GOLDENEYE

PROJECT GOLDENEYE:

Developing Golden AI - the AI powered platform for mine site monitoring using EOD, UAV and proximity sensor data

CONSORTIUM MEMBERS

VTT, OPT/NET, timegate, beak CONSULTANTS, SITEMARK, SINERGISE, radai, CUPRUMIN, DARES, Galileo Satellite Navigation Ltd., EARTH OBSERVING SYSTEM, UNIVERSITATEA TEHNICĂ DIN CLUJ-NAPOCA, AKG, SANDVIK, UNIVERSITY OF OULU

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No [869398]

INTRODUCTION

OVERVIEW

Improved use of EOD and positioning data, together with UAV operated and proximal sensors, offers the mining industry additional potential exploitation and environmental control and increases mine productivity.

The Goldeneye project develops an Artificial Intelligence platform - **Golden AI** - to allow satellites, drones and in situ sensors to collect high-resolution data from an entire mine.

Collected data will be processed and converted into intelligence to be used in pilot sites offering improved safety, environmental observation, exploitation and increased extraction.

The project will combine different sensing and positioning technologies to take advantage of data fusion and processing powered by data analytics and machine learning algorithms.

The Golden AI platform will be piloted on five mining sites across Europe. The use-cases address the different phases of the mine's life cycle from exploration to closure and post-closure. The applications developed in the project include mineral detection, safety monitoring, operational management, geo-hazard monitoring, and environmental monitoring. End-users will have visualized analytical maps in their use offering easily comprehensible information. The required data pre-processing is provided automatically by the platform and the required AI tools are developed by the experts. The end-users can communicate with the platform's AI assistant and make use of the results.

The project will also develop new sensing solutions for both UAV surveillance as well as proximity sensing.

New technologies will provide better 3D mineralogical mapping of mining sites.

GOLDENEYE

FIGURES

Call:

H2020-SC5-2018-2019-2020

Greening the economy in line with the Sustainable Development Goals (SDGs)

€8.4M

Total budget

Duration

2020-2023

16 Partners

Consortium consists of research institutes, academia,service providers & industry

Coordinator:

VTT Technical Research Centre of Finland

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Golden Eye Project Applications

Mineral Detection

Safety Monitoring

Operational Management

Geo-Hazard Monitoring

Environmental Monitoring

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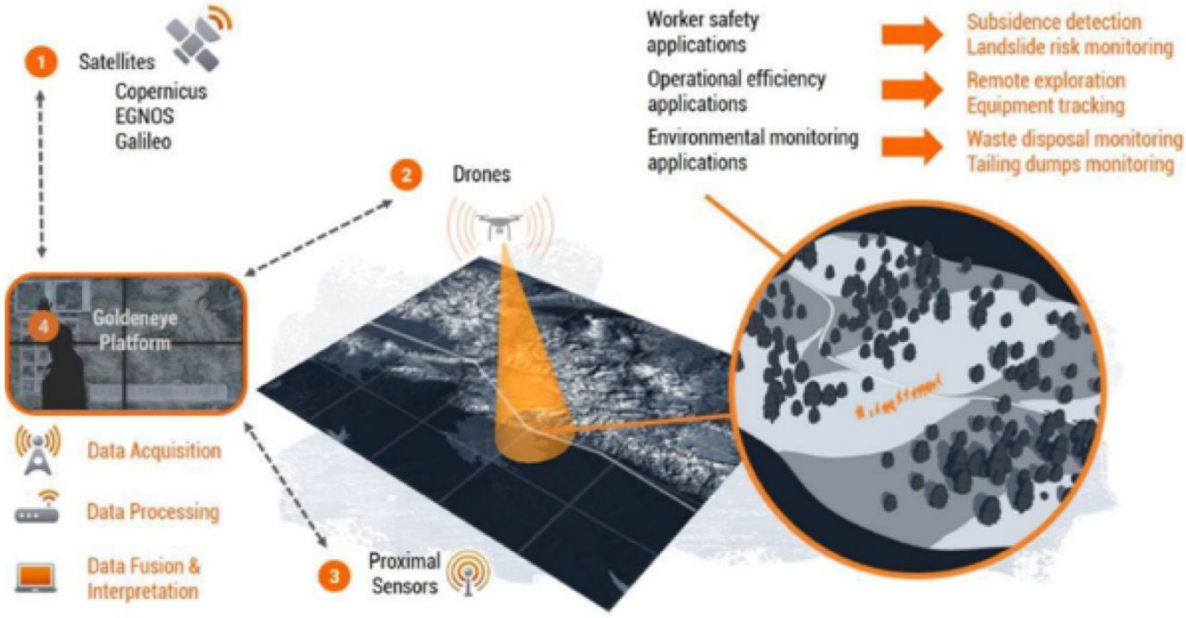

