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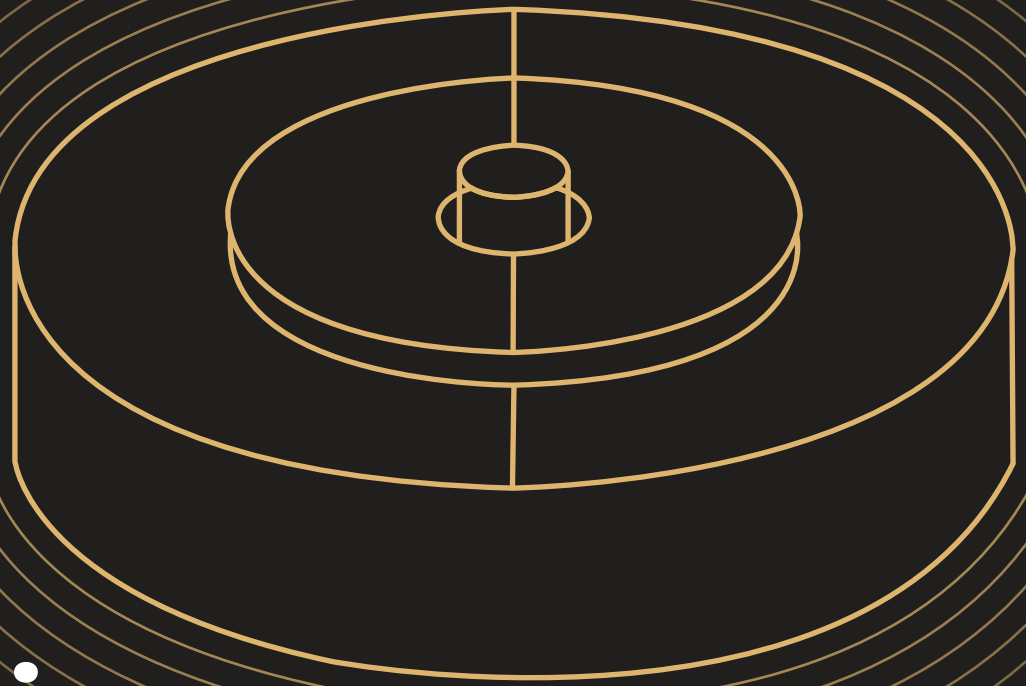


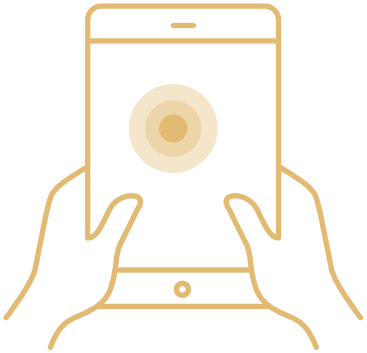
ZPOKEN
Mines Detection

Abstract

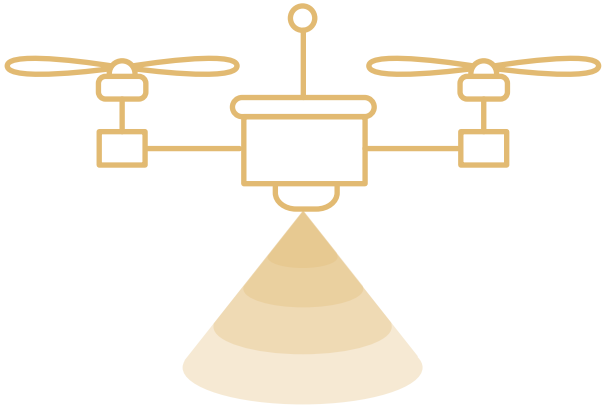
Explosive landmines have cost the lives of hundreds in several countries. This presentation describes a technology of a fast and low cost solution that consists of mobile applications and unnamed aerial vehicle software used as a complemented tool for landmine visual detection in rural scenarios. Based on visual feedback from the onboard camera, algorithms for landmine detection are applied. Technology covers also the design, implementation and integration of a ground penetrating radar (GPR) using a software defined radio (SDR) platform into the aerial drone.

Landmines Detection

Zpoken Landmines Detection is a software complex for mines detection and collecting this data.



