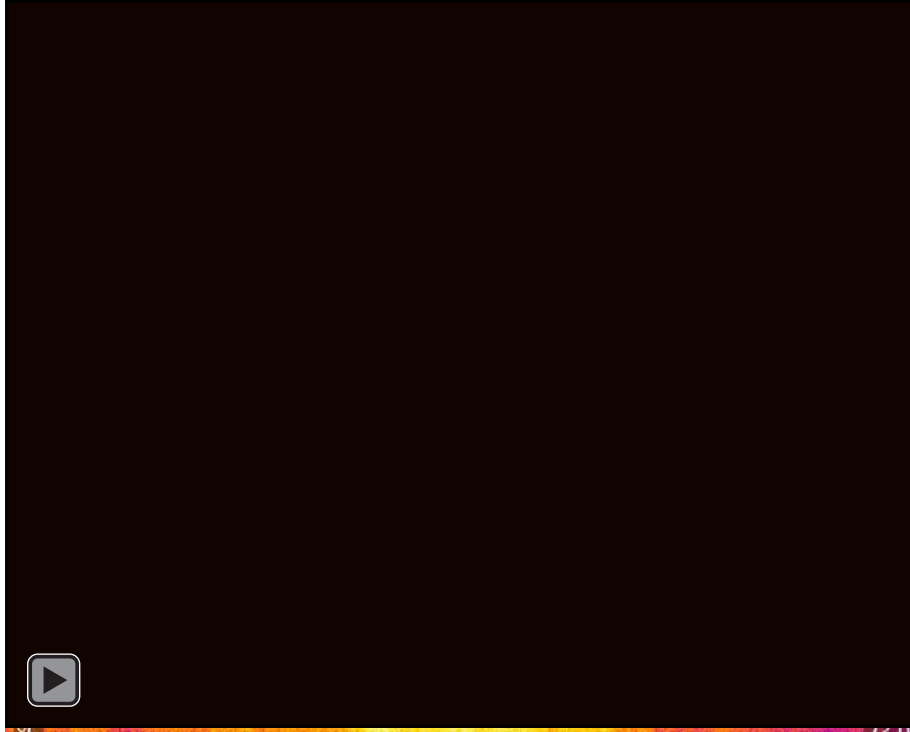
Time +/-10min *Temp.* UV index	PFM-1 (exposed)	Warhead (mostly covered)	TM-62 (buried)
09:05 *17* °C 1			
10:35 *20* °C 3			
11:45 *22* °C 4			
12:50 *22* °C 5			
14:10 *23* °C 5			
15:35 *24* °C 3			
16:50 *24* °C 3			

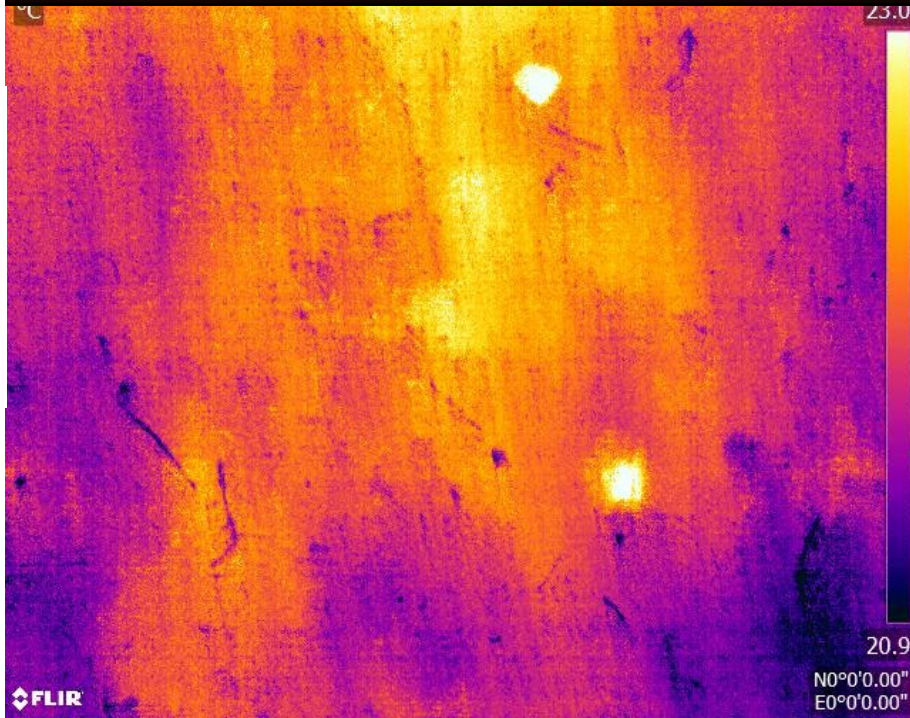
Time +/-10min *Temp.* UV index	PFM-1 (exposed)	Warhead (mostly covered)	TM-62 (buried)
18:40 *24* °C 1			
20:15 *22* °C 0			
21:40 *20* °C 0			
23:15 *20* °C 0			
01:25 *18* °C 0			
03:15 *18* °C 0			
04:45 *18* °C 0			











