

WPWEB Italian innovative SME

# Autonomous robotic systems



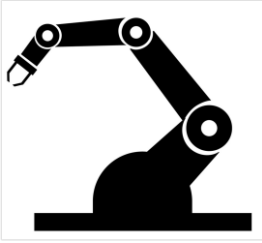
## WPWEB is an Italian innovative SME.

In collaboration with Italian and European research centers, WPWEB experiments and designs autonomous robotic systems for the collection of data in the explored environment.



WPWEB has the broader goal of implementing autonomous systems that allow for improved security in critical environments, where advanced capabilities increase the awareness of the environment in which the system operates.

# Industrial robotics VS Service robotics



## Industrial Robotics.

**An automatically controlled, reprogrammable, multipurpose manipulator working in three or more axes**, which can be either fixed in place or mobile for use in industrial automation.



## Service Robotics

**Service robots** assist human beings, typically by performing a job that is dirty, dull, dangerous  
service robots usually work in unstructured environments and collaborate directly with humans

# Mobile robotics in manufacturing – examples



**Shelf Units** the shelf units are often used to transport semi-finished or finished goods between productions, between production and warehouse and/or in warehouse logistics. Shelf modules are often used in semi-automated installations, where an employee fills up the robot with the goods and send it on its way with just one click on a button.

**Conveyor belts** the mobile robots can be deployed with a conveyor top module, so they can transport items between fixed conveyor band/belts. These are often seen in fully automated solutions where the mobile robots move items between production lines or from production line to delivery. The mobile robots are the adaptable link between the traditional conveyor bands and enable companies to be more efficient because they can transport items flexibly between several production lines.



**Automated Pallet Fork.** The mobile robot can locate the pallet fork and transport it to its destination autonomously. In this way the employees only have to load and unload the pallet from the pallet fork and they save valuable time, because they do not need to do the transportation themselves.

# Research projects

The **PLUTO project** was developed in response to a challenge proposed by the French railway company (SNCF) and aims to autonomously inspect a railway tunnel in order to identify possible areas that need maintenance.



The **SEI project** is aimed at experimenting with the integrated use of data acquired through UAV sensors and systems during the preflight inspection of aircraft in the airports. The project is based on a **patent** owned by WPWEB.

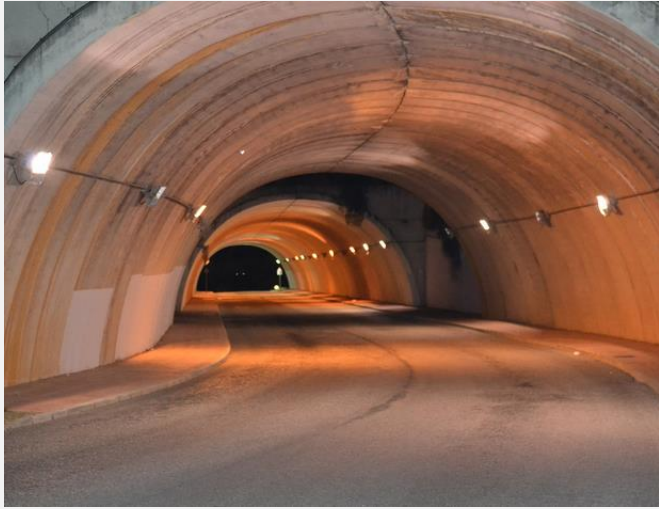
WpWeb is the lead partner for the **ARS (Autonomous Remote Sensing) Project**: a UAV system was created for the autonomous inspection of confined spaces. The project was carried out in collaboration with IREN





# The inspection and maintenance market

Italy is today one of the European countries with the highest number of road and railway tunnels.



**ROAD Tunnels:**  
about 2.000 for a  
total length  
of about 800 Km



**RAILWAY  
Tunnels:**  
about 2.100 for a  
total length  
of about 1.480  
Km



**1,5 M BRIDGES**



**6.000 WIND  
Turbines**

## An example: the PLUTO project



**PLUTO**  
demonstrated the  
autonomous  
inspection of railway  
tunnels.



**A flying robot (UAV – Unmanned Aerial Vehicle)** that provides:

- Autonomous navigation in confined spaces (tunnels)



- Mission planning through a cloud application



- 3D mapping of the explored environment



- Automatic tunnel crack identification powered by deep learning



# The technical challenges

Limitations of  
weight and battery  
life



Lack of external  
communication and  
GNSS signal



Obstacle  
avoidance



Design of controllers  
that allow robust  
behavior for  
autonomous navigation



Strong electromagnetic  
interferences due to  
catenary














# Pluto prototype

 **ROS**  
Robot Operating System

 **PX4**  
autopilot



-  High performance computer
-  High resolution cameras
-  LIDAR
-  Altimeter
-  Compass
-  Gyroscope
-  GPS
-  High precision IMU
-  LED lighting system

