Software Package for Monitoring Cyclical Processes with Machine Learning

Development of a modular and scalable system including AI model training, live process surveillance and a web app

Graduate

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Introduction: Industrial processes have reached a degree of complexity which make them difficult to monitor without the assistance of digital solutions. These systems process and respond to substantial amounts of data, both from the industrial process and any machinery involved, as well as from sample analyses of the resulting products. While conventional methods of control engineering are widely adopted for such applications, machine learning (ML), and more broadly artificial intelligence (AI), shows the potential to provide more adaptive and user-friendly control systems.
Although solutions employing machine learning to this effect may already exist on a small scale, with individual products tailored to a specific process, the operation of these product requires trained professionals, and commercial platforms and services to support these systems are not yet widely available.

Approach: A software ecosystem is designed which consists of modular components, separated by function. The primary separation is between the IT and OT, where IT encompasses the high-powered computers required for data processing and model training, and OT encompasses the IT on the shop floor, including the industrial process.
This separation allows for the flexible deployment and usage of the ecosystem, where data and processing power are consolidated in the server infrastructure, and the processed, real-time information is available where it is needed on the shop floor.
Three user stereotypes are defined, based on the required expertise and access level to fulfil certain tasks.
Operators have minimal training, and can observe the current state of the industrial process, as well as predictions from the selected AI model, trough a user-friendly web app.
Maintainers have access to the underlying database through an administrator web app, allowing them to modify the underlying data, set up new monitoring jobs, and create new AI models.
Developers implement additional modules, allowing them to easily expand the supported functionality across all systems wherever desired.

Result: The resulting ecosystem is called Meercat (Mechanical Error Categorisation), and consists of a software for bulk data processing (Burrow), and another for monitoring and displaying information on real-time events (Lookout).
Burrow is responsible for all the data processing, and can be modularly expanded to include different data processing steps and data from different industrial processes without downtime. It can use data from any static source, such as a database or CSV file, and will work continuously in the background once started.
Lookout runs on-demand and live, monitoring and analysing live processes in the background while presenting its results in a web app.

The 3D data used for training, labled by desirability (deviation from ideal quality).
Own presentment

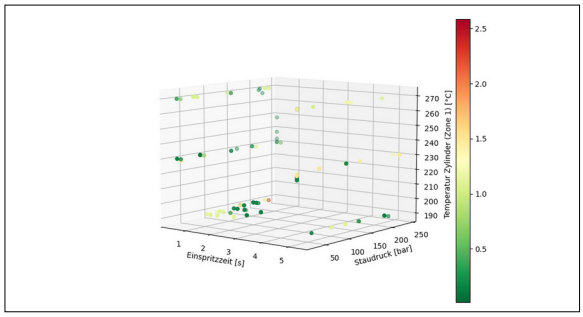
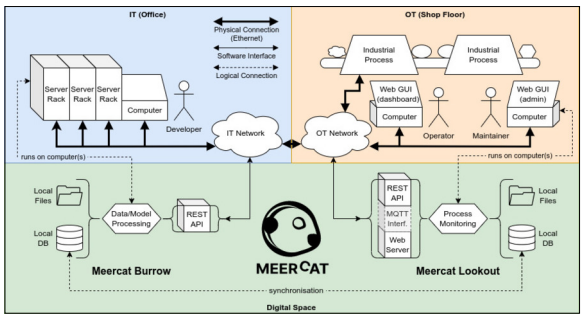
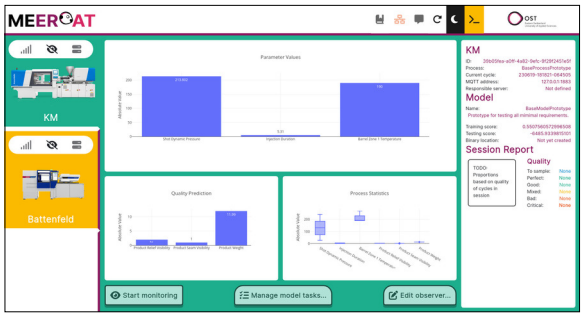


Diagram of the various components of the system, and the technologies they employ.
Own presentment



Screenshot of the prototype running on Meercat Lookout, showing the dashboard of one of the monitored processes.
Own presentment



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Subject Area
Information Technology for Mechanical Engineering, Automation & Robotics, Operation & Maintenance, Manufacturing Technology