This is the template for the 1 page proposal (500-600 words) that presents a solution (new usage or suggest improvements on a new technology).

If your proposal is selected for the second stage of the Challenge, you will be asked to expand the description to 10 pages (5000-6000 words) which should be a development of the previously submitted proposal.

IMPORTANT: Students are strongly encouraged to team up in pairs, finding a partner in a different university or country. Teams will get an additional point in the final score.

A fresh view is valued. Please, defend your proposal by including not only technological, but also socio-economic, political, ethical and/or environmental aspects.

SEND TO: challenge@assets-plus.eu

Participant # 1

Name Radosław Ciećko

University Rzeszow University of Technology

Country Poland

Email 167470@stud.prz.edu.pl

Participant #2

Name Matylda Iwanicka

University Rzeszow University of Technology

Country Poland

Email 167493@stud.prz.edu.pl

Subject/title: The concept of ultrasonic mine detection

The concept of ultrasonic mine detection is based on using advanced acoustic technology to identify hidden explosive charges. This innovative approach uses ultrasonic sensors, drones and artificial intelligence (AI) to provide a safer and more effective method of mine detection compared to traditional techniques.

At the core of this concept is the use of an acoustic defectoscope. This device generates sound waves that penetrate the ground in a designated area. When the sound waves hit an anomaly, such as a mine, they are reflected back to the defectoscope. The defectoscope then records these reflections. With information from several sensors, the exact location of the anomaly's occurrence can be determined and the type of material it is can be identified.

This method offers a significant advantage over conventional metal detectors, which can only identify metallic objects. Since many modern mines are made of non-metallic materials, conventional detectors are often unable to locate them. Ultrasonic waves, however, can detect these non-metallic mines by identifying discrepancies in the density of the materials they pass through.

The ultrasonic mine detection system consists of several key components:

1. Ultrasonic sensor: the basic detection device is a microsonic sensor. It is responsible for emitting and receiving ultrasonic waves.
2. Microcomputer: Each sensor is equipped with a microcomputer, for processing the data collected by the sensor.
3. GNSS GPS module: A GNSS GPS module with receiver, is included to provide precise localization.
4. Wireless Module: A wireless communication module, allows the sensor to transmit data back to the control unit.
5. Battery: A 2000 mAh battery, that powers the sensor.

The sensor's case contains electronic components made of fiberglass and a steel pin that will allow the sensor to be driven into the ground.

The detection system also involves drones for sensor deployment and retrieval. Two types of drones are used::

1. Transport drone: the Dji Flaycart-30, with a lifting capacity of 40 kg, will be used to transport sensors and precisely deploy equipment in the field by dropping them so that they penetrate the ground.
2. A drone with a grappling arm: this drone is responsible for picking them up after use and returning to the starting point to reload the transport drone.

A heavy-duty field computer, such as the Dell 5424, serves as the operation's control unit, handling data collection and processing.

AI plays a key role in this system. The AI model is trained to analyze complex patterns in ultrasonic data and distinguish real signals reflected from mines from false alarms caused by rocks, roots or other terrain features. This capability greatly increases the accuracy and reliability of mine detection.

The operational method includes several steps:

1. Deployment: Drones drop ultrasonic sensors over a designated area. The flight path is carefully planned to ensure comprehensive coverage.
2. Detection: Once deployed, the sensors emit ultrasonic waves. When these waves encounter a mine, they bounce back to the sensor.
3. Data processing: The data collected by the sensors is sent wirelessly to a field computer. An artificial intelligence system processes this data, filtering out noise and identifying the presence of mines.
4. Retrieval: After the detection operation, the grappling-arm drone retrieves the sensors and returns them to the starting point for reloading.

This method allows for rapid and extensive coverage of large areas, significantly reducing the time and risk associated with mine detection operations.