illuMINEation
THE FUTURE OF MINING

NEWSLETTER

ISSUE 4 | March 2023

The *illuMINEation* project started in September 2020 and is a 3 ½ - year project funded by the European Commission. Nineteen partners are collaborating in order to develop bright concepts for a safe and sustainable digital mining future. With this newsletter, the interdisciplinary *illuMINEation* consortium provides a short summary of important recent project activities.

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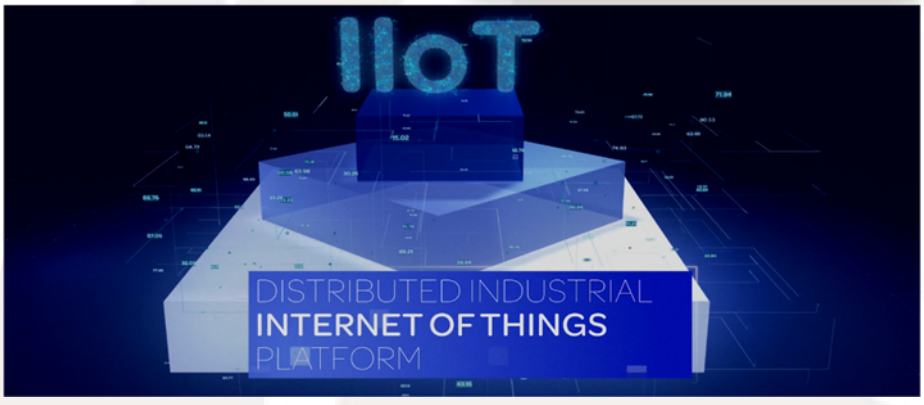
COMBINING DATA TO MINIMISE RISKS

IIoT PLATFORM

Europe's valuable mineral deposits can only be exploited if the very strict legal and environmental requirements are met. For this very reason, health, safety and environmental (HS&E) standards and performance are considered the most important core values applicable to the mining industry sector.

The illuMINEation project uses various sensing technologies comprising off-the-shelf low-cost sensors combined with sensors serving specific needs for integration into a digital mine management system. Valuable information acquired by extensive sensor networks are subsequently processed and analysed via sophisticated data analytics including machine learning algorithms in order to:

i. Support a comprehensive HS&E, risk and sustainability assessment;
ii. provide a cost-effective way of ensuring that high HS&E standards are kept;
iii. ensure, in the long run, sustainable and economically efficient extraction of raw minerals that are crucially needed by the European industry sectors; and to
iv. facilitate a more transparent mining industry so that public acceptance, awareness and trust in mining activities can be increased.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 869379.

The project is centred around the development of a reliable, large-scale data-intensive and highly adaptable digital Industrial Internet of Things platform, capable of processing data for various mining-related applications.

USE CASE TESTING

INITIAL TESTING PHASE SUCCESSFULLY COMPLETED

After the initial developments of technology solutions were largely completed, the preliminary test phase for use cases began. Between April and December 2022, the use case partners conducted various tests in real environment, covering all five use cases.

The following technologies developed were tested and evaluated:

(**a**) Intelligent rock bolt sensor heads; (**b**) Measurement While Drilling (MWD), (**c**) Analyse While Drilling (AWD); (**d**) environmental monitoring via deployment of low-cost sensor solutions; (**e**) novel machine learning algorithms for tailings dam stability monitoring; (**f**) human and equipment detection and position monitoring; (**g**) Long Range Wide Area Network (LoRaWAN) communication system for underground sensor solutions; (**h**) drones in underground applications, such as first response unit or data link range extenders; and (**i**) predictive maintenance, battery condition monitoring and additive manufacturing solutions.

(1) Minera de Orgiva, Spain

The team of the Lujar mine, owned and operated by Minera de Orgiva, had the opportunity to test solutions together with project partner Worldsensing, in the field of environmental monitoring (air quality sensors), movements of the rock mass as well as MWD and AWD tools. In addition, the LoRaWAN technology was used as a part of the communication and data transfer tests.

