



MISKOLCI
EGYETEM
UNIVERSITY OF MISKOLC

Föld alatt és Föld felett – a jövő ipari megoldásai a Miskolci Egyetemen

2020. december 03.

Dr. Zajzon Norbert

**Zárt terekben úszó vízalatti robotok
– Az UNEXUP projekt**

UNEXUP



This activity has received funding from European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation.



Az UNEXUP projekt főbb számokban

UNEXMIN developed a robotic system for autonomous exploration and 3D mapping of flooded underground mines.

UNEXUP stands for „UNEXMIN Upscaling” which is an EIT Raw Materials funded project aiming to develop further the UNEXMIN (completed H2020 project) technology, taking it closer to the market and also aims to develop its own market (segment).

- **EIT RawMaterials funded Acceleration, Upscaling project (D2.2)**
- Agreement number: **19160**
- **8 organizations** (6 EU countries)
- **3 years** (36 months duration; start: 1st of January 2020)
- Funding sum: **3 million Euro** (80% from EIT RM)
- Outcomes:
 - **2nd generation of UX robots (UX-2)**
 - **New raw materials exploration / mine mapping service for flooded underground mines and other flooded areas**
 - **Technology from TRL 6 to TRL 7/8**





Az UNEXUP konzorciumi partnerek – a 3 tudáspillér

- 8 szervezet



- 6 EU ország



Research



Education



Industry



Education



Industry



Industry



Research



Education



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Miért van szükség az UX robotokra?

- Strong dependence of the EU on the import of raw materials → Critical Raw Materials list of the EU ↑ since 2008.
- There are of the order of 30,000 closed mine sites in Europe and many of them flooded and potentially contain considerable amounts of valuable mineral raw materials. The closure of a mine is usually more related to actual economics and technological challenges rather than to the actual depletion of mineral resources. Often commodities were disregarded during the operational life of the mine (such as fluorite in lead/zinc mines).
- These mines are now flooded and the last piece of information of their status and layout is decades, or over a hundred years old.
- Complex underground layout, topology and geometry of most flooded underground mines make it unfeasible to do any surveying by conventional, or remotely controlled equipment. Human risks and high costs, such as dewatering are also barriers to explore flooded environments.

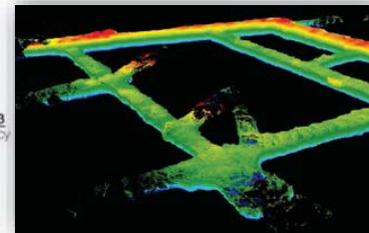
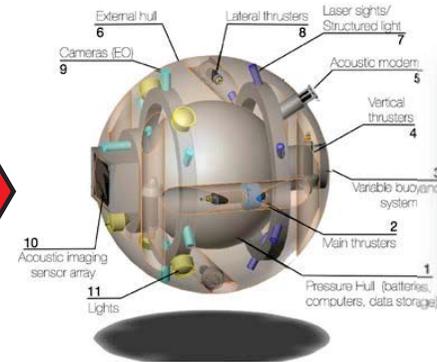
Human risk



Financial risk



Develop and send autonomous robots





Az UX robotok fejlődése

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Concept idea (2015)

