



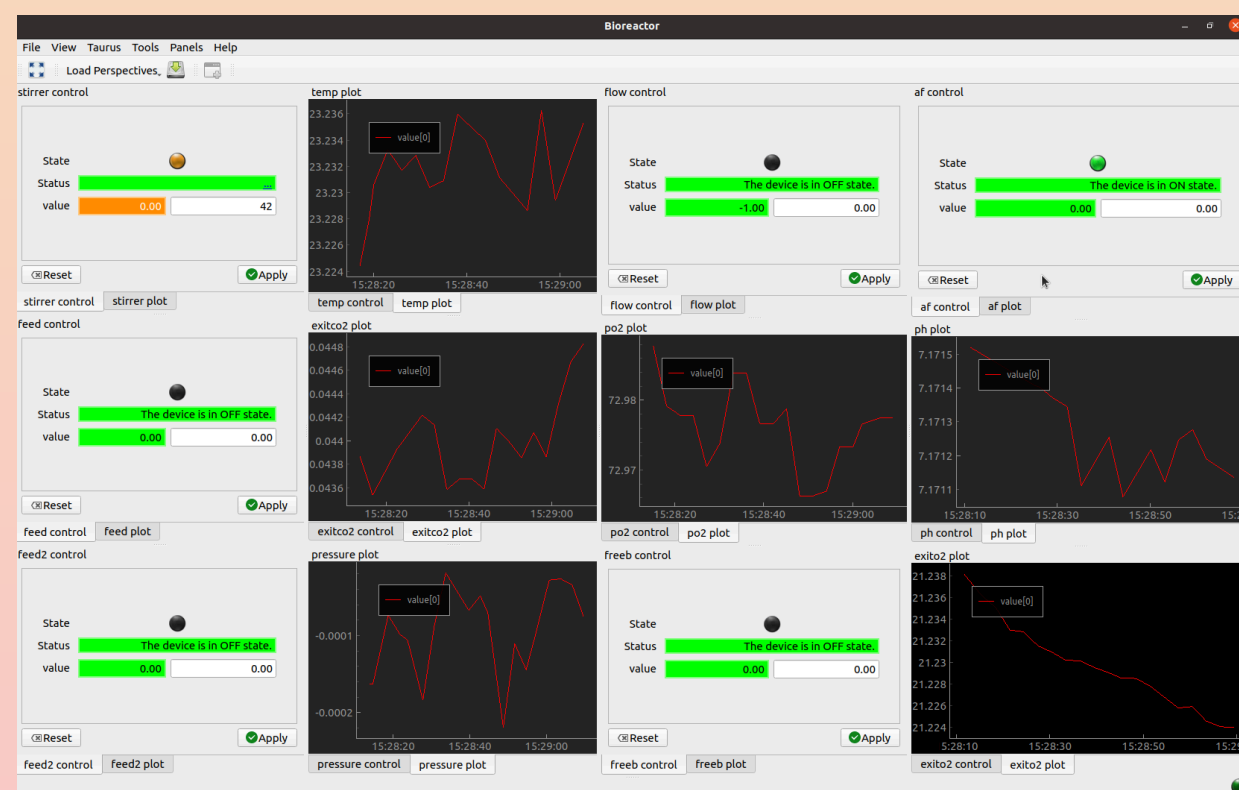
Microbes Dancing



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Chosen Framework

As an open source framework to develop the control system “Tango Controls” was chosen. It is a project originating at some of Europe’s particle accelerators and has now been adopted by over 40 small and large organisations. Its core software can be deployed on both Windows and Linux and development can be done in C++, Java and Python. Furthermore it is hosted on Gitlab and provides support for dockerisation. It comes with multiple graphical tools and a web interface. Hence it uses state-of-the-art software development tools and gives the developer many possibilities to construct and extend a custom-made and flexible system, yet based on a standardised framework. This is in stark contrast to current proprietary software.