Humanitarian engineering

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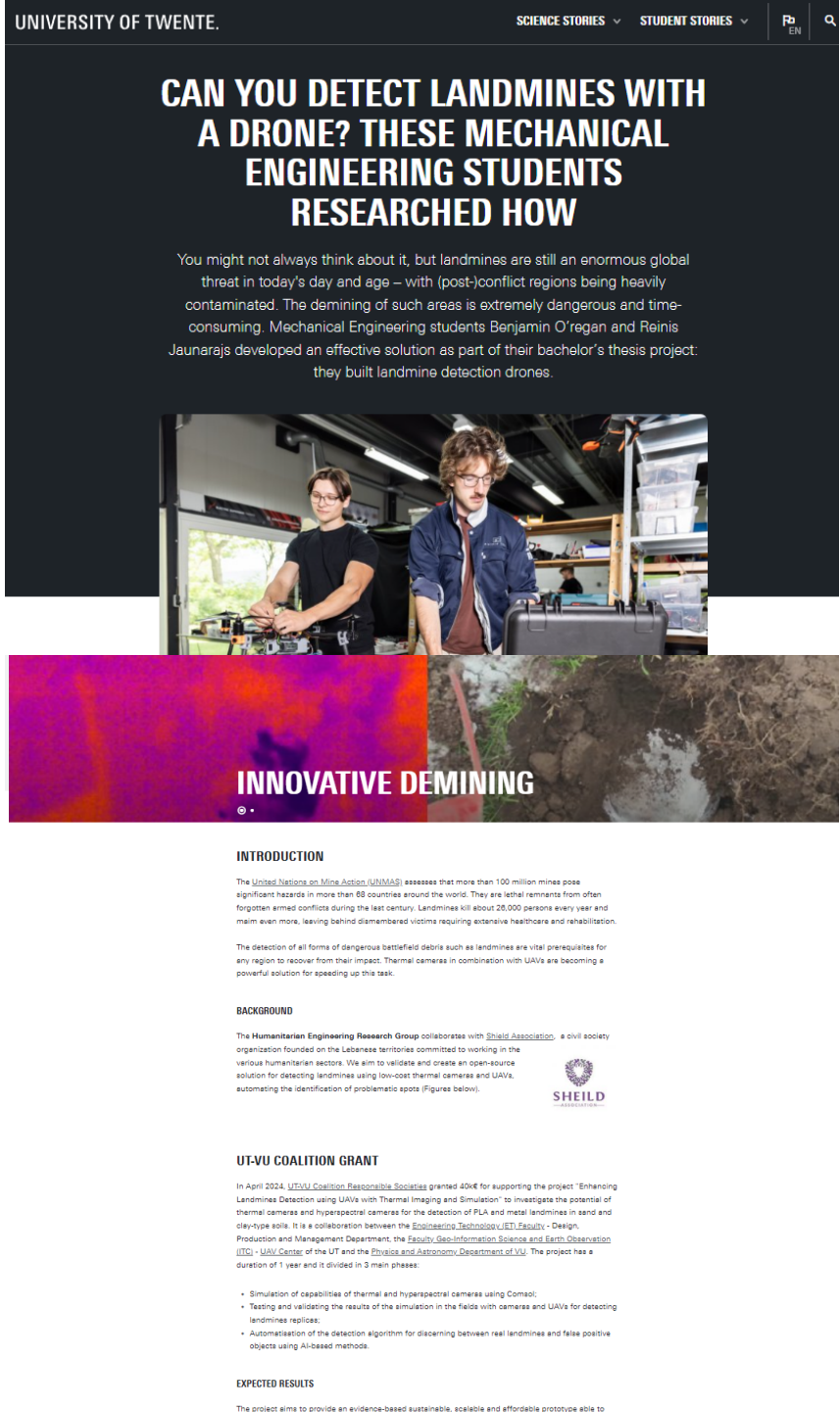
Next steps and dissemination