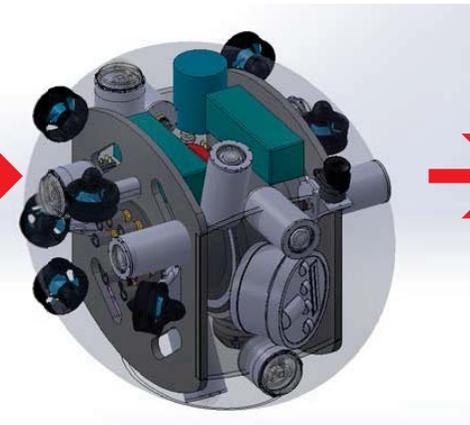
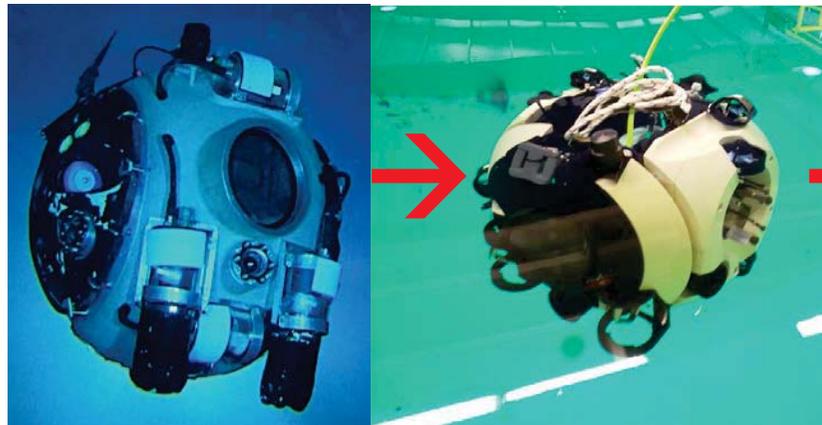
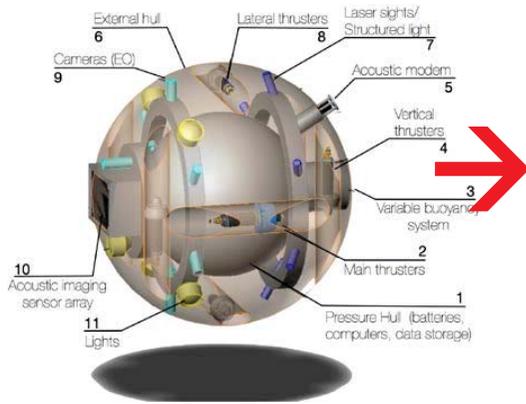
UX-I Nata (2018)
closed hull version

MARA (2020)
open frame concept

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UX-1Neo (2020)

UX-2Deep (2021)



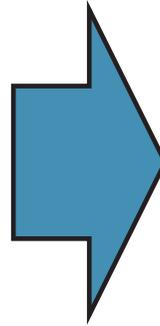


A projekt lényegi elemei

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(2016-2019)

- Focus on research and development of a robotic platform to survey flooded underground mines and other flooded environments. Prove the concept.
- Core objective: Develop a prototype for underwater exploration; raise scientific interest.



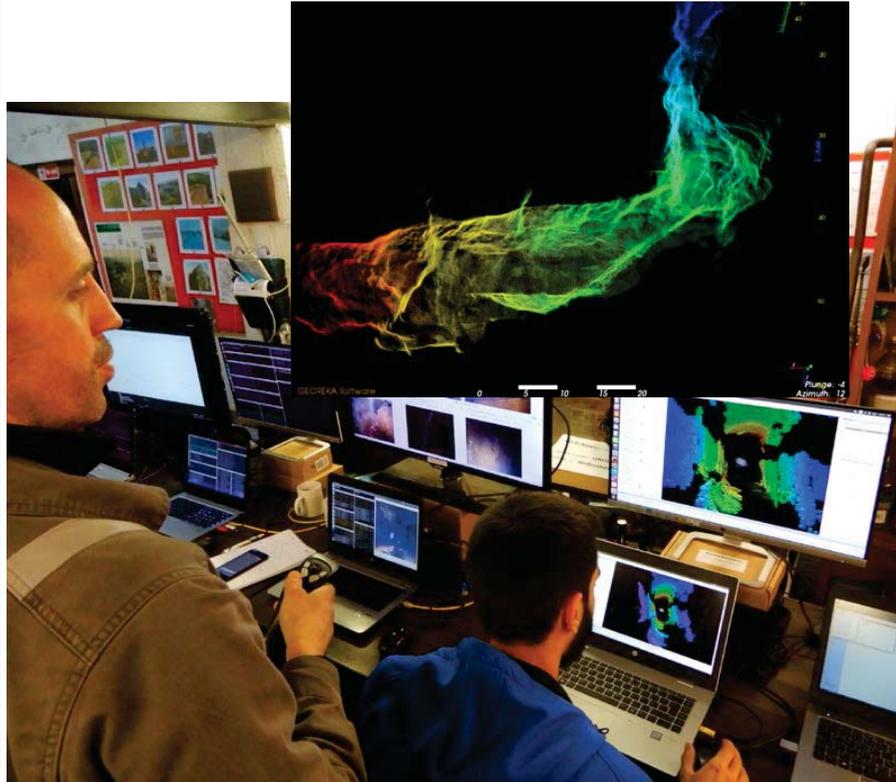
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(2020-2022)