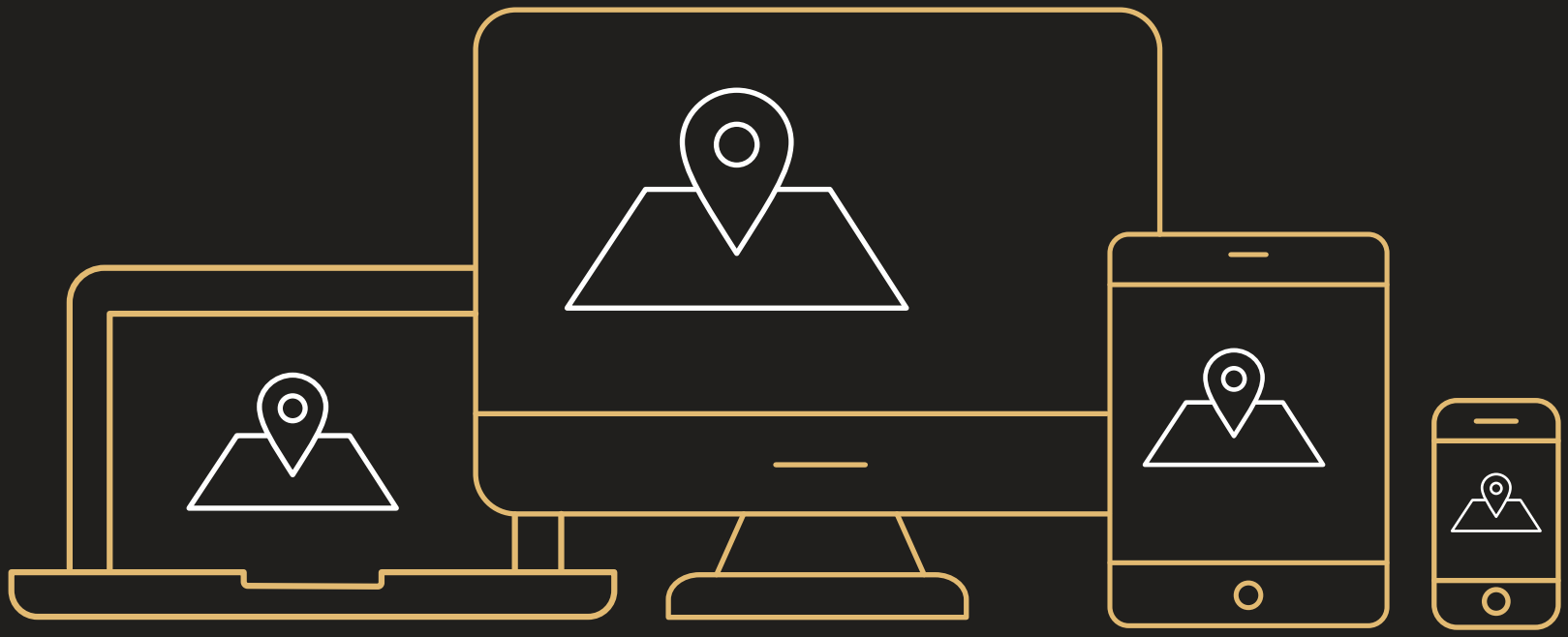
a. On the ground (mobile scaner)



b. From the air (UAV)

Data Visualization

After scanning the data is available for the operator

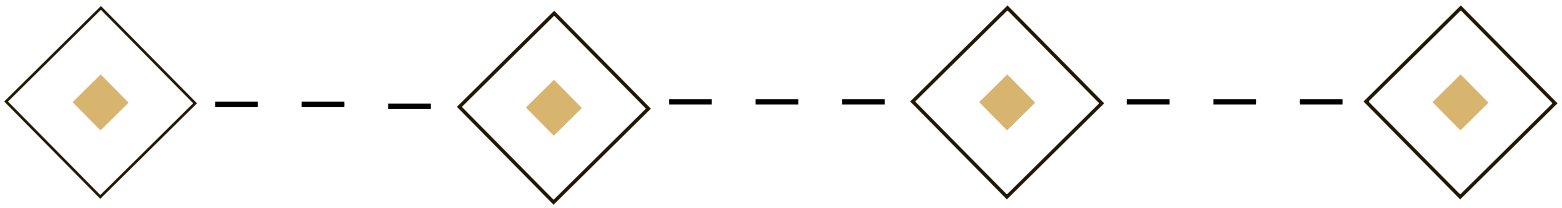


Mobile Scanner

Mobile scanner – is a mobile application used for real-time landmines definition. App runs on tablet device using camera and image recognition to match the image with database.

