Information Technologies Institute

ALADDIN

CERTH
CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

European Commission | Horizon 2020 European Union funding for Research & Innovation

ALADDIN

Advanced ho**L**istic **A**dverse **D**rone **D**etection **I**dentification & **N**eutralization

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AGENDA

- Introduction
- Project description
- System description
- Progress - achievements
- Next Steps

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INTRODUCTION

Where does it come from?

RESPONSE TO CALL

- Secure societies – Protecting freedom and security of Europe and its citizens
  - Fight against Crime and Terrorism
  - Detection and neutralization of rogue/suspicious light drone/UAV flying over restricted areas, and involving as beneficiaries, where appropriate, the operators of infrastructure

- Develop a state of the art counter-UAV platform
- Start in September 2017
- Duration : 36 months – 3 years
- Nature of the topic: terrorism and organized crime activities

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PROJECT DESCRIPTION

What is it about?

ACTION / PROJECT MAIN OBJECTIVES

- Study and develop a state-of-the-art, global, and extensible system to
  - Detect, Localise, Classify, and Neutralize :
    - suspicious, and potentially multiple, light UAVs over restricted areas
- Build a Counter-UAV system
  - Using BOREADES as the foundation
- Take into account Operational Constraints
  - Ease of use and deployment,
  - Quality of detection
  - Safety
- Provide tools for operational support
  - Investigations
  - Training

OTHER OBJECTIVES

- Assess
  - Relevant technology
  - Threat trends
  - Regulations
  - Societal, Ethical and Legal (SoEL) frameworks
- Develop new knowledge for
  - LEAs,
  - Infrastructure designers, constructors, and operators
- Develop innovative Curricula
  - E-learning
  - On site training

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CONSORTIUM

Who is involved

CONSORTIUM – 18 PARTNERS

- 3 Industrial leading companies
  - Diginext (DXT), CS, IDS
- 3 Innovative SMEs
  - SIRC, MC2, HGH
- 3 European Technical Research Centres
  - CERTH, Fraunhofer IDMT, PIAP
- 1 European Aeronautic Expert Centre
  - FADA CATEC
- 1 European Research Centre and Academic Institute
  - VUB
- 1 World-class Infrastructure company
  - Acciona Construcion
- 6 LEAs (End Users) : KEMEA, CAST/DSTL, MIF, PJ, MIPS, ADM

CONSORTIUM – EUROPEAN DIMENSION

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IMPLEMENTATION

How is it implemented

WORK PACKAGES

- WP1 - Project Management (DXT)
- WP2 - Dissemination & Exploitation Preparation (IDS)
- WP3 - Societal, ethical, and legal aspects (VUB)
  - Including WP10 – Ethics requirements
- WP4 - Mission, Operational & System Requirements (CS)
- WP5 - Detection, Localisation, and Classification (IDS)
- WP6 – Neutralisation (FADA)
- WP7 - Advanced C2 and Support to Operations (DXT)
- WP8 - Iterative System Integration and Verification(CS)
- WP9 - Curricula, Training, Pilots, and Evaluation (KEMEA)

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SENSING MODALITIES

1

- 2D Radar modality
- 3D Radar modality
- Optronic modality
- Thermal modality
- Acoustic modality

2D RADAR MODALITY

- ALADDIN's 2D long range radar will be a low-probability-of-intercept (LPI) frequency modulated continuous wave (FMCW) architecture manufactured by IDS
- Observer is a Range – Doppler Surveillance Radar that offers, Multi-Target Search, Detection and Tracking of small/mini class drones (Fixed or Rotary)

Observer Features

Waveform Type	FMCW
Azimuth Coverage	360°

IDS
INGEGNERIA DEI SISTEMI

3D RADAR MODALITY

- 3D medium-range radar prototype has been designed and implemented by SIRC. It is FMCW AESA type radar
- 3D radar processing and MHT tracker have been implemented, radar box has been prototyped and the radar has been extensively tested in field

THERMAL MODALITY

- ALADDIN's thermal modality will be based on two rotating infrared cameras, manufactured by HGH

