Applying Service-Oriented Architecture to Archiving Data in Control and Monitoring Systems

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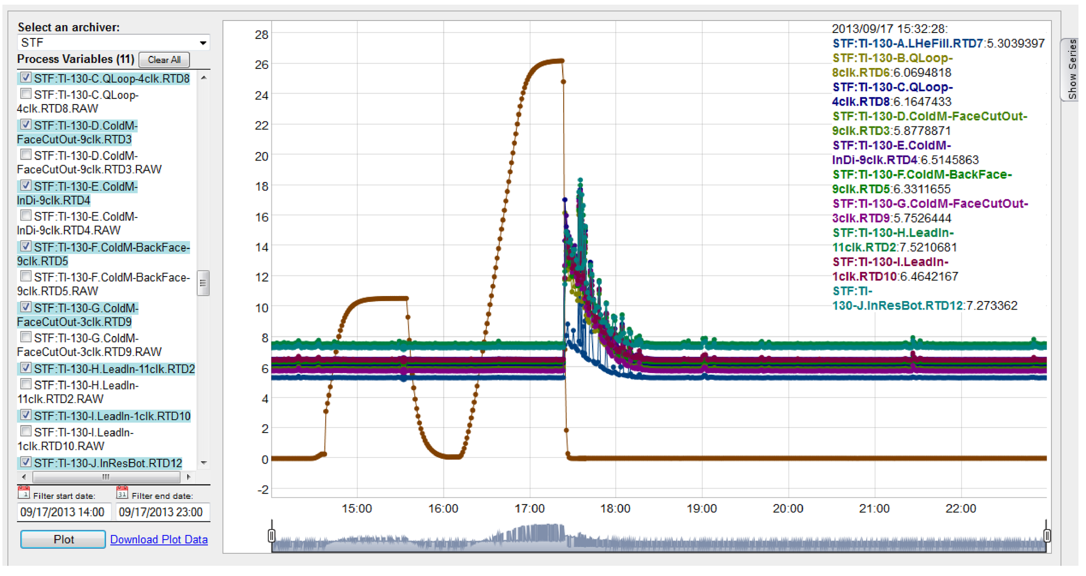
Overview

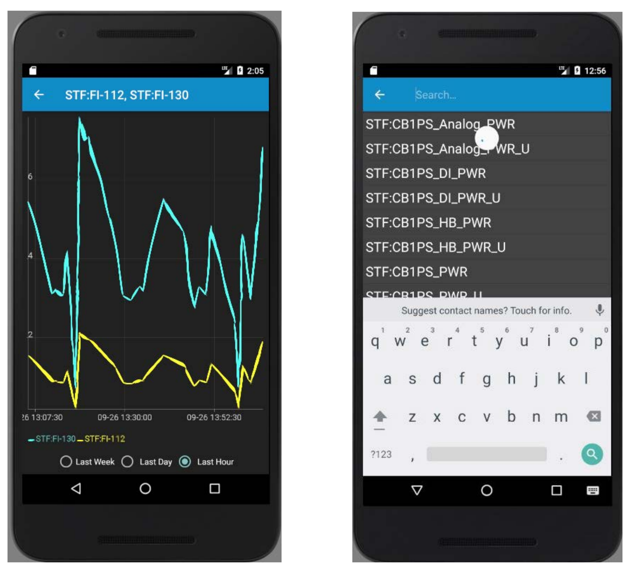
Current trends in the architecture of software systems focus our attention on building systems using a set of loosely coupled components, each providing a specific functionality known as service. It is not much different in control and monitoring systems, where a functionally distinct sub-system can be identified and independently designed, implemented, deployed and maintained. One functionality that renders itself perfectly to becoming a service is archiving the history of the system state. Such a service, built as a microservice and designed to archive time-series data, has been developed for the Mu2e Solenoid Test Facility at Fermilab.

Presentation Layer

The Presentation Layer includes two applications used for data visualization: a Web-based application and a mobile application.The Web application allows for historical trend analysis via charting and data extraction. The user chooses a set of data to be visualized by selecting the appropriate archive, data tags, and a time range. The Android mobile app shows real-time trends (hour, day, or week long) of selected data tags from the chosen archive.



Web-based application



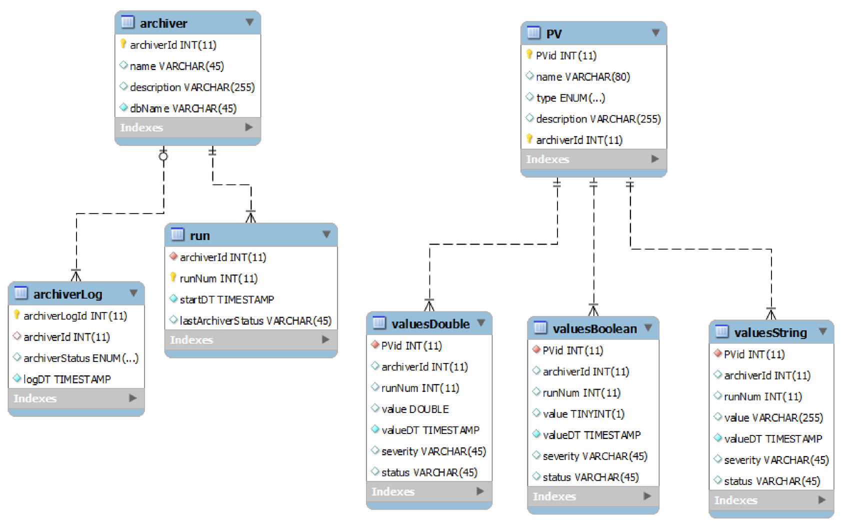
Mobile app

XML

Data Storage Layer

The data storage layer comprises a microservice with an XML-based API and a storage mechanism based on a relational database management system. The specifics of an R&D testing environment allowed the choice of a standard relational database for a time-series data repository. The data is organized into archives, each of which store a set of runs consisting of sets of time-series data.

