

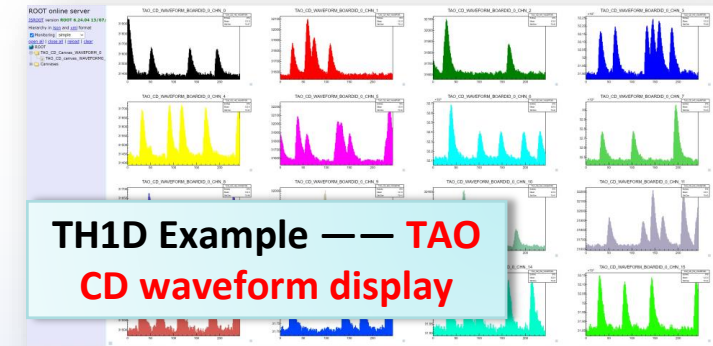
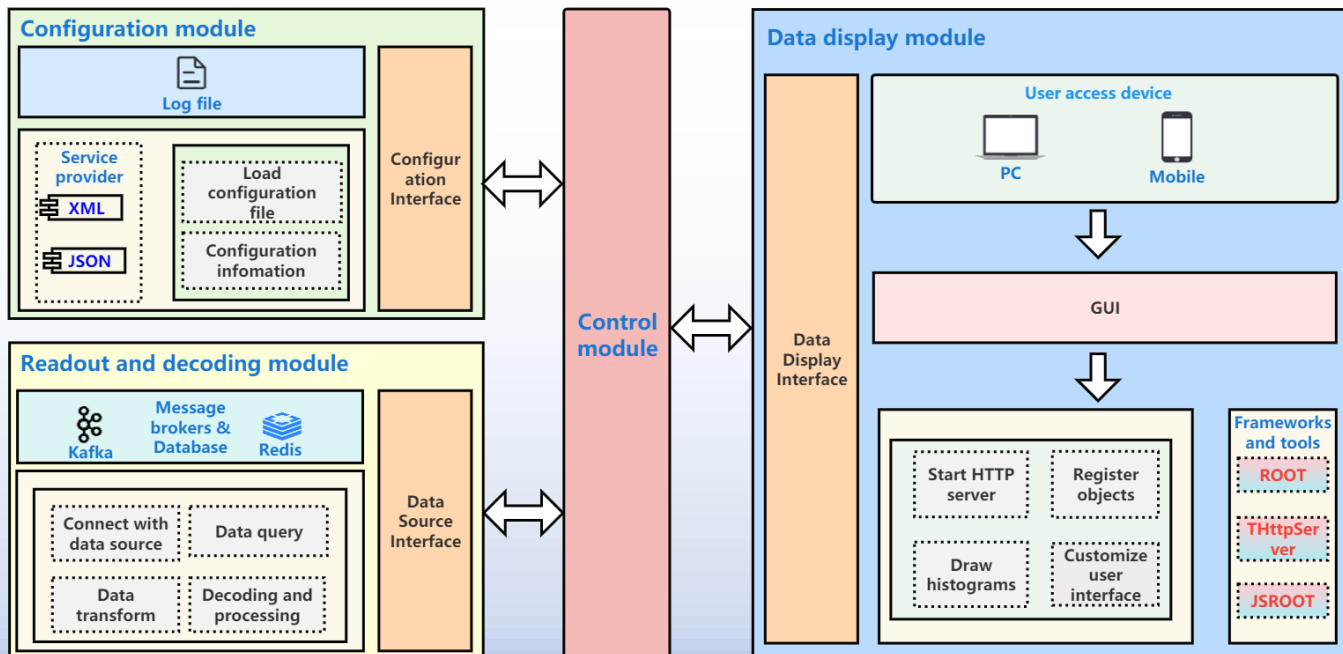
A ROOT-based General Online Data Visualization System

Shuihan Zhang, Institute of High Energy Physics

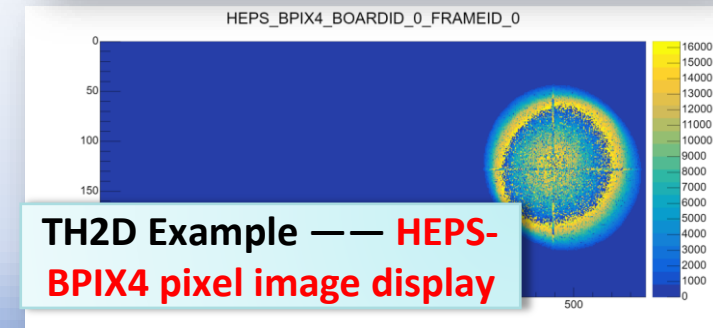
- **ROOT-based general online data visualization system (ROBOT)**
- Purpose: **Generality and scalability**
- Integration test & Operation: Real-time online data monitoring
- Completed system design and major module implementation

Purpose:

- ✓ Quick implementation and integration
- ✓ **Detector / Electronics independent**
- ✓ Online real-time monitoring
- ✓ **ROOT & JSROOT** based



TH1D Example — TAO
CD waveform display



TH2D Example — HEPS-
BPIX4 pixel image display

Applied to the joint test and JUNO on-site installation

A ROOT-based General Online Data Visualization System

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Introduction

The online data visualization system is an essential component of the data acquisition system, delivering swift, efficient, and comprehensive real-time monitoring for detectors and readout electronics. Simultaneously, ROOT, an open-source software framework for data analysis in high-energy physics, provides a variety of data analysis tools. Utilizing ROOT-based online histogram monitoring, researchers can efficiently analyze data in real-time and promptly detect potential anomalies. To minimize development costs and enhance deployment efficiency, a ROOT-based general online data visualization system called ROBOT has been designed and implemented.

Architecture Design

System goals:

- Generality and scalability
- Online real-time monitoring
- Quick implementation and integration
- Detector / Electronics independent

System Implementation

- **Configuration module:** Providing parameter information required for image display
- **Readout & decoding module:** Acquiring data and decoding based on the specified format.
- **Data display module:** Drawing the histogram based on the configuration information.

Results

- Integrate with different experiments
- System deployment

Performance Study

- JSON:
- Easy to parse
- Lightweight
- Protobuf:
- Efficient serialization
- Binary encoding

Conclusions

The system has completed the architecture design and main modules implementation, and has been successfully applied to integration test for different experiments and the on-site installation of JUNO. In particular we performed:

1. Easily integrate with different experiments: file-based configuration management
2. Multiple data source interfaces: Redis & Kafka
3. ROOT-based image visualization: TH1D & TH2D

Motivation and Background

System Design Scheme

Deployment and Display Interface

- ✓ Easily integrated by different experiments: file-based configuration management
- ✓ Multiple data source interfaces: Redis & Kafka
- ✓ ROOT-based image visualization: TH1D & TH2D

System Implementation

Welcome to No.29

Performance Study