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UNEXUP, towards the exploration of underwater environments with a robotic solution

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UNEXUP is a project co-funded by EIT RawMaterials that started in January 2020 and will be concluded in December 2022. The main objective is to develop, test, and commercialize a novel robot-based technology to survey flooded mines and other underwater structures. The robots are equipped with geoscientific and navigation instruments that allow the collection of valuable data from sites that cannot be assessed without human risks or high investments for dewatering, for example.

This technology was initially developed during the H2020 UNEXMIN project – UNEXUP predecessor, during which three (UX-1) robots were built and tested in five different underwater sites in Europe with increasingly challenging conditions. From the lessons learned on these pilot tests, the engineers collected crucial points for improvement – in close connection with the feedback and requirements from potential users of technology.

In UNEXUP the objective is to build two new robots, with improved software and hardware compared to the previous generation, and to launch them to the market as a commercial service. The first robot, UX-1Neo, was developed in 2020; while UX-2 will be ready in 2022.

UX-1Neo is the upscaled version of the UX-1, equipped with improved navigational and geoscientific instruments and sensors. The upscaling robot has performed four field missions in 2021 – ranging from flooded mines, a water well, and an underwater cave.

The field missions proved the added value that the technology can provide to the mining community and other sectors involving underwater structures. UX-1Neo is a modular vehicle, ca. 90 kg, with swappable batteries, autonomy of approximately 9 hours, and depth capacity of 500 m. An IMU and DVL support the navigation of the robot, to measure the position and depth during the missions. The multibeam (1) and scanning sonars (2) allow the robot to map close, mid, and long-range cavities, and to detect and avoid obstacles in the environment. In addition, the robot is

equipped with six SLSs (Structured Light Systems) for more detailed mapping when visibility and turbidity allow. Six cameras – natural light – allow the visualization of the environment and identification of rock types and geological structures. The motion control is supported by eight thrusters, and a mechanical pendulum, for pitch position lock.

The geoscientific instrumentation in UX-1Neo includes a hyperspectral unit, water sampler unit, water chemistry unit (pH, oxygen concentration, EC, temperature, pressure), sub-bottom profiler and a fluxgate magnetometer. This payload allows geoscientists to collect and interpret spatial and geoscientific data from underwater sites.

UX-2 is being developed with increased modularity and depth range compared to UX-1Neo, and some instruments and sensors in UX-1Neo were designed to be compatible with UX-2. It will have higher Technology Readiness Level; and a rock sampling unit supported by a robotic arm. Therefore, the UX-2 will be able to perform in even more challenging environments – broadening the applications of the commercial service – and extending its reliability to perform.