Microservice

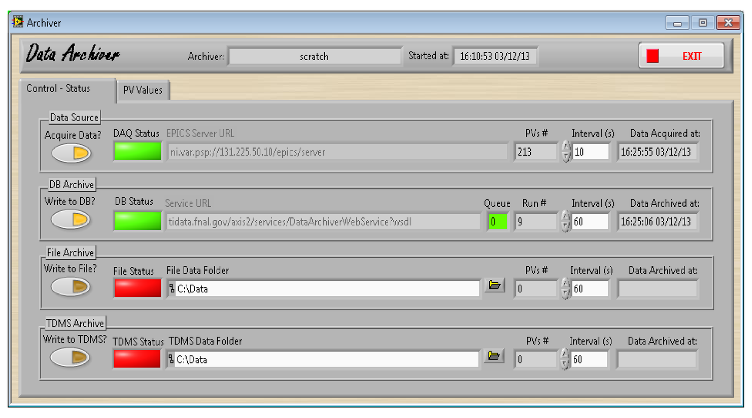


Database data model

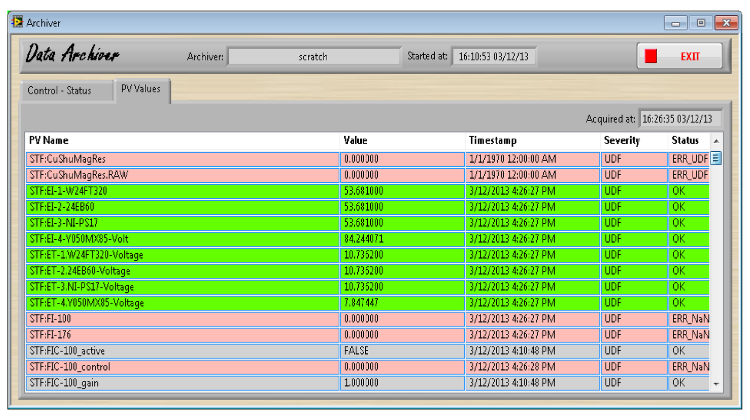
XML

Data Archival Layer

The Data Archival Layer allows for concurrent execution of multiple archivers; each archiver collects data from the Data Acquisition Layer, aggregates them, and submits them to the archival microservice in the Data Storage Layer. Two additional file-based storage options include high-throughput TDMS formatted files, and ASCII CSV formatted files for ad-hoc use.



Archiver: console

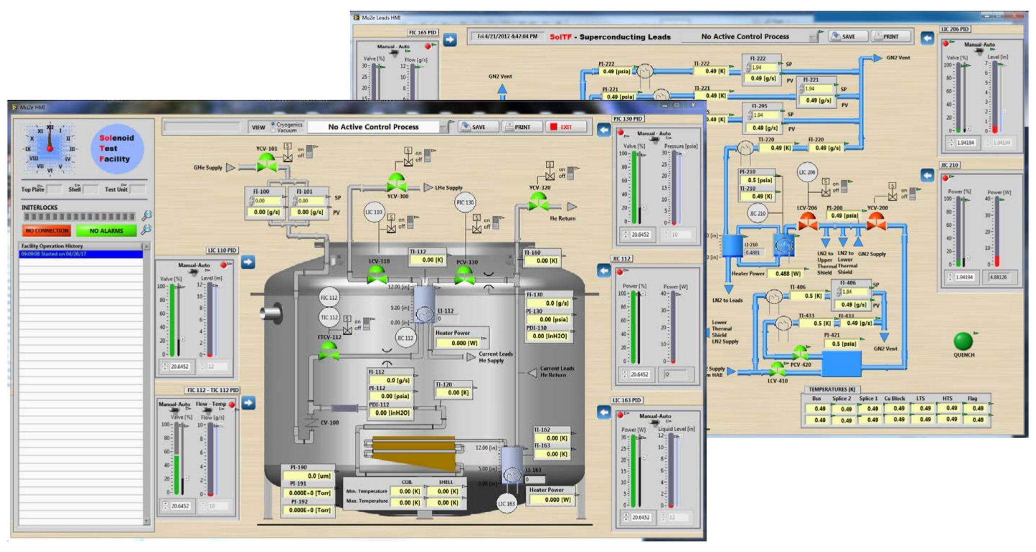


Archiver: PV statuses

EPICS PV, LabVIEW SV

Data Acquisition Layer

The Data Acquisition Layer provides access to PVs via the EPICS Channel Access interface and LabVIEW shared variables. Using the IFIX gateway developed as part of the facility control and monitoring system, the archiver can also gather data from iFIX SCADA systems.



Control and monitoring system