Mobile Scanner

Workflow:



Operator
see the mine

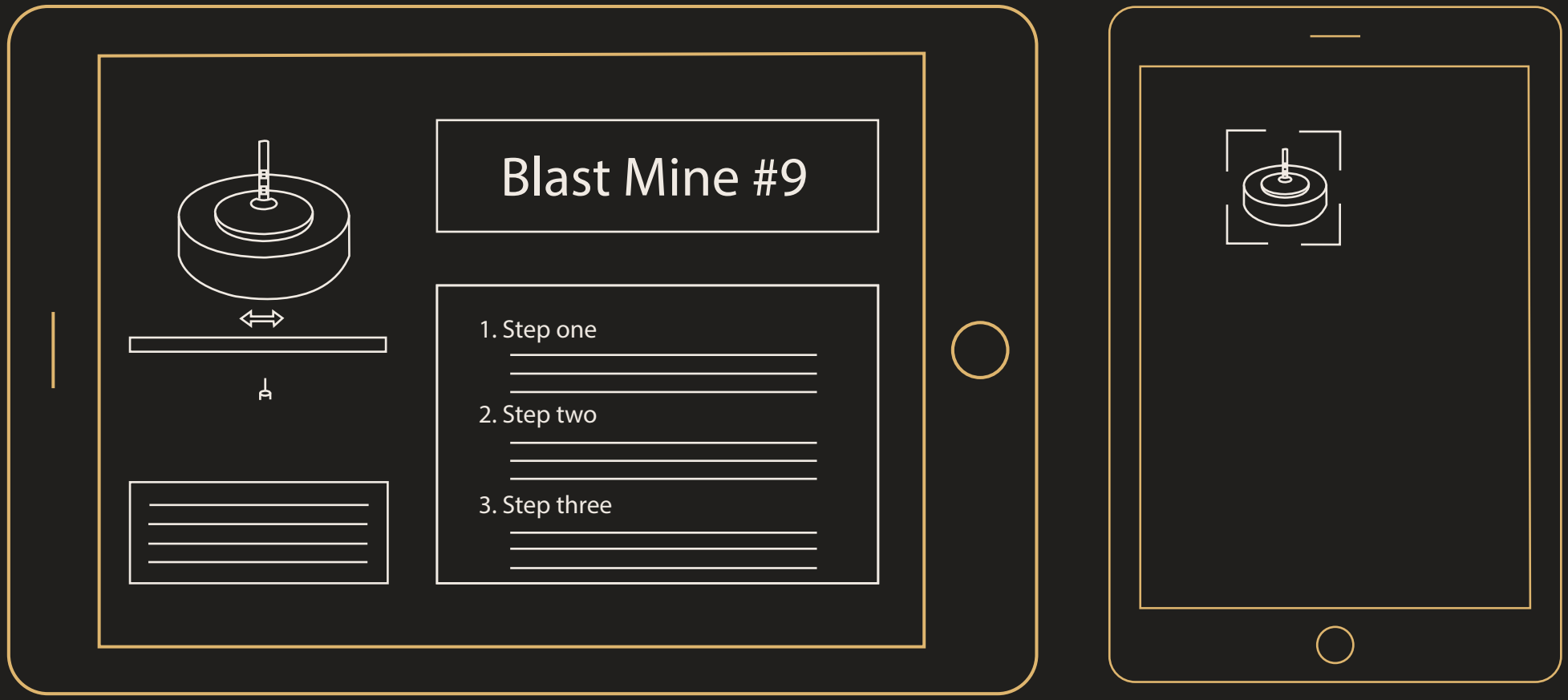
Launches the
app on
the tablet

Points the
