BAB V
KESIMPULAN

Melalui hasil perancangan alat berupa perangkat keras dan perangkat lunak, kemudian dilakukan pengujian sesuai dengan prosedur yang ditentukan hingga analisis hasil pengukuran dapat disimpulkan beberapa hal antara lain:

1. Berdasarkan pengukuran sensor tegangan, sistem yang dikembangkan mampu mengukur tegangan baterai dengan tingkat akurasi ketepatan sebesar 98.93%. Tingkat akurasi ini dibuktikan melalui pengujian validasi dengan multimeter, di mana rata-rata persentase error yang dihasilkan hanya sebesar 1.07%.
2. Berdasarkan pengukuran arus menggunakan sensor ACS758 terbukti andal, dengan tingkat akurasi ketepatan mencapai 97.11% (rata-rata error 2.89%) setelah divalidasi. Akurasi ini sudah memadai untuk menjadi dasar perhitungan *coulomb counting* yang sensitif terhadap kebenaran data arus.
3. Berdasarkan pengujian komparatif baterai berhasil membuktikan bahwa parameter fisik dapat digunakan untuk membedakan kesehatan baterai. Baterai tidak sehat menunjukkan resistansi internal yang secara signifikan lebih tinggi (62.69 mΩ) dibandingkan baterai sehat (31.89 mΩ) dan tidak mampu mempertahankan tegangan saat diberi beban kontinu.
4. Implementasi metode estimasi State of Charge (SOC) terbukti berhasil melacak penggunaan energi secara dinamis. Selama pengujian sistem terintegrasi selama 60 menit, sistem mampu menampilkan penurunan

nilai SOC secara bertahap dari 100% menjadi 94.5%, sesuai dengan energi yang dikonsumsi oleh beban.

5. Fungsionalitas Internet of Things (IoT) melalui protokol MQTT terbukti berjalan dengan sukses. Sistem mampu secara berkala setiap 3 menit mengirimkan paket data telemetri yang terstruktur dalam format JSON berisi informasi tegangan, arus, SOC, dan SOH ke *dashboard* pemantauan, yang memungkinkan monitoring secara *real-time* dan jarak jauh.

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