- Features:
  - Panoramic 360° images

- ALADDIN's infrared modality will:
  - provide a 360° coverage of the surrounding area
  - Thermal-> enable optical operation of the system during the night

HGH Infrared Systems

OPTRONIC MODALITY

- ALADDIN's optical modality will be based on a Pan-Tilt-Zoom (PTZ) visual camera, manufactured by PIAP

- Features:
  - optical zoom
  - 360° in pan and tilt

- ALADDIN's optical modality will focus on targets and assist in target verification

ACOUSTIC MODALITY

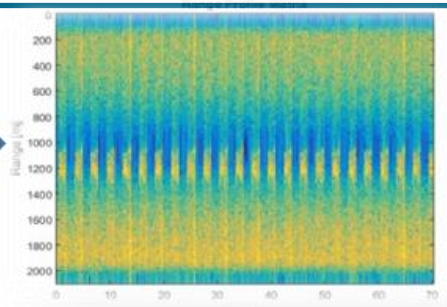
➔ Remote intelligent acoustic sensors for UAV detection

- Exchangable recognition modules (Machine Learning)
- High quality robust multichannel audio frontend
- Wireless communication with variable interface
- Detection & Localization of UAV
- High scalability, high mobility, battery driven

Fraunhofer IDMT

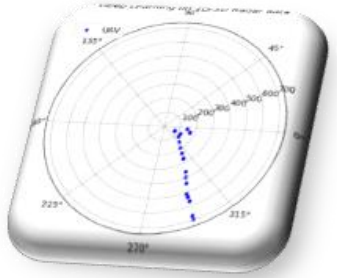
UNIMODAL DEEP LEARNING ANALYSIS

2D Radar

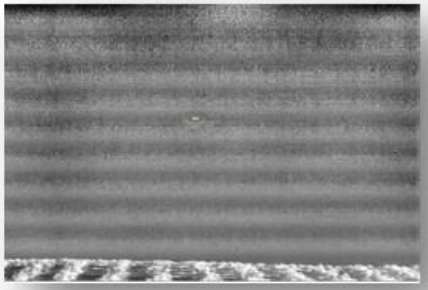


Deep Learning

Detection + Localization + Classification

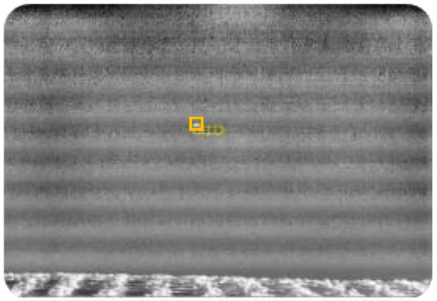


Thermal Camera



Deep Learning

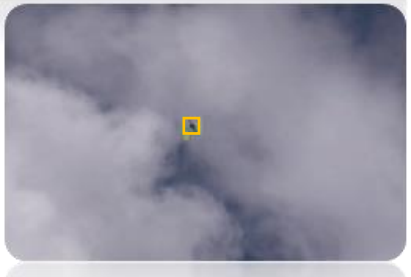
Detection + Localization + Classification



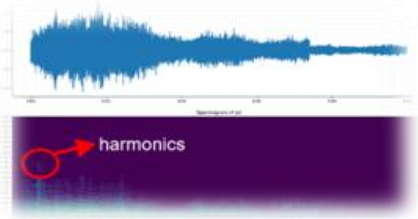
PTZ Camera

Deep Learning

Detection + Localization + Classification



Microphone Array



Deep Learning

Detection + Localization + Classification

UAV
fixed/rotary wing
Not Drone

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MULTIMODAL INFORMATION FUSION