APPLICATIONS FOR EVERY STAGE OF THE LIFECYLE

The use cases of the Goldeneye platform address the different phases of the mine's life cycle from exploration to closure and post-closure. The applications developed in the project include mineral detection, safety monitoring, operational management, geo-hazard monitoring, and environmental monitoring.

For example, in the safety monitoring application the aim is to improve the safety of the mines by monitoring the mining sites for sudden slope and ground changes as well as analysing the environment of the mines to detect any mining water leakages from their indirect influence to the surrounding nature.

FIVE PILOT SITES

During the project, the Goldeneye platform will be piloted on five mining sites across Europe. Two pilot sites, Pyhäsalmi mine in Finland and Trepča Mines Complex in Kosovo will focus on the study of the environmental impact and stability of the mines. The Pyhäsalmi mine will also be used as a test site for underground location positioning trials.

Furthermore, the project will develop mineralogical sensor solutions including optimisation of ore drilling by integrating Sandvik drilling machines with time-gated Raman sensors and development of rock surface analysis with remotely scanning Active hyperspectral Imager. This will improve the mineral exploration and extraction efficiency and support the profitability of mines. Accurate location improves the safety of the underground mines as it enables better tracking of the mining activities.

Two field trial sites, Erzgebirge district in Germany and Panagyurishte district in Bulgaria, will focus on mineralogical mapping. The geophysical and proximity sensors will be used to calibrate satellite Information and teach AI algorithms. The aim is to develop mineral exploration with higher resolution imaging and improved mapping of valuable mineral deposits.

The fifth site in the Roşia Poieni district in Romania aims to improve mineral predictions with combined satellite imagery and drone-produced data. The aim is to improve profitability, and support the mining community of the area.

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PARTNER & USER INTERFACES

Golden AI platform is managed using AI Knowledge Packs, data structures that enable efficient data fusion. Experts are special users responsible for the creation of AI Knowledge Packs, the management of the Goldeneye platform, and the administration of the cloud infrastructure. There will be different types of experts: administrators, operators, editors, auditors and super-users. They create new AI KP workflows, combining platform functions, operators and configuring different system interfaces, training of the AI engine in order to analyse any kind of EOD scene time-series data. They should also understand how to select and prepare the required EOD data for analysis and prepare the machine training data for a particular scene on the Earth surface. This allows AI to perform automatic data selection, preparation, processing and analysis of the time-series autonomously. The execution of the microservice compute workloads can be distributed across cloud platforms.

DATA PROCESSING & CO-REGISTRATION

Creation of mine site change detection maps with land cover classification and Earth surface motion quantification requires image-to-image and in-situ data co-registration of Earth observations and remote sensing time series.

The analysis of Sentinel-1 SAR satellites and Sentinel-2 optical EO data in combination with data from commercial satellites, drone sensing missions and in-situ sensors has great potential to offer valuable information on the mining sites due to the combined benefits of spatial properties (especially those which have free and open data access policies). The accurate selection of the right imagery and data for the Regions of Interest (ROI) and multi-temporal co-registration of image and data time series is an indispensable prerequisite for the applications provided by Golden AI platform including mineralogical mapping, monitoring of mine stability and observing of environmental changes.