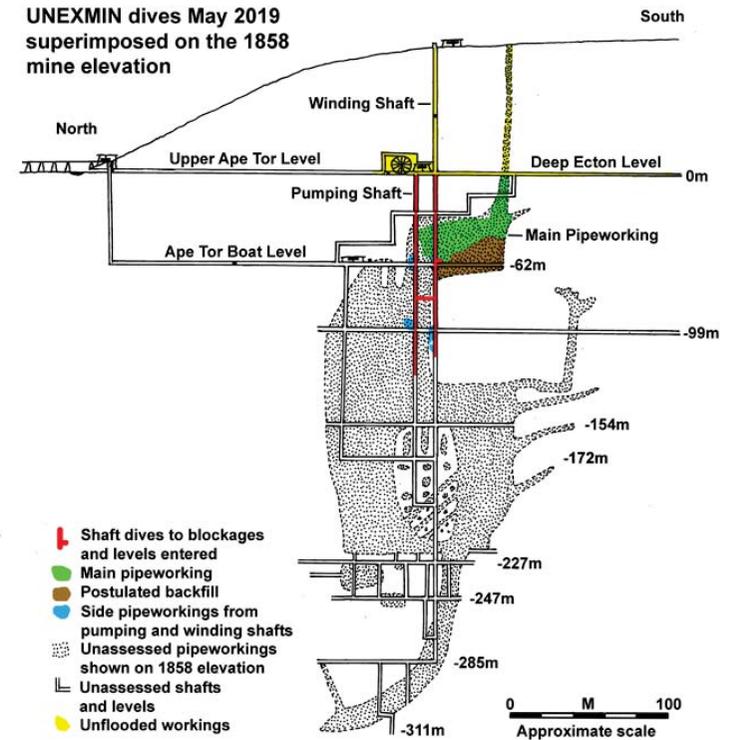
- Focus on the commercial deployment of the technology developed in UNEXMIN, while further improving the robotic system's hardware, software capabilities.
- Core objective: Upgrade the prototype; sell an exploration service.



UX-1 teszt, Ecton rézbánya, UK (május 2019)



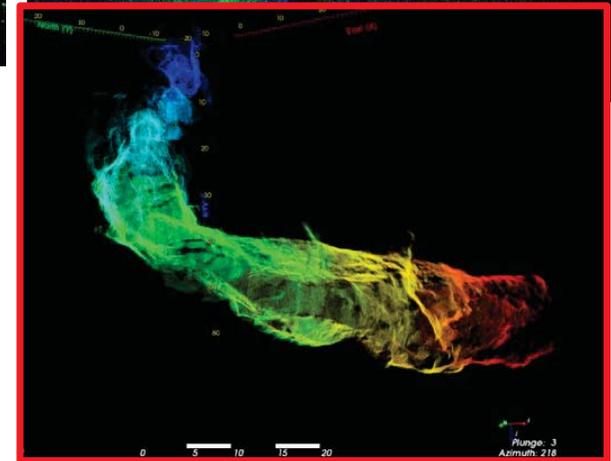
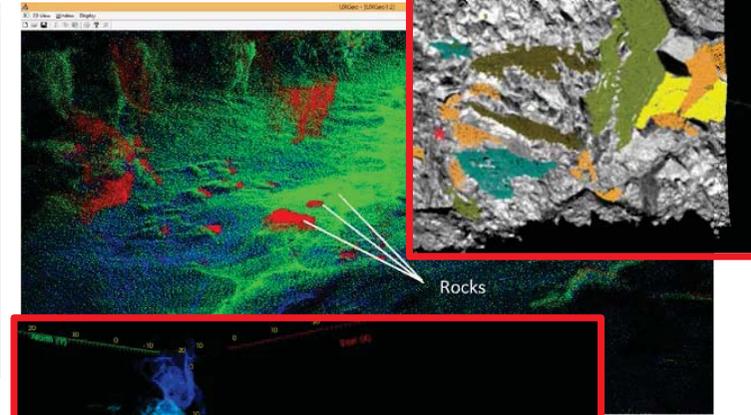
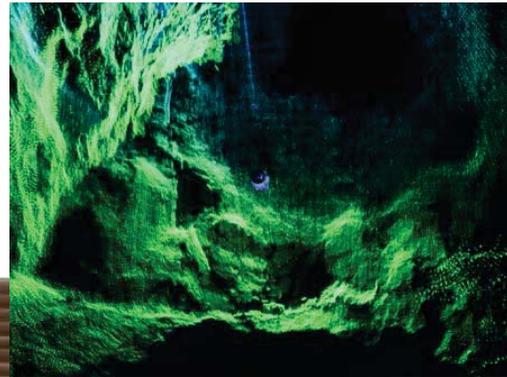
UNEXMIN dives May 2019 superimposed on the 1858 mine elevation





