International Journal of Computer Science and Engineering (IJCSE)
ISSN (P): 2278–9960; ISSN (E): 2278–9979
Vol. 11, Issue 2, Jul–Dec 2022; 391–418

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

INTEGRATION OF ZEPHYR RTOS IN MOTOR CONTROL SYSTEMS: CHALLENGES AND SOLUTIONS

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ABSTRACT

The integration of Zephyr Real-Time Operating System (RTOS) into motor control systems is emerging as a strategic solution for enhancing performance, flexibility, and real-time capabilities. This paper explores the key challenges associated with deploying Zephyr RTOS within motor control environments, such as resource constraints, deterministic latency requirements, and synchronization complexities. One of the primary obstacles is ensuring seamless coordination between hardware peripherals and the software stack to achieve precise control. Additionally, configuring Zephyr's scheduler for real-time operations, managing interrupts efficiently, and handling multiple motor control tasks without compromising performance pose critical challenges.

This study also investigates solutions aimed at overcoming these hurdles, focusing on multi-threading support, priority-based scheduling, and power optimization techniques provided by Zephyr RTOS. The modular architecture of Zephyr, along with its support for lightweight communication protocols, proves beneficial in managing distributed motor control systems. Furthermore, the integration of hardware abstraction layers (HAL) simplifies the interaction with various microcontrollers, enabling scalable and adaptable designs. This paper highlights real-world use cases where Zephyr RTOS has been successfully applied, such as industrial automation, robotics, and electric vehicle motor systems.

While the deployment of Zephyr RTOS in motor control systems presents notable challenges, it also unlocks opportunities for innovation and efficiency. Proper configuration, real-time scheduling, and the use of Zephyr's extensive libraries offer practical solutions for achieving optimal motor control performance. The findings of this paper provide valuable insights for engineers and developers aiming to leverage Zephyr RTOS to build robust and responsive motor control systems.

KEYWORDS: *Zephyr RTOS, Motor Control Systems, Real-Time Scheduling, Hardware Abstraction Layer, Multi-Threading, Priority-Based Scheduling, Interrupt Management, Power Optimization, Industrial Automation, Robotics, Electric Vehicle Motors*

Article History

***Received:** 14 Nov 2022 | **Revised:** 19 Nov 2022 | **Accepted:** 22 Nov 2022*