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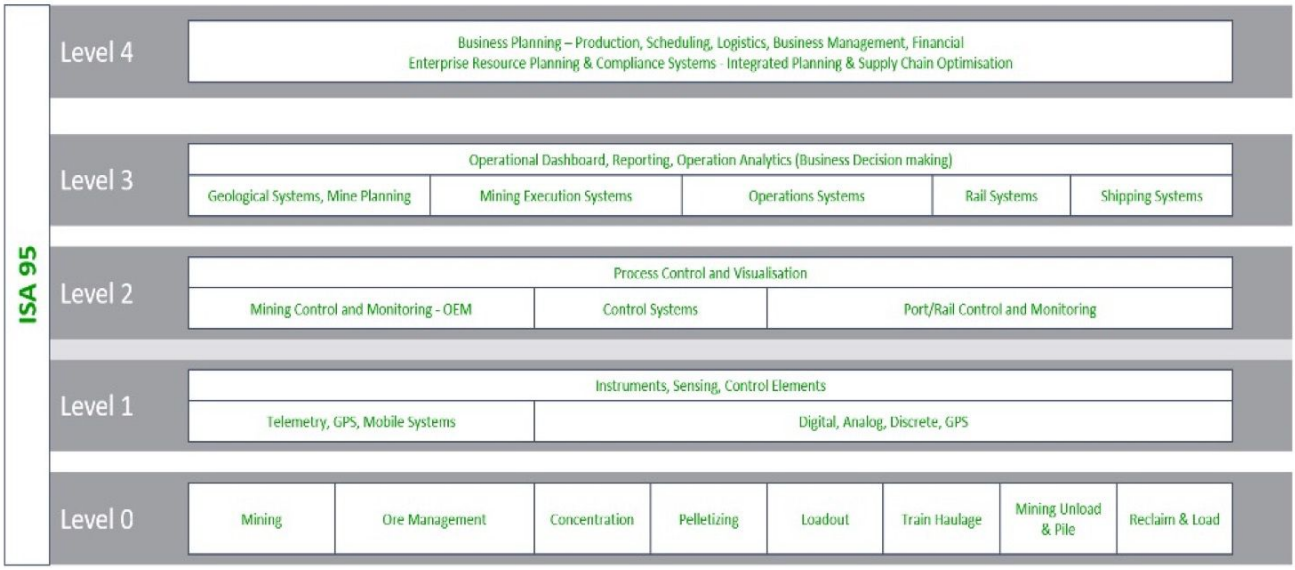
DATA FUSION & ANALYTICS

Data fusion is used for combining information from two or more sensors monitoring the same land surface. Data fusion can be applied in the case where two or more sensing sources provide information on the same area with similar resolutions (e.g. Sentinel-1 and Sentinel-2) to provide higher quality information. Data fusion can also be applied to the case where sources provide information in different spatial and temporal resolutions, in order to increase the temporal resolution of high-resolution low-frequency satellite data with high-frequency low-resolution data. Furthermore, data fusion is applied, where satellite information can be linked with other datasets, such as multisensor geophysical datasets from drones and in-situ measurements.

Using machine learning techniques, the remote sensing information from the satellites can be fused with the surface geophysical information from the drones in 2D and then used to interpolate/ predict 3D spectral data into depth (below surface) based on available 3D geophysical data, without having the spectral data from the satellites continuing into the depth (below surface).

The fused data products of the Golden AI platform outputs will be added to a stack of generated ARD in ESA Data Cube (European Datacube) facility for reuse.



DATA STANDARDS & INTEROPERABILITY

The importance of the fusion of image data coming from different types of Earth Observation (EO) sensors is growing rapidly. The Golden AI platform will therefore work with new standards such as EN 17030:2018, the European Data Cube Facility service, the INSPIRE Implementing Rules on interoperability of spatial data sets and services (IRs) and Technical Guidelines (Data Specifications) and the EO Profile of Open Geospatial Consortium Implementation Standards Given the timeframe of the project (3 years), the project does not aim to develop new standards, but may contribute to existing or upcoming standards as applicable.

The consortium will also study the IEC/ISO 62264 standar dANSI/ISA-95). This is a key standard in relation to process control automation as it provides the foundations for the interfaces between enterprise & control systems. Large digital mine software suppliers are already applying the standard in their line of process control automation solutions.