3D modellek és a virtuális valóság

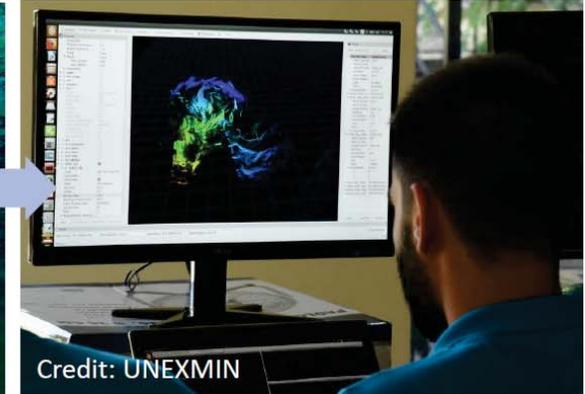
- 3D modelling combines large point clouds from various sources (e.g. sonar, SLS, RGB, multispectral)
- Specialized tools developed to handle these data
 - Octree visualization
 - Object detection: e.g. falling rocks
 - Detecting planar structures: e.g. faults
 - Filtering and triangulation of noisy point clouds
- Virtual reality software and hardware fully developed and available for data flow





UNEXUP objectives

- Improve the current UX-1 system's hardware, software and limitations
- Build an additional, more complex robot, with further capabilities and sensors
- Test the robots's performance in different pilot tests
- Bring commercial interest to the innovative technology
- **LAUNCH THE SERVICE INTO THE MARKET!**
 - UNEXMIN GeoRobotics Ltd., founded by members of the UNEXMIN consortium, is responsible for the Go-to-market strategy of the UNEXUP technology





Technology upscaling and development

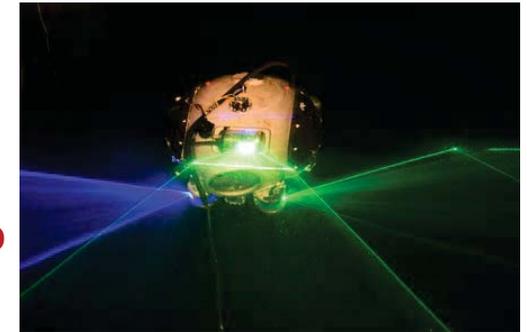
Objectives

- Upscale UNEXMIN
- Increase Robot TRL
 - Robot Operation
 - Maintenance
- Improve support operations
- Develop a commercial service



Technical developments

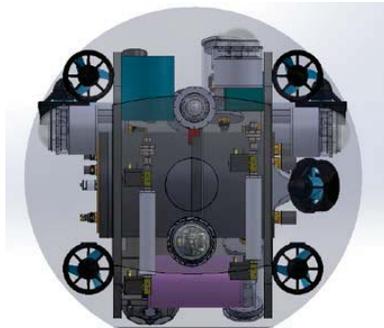
- Upscale UX-1 robots: **UX-1 Neo**
- Develop deep water prototype **UX-2 Deep**
- Extending exploration capabilities
- Further develop scientific instrumentation and tools
- Operation support systems
- Post –processing software upgrades
- Testing components