- *Ground Penetration radar test (3rd October 2024)*
- *Go beyond the detection space into the landmine removal space with robotics devices (due to travel limitation to Lebanon)*
- *Application to next grant money based on the results (i.e. UNMAS, EDF etc.)*
- *Research publication and open-source repository*



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CAN YOU DETECT LANDMINES WITH A DRONE? THESE MECHANICAL ENGINEERING STUDENTS RESEARCHED HOW

You might not always think about it, but landmines are still an enormous global threat in today's day and age – with (post-)conflict regions being heavily contaminated. The demining of such areas is extremely dangerous and time-consuming. Mechanical Engineering students Benjamin O'regan and Reinis Jaunarajs developed an effective solution as part of their bachelor's thesis project: they built landmine detection drones.

INNOVATIVE DEMINING

INTRODUCTION

The United Nations on Mine Action (UNMAS) assesses that more than 100 million mines pose significant hazards in more than 68 countries around the world. They are lethal remnants from often forgotten armed conflicts during the last century. Landmines kill about 26,000 persons every year and maim even more, leaving behind dismembered victims requiring extensive healthcare and rehabilitation.

The detection of all forms of dangerous battlefield debris such as landmines are vital prerequisites for any region to recover from their impact. Thermal cameras in combination with UAVs are becoming a powerful solution for speeding up this task.

BACKGROUND

The **Humanitarian Engineering Research Group** collaborates with Shield Association, a civil society organization founded on the Lebanese territories committed to working in the various humanitarian sectors. We aim to validate and create an open-source solution for detecting landmines using low-cost thermal cameras and UAVs, automating the identification of problematic spots (Figures below).

SHEILD

UT-VU COALITION GRANT

In April 2024, UT-VU Coalition Responsible Societies granted 40k€ for supporting the project "Enhancing Landmines Detection using UAVs with Thermal Imaging and Simulation" to investigate the potential of thermal cameras and hyperspectral cameras for the detection of PLA and metal landmines in sand and clay-type soils. It is a collaboration between the Engineering Technology (ET) Faculty - Design, Production and Management Department, the Faculty Geo-Information Science and Earth Observation (ITC) - UAV Center of the UT and the Physics and Astronomy Department of VU. The project has a duration of 1 year and it divided in 3 main phases:

- Simulation of capabilities of thermal and hyperspectral cameras using Comsol;
- Testing and validating the results of the simulation in the fields with cameras and UAVs for detecting landmines replicas;
- Automatisation of the detection algorithm for discerning between real landmines and false positive objects using AI-based methods.

EXPECTED RESULTS

The project aims to provide an evidence-based sustainable, scalable and affordable prototype able to

THANK YOU
FOR THE ATTENTION

ALBERTO MARTINETTI, FRANCESCO NEX, SVEN ASKES

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