SMART VIDEO PLUG-IN SYSTEM FOR BEAMLINE OPERATION AT EMBL HAMBURG

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Fast data collection, image processing, and analysis of video signals are required by an increasing number of applications at the EMBL beamlines for structural biology at the PETRA III synchrotron in Hamburg, Germany.

For the EMBL beamlines, the TINE control system, developed by DESY, has been chosen as a transport layer for the communication between devices at the experiment.

Consequently, a new TINE Smart Video Plug-in System has been designed in-house to meet the needs by combining video capture, machine learning, and computer vision with online feedback for motion control and integration into the TINE Control data acquisition and experiment control system. The .NET built-in dependency injection pattern makes it easy to connect different platforms and SDKs like OpenCV and ML. NET into a single application as well as adding video camera API from different vendors. Fast data acquisition and streaming are achieved using high-performance C/C++ code libraries, including Advanced Video Coding (H.264).

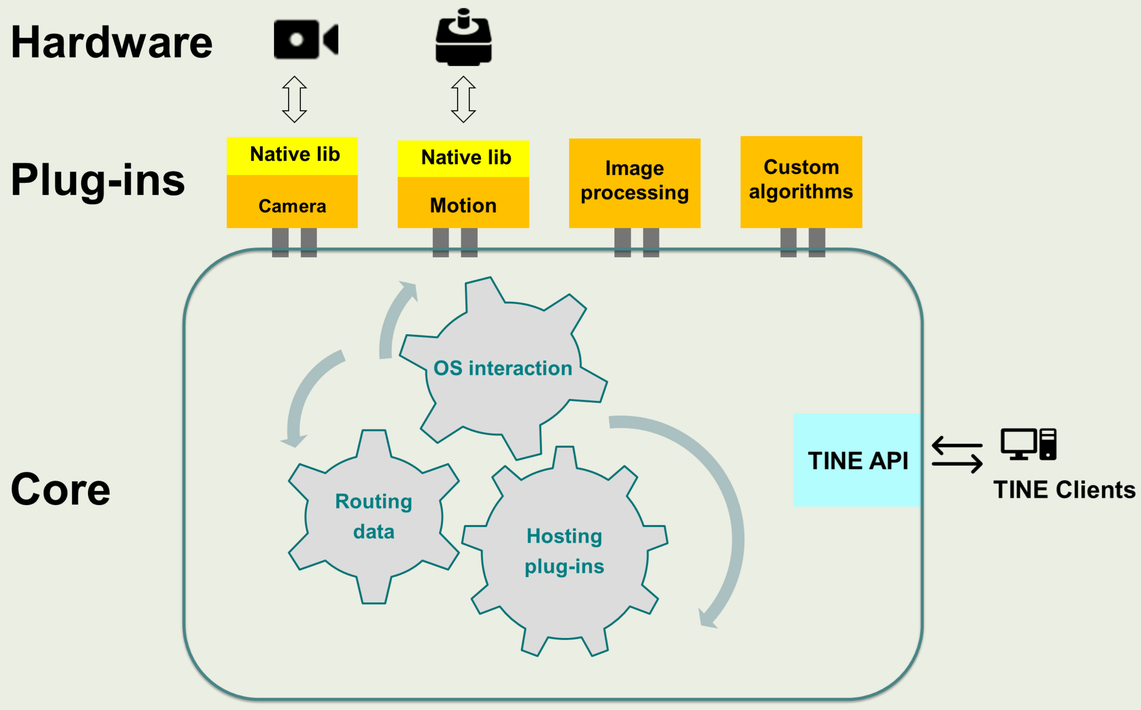
Features

Video camera plug-in
- Receiving raw images captured from specific cameras
- Video streaming into the beamline control environment
- H.264 compression and transfer into the video storage for the offline sample motion analysis

Image processing plug-in
- Processing raw images using OpenCV
- Receiving inputs for image processing algorithms from configuration and user interface
- Providing processed output for different consumers (e.g. lens auto focusing, sample positioning)

Motion control plug-in
- Piezo stage control using native libraries of SmarAct, PI and other vendors
- Stepper and DC motor control via the Common Device Interface (TINE)