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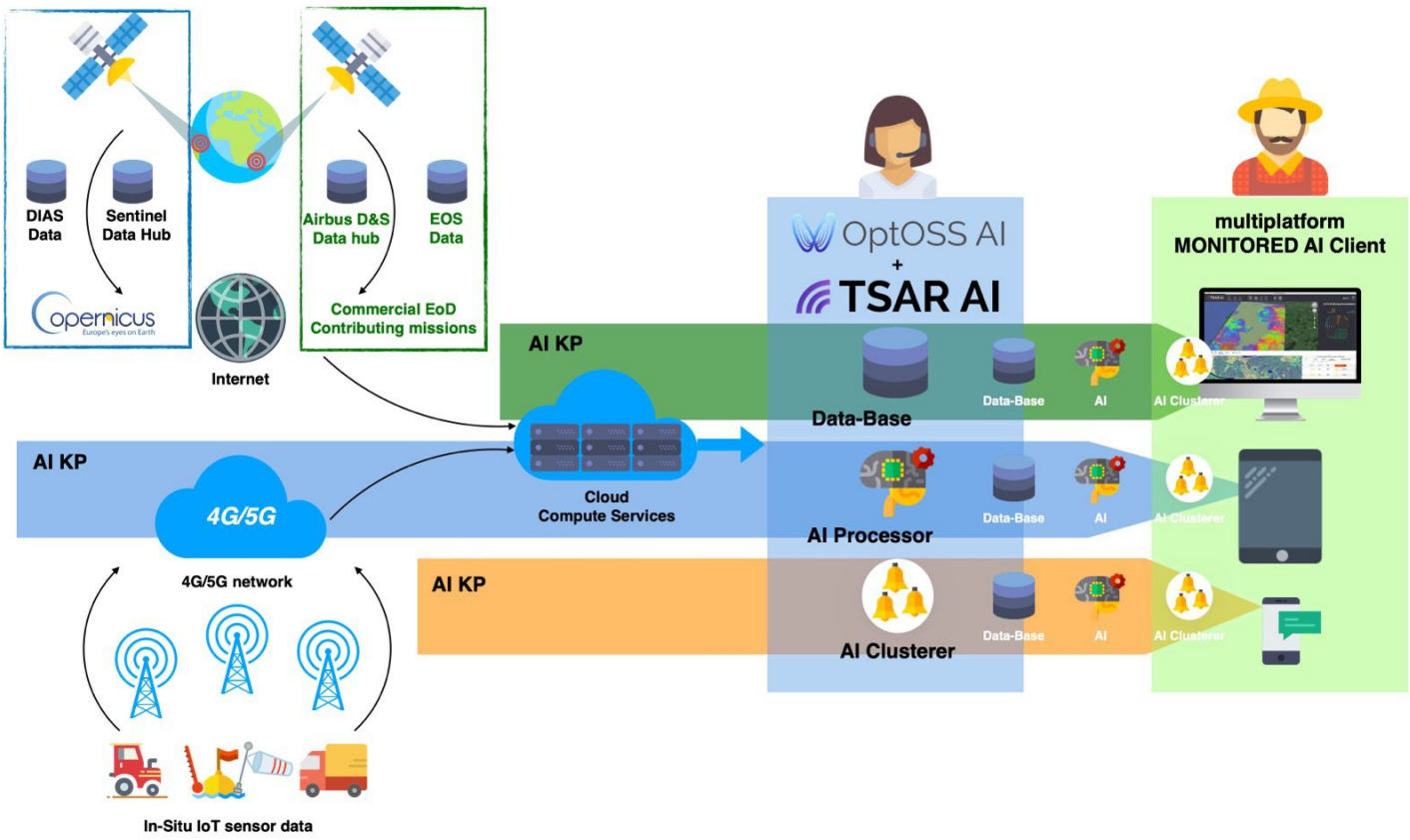
| GOLDEN AI Platform High Level Architecture |



HIGH LEVEL ARCHITECTURE

The proposed architecture for the Golden AI platform includes ability to integrate with open data sources, ingest commercial data, access and organise the data acquired during Goldeneye project, present the data processing results as well as store and serve the outputs of the in-platform or out-of-platform solution components.

