LABVIEW-BASED TEMPLATE FOR ENHANCED ACCELERATOR SYSTEMS CONTROL: SOFTWARE SOLUTIONS FOR THE CERN-ISOLDE FACILITIES

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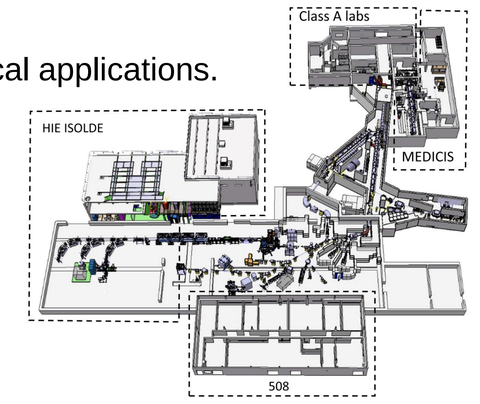
Context and motivation

- ISOLDE provides radioactive ion beams for studies of fundamental nuclear physics, astrophysics, condensed matter physics and medical applications.
- It includes RILIS, MEDICIS and MELISSA, OFFLINE1 and OFFLINE2.
- To operate the facilities, a **large set of machine parameters** needs to be controlled and monitored.
- It is important to avoid large monolithic and complex applications, as these are difficult to maintain over time.
- Given the significant number of facilities and experiments, there was the need for a **modular application** that:
    1. Allows to **quickly deploy** a solution when needed,
    2. Helps users to **maintain a clean code**,
    3. Provides a **common communication approach** at the software and hardware communication layers
    4. Is already **integrated** into the CERN network and data infrastructure.



Design template

Module Manager

1. Way-point and data dispatcher for communication between the other modules.
2. **Management logic** of the template, keeping track of the states of all the other modules by buffering and relaying messages as needed.
3. **Higher level of awareness**.
4. Ensuring application-specific sequences and timing restrictions.

Components

1. The design template provides components that can be used as a starting point for creating new modules.
2. These components allow a module to send commands to itself and provide a case structure to handle incoming commands and basic error-to-message conversion.

API

1. Inter-module communication.
2. Each module has an **Event Handler component** with public API messages associated with it.
3. External modules can use the API to schedule parallel work, resulting in **asynchronous** messaging.

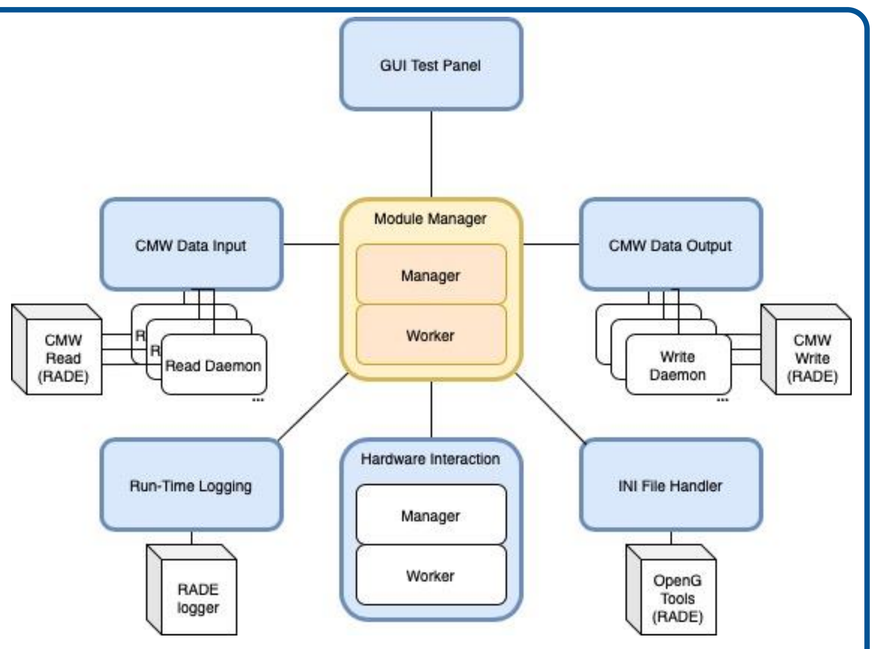


Figure 1: a Queued-Message-Handler (QMH) template consisting of an Event Handler (Manager) and a Message Handler (Worker).

Using the template

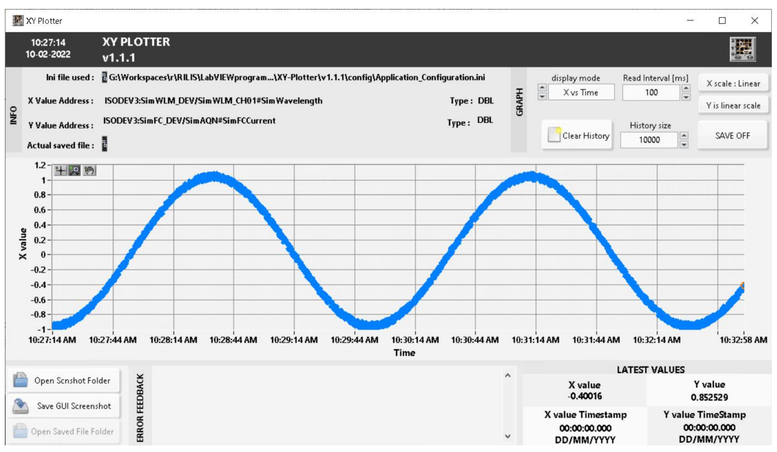


Figure 2: XY Plotter interface

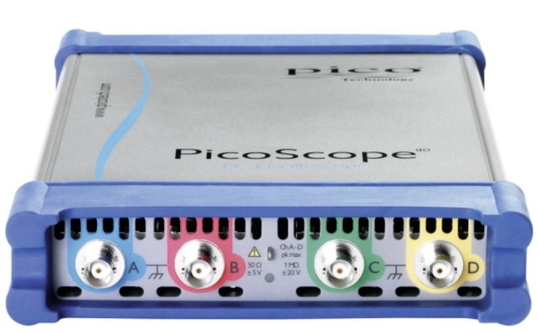
- The **XY Plotter**: graph and value indicator. It displays and logs two data values either in dependence to each other or versus time.
- The **game controller interface**: it aims at optimizing the laser beam position and gives the operator the freedom to move around the installation during operations while still viewing the screens on the walls where they can visualise the manipulations using, for example, the XY Plotter application.

Figure 3: game controller interface

Combining multiple applications

Laser Timing Feed-back Loop: Combining multiple applications, they can work together and perform more complex operations.

The time delay of the pulse peak with respect to a master clock trigger is published through CMW.



PicoScope driver application → *CMW* → Generic feedback loop → *CMW* → Pulse generator driver application

PicoScope driver application ↔ *Serial comm.* ↔ PicoScope hardware

Pulse generator driver application ↔ *Serial comm.* ↔ Pulse generator hardware

measured time – operator value
=
correction to individual laser trigger timings

Control the pulse timing hardware, possible longer internal processing times in the lasers are compensated by an earlier trigger command.

Conclusions

- The result is a **modular**, **flexible**, and **maintainable entry-level application template** that allows rapid development and commissioning of new applications without requiring a software engineering background.
- More than 30 applications were developed **reducing the maintenance time** for a small application **from 7 to 2 days** per year.
- Despite the current focus on supporting the CERN-specific communication infrastructure through the RADE library, the Module Template can be easily **transferred and expanded for use outside** the CERN accelerator environment.

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