camera at the
mine

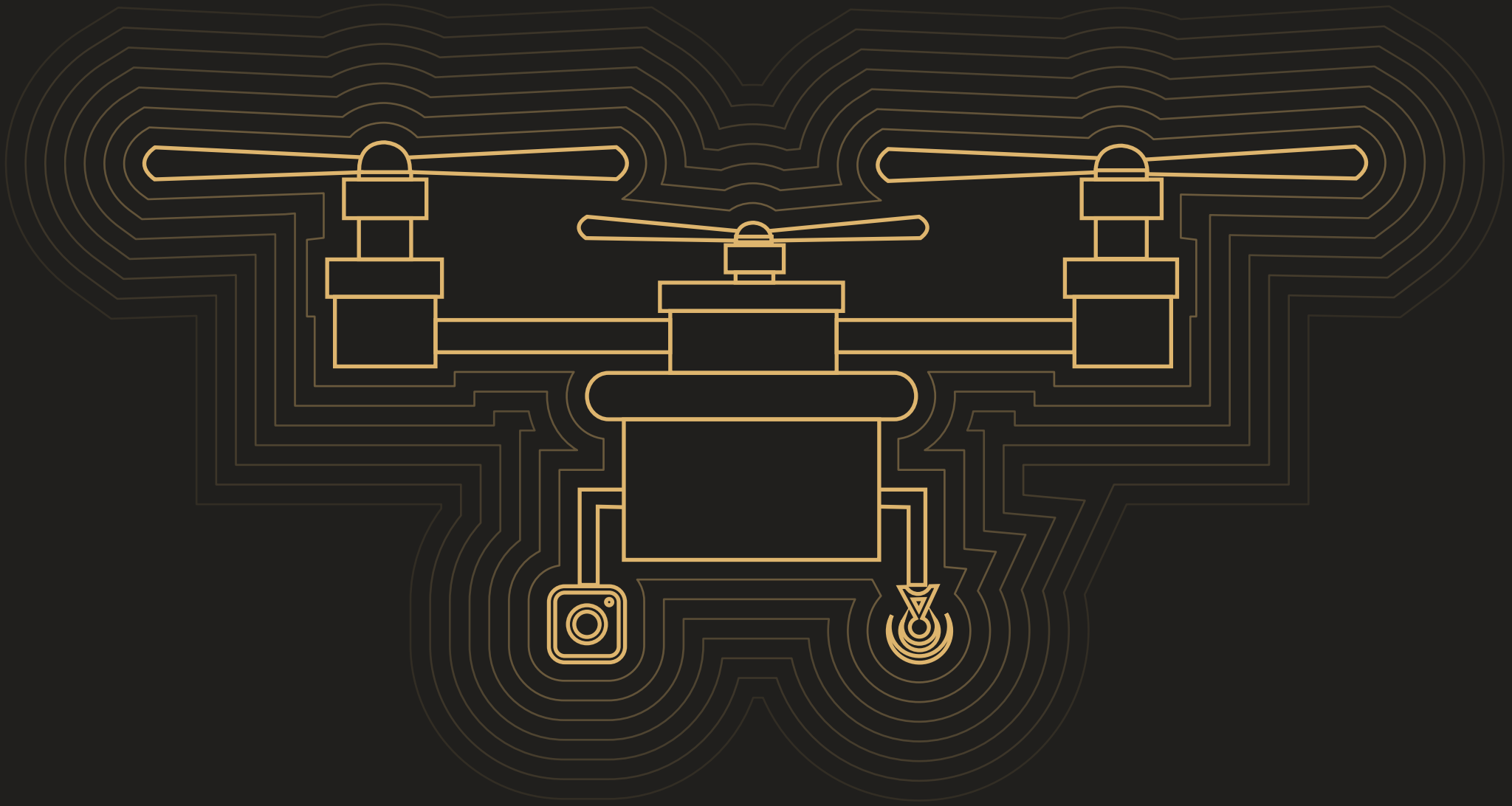
Gets the description of this
mine and instructions how
to deactivate it

