

JOANNEUM RESEARCH
Forschungsgesellschaft mbH

X-AMINOR

Cross sensor platform for lifecycle-monitoring of transformers

R&D Cooperation, 3 years



CROSS SENSOR PLATFORM FOR LIFECYCLE-MONITORING AUTONOMOUS, SELF-DRIVING ROBOT EQUIPPED WITH MULTI- CAMERA-SYSTEM, 3D-MICROPHON-ARRAY AND LIDAR-LASERSCANNING REVOLUTIONIZES TRANSFORMER MONITORING

Transformers are central components of the energy infrastructure, hence their availability is an integral factor of **security of supply**. Continuous monitoring and predictive maintenance are therefore an important factor in increasing the longevity of these infrastructure elements. Although transformers are extremely durable and stable, undetected changes can lead to unplanned outages, therefore high repair costs, and long downtimes.

For this reason, a **multi-sensor platform** for the lifecycle-monitoring of transformers was designed and implemented in the X-AMINOR project. Models for inspection, diagnosis and condition assessment were developed based on the collected sensor data. This continuous monitoring enables the detection of rare and unusual changes of the transformer, which cannot currently be identified using standard methods and sensors for **transformer diagnostics**.

In X-AMINOR, a **mobile robot** was developed under the leadership of JOANNEUM RESEARCH together with Pro²Future, Siemens Energy Austria GmbH, Austrian

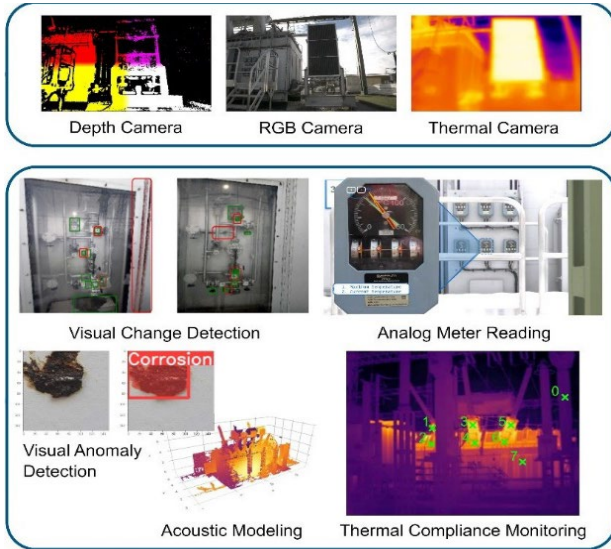
Power Grid AG and Siemens AG Austria, which is equipped with a multi-camera system consisting of thermal, depth and RGB cameras, a 3D microphone array and LiDAR sensors. This **measuring system can move autonomously** and monitor the transformer from several sides in order to detect changes, anomalies and faults. The data collected is stored in a cloud backend, where it can be processed and evaluated automatically and linked to data from additional services such as SCADA systems or weather data. Furthermore, the system can be used both during the production and operation phase of transformers.

A **high-resolution 3D model** of the transformer serves as the basis for data analysis. The depth camera integrated in the sensor network allows all the sensor data recorded as well as the analysis results to be mapped onto the point cloud. For example, heat and noise emissions can be visualized directly on the 3D model. If the process is carried out iteratively for several measurement positions around the transformer, a comprehensive **point cloud representation of the measured data** for the entire transformer is created. Furthermore, analog displays on the transformer (e.g.

SUCCESS STORY



pressure meters) can be read automatically using visual recognition methods in order to include this data in the assessment of the health status.



Camera sources and provided services

Furthermore, corrosion, leakages and other anomalies on the surface of the transformer can be detected by analyzing the RGB images. Finally, the 3D microphone array is used to measure the transformer's acoustic emissions and visualize them using the 3D point cloud.

Contact

JOANNEUM RESEARCH
Forschungsgesellschaft mbH
DIGITAL – *Institut für Digitale Technologien*
Steyrergasse 17, 8010 Graz, Austria
www.joanneum.at/digital

DI Dr. Ferdinand Fuhrmann
T +43 (0) 316 876-1309
ferdinand.fuhrmann@joanneum

Project partner

- JOANNEUM RESEARCH Forschungsgesellschaft mbH
- Graz University of Technology, Austria

Success Story by

DI Dr. Ferdinand Fuhrmann
Dr. Jesus Pestana
jesus.pestana@pro2future.at

Pro²Future Area Manager

DI Dr. Michael Krisper
michael.krisper@pro2future.at

Repeated inspection runs by the robot allow an extensive archive of historical images and data to be accumulated over time. This archive enables the operator, but also automatic algorithms, to compare the current condition of the transformer with previous observations and to **detect changes in the transformer** that could lead to failures.

Impact and Effects

Depending on the design, the cost of a transformer can be in the low to mid two-digit million range. In the worst-case scenario, a malfunction can lead to a fire and the complete destruction of the transformer and can therefore result in very high maintenance or replacement costs. The X-AMINOR platform monitors, archives and analyzes data to **detect potential failures** before dangerous events occur. In this way, **costs can be saved** through preventive measures by using robots to automatically monitor infrastructure systems.



This report was released for publication at the FFG website by the centre management and its project partners. Pro²Future is a COMET Centre within the COMET – Competence Centres for Excellent Technologies Programme and funded by BMK, BMDW, Upper Austria and Styria. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet

 Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

 Federal Ministry
Republic of Austria
Digital and
Economic Affairs

Austrian Research Promotion Agency
Sensengasse 1, A-1090 Vienna
P +43 (0) 5 77 55 - 0
office@ffg.at
www.ffg.at