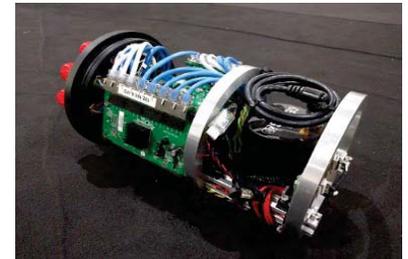
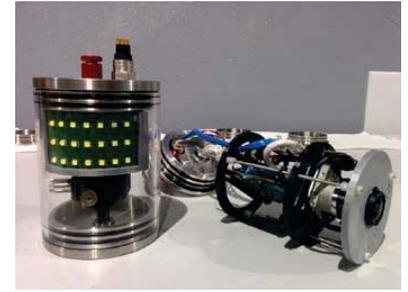


UX-1Neo – Tervezési szempontok Tudományos műszerek fejlesztése

- Similar dimensions and functionalities
- Modular robot – open frame
- Increase functionalities
 - Easily swappable batteries
 - Quick data retrieval
 - Additional camera
 - Ease of transport
 - Lower weight
 - **More versatile and effective hardware on the field**



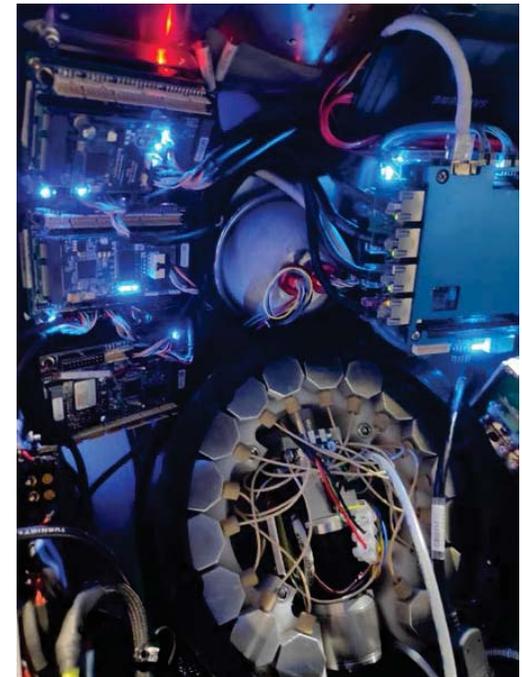
- SLS system miniaturization
- New camera design with embedded processing
- Water/pressure proof instrumentation modules
 - Water sampler unit
 - Multispectral camera
 - Magnetic field sensors
- New instruments:
 - eg. small sampler unit