PLUTO

# The autonomous navigation



## SLAM

We adopt a real-time method for odometry and mapping using range measurements from 3D lidar



## Exploration/Inspection

1. In the exploration phase (**Local Path Planning**) searches for all possible trajectories and creates a map
2. the **Global Path Planner** calculates the shortest path and navigates to that point



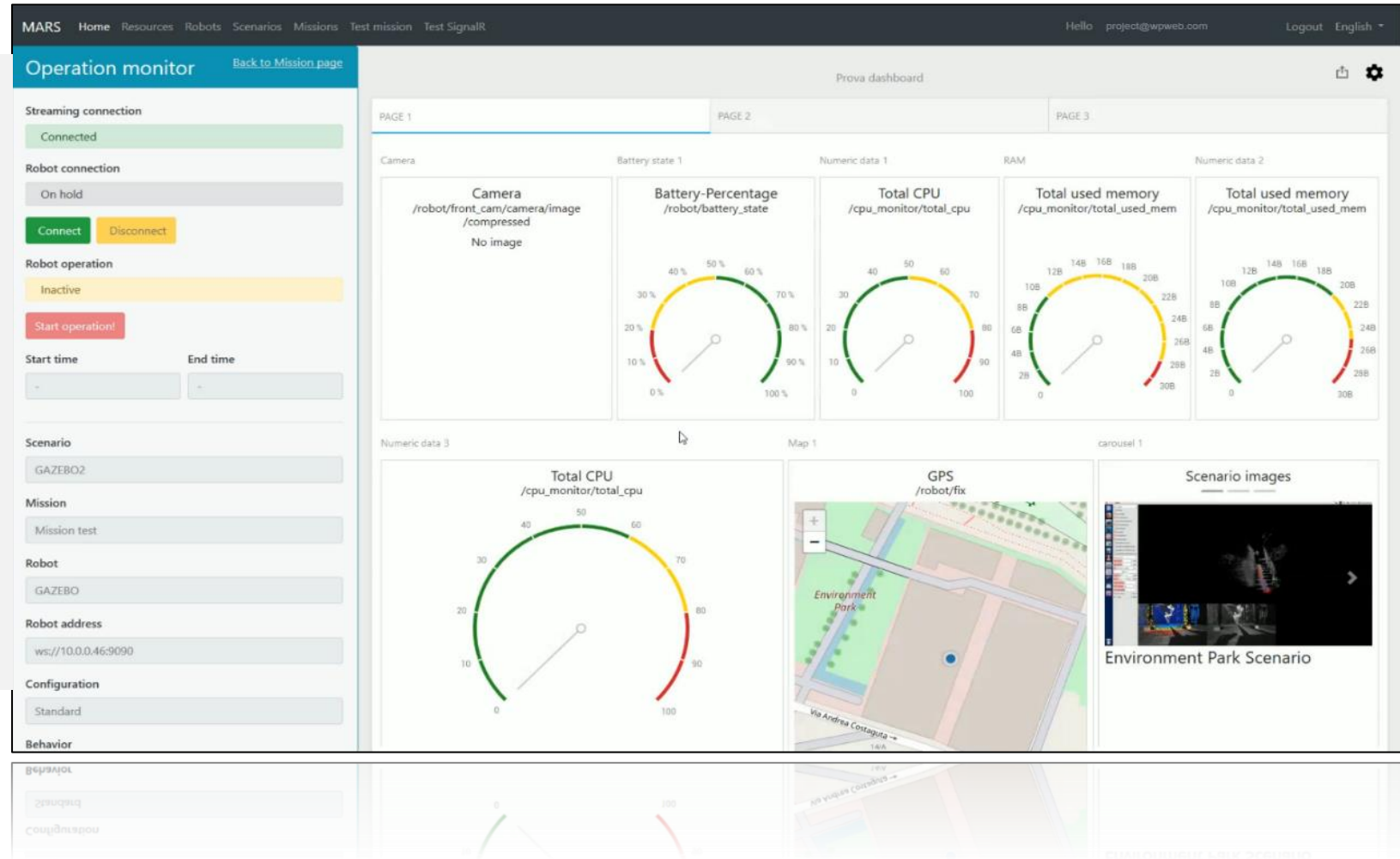
## Mission supervisor

Essentially it is a **state machine** that reacts to events received from the various software components and sensors or to commands and settings

# The web interface

The **control panel** allows to choose or create the mission scenario and select the drone and the behavior to perform.