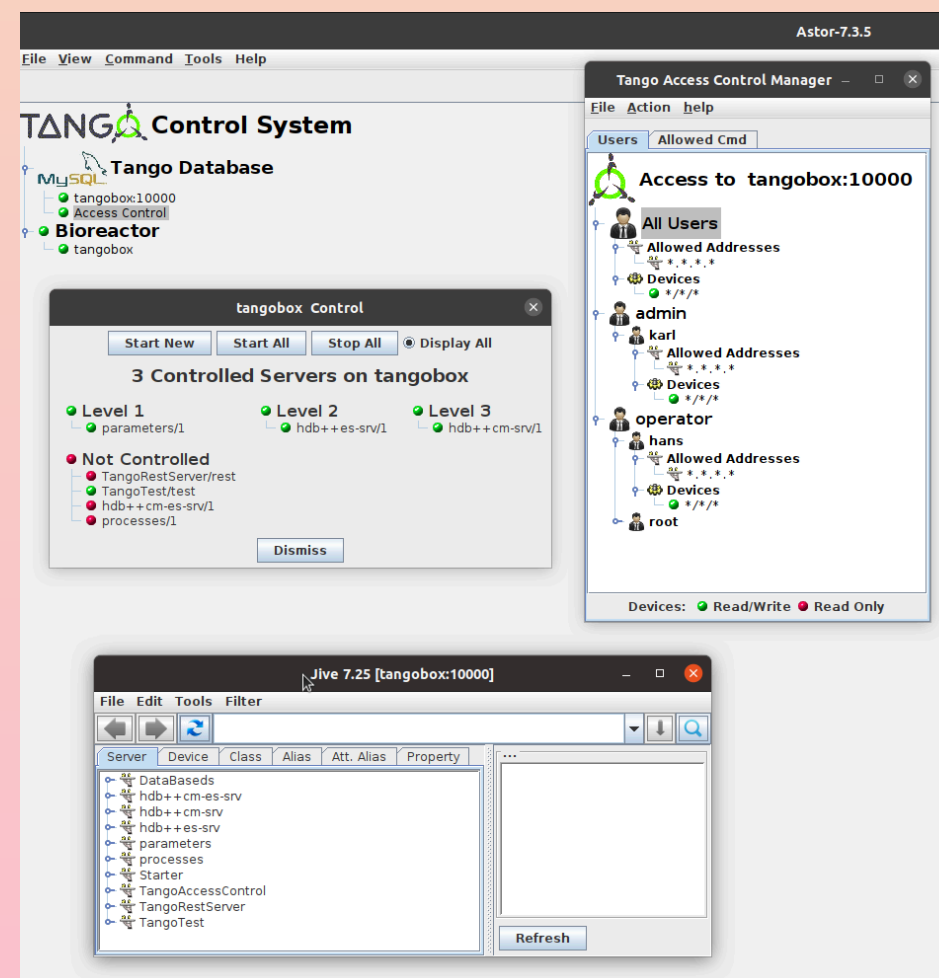
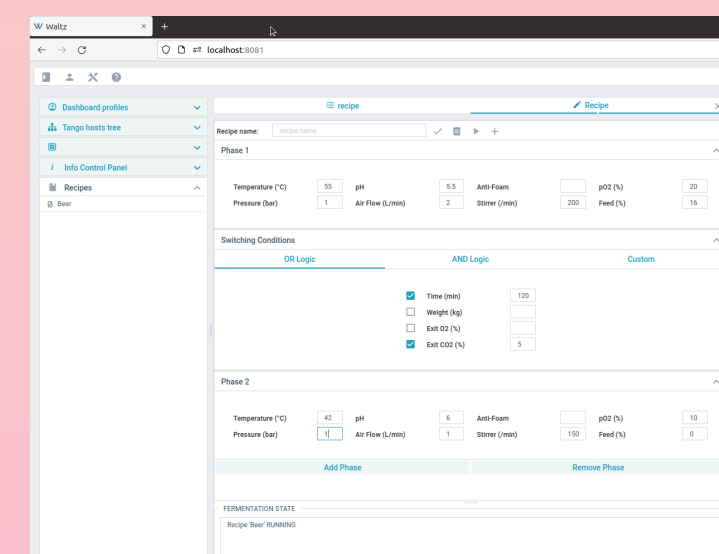
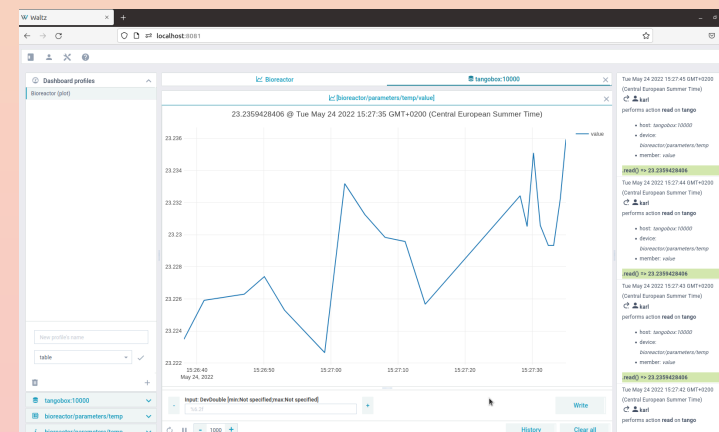
The user can interact with the system through a stand-alone desktop app as well as a web tool. They allow monitoring of the process parameters as well as adjustment of setpoints. Furthermore the apps are customisable. Particularly promising is the possibility of using a web app. It provides the integration of controls systems with the internet - and thus opens the possibility to move from a single centralised control room to distributed and flexible systems. The web app has also been extended with a tool to write fermentation recipes based on customisable logic.

