UNEXMIN DELIVERABLE D1.1

UX1 ROBOTIC PLATFORM PROTOTYPE REQUIREMENT SPECIFICATION

Summary:

This requirement specification document is based on analysis and synthesis of UX1 end user requirement specification and limits of available technology. It identifies most essential technical design requirements and specifications to be used throughout the prototype design and provides unambiguous engineering metrics for their measure.

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Acronyms and Abbreviations:

SONAR	Sound navigation and ranging
LIDAR	light detection and ranging
INS	Inertia navigation system
DVL	Doppler velocity log

1 Introduction

UX1 prototype technical design requirements and specifications are set by constraints and requirements given in UX1 end user requirement specification and limits of available technology. This requirement specification document is based on analysis and synthesis of them.

1.1 Description of UX1 and its mission

There are number of abandoned old flooded mines in Europe, with inadequate information of their current status. Exploring and surveying such mines is both infeasible and hazardous for humans. UX1 is an autonomous robotic platform for survey and exploration of such mines. UX1 is to autonomously explore and survey such mines in order to provide high resolution data and information from these inaccessible environments.

1.2 Scope of this report

This report identifies most essential technical design requirements and specifications to be used throughout the prototype design of UX1 and provides unambiguous engineering metrics for their measure.

2 Prototype technical requirements and specifications

Table below contains prototype technical requirements and specifications for UX1. Requirements and specifications are classified as demands and wishes depending on their importance. Items classified as demands must be complied in in order to meet end-user requirements.

Table 1 Technical requirements and specifications

	Demand/ Wish	Item	Responsible
Performance	D	Max operating depth: 500 m	
	D	Speed: 2 km/h (max. continuous)	
	D	Five hour independent operation time	
	D	Manoeuvrability – Able to manoeuvre out of dead ends without turning	
	D	Able to manoeuvre in vertical shafts	
	D	Able to manoeuvre in horizontal tunnels	
	D	Able to manoeuvre in long large diameter galleries	
	W	Able to manoeuvre in open pits without assistance	
Structural Design	D	Geometry: Spherical, Diameter < 60 cm	TUT
	D	Total dry weight: < 113 kg	
	W	Streamlined	
	D	Design safety factor = 2	
	D	Test pressure: 60 bar	
	W	Design safe life > 1000 missions to max. depth	
	D	Acid resistant materials	
Controller Unit	D	Geometry: < 300170✖ 80mm	TUT
	W	Weight: < 4 kg	
	D	Operating voltage: 12 < VDC< 24	
	W	Interfaces: Ethernet, UDP, RS232, USB, TTL, AI/O	
	D	Controller unit must be able to self-recover in case of software crashing or hang-up	
Propulsion System		Thrusters:	TUT
	D	Geometry: < 150 (L) ✖ 110 (D) mm	
	D	Weight: < 0.5 kg / unit	
	D	Operating specification: 1.4 N < Thrust < 5 N	
	D	Operating voltage: 12 < VDC < 24	
	W	Quantity: Optimal configuration of thrusters to maximize manoeuvrability and minimize drag	
		Ballast system, pump:	
	D	Operating voltage: 12 < VDC < 24	
	D	Weight: < 2 Kg	
		Ballast system, bladder:	
	D	Volume: 5 l	
	D	Weight: < 6 Kg	

Navigation and mapping	D W D D D D D D D	System total weight: 15 kg 3D acoustic camera SONAR Laser structured light (for LIDAR) 360 degree beam light EO camera DVL with fluid flow measurement capability (abs.velocity) INS Operating voltage of all equipment: 12 < VDC < 24	INESC & UPM
Batteries	D D D D D D D D D W	Quantity: 4 - 5 units Geometry: < 200 (L) * 80 (H) * 80 (W) mm Weight: < 2 Kg / unit Capacity: > 16000 mAh Nominal voltage: 12< VDC<24 Redundant set-up Management system which able to monitor remaining capacity with ± 2% accuracy Charging must be possible without removing batteries Battery management system must provide protection for short circuit and over heating Batteries must be field replaceable	TUT
Instrumentation	D D D D D D D D D	System total weight: 5 kg Predefined instruments on robot surface and two pcs sealed cylindrical pocket with electrical connection for bigger instruments; dia150x150mm Hyperspectral camera Pressure, temperature, pH and EC sensors pH Water sampler, 30 - 60 water samples; 5… 10 ml/samples Magnetic Field Sensor Gamma counter Operating voltage: 12< VDC<24	UNIM
Cooling system	D D W	Able to keep all electronics in safe stable operating temperature Total weight: 4 kg Water cooling system	TUT
Maintanability, usability, reliability	D W D D D	All systems must be field serviceable in underground mine environment All essential systems must have built in redundancy All programmable controllers must be able to self-recover Robot must have leak detection system All fuses must be self-resetting type	