ANALISIS KOMUNIKASI DATA SISTEM *MONITORING* PADA SISTEM MOTOR *BRUSHLESS DIRECT CURRENT* BERBASIS *PROGRAMMABLE SYSTEM-ON-CHIP* DENGAN *LOGGING* PARAMETER *REAL-TIME*

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INTISARI

Motor *Brushless Direct Current* (BLDC) dikenal andal dan berbiaya perawatan rendah, sehingga banyak digunakan pada kendaraan listrik. Namun, motor BLDC tetap memerlukan pemantauan parameter penting seperti beban, tegangan, arus, suhu, dan kecepatan putar agar performanya optimal. Sistem *monitoring real-time* yang valid dan terstruktur diperlukan untuk mencegah kerusakan dan menjaga efisiensi operasi.

Penelitian ini bertujuan mendapatkan hasil uji sistem *monitoring* motor BLDC terhadap parameter utama secara terstruktur, *real-time*, valid, dan andal. Pengujian dilakukan baik pada sistem *opened loop control* maupun *closed loop control* dengan kontrol PID dan *fuzzy logic*.

Mekanisme pengujian dilakukan dengan pemrosesan data di PSoC dan pengiriman ke komputer setiap 20–30 detik. Hasilnya menunjukkan sistem *monitoring* mampu mencatat parameter utama motor BLDC secara *real-time*, valid, dan andal. Pada sistem *opened loop control*, rata-rata waktu pemrosesan 24 ms dengan interval pengiriman 223 ms, sedangkan pada sistem *closed loop control* untuk kontrol PID 29 ms dengan 235 ms, dan *fuzzy logic* 30 ms dengan 309 ms, seluruhnya memiliki validitas dan keandalan 100%. Pengujian hingga beban 3 kg dan kecepatan 3000 RPM mencatat tegangan maksimum 65,4 V, arus 3,4 A, suhu motor 54 °C, dan suhu eksternal 25 °C. Sistem ini dapat dimanfaatkan untuk mengurangi risiko kerusakan dan memungkinkan pencegahan dini terhadap kondisi *overvoltage*, *overcurrent*, maupun *overheat* untuk menjaga keselamatan dan keandalan motor BLDC.

Kata kunci: *Motor BLDC, sistem monitoring, komunikasi data, real-time*

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DATA COMMUNICATION ANALYSIS OF THE MONITORING SYSTEM IN BRUSHLESS DIRECT CURRENT MOTOR BASED ON PROGRAMMABLE SYSTEM-ON-CHIP WITH REAL-TIME PARAMETER LOGGING

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ABSTRACT

Brushless Direct Current (BLDC) motors are known for their reliability and low maintenance costs, making them widely used in electric vehicles. However, BLDC motors still require careful monitoring of key parameters such as load, voltage, current, temperature, and rotational speed to maintain optimal performance. A real-time, valid, and structured monitoring system is essential to prevent damage and ensure operational efficiency.

This study aims to evaluate a BLDC motor monitoring system for these key parameters in a structured, real-time, valid, and reliable manner. Testing was carried out on both open-loop and closed-loop control systems, with the closed-loop system implementing PID and fuzzy logic controllers.

The testing mechanism involved data processing on the PSoC and transmission to a computer every 20–30 seconds. The results showed that the monitoring system was able to record the main BLDC motor parameters in real time with high validity and reliability. In the open-loop control system, the average processing time was 24 ms with a data transmission interval of 223 ms, while in the closed-loop control system, the PID controller achieved 29 ms with 235 ms, and the fuzzy logic controller 30 ms with 309 ms, all maintaining 100% data validity and reliability. Testing up to a load of 3 kg and a rotational speed of 3000 RPM recorded a maximum voltage of 65.4 V, current of 3.4 A, motor temperature of 54 °C, and ESC temperature of 25 °C. This monitoring system can help reduce the risk of damage and enable early prevention of overvoltage, overcurrent, and overheating, thereby maintaining the safety and reliability of the BLDC motor.

Keywords: *BLDC motor, monitoring system, data communication, real-time*

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