2

- Simple fusion
- Multimodal Deep Learning (DL) fusion

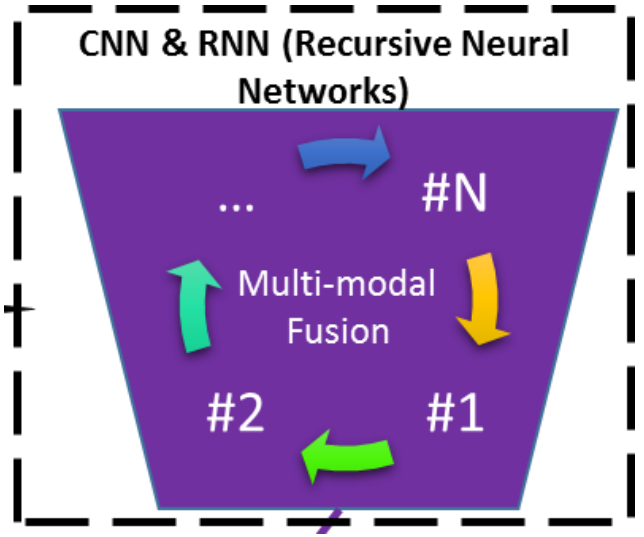
SIMPLE FUSION

- Command & Control system is able to receive various sensors tracks
- To present a clear situation, these tracks are fused
- The displayed track is a balance between these different sources

DEEP LEARNING FUSION

- Fusion Component Architecture
  - Three input streams
    - Infrared features input stream
    - Optro features stream
    - 2D radar localization information input stream
  - One output stream with increased confidence value (depending the amount of sensors detecting the drone)

- Features extracted from Unimodal DL networks are passed to Fusion DL networks that classify potential UAV threats



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COMMAND AND CONTROL – C2

3

- C2 overview
- C2 functionalities

C2 – COMMAND AND CONTROL

- Situation presentation
- Rising alarm in prohibited area
- Automatic aiming of Camera and Jammer
- Intruder tracks management
- Neutralization authorisation and control

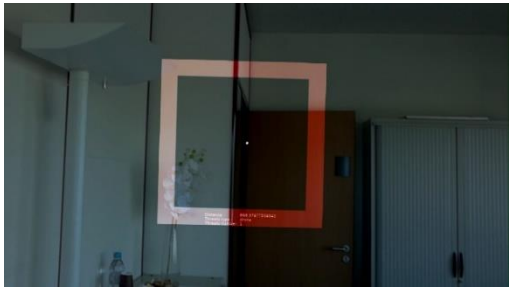
In the final version

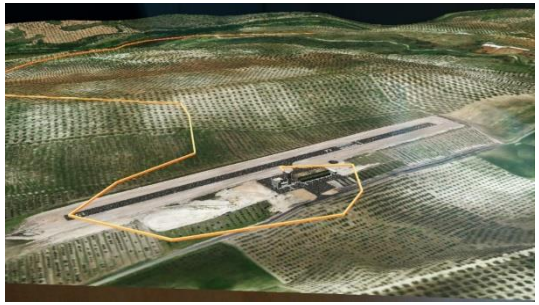
- Devices supervision
- Able to define different kind of area

MIXED REALITY MODULE

- A Mixed Reality (3D and Augmented Reality) interface to enhance the operation
- By relieving the user from the “mental distance” between the situation represented on the screen (usually on a top-down 2D map) and the real world he perceives through her/his eyes.

- Using HoloLens Device
  - To display head-up information and enable faster visual tracking and/or eye contact with the target
  - To display a 3D mock-up of the site to protect, enriched with deployed sensors information and incoming threats.