Mobile Scanner

Mobile Scanner



UAV complex

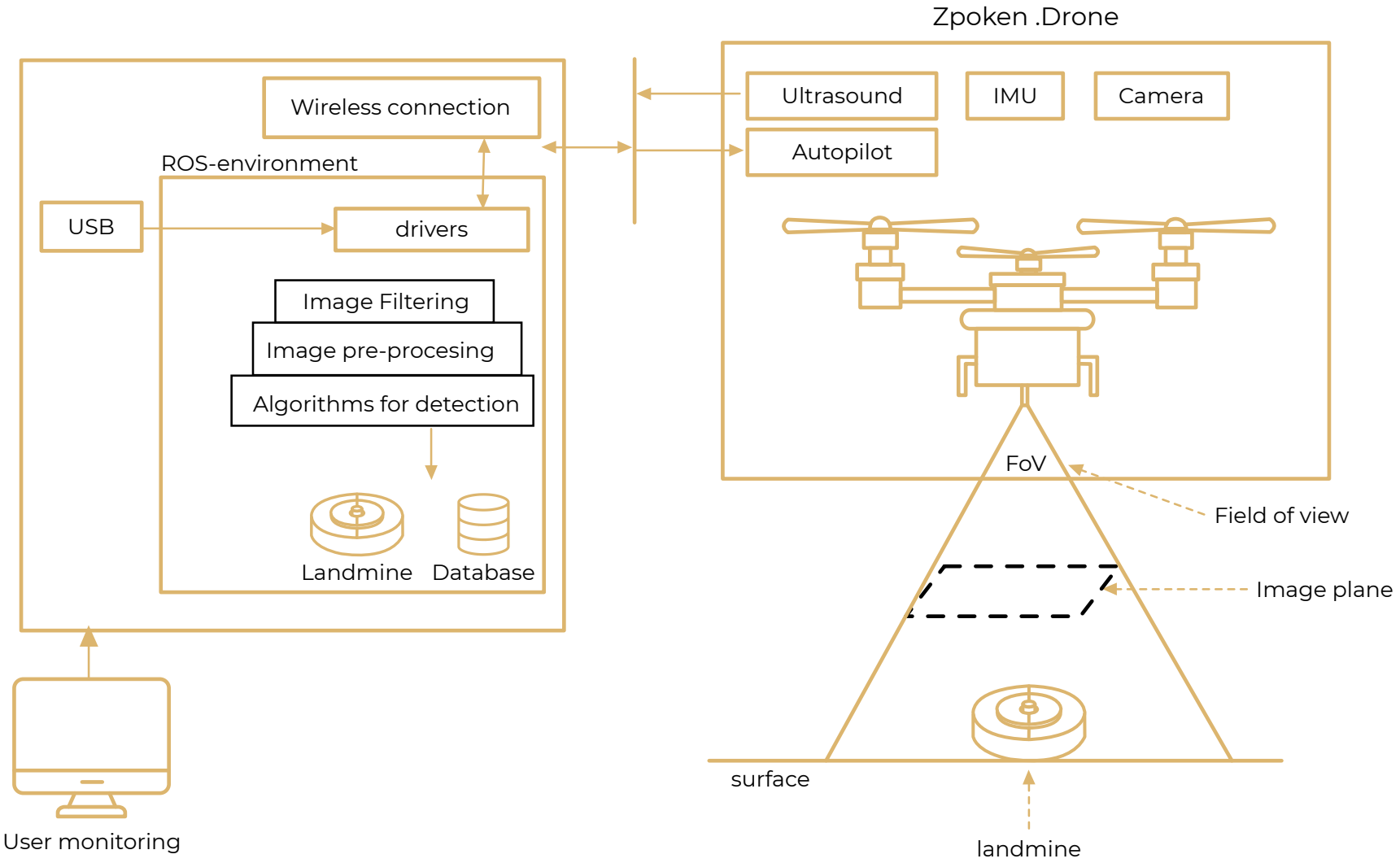


UAV complex

Unmanned aerial vehicle is able to autonomously cover a larger area of any type of terrain in less time and without compromising the mission. It can be also used as a remote sensing platform for collecting key information about the terrain. Terrain information can be acquired using visual methods based on target localisation, tracking and image mosaicing techniques which might provide a better understanding about the area to be covered. The UAV is remotely controlled from a base station that uses the Robot Operating System (ROS) environment for handling wireless communication, remote operation, flight control, image acquisition, filtering, pre-processing and the final landmine detection