Project Background

Supervisory Control and Data Acquisition (SCADA) systems have been an integral part of industrial production for decades. The systems in use today are large and expensive applications made to meet many different demands from different industries and companies. Furthermore they are proprietary. In practice this has many disadvantages which can be summarised as being locked-in with one vendor. The internet has opened up the age of open source software. Nowadays even most proprietary software makes use of countless respective libraries. No one has to invent the wheel from scratch. Thus this project aims to investigate the possibilities to employ an open source solution as a SCADA system to control a fermenter.

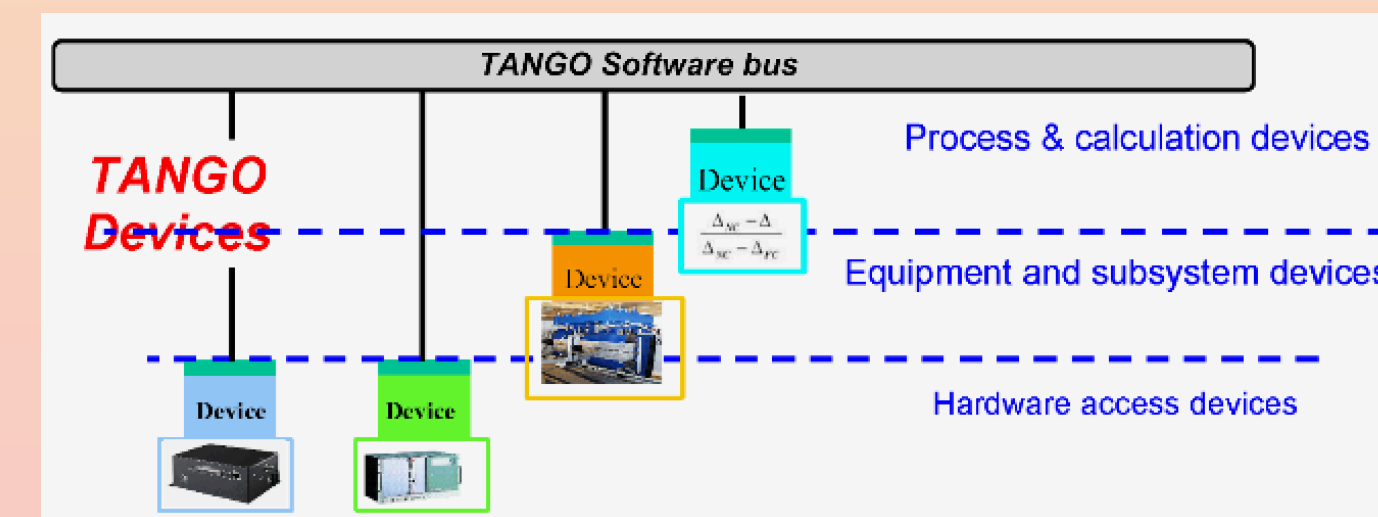
Project Scope

The aim is to develop a control software for a research fermenter located at Helix Lab with all essential functionalities. Hence it is possible to control all fermentation parameters with a system running on an edge device. Moreover graphical user interfaces and archiving systems are developed.



Implementation

In the developed system, the sensors and actuators are represented as “devices” which can all be controls independently as well as communicate with each other. The mature message queue technology ZeroMQ and object representation framework CORBA ensure that multiway, concurrent communication is robust. Furthermore the single devices are conceptualised as finite-state machines which supports the correct correlation of their physical and digital states.



Outlook

The practical results of this project are promising. In principle, it is possible today to shift to controls systems based on open source software. An open source system dismisses the commercial vendor of control software and at the same time necessitates the employment of developers in one form or the other. It is an open question which approach is likely to be more financially salient. Technology-wise it is important to assess the reliability of the system which has to provide data integrity and security. A considerable potential advantage of an open source system and respective internal developers in the biotech industry is its flexibility. As the system can be adjusted without external consultants having the exclusive access to the code, modern data science and industry 4.0 can possibly be implemented more efficiently in a science-driven field like biotechnology.