Modular Data Acquisition System for ITER-India Diagnostic Laboratory

Abstract

This project proposes the development of a modular, low-cost Data Acquisition System (DAQ) for deployment in the ITER-India Diagnostic Laboratory. The system is designed to provide a scalable and flexible platform for acquiring, monitoring, and controlling both analog and digital signals in experimental environments. Leveraging cost-effective embedded platforms such as the ESP32 and Raspberry Pi, the architecture emphasizes affordability while maintaining reliable performance.

The proposed DAQ system will interface with external Analog-to-Digital Converters (ADCs) for high-resolution analog signal acquisition and incorporate relay modules for digital control tasks. A modular hardware design enables easy scalability, allowing additional acquisition or control nodes to be integrated as required. Communication between modules will utilize standard protocols such as UART, SPI, I2C, and Ethernet/Wi-Fi, supporting distributed data acquisition across multiple diagnostic subsystems.

A key feature of the system is its integrated logging and monitoring capability. A console-based interface will provide real-time diagnostics and configuration for local operation, while a web-based dashboard will enable remote visualization, control, and data access.

In addition to system development, comprehensive performance evaluation will be carried out. The DAQ system will be characterized in terms of key parameters such as Signal-to-Noise Ratio (SNR), Effective Number of Bits (ENOB), and overall acquisition accuracy through controlled testing. This ensures that the system meets the reliability and precision requirements of diagnostic applications in fusion research environments.

Academic Project Requirements:

1) Required No. of student(s) for academic project: 1

2) Name of course with branch/discipline: B.E./B.Tech. Electronics and Instrumentation Engineering

3) Academic Project duration:

(a) Total academic project duration: 6 Weeks
(b) Student's presence at IPR for academic project work: 4 Full working Days per week

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