The Goldeneye-project will provide an open public demonstrator, which illustrates the reference architecture for the future implementations of the Golden AI platform for commercial uses. The Golden AI platform architecture consists of functional and operational data flow views making the implementation of the platform easy for future customers.

The proposed high-level architecture serves as the basis for development of the robust, scalable, cost efficient and sustainable commercially viable solution, which is future proof, flexible and open for incorporation of the novel technologies as progress moves forward. The illustration above provides an overall vision of the Golden AI architecture by describing its main architectural components and their interactions with external elements of the solution.

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THE CONSORTIUM

The project is coordinated by the **VTT Technical Research Centre of Finland** and it involves the following partners:

AKG sh.p.k

Beak Consultants

Cuprumin

Dares Technologies

Earth observing system

Galileo Satellite Navigation

OPT/NET

Radai

Sandvik Mining and Construction

Sinergise

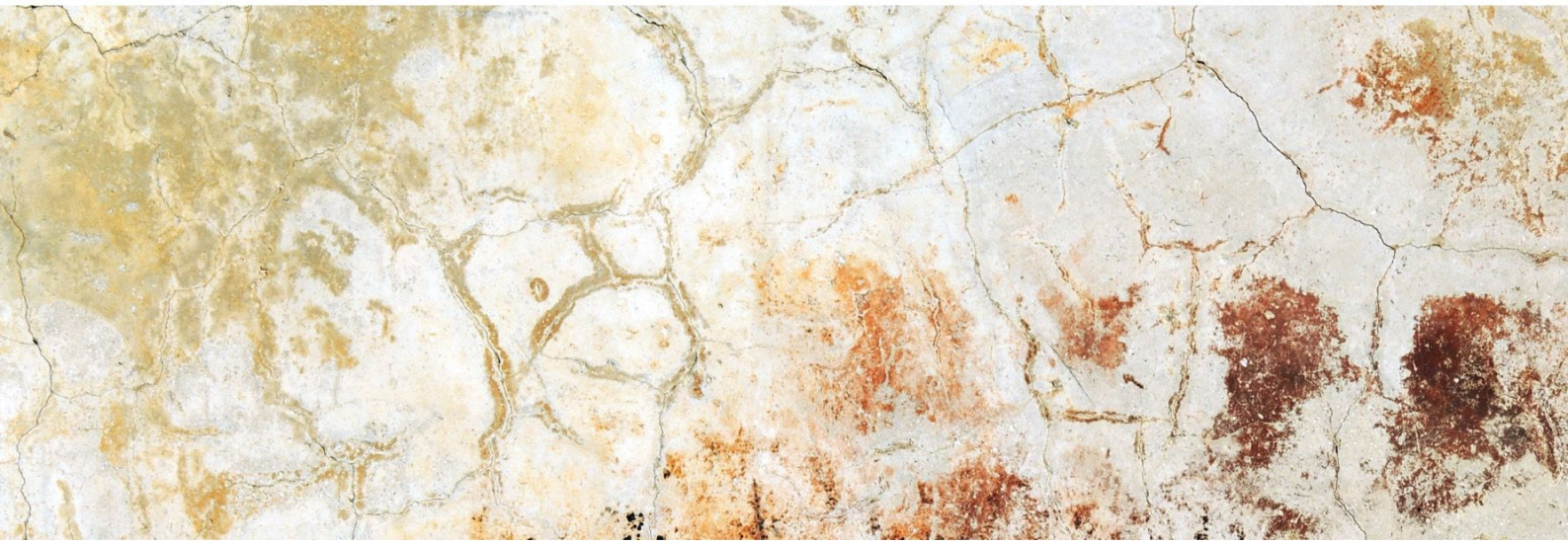
Sitemark

Technical University of Cluj Napoca

Timegate Instruments

University of Oulu

University of Sofia



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