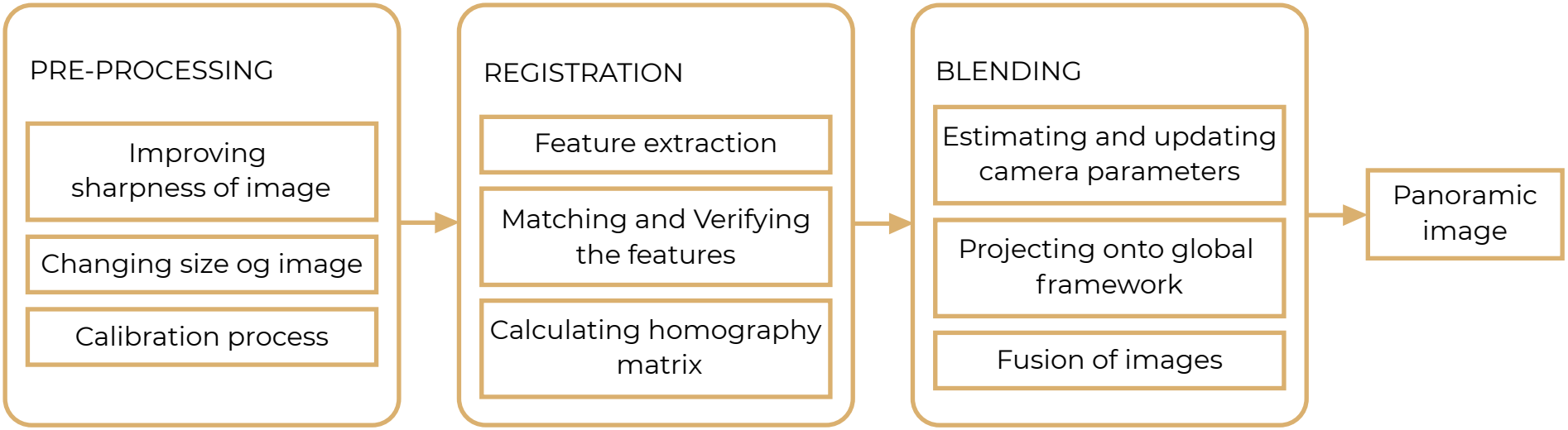
The Architecture of UAV

ZPOKEN UAV software and a base station that handles both flight control and the landmine detection algorithms. The flight control is integrated with ROS whereas the landmine detection process is carried out by a set of algorithms that require an image captured by the bottom camera onboard the drone.

