BAB V

KESIMPULAN

Berdasarkan hasil perancangan, realisasi, dan pengujian sistem kontrol level air berbasis Arduino menggunakan pengendali PID, dapat diambil beberapa kesimpulan sebagai berikut:

1. Sistem kontrol level air berbasis Arduino berhasil dirancang dan direalisasikan menggunakan sensor ultrasonik HC-SR04 sebagai sensor level air, pompa DC sebagai aktuator, serta Arduino Uno sebagai pengendali utama. Sistem mampu melakukan pengukuran level air, menjalankan algoritma PID, dan mengatur kecepatan pompa secara otomatis berdasarkan nilai *error* terhadap *setpoint*.
2. Parameter PID terbaik diperoleh melalui metode *trial and error* pada nilai Kp = 20, Ki = 0,05, dan Kd = 0,1. Dengan parameter tersebut, sistem menghasilkan *rise time* sebesar 434,87 detik, *settling time* sebesar 497,44 detik, *overshoot* sebesar 2,89%, dan *steady-state error* sebesar 2,33% pada *setpoint* 9 liter.
3. Pengujian gangguan menggunakan pembukaan *valve* pada sisi keluaran tangki menunjukkan bahwa sistem PID mampu mempertahankan level air di sekitar *setpoint* dan mengembalikan sistem menuju kondisi tunak dengan *recovery time* sebesar 20 detik pada gangguan pertama, 70 detik pada gangguan kedua, dan 90 detik pada gangguan ketiga.
4. Hasil perbandingan menunjukkan bahwa sistem dengan PID memiliki performa yang lebih baik dibandingkan sistem tanpa PID. Sistem tanpa PID memiliki *rise time* sebesar 214,01 detik dan *settling time* sebesar 1029,59 detik, sedangkan sistem PID memiliki *settling time* sebesar

497,44 detik serta kemampuan pemulihan yang lebih baik terhadap gangguan. Dengan demikian, pengendali PID terbukti efektif dalam meningkatkan kestabilan sistem, mempercepat proses pemulihan setelah gangguan, dan mempertahankan level air pada nilai *setpoint* yang diinginkan.

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