

ABSTRAK

Kelalaian manusia dalam operasional AC di fasilitas publik seperti masjid sering kali memicu pemborosan energi dan ketidaknyamanan termal. Penelitian ini mengimplementasikan sistem pengondisian temperatur otomatis berbasis IoT yang adaptif terhadap fluktuasi jemaah dan jendela waktu jadwal salat. Infrastruktur nirkabel dibangun menggunakan protokol *mesh* pada ESP32 tanpa ketergantungan pada *router* pusat. Pengaturan level AC (skala 0–5) dihitung secara *real-time* lewat algoritma Logika Fuzzy Sugeno tertanam berdasarkan input sensor DHT22 (suhu) dan PIR (jumlah jemaah). Hasil pengujian lapangan menunjukkan jaringan *mesh* sukses membentuk topologi *balanced tree* dengan *Packet Delivery Ratio* 100%. Mekanisme *self-healing* terbukti andal mengalihkan rute saat skenario *node* mati diterapkan. Validasi algoritma Fuzzy Sugeno juga menunjukkan akurasi mutlak dengan nilai validasi 100% dibandingkan hitung manual. Sistem ini efektif mengunci suhu optimal saat salat berjamaah dan otomatis mematikan AC 30 menit setelah salat.

Kata Kunci: *Wireless Mesh Network*, ESP32, Logika Fuzzy Sugeno, Otomatisasi AC, Kenyamanan Termal.

ABSTRACT

Human negligence in managing air conditioning (AC) operations in public facilities, such as mosques, often leads to energy waste and thermal discomfort. This research implements an IoT-based automatic climate control system that adapts to crowd fluctuations and prayer time windows. The wireless infrastructure is developed using the painlessMesh protocol on ESP32 microcontrollers, eliