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Perancangan Sistem Kendali Pintu Air Otomatis pada Model Fisik Saluran Irigasi Sekunder
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ABSTRAK

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Penelitian ini bertujuan untuk merancang dan menguji sistem kendali pintu air otomatis pada jaringan irigasi, menggunakan sensor ultrasonik untuk memonitor tinggi muka air dan motor stepper sebagai aktuator. Tahapan penelitian mencakup analisis, pengembangan model fisik, perancangan sistem kendali, simulasi, implementasi, pengujian, dan validasi. Evaluasi kinerja dilakukan pada tiga variasi target tinggi muka air (1 cm, 1.5 cm, dan 2 cm) dengan dua variasi simpangan (0.2 cm dan 0.3 cm), serta uji kinerja jangka panjang selama 1 jam pada target tinggi muka air 1.5 cm dengan simpangan 0.3 cm dan perubahan tinggi muka air hulu setiap 5 menit (16 cm - 18 cm). Hasil menunjukkan respon terbaik pada target 1 cm dengan *rise time* 15 detik, *settling time* 20 detik, dan *steady state error* 2% pada simpangan 0.2 cm, kemudian pada simpangan 0.3 cm, *rise time* 5 detik, *settling time* 60 detik, dan *steady state error* 2%. Pengujian jangka panjang menunjukkan *rise time* 30 detik, dengan sistem menjaga tinggi muka air dalam rentang -0.3 hingga +0.3 cm dari set point 1.5 cm, meskipun ada overshoot dan undershoot. Penelitian ini diharapkan meningkatkan efisiensi penggunaan air dalam irigasi dan penghematan sumber daya air.

Kata kunci : Sistem kendali pintu air otomatis, Sensor ultrasonik, Motor stepper, Kinerja sistem, Efisiensi irigasi

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ABSTRACTS

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This study aims to design and test an automatic water gate control system that can regulate water levels in irrigation networks automatically. The system uses ultrasonic sensors to accurately monitor water levels and stepper motors as actuators to adjust the gate opening based on the collected data. The research encompasses stages of analysis, physical model development, control system design, simulation, implementation, testing, and validation. Performance evaluation was conducted with three target water levels (1 cm, 1.5 cm, and 2 cm) and two tolerance variations (0.2 cm and 0.3 cm), along with a long-term performance test over 1 hour at a 1.5 cm water level with 0.3 cm tolerance and upstream water level changes every 5 minutes (16 cm-18 cm). The results showed the best response at the 1 cm target with a rise time of 15 seconds, settling time of 20 seconds, and steady state error of 2% at 0.2 cm tolerance. At 0.3 cm tolerance, the rise time was 5 seconds, settling time 60 seconds, and steady state error 2%. The long-term test showed a rise time of 30 seconds, with the system maintaining the water level within a range of -0.3 to +0.3 cm from the 1.5 cm set point, despite some overshoot and undershoot. This study is expected to significantly contribute to water use efficiency in irrigation and water resource conservation.

Key words : Automatic water gate control system, Ultrasonic sensor, Stepper motor, System performance, Irrigation efficiency