Product Report: AI-based Predictive Maintenance and Scheduled Servicing with Forecasting Software

Qualitative Labeling of Machine Data

The AI software Deep Qualicision learns patterns in process data automatically by means of qualitative labeling and has been used to optimize the product life cycle as well as service and maintenance process for machinery and plants in the age of Industry 4.0. The software is integrated into the PSI technology platform so it can be connected to other PSI software products, in this case PSIpenta. The AI software offers real added value by implementing predictive and automated service and maintenance.

There are several challenges that need to be met every day when planning maintenance and servicing. These often give rise to the following questions: How can machine availability be increased while minimizing maintenance and repair work? And are there any cost-effective ways to take account of maintenance orders and resulting operational changes that may be required when planning and classifying capacity peaks?

Qualitative Labeling of Micro KPIs with Qualicision

During predictive maintenance with automatic classification from the intelligent software solution Deep Qualicision, the first step is to make a distinction based on the selection of relevant criteria (see Figure 1) such as temperature, pressure, working hours, date of last maintenance, power consumption or criticality of the machine failure and their negative, normal and positive effects on machine maintenance. For this purpose, micro KPIs are defined in advance on the basis of standard machine parameters, which are agreed with the machine manufacturer, and qualified through Qualicision evaluation functions based on extended fuzzy logic. The qualified micro KPIs are used to detect correlations in the micro KPIs so the machine data can be processed with the Deep Qualicision algorithm and qualitative labeling can be applied.

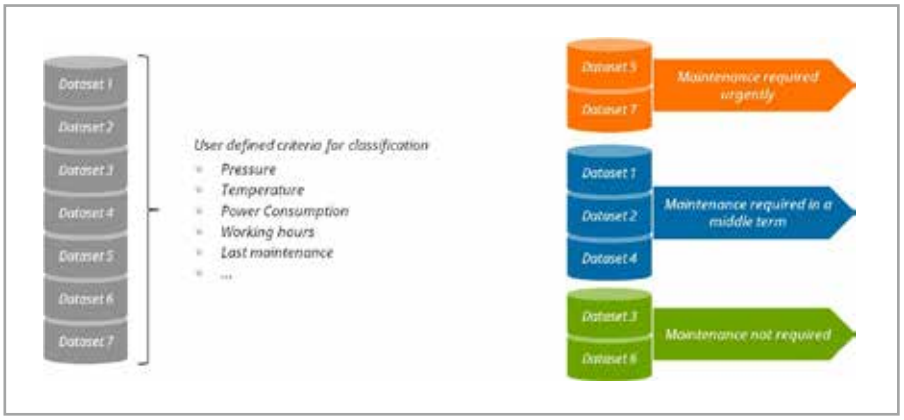

Figure 1: Relevant criteria.

Learning Macro KPIs from Data with Qualitative Labeling

Based on the labeled machine data, aggregated macro KPIs are then learned and used as criteria for detecting machine states and classifying maintenance requirements. The classification (see Figure 2) may be based, for example, on the categories "maintenance required urgently ", "maintenance required in a middle-term" or "maintenance not required now". The machine manufacturer itself determines the exact classifications by adjusting the self-diagnostics of the machines using Deep Qualicision—but this is not essential.

Automatic Detection of Maintenance Requirements through Short-Term and Long-Term Learning

This enables automatic detection of maintenance and servicing require-

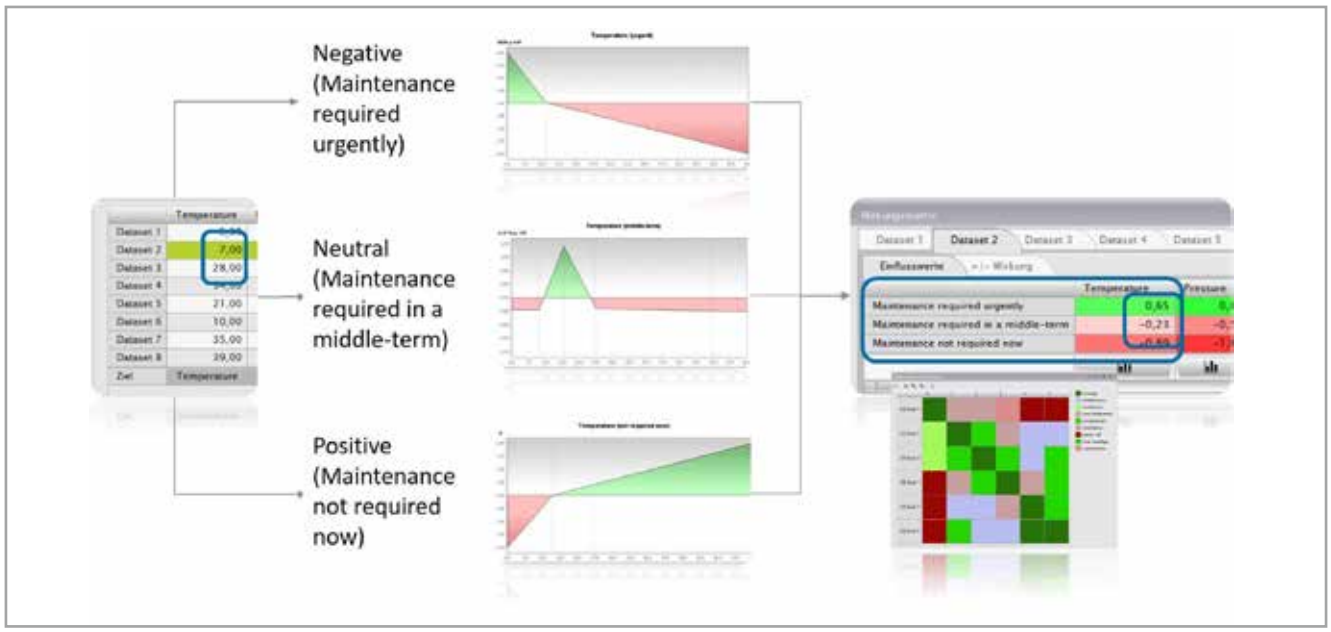

Figure 2: Classification of maintenance requirements.

ments based on sensor data. The criteria can be adjusted by applying different priorities to the relevance of the labeled data—either manually or in combination with further automatic learning of the criteria priorities. This means the appropriate weighting of the sensor signals can continuously re-learn the interactions between the qualitatively labeled criteria for maintenance-related classification of the sensor signals for both current, actual patterns and long-term patterns.

Presentation at Hanover Trade Fair 2019

The software was presented at the Hanover Trade Fair 2019 in conjunction with its use in predictive maintenance of high-tech winding machines (see Figure 3) at KAMPF.

For the processing of web-shaped materials with a thickness of only a few micrometers, the produced parent rolls, which can have a diameter of 1700 mm, a width of 11 m and a weight of up to 26 000 kg, are finished into many individual intermediate products according to the customer's application and requirements. Special rewinding stations are installed in the individual slitting machines, which are designed to meet individual end customer requirements and therefore have to be compact and efficient due to the wide range of applications.

Process data such as speed profiles or system-related dynamic factors, variable foil types, running lengths, foil width-dependent web tensions and roll weights, as well as sensor data such as temperature, humidity or vibrations, play a decisive role in achieving high total plant efficiency.

Figure 3: High-tech winding machines at Kampf.

They also act as input micro KPIs for the Deep Qualicision AI.

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