



Newsletter

Preface

Dear Reader,

We are glad to introduce you the 2nd and intermediate newsletter of the SERENA project.

Purpose of this newsletter is to provide an overview of the SERENA 2nd year activities, along with an early testbed and news on the ForeSee cluster on predictive maintenance.

SERENA is a European Union funded Research & Development Project under the Horizon 2020 Framework Program. The project has started on 1st October 2017 and will last until the 30th September 2020. The project engages 14 organizations from various EU countries and the consortium is coordinated by COMAU S.p.A, Italy.

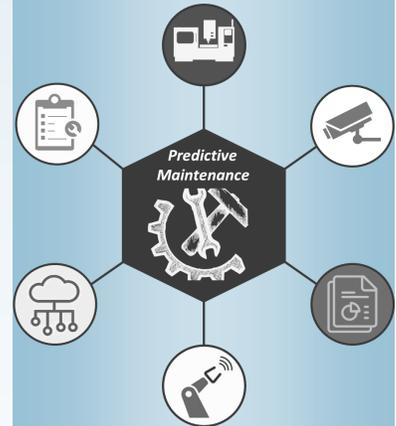
SERENA will provide a bridge for transferring the latest R&D results in predictive maintenance by providing:

- ◆ advanced IoT systems and smart devices for collecting data from different resources and cloud-based remote management of these data
- ◆ platform for predictive maintenance activities & AR based operator local maintenance personnel support,
- ◆ advanced artificial intelligence methods for predictive maintenance,
- ◆ plug-and-play cloud-based communication framework.

SERENA represents a powerful platform to aid manufacturers in simplifying their maintenance burdens, by reducing costs, time and improving the productivity of their production processes.

Sincerely,

The SERENA project consortium



This project has received funding from the European Union's Horizon 2020 Framework Programme for research and innovation under grant agreement No 767561.

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Future Events

- **Oct 19:** SERENA General Assembly meeting to take place at the premises of KONE in Hyvinkää, Finland.

Biandronno meeting

In May 2019, a technical meeting took place in Biandronno, ITALY, hosted by Whirlpool EMEA S.p.A., one of the project's end users.

Technical discussions took place concerning R&D activities, the integration and deployment of the SERENA system as well as its instantiation to the project use cases.



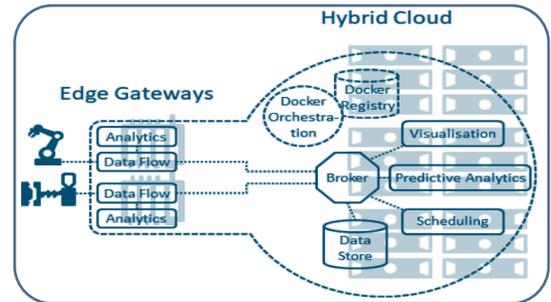
SERENA system architecture

It is a *cloud-based* system comprising of a number of services, which collectively provide its condition monitoring and predictive analytics functionality.

It is implemented using a light-weight *micro-services architecture*, which utilizes Docker containers to wrap the services into deployable units. The distribution of services and dynamic communications channels are implemented using a *Docker* orchestration manager.

The SERENA system has been designed with respect to the needs for:

- compatibility with both the on-premises and the in-the cloud environments;
- virtually unlimited horizontal scalability;
- easy deployment through containerized software modules.



Bowden et al. A cloud-to-edge architecture for predictive analytics. vol. 2322. 2019.

SERENA

Versatile plug-and-play platform enabling remote predictive maintenance

ForeSee cluster news

- ◆ SERENA project presentation in EFFRA community days 2019 along with the ForeSee cluster projects.



- ◆ Paper presentation in KET4DF workshop 2019 in Rome, Italy.

- ◆ Common working group on standardization activities.

