

# **Review of "An Embedded Software Middleware that Supports PCS"**

## **1. Main Technical Contributions**

This paper introduces an embedded software middleware used to support the development of power conversion systems (PCS). PCS, as a key component in energy storage systems, can achieve bidirectional energy conversion and play a crucial role in grid stability, energy storage, and renewable energy systems. This middleware provides solutions for PCS core functions such as task scheduling, simulation data collection, Modbus communication, event management, and battery cluster management through modular and component-based approaches. By organizing these functions into reusable components, middleware improves development efficiency, enhances modular design, and promotes system scalability. Its architecture includes four task management levels to meet different real-time requirements, and supports ADC based analog data acquisition, EEPROM parameter management, and event processing mechanisms for real-time and historical data recording. This modular approach significantly reduces the labor cost of PCS development while ensuring the real-time control capability of the system.

## **2. Possible Applications**

This middleware has direct application value in multiple PCS based fields, including renewable energy systems, microgrids, electric vehicles, and industrial automation. In grid connected energy storage applications, it can support peak shaving, load balancing, and voltage regulation. In renewable energy applications, this middleware can be used to manage the energy conversion between solar or wind energy and storage systems. In addition, it is also suitable for achieving efficient bidirectional energy flow and optimization in electric vehicle charging stations. Its modular design makes it equally suitable for customized PCS solutions in specific fields such as the petrochemical industry and rail transit, which have high requirements for real-time energy management and safety.

## **3. Possible Future Extensions**

Future work can focus on integrating advanced communication protocols to support PCS systems driven by the Internet of Things (IoT). Strengthening support for cloud based monitoring and control can expand its applicability in smart grids. Introducing machine learning algorithms for predictive maintenance and energy flow optimization can help improve system efficiency and reliability. In addition, expanding compatibility with multiple hardware platforms, such as ARM based systems, will also broaden its adoption range. Another direction worth exploring is supporting dynamic configuration and runtime adaptability to meet constantly changing operational requirements.

## **4. Choice of Paper and Personal Interest**

The reason for choosing this article is that it is related to embedded systems in renewable energy, which is crucial for sustainable development. As a master's student specializing in embedded software engineering, I am particularly interested in this modular approach to middleware because it aligns well with my academic focus on improving system scalability and software design efficiency. This article provides a detailed explanation of task management, simulated data acquisition, and Modbus communication, which deepens my understanding of real-time demand solutions for energy systems. This article has broadened my horizons and given me a deeper understanding of how embedded software can improve the energy efficiency and adaptability of PCS solutions.

## 5. Review Details

- **Reviewer:** Xukang Wang
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