Defence-related Research Action - DEFRA

ACRONYM: TaMaCare	
Title: Tactical Environmental Mapping for Battlefield Casualty Care	
Duration of the project: 01/12/2024 - 01/03/2028	**Budget: 941.812 €** **of which RHID contribution: 901.930 €**
Key words: victim tracking, threat detection, mapping	

PROJECT DESCRIPTION

Context

On the battlefield, injured soldiers can face significant delays in medical treatment or evacuation due to ongoing hostilities and treacherous terrain. Traditional methods of casualty care rely on limited information and may put medics at unnecessary risk: medics often lack a comprehensive picture of the battlefield, hindering their ability to locate and prioritise casualties while minimising exposure to threats.

TaMaCare emerges from this critical observation, aiming to revolutionise battlefield casualty care by creating a real-time digital twin of the frontline. More precisely, we aim to improve response times and decision-making in critical situations. The proposed digital twin aims to provide medics with a clear view of the battlefield, encompassing the location of injured soldiers, their vital signs, and any structures or potential dangers present in the vicinity.

Figure 1: Illustration of the proposed digital twin visualization

Objectives

TaMaCare focuses on situations where immediate evacuation is not feasible. The project's scope encompasses the development and integration of the following key functionalities within the digital twin:

- **3D Mapping:** Creating a highly accurate and detailed 3D representation of the battlefield environment, including buildings, roads, and other relevant features.
- **Casualty and Threat Detection:** Automatically identifying and locating injured soldiers and potential threats (explosive devices) through a combination of visible and infrared camera systems.
- **Real-Time Localization and Health Monitoring:** Establishing a network of Ultra-Wideband (UWB) anchors and tags to track the location of casualties in real-time and simulate a health monitoring system. With this data, the command post will have an annotated overview of the front-line, with the necessary situational awareness to plan and assess the intervention of the medics.

Figure 2. Example of multi-spectral (RGB, SWIR, LWIR) camera and LiDAR payload for object detection

Methodology

The successful implementation of **TaMaCare** hinges on a multi-pronged approach. At the core lies a consortium of leading experts from diverse fields. Robotics and 3D vision specialists from the RMA will contribute their expertise in 3D mapping technologies. Ghent University's Image Processing and Interpretation research group (IPI) brings a wealth of knowledge in image processing, computer vision, and positioning systems. Finally, Pozyx, a Belgian SME, provides its cutting-edge UWB localization solutions. This consortium is further strengthened by the inclusion of experienced military and civilian first responders who will act as advisors, ensuring the project remains grounded in real-world needs.

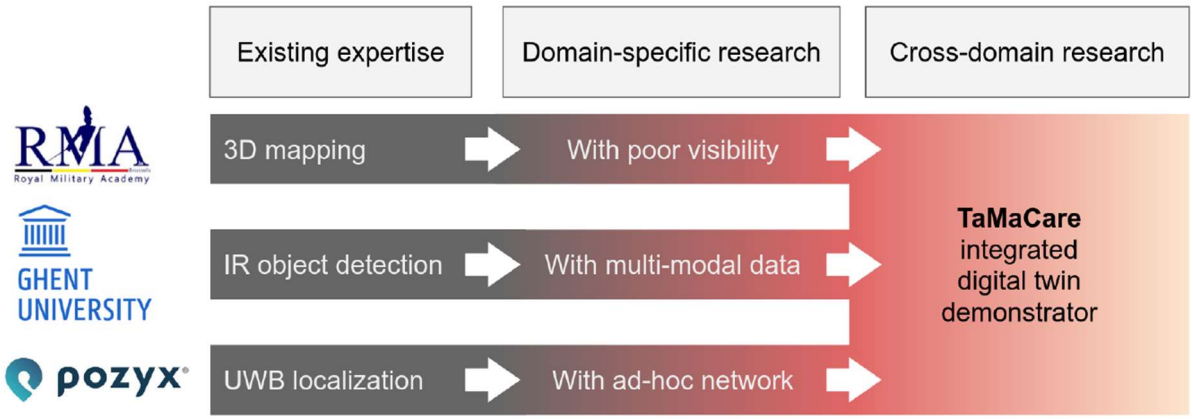

Figure 3: Proposed approach

To expedite development and facilitate rigorous testing, **TaMaCare** employs a modular research approach. The project breaks down into distinct subsystems. One subsystem concentrates on constructing a highly accurate 3D map of the battlefield with visible and infrared cameras (in the near, shortwave-and longwave-infrared spectrum), allowing operations during day-and nighttime. Another subsystem focuses on robust methods for casualty and threat detection, also using visible-infrared camera systems. Finally, a dedicated subsystem tackles the challenge of real-time localization and simulates patient health monitoring through a network of UWB anchors and tags. All subsystems will then be integrated in a portable rig for early tests, and on a ground rover later on. Integration tests will be performed at partner locations such as Belgian Defence's training compound in Marche-en-Famenne.

Expected Impact

The impact of **TaMaCare** on battlefield casualty care is multifaceted and far-reaching:

- **Faster and better decision making:** TaMaCare will create a digital twin of the battlefield for use by the rear echelon and decision makers, allowing faster response times and improved decision-making.
- **Reduced risk for soldiers and medics:** The digital twin will be created using unmanned systems, i.e. without putting soldiers in harm's way.
- **Post-action analysis:** The digital twin allows for an after action analysis of the decision and actions that were made, allowing to draw lessons for future interventions.

The benefits of **TaMaCare** extend beyond immediate casualty care and contribute to a broader strengthening of defence capabilities. The advancements in 3D mapping, threat detection and UWB localization will have broader applications for military and civilian operations and for intelligence gathering: planning for offensive/defensive operations, re-assessment of the geometrical environment after man-made or natural calamities, improved navigation of unmanned vehicles, removal of UXO/IED (Unexploded Ordnance/Improvised Explosive Devices), etc.

Expected Research Results
TaMaCare will plan several dissemination and outreach activities: journal and international conference publications, a final workshop for Belgian stakeholders (medical first responders), and continuous dissemination of the project milestones on the partners' websites.

Valorisation Perspectives
We foresee two main types of exploitation activities:

- **Non-commercial exploitation:** results will be sustained and leveraged through submission of follow-up projects with various sources of national and international funding.
- **Commercial exploitation:** the institutional partners will exploit their research results preferably through non-exclusive licensing models (under patent rights).

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