The cluster



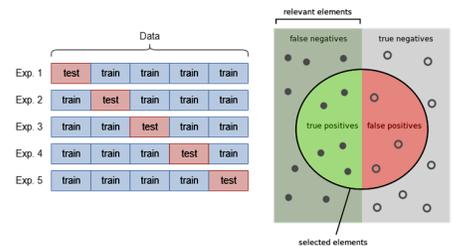
Developments

The SERENA system is designed to integrate external applications using a *service-oriented* approach. Some of its components, hardware and software, are the following:

- **Edge gateway:** Located on the shopfloor gateways collect raw sensor data and channel them to the SERENA cloud.
- **Predictive analytics:** Set of machine learning algorithms for condition monitoring and prediction.
- **Visualization:** A 3D interactive visualization service providing real-time animation and indications for a maintenance operator.
- **Scheduling:** Consuming the result of the predictive analytics, proactively schedules required maintenance operations.



Uncover the bearing ring-out of the protection window using the appropriate wrench supplied and remove it. Overturn the protection window

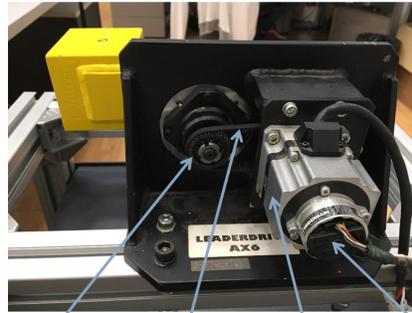


FRONT



5 kilos bulk

BACK



Gearbox Belt Motor Encoder

SERENA system early validation in COMAU's testbed, consisting of a motor from a COMAU medium sized robot, its associated controller, an adapter and a 5 kgs weight in place of the robot end-effector.

COMAU test bed

In order to test and validate the proposed approach, a *test-bed* has been built to replicate the behavior of the robot as it regards the following two aspects, in a cost effective approach:

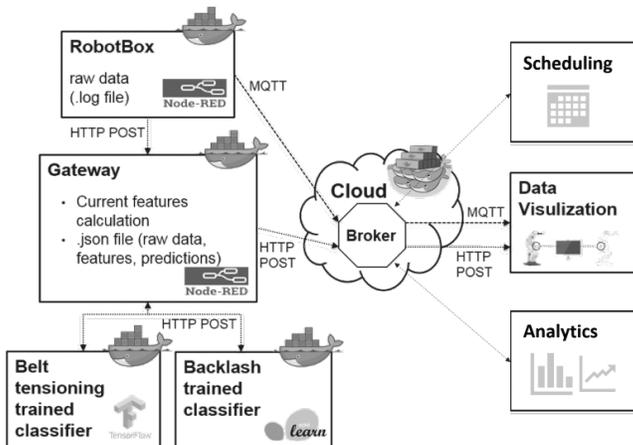
⇒ The evaluation of incorrect belt tensioning and

⇒ The Identification of the backlash phenomenon.

This testbed, namely the "RobotBox", facilitated testing and validating the SERENA approach but also the assessment of the overall solution deployment and customization cost.

Raw data are transmitted in a JSON format to the edge gateway, where they are pre-processed locally. Afterwards, these data are classified into 6 levels of tensioning by the backlash trained classifier.

Additionally, a visualization service is integrated to provide meaningful information to shopfloor personnel while carrying out their maintenance tasks, as assigned by the scheduling service.



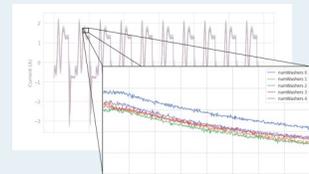
SERENA system instantiation for the "RobotBox" experiments

First results

Data visualization



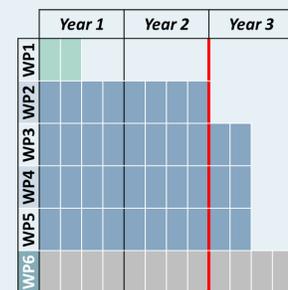
Analytics



Scheduling

Resource Name	Task	Duration (minutes)	Cost (Euros/minute)
Newcomer, Middle	machine inspection	20	0.25
Newcomer, Expert	machine inspection	120	0.25
Expert	machine inspection	15	0.4
Newcomer, Middle	replacement of the gearbox	100	0.4
Newcomer, Expert	replacement of the gearbox	10	0.5
Expert	replacement of the gearbox	80	0.5

Timeline



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