The **technician** can set the specific parameters of the mission he is about to perform, for example the distance the drone will have to cover to reach the target.





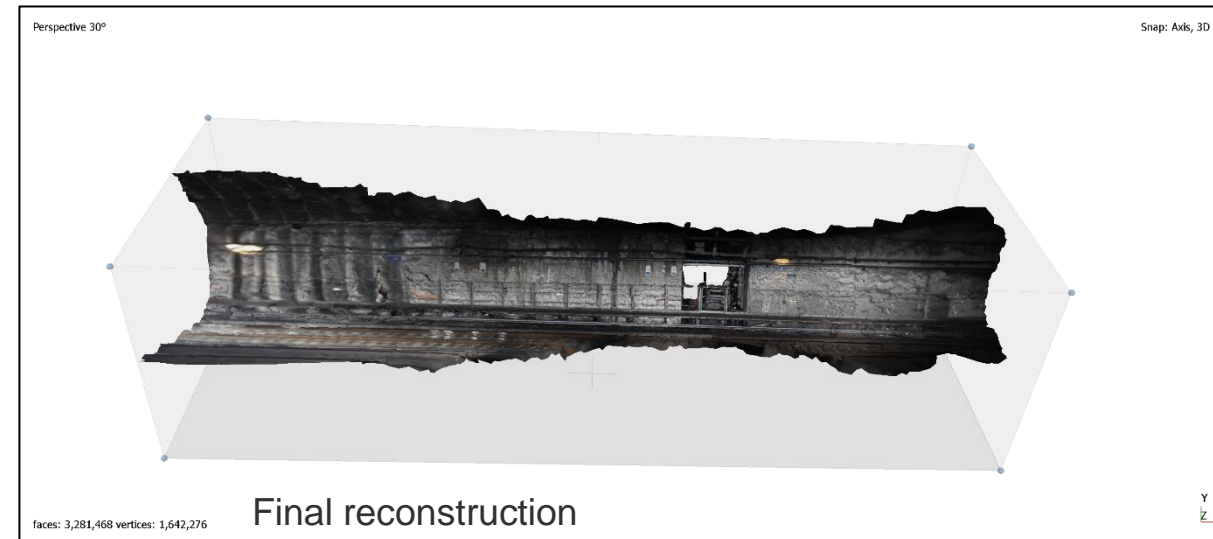