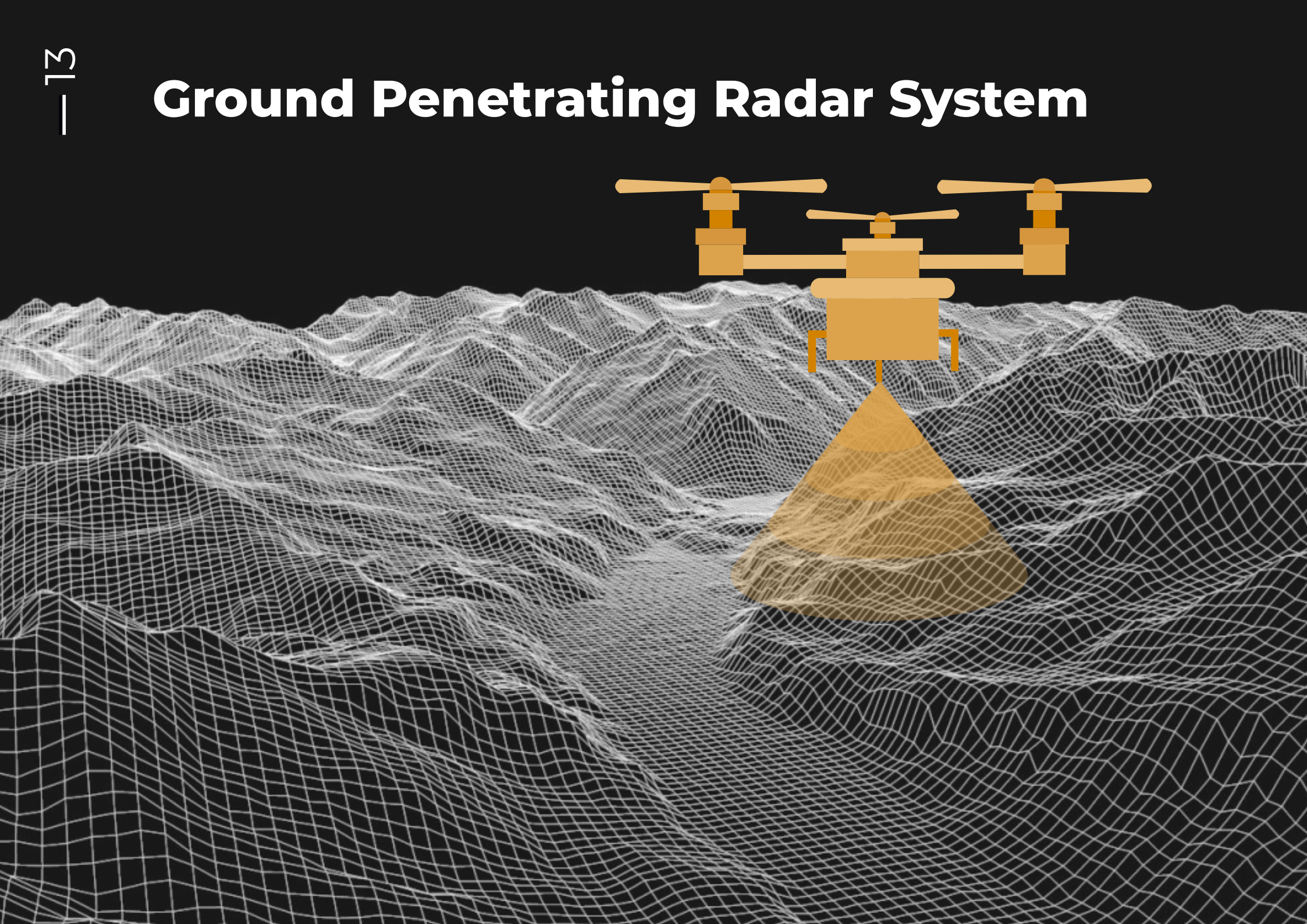


The Architecture of UAV

The visual algorithm is composed by three steps:
a. noise filtering
b. feature extraction
c. image classification