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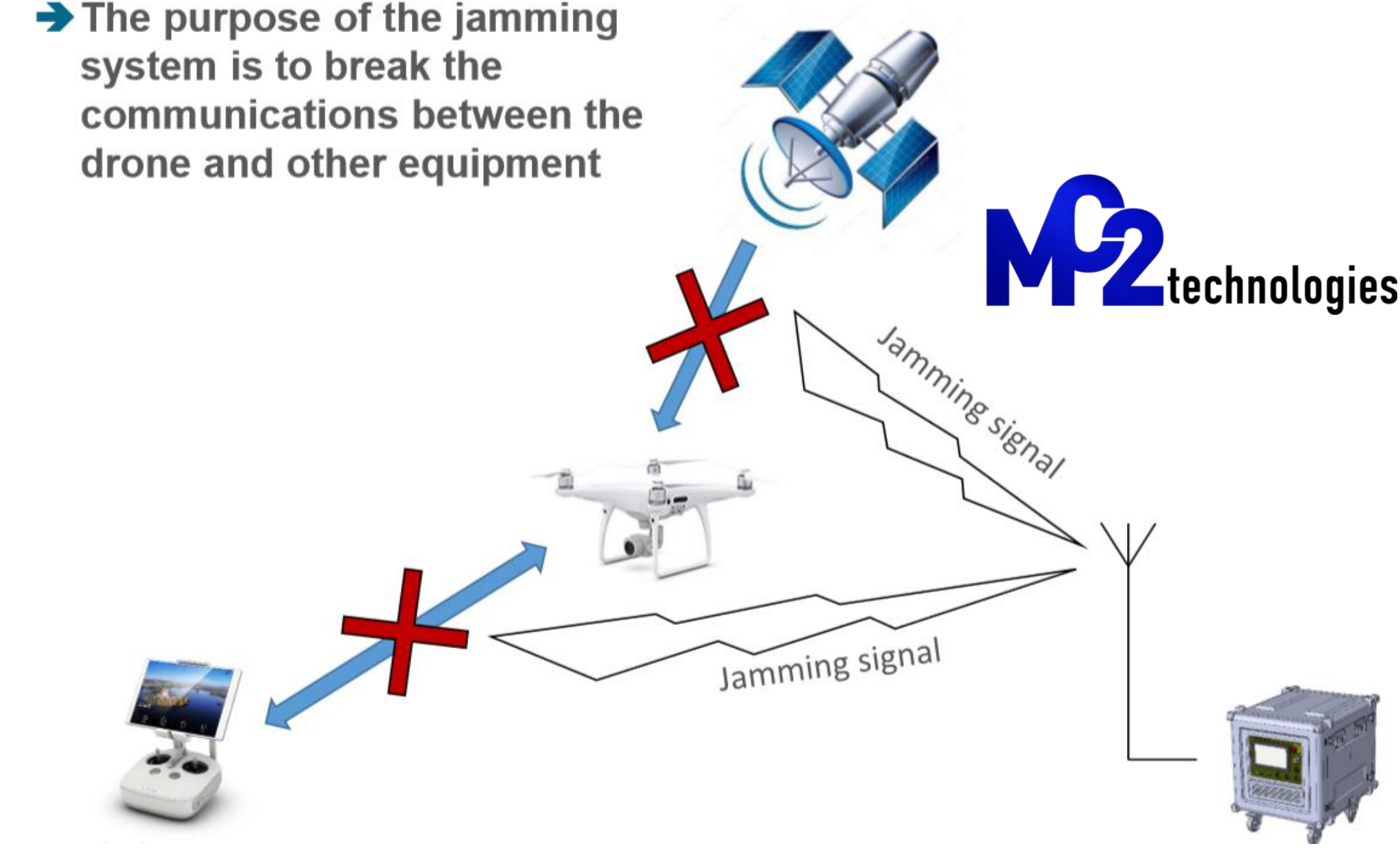
NEUTRALISATION

4

NEUTRALISATION – JAMMING SYSTEM

- The purpose of the jamming system is to break the communications between the drone and other equipment



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PROGRESS

Where are we?

ACHIEVEMENTS

- Beta version integrated and tested in open-field environment
- Successful End Users Training, pilots experiments and demonstration on 7 February in Spain
  - 80+ attendees
- Main objectives for Beta version achieved
  - Smart Objectives KPI described

NEXT STEPS

What's next?

NEXT PERIOD

- Start of second iteration - March 2019
- Finalisation of final platform - March 2020
- Integration, test and evaluation - May 2020
  - Demonstration

END OF INTRODUCTION PRESENTATION

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➔ Questions / Answers

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DIGINEXT be visionary

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Fraunhofer IDMT

PIAP

VUB VRIJE UNIVERSITEIT BRUSSEL

CS

IDS INGEGNERIA DEI SISTEMI

SIRC Sensing and Imaging Research Center

M2 technologies

HGH Infrared Systems

FADA FUNDACIÓN ANDALUZA PARA EL DESARROLLO AEROESPACIAL

KEMEA CENTER FOR SECURITY STUDIES

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