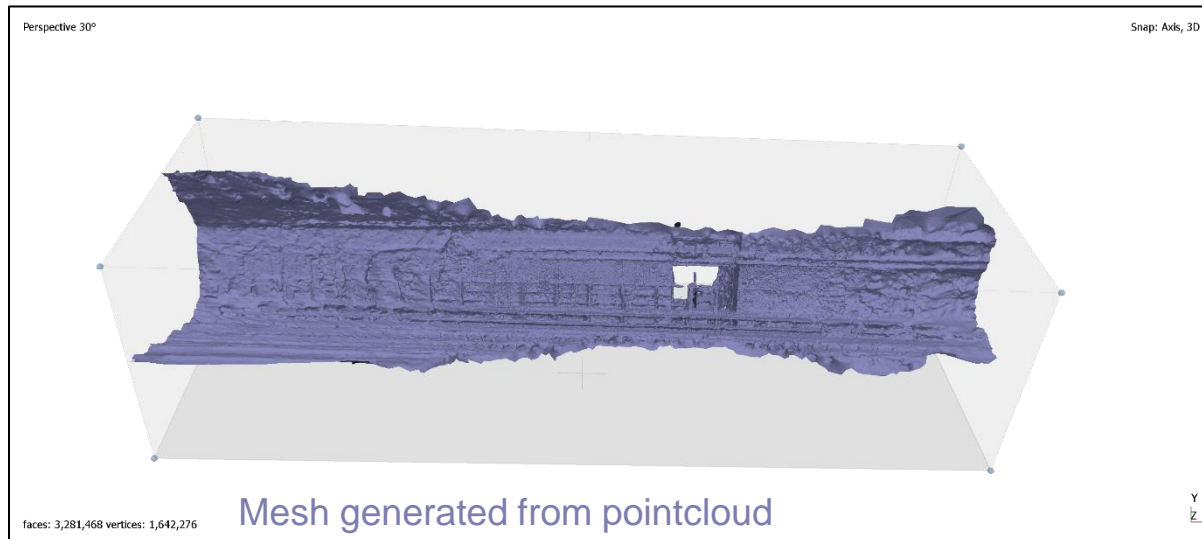
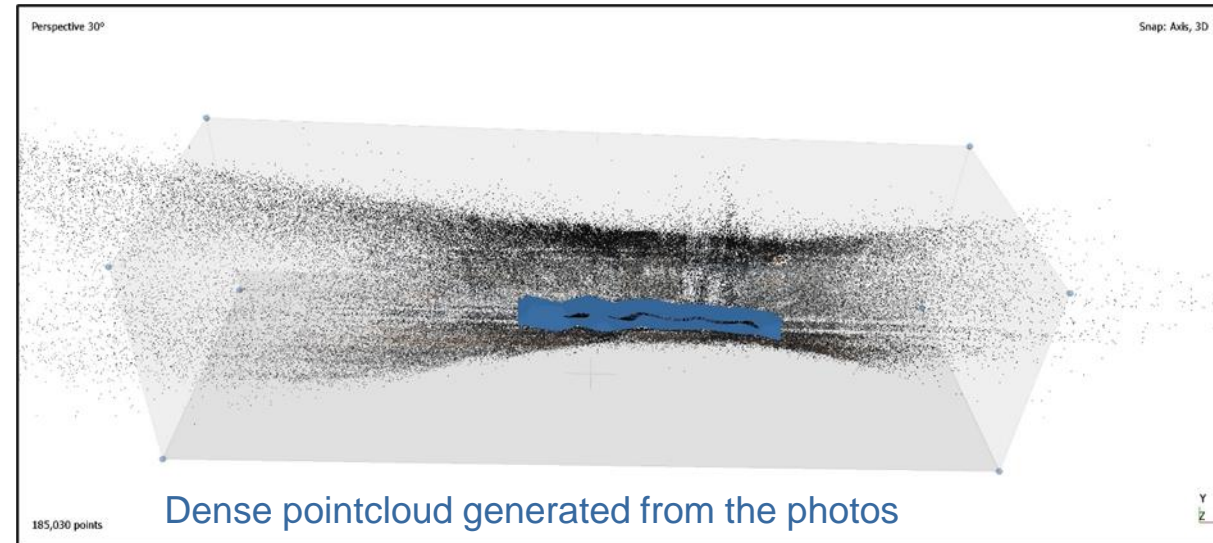
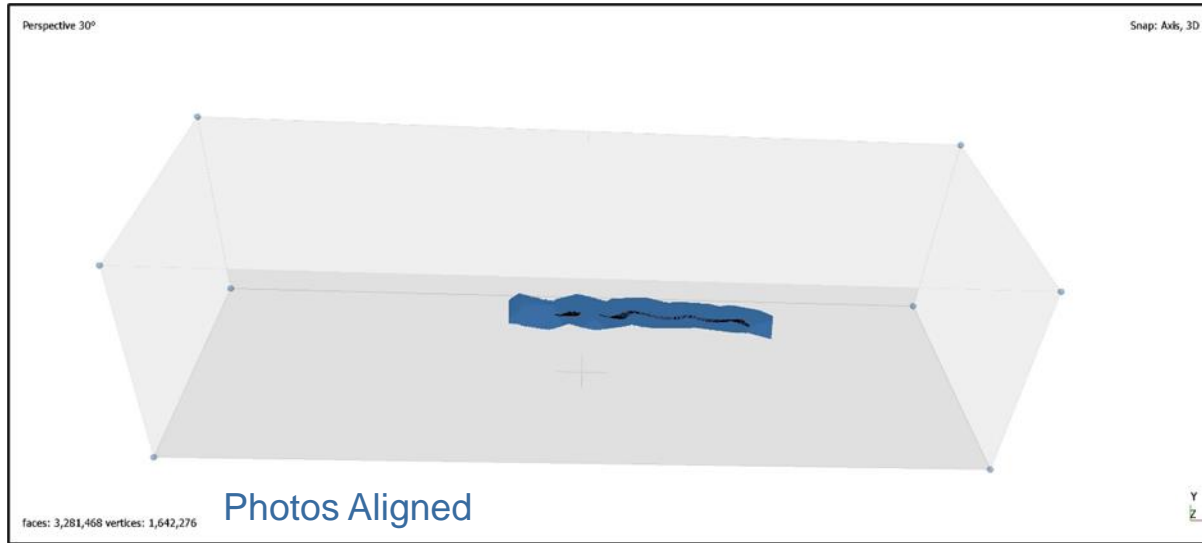
# The experiment scenario



PLUTO



# 3D reconstruction





THANKS!