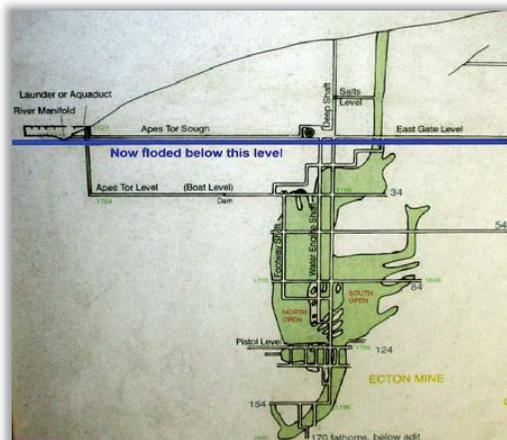


UX-1Neo szoftver fejlesztések

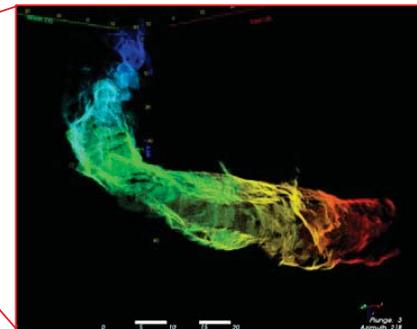
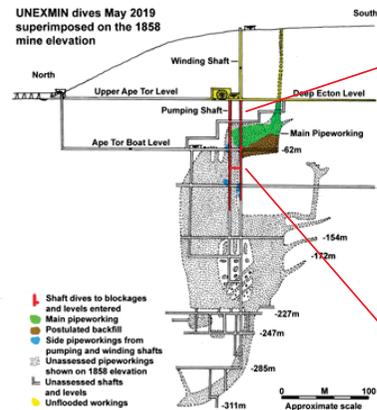
- Autocalibration
 - Improvement localization initialization procedures and SW tools
 - Data post processing streamlining and management tools
 - New robot functionalities
 - Mission definition and supervision SW tools
- ➔
- Reducing number of operating personnel
 - Reducing mission setup time and requirements
 - Improving data collecting and processing efficiency
- **Reduced crew → more productive and cost effective operations**



Before UNEXMIN



UNEXMIN (2019)



UNEXUP(2022)



- Regular evaluation and selection of available sites
- „Real service to real client” approach

- „Hot” geoscientific sites, good visibility
- Diversifying service (other than mining)
- Build up strong references for UGR



TECHNOLÓGIA PIACOSÍTÁSA

UNEXMIN GeoRobotics Kft.

Szerviz szolgáltatás a piacon, további kutatásfejlesztés

▪ Strong focus on commercializing the technology

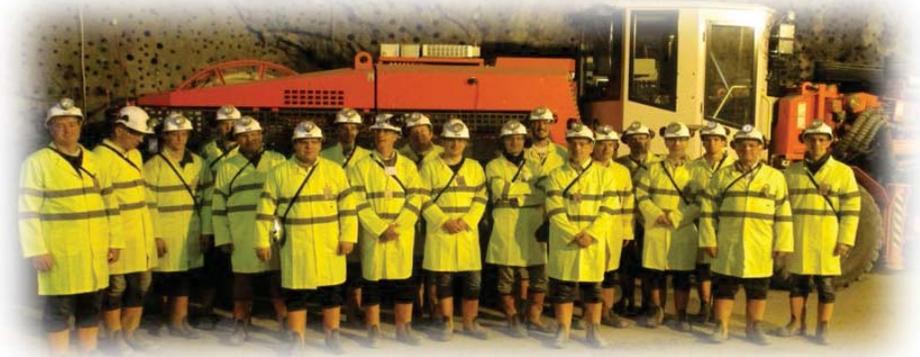
- Raw materials exploration
- Water reservoirs surveying
- Cavity measurement (e.g. salt mines)
- Cave system exploration
- Cultural heritage sites investigation
- Environmental monitoring

- Underwater exploration and mining
- Sensor and instrument development
- Automated measurements
- Autonomy, multi-robot platform
- Data processing, geoscientific evaluation
- 3D visualization
- Space applications

**SERVICE
OFFERED**



**PARTIAL UTILIZATION
FURTHER DEVELOPMENT
OF THE TECHNOLOGY**



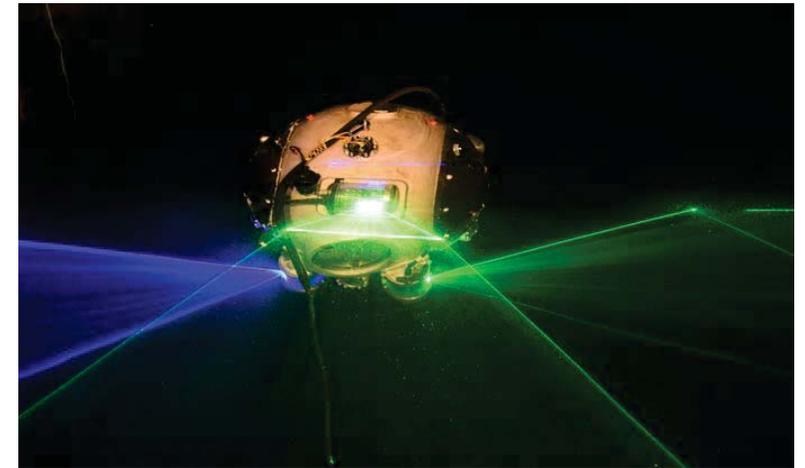
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26 min video: https://www.youtube.com/watch?v=OPMQvKE_z5I



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