ABSTRAK

AKMAL NURYADIN. Rancang Bangun Prototipe Sistem Pendeteksi Segmen Kebocoran Pipa Air Bercabang dengan Integrasi IoT dan Suplai Daya PLTS. Dibimbing oleh KARTIKA TRESYA MAURIRAYA, S.Pd,. M.Pd.

Kebocoran pada jaringan pipa air sering kali menyebabkan pemborosan dan penurunan kualitas pelayanan distribusi, sementara deteksi manual dinilai kurang efisien dan lambat. Penelitian ini bertujuan untuk merancang dan membangun prototipe sistem pendeteksi segmen kebocoran pipa air bercabang yang terintegrasi dengan *Internet of Things* (IoT) serta ditenagai secara mandiri oleh Pembangkit Listrik Tenaga Surya (PLTS) tipe *off-grid*. Sistem ini menggunakan mikrokontroler ESP32 sebagai pusat kendali dan empat buah sensor *flow* meter YF-S201 untuk membaca debit aliran air pada berbagai titik. Pendeteksian kebocoran dilakukan berdasarkan prinsip Hukum Kontinuitas, yakni dengan melacak selisih debit air antara jalur utama dan jalur percabangan. Hasil pengujian menunjukkan bahwa sensor aliran memiliki tingkat akurasi gabungan sebesar 99,33% dengan tingkat *error* 1,30% akibat faktor turbulensi. Sistem berhasil mengidentifikasi lokasi kebocoran secara presisi pada Segmen A (jalur utama) dengan deviasi 6,14 L/min, Segmen B (cabang kiri) sebesar 2,88 L/min, dan Segmen C (cabang kanan) sebesar 3,29 L/min. Saat kebocoran terdeteksi, sistem memutus arus pompa secara otomatis dan mengirimkan peringatan dini melalui Telegram dengan waktu respons rata-rata 2,52 detik, sementara data *real-time* terus ditampilkan pada *dashboard* aplikasi Blynk. Dari segi catu daya, panel surya 100 Wp dan baterai LiFePO4 27 Ah terbukti andal. Pengujian ekstrem selama 1 jam hanya menyerap energi sebesar 95,42 Wh (29,63% dari total proyeksi produksi harian), sehingga mampu memberikan otonomi sistem (*days of autonomy*) hingga 115,34 jam pada mode *standby*.

Kata Kunci : Deteksi Kebocoran, Hukum Kontinuitas, *Internet of Things*, Sensor *Flow* Meter, Pembangkit Listrik Tenaga Surya.

ABSTRACT

AKMAL NURYADIN. *Design and Development of a Prototype System for Detecting Leakage Segments in Branched Water Pipelines with IoT Integration and Solar Power Supply. Supervised by* KARTIKA TRESYA MAURIRAYA, S.Pd., M.Pd.

Leakage in water pipeline networks often causes waste and a decline in distribution service quality, while manual detection is considered inefficient and slow. This research aims to design and build a prototype system for detecting leakage segments in branched water pipes, integrated with the Internet of Things (IoT) and powered independently by an off-grid Solar Power System (PLTS). The system uses an ESP32 microcontroller as the control center and four YF-S201 flow meter sensors to read the water flow rate at various points. Leak detection is carried out based on the Continuity Law principle by tracking the difference in water discharge between the main line and the branched lines. The test results show that the flow sensors have a combined accuracy rate of 99.33% with an error rate of 1.30% due to turbulence factors. The system successfully identified leak locations precisely in Segment A (main line) with a deviation of 6.14 L/min, Segment B (left branch) at 2.88 L/min, and Segment C (right branch) at 3.29 L/min. When a leak is detected, the system automatically shuts off the pump current and sends an early warning via Telegram with an average response time of 2.52 seconds, while real-time data continues to be displayed on the Blynk application dashboard. In terms of power supply, the 100 Wp solar panel and 27 Ah LiFePO4 battery proved reliable. A 1-hour extreme test only consumed 95.42 Wh of energy (29.63% of the total projected daily production), providing system autonomy (days of autonomy) for up to 115.34 hours in standby mode.

Keywords : Leak Detection, Continuity Law, Internet of Things, Flow Meter Sensor, Solar Power System.