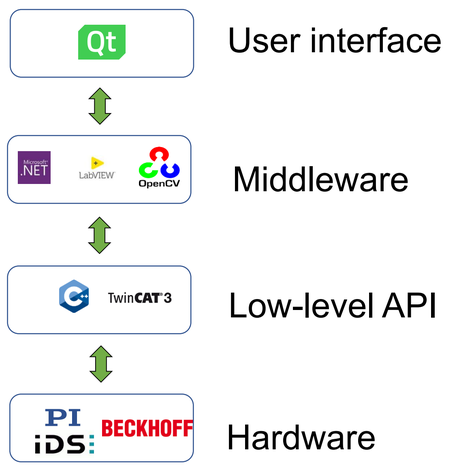
Solution architecture



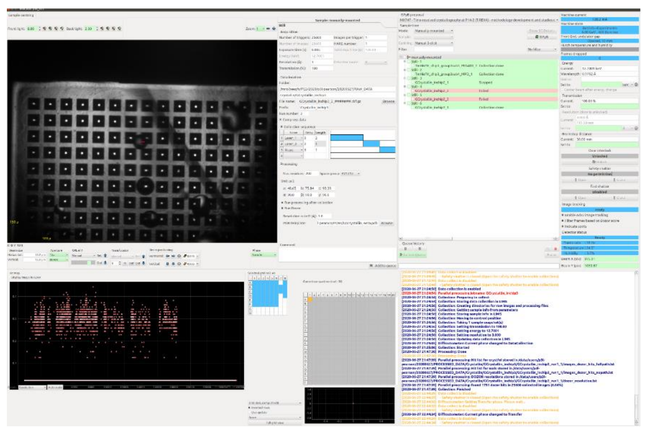
Implementation

Highlights
- Cross-platform application
- Plug-in architecture
- C# with native/managed interoperability
- Dependency injection (DI) software design pattern
- Windows Service or Linux Daemon using .NET Worker Services
- TINE services integration

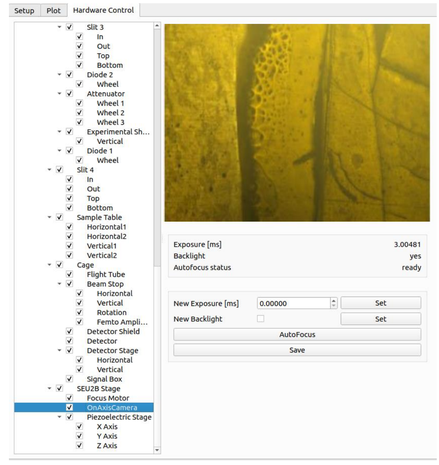
Technology Stack(P12 beamline)



User Interface



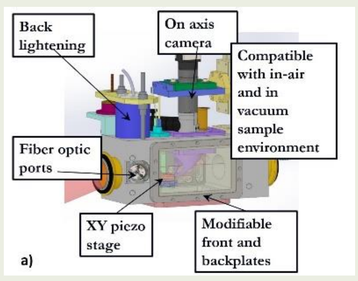
MxCuBE, beamline control software for time-resolved experiments at P14.2 beamline

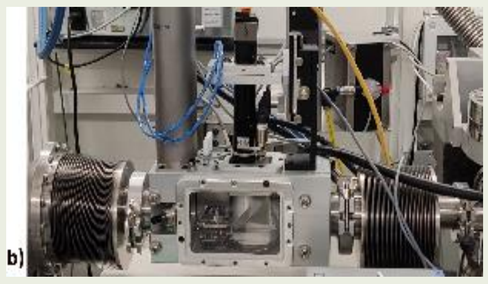


BECQUEREL, beamline control software at P12 SAXS beamline

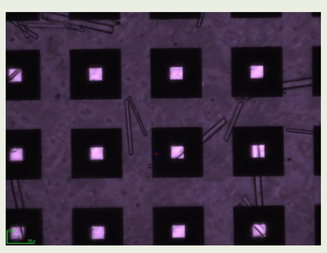
Applications

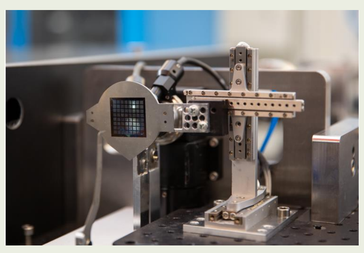
Sample exposure unit: a) Model b) Installation at the P12





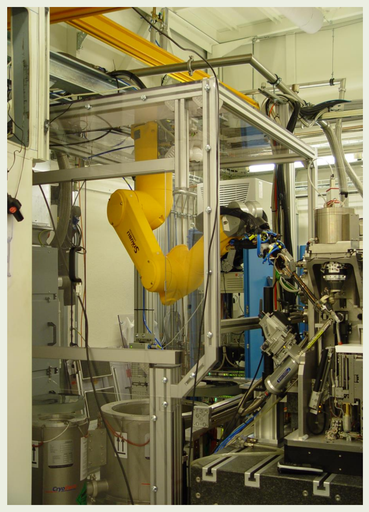
Patterned silicon chips for time-resolved experiments at the T-REXX





Future developments

- Sample distribution anomalies detection
- Sample pin robot misalignment detection for the MARVIN robotic sample changer system
- GPU acceleration for ML and computer vision
- Web API and MVC



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