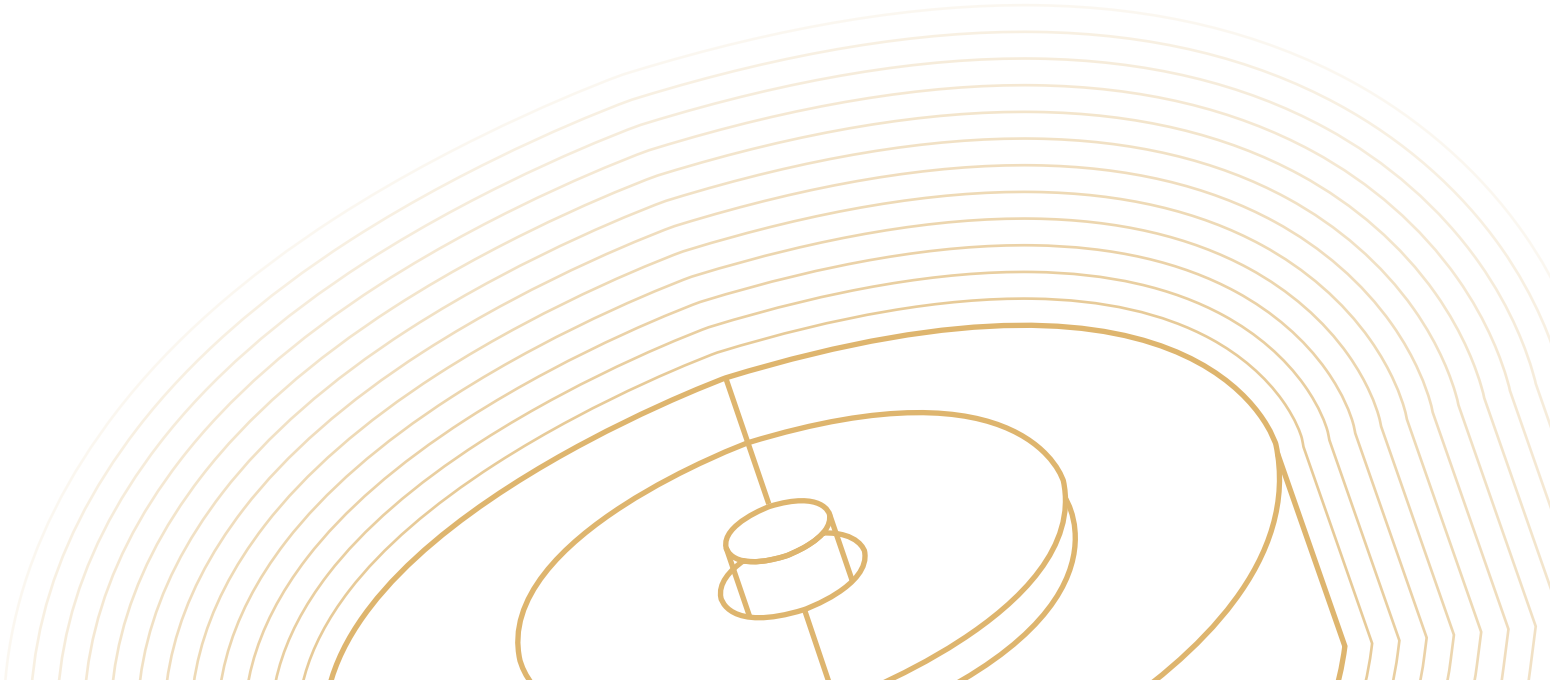


Ground Penetrating Radar System



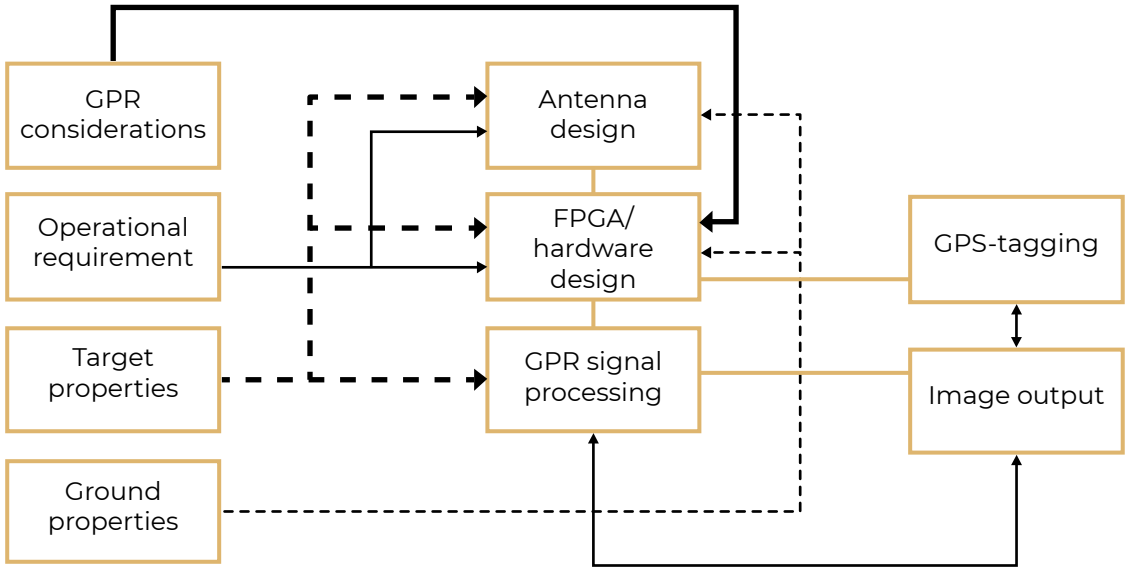
Ground Penetrating Radar System

The GPR hardware system based on UAV is composed by two main blocks, the transmitter (TX) and receiver (RX). The TX module generates the pulse, which is then shaped by a root-raised cosine filter in order to reduce the frequency bandwidth of the signal due to the restrictions of the platform itself. The pulse modulates a carrier that is finally transmitted to the USRP platform to being radiated by the TX antenna. The radiated modulated pulse travels along the path air-soil, and in case of detection, there is a reflected wave, which is sensed by the RX antenna. The RX system down-sampled the signal. The amplitude and delay of the received signal are then post-processed aimed at generating the heat map.



Ground Penetrating Radar Architecture

In the first place, the technical specifications of the GPR are defined by taking into account the operational requirements, such as signal frequency operation and bandwidth, propagation speed in different media, noise, etc. Also, it is considered how the aforementioned variables might be affected by the target and material properties. This analysis enables to define and design criteria for developing the antennas, the required hardware and the signal processing algorithms. Finally, GPR storage and visualisation process refer the way how information is stored and presented to the final user.



UAV complex

Workflow:

1. The operator selects the GPS coordinates of the starting point of the mission.

2. Before proceeding to real mission, the operator starts the simulator in order to verify that the drone is able to operate at the desired altitude and speed.

3.Once the mission is validated, the operator sends the mission parameters to the drone, including list of trajectory waypoints, commanding height and speed and GPR configuration parameters and drone starts.

4. Once the drone finishes the mission, the drone sends all data to the base station.

5.Within the base station, the operator can visualise Image Recognition and GPR results and the geo-mapped terrain.

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