(2) RHI Magnesita, Austria

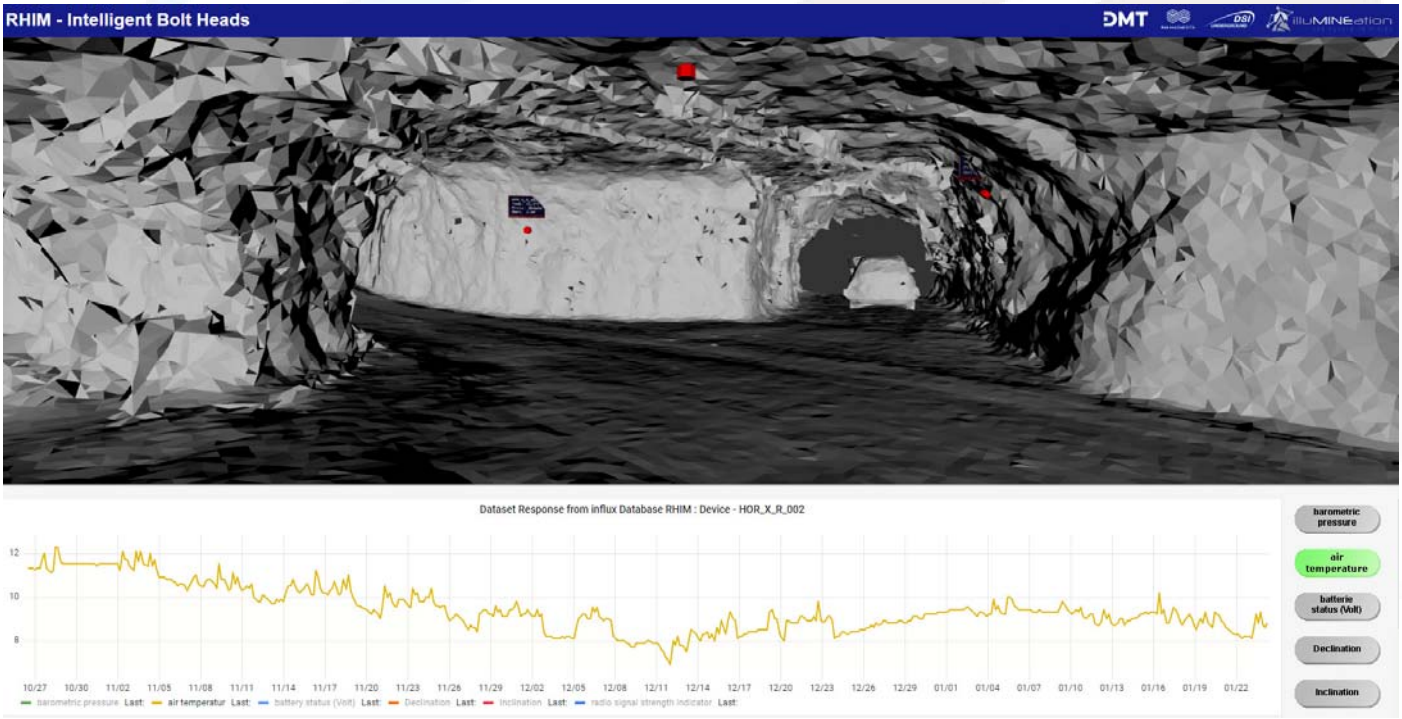
In the Austrian Breitenau mine of RHI Magnesita, sensor solutions for monitoring the ambient atmosphere were tested, which will be installed on the intelligent rock bolts. These devices have built-in communication modules, which also allowed to test how WiFi and LoRaWAN transmission works in the underground mine environment. The below picture shows an IIoT dashboard visualising the temperatures measured by the abovementioned rock bolt sensor heads. Other solutions tested in the Breitenau mine comprise MWD and AWD.

(3) KGHM Polska Miedź S.A., Poland

Project partner KGHM Polska Miedź, in collaboration with Geoteko and KGHM Cuprum, tested novel machine learning algorithms for data from the monitoring of the Żelazny Most tailings storage facility operated by KGHM, devices for environmental monitoring of mining areas and the influence of mining activity, with the main focus on groundwater.

(4) Boliden, Sweden

Based on data from existing geotechnical monitoring, the Boliden team



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together with researchers from the Montanuniversitaet Leoben have created a theoretical model that will support the interpretation of data collected by smart anchors.

(5) Epiroc, Sweden

As part of the preliminary test phase, the mining equipment manufacturer Epiroc has examined the integration of its machines with the emitrace® solution of project partner Retenua for personnel and equipment positioning system. Moreover, algorithms for prediction of necessary repairs of machinery, the use of drones in underground mining environment and the possibility of on-demand manufacturing of machine spare parts via 3D printing technology were assessed.

All use case partners involved in the preliminary testing phase agreed that the solutions tested support their work and have the potential to further improve mining industry development, especially within their operations.

Additional testing will be conducted during the coming months in order to further advance the technology developments and to ensure their functionality.

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5TH CONSORTIUM MEETING
MADRID, SPAIN

After more than two years of intensive cooperation and close collaboration, the project partners were able to meet in person for the second time at our 5th Consortium Meeting, which took place on 29th and 30th of November in Madrid, Spain. The meeting was hosted and organized by our Project Partner Universidad Politécnica de Madrid; many thanks to our Spanish colleagues for the excellent organization and hospitality.

The two days of meetings flew by as all project partners reported on the progress of their tasks, challenges and achievements. The first day focussed on the use case testing phase whereas the second was entirely dedicated to the IIoT platform development.

All participants benefited greatly from this meeting and the up-to-date information on the individual project activities. We already decided that our next 6th consortium meeting will be held in Sweden in June 2023.

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SNAPSHOT OF PUBLICATIONS

Many scientists, researchers and professionals are involved in illuMINEation and together they contribute to valuable research results. The project has already produced more than 30 open access publications and conference papers. They are all available for download on our project website or on Zenodo, just search for "illuMINEation" and you get the full list of papers, datasets or software. Two of the recent papers are titled: *"Prototype of Instrumented Rock Bolt for Continuous Monitoring of Roof Fall Hazard in Deep Underground Mines"* and *"Automatic fluorite grade identification using borehole images and machine learning-based models"*.

PROJECT VIDEO

In autumn last year, we proudly released our 5-minute project video and a short 1-minute trailer, both available on YouTube (QR Code) and on our project website. The video introduces the viewer to the various aspects of this amazing research and innovation project. It showcases the potential that digitalisation offers to the mining industry, our approach to improving sustainability and our contribution to securing a bright future for Europe's high-tech sector. Enjoy watching!

Editorial

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Check out our project website and follow us on LinkedIn and Twitter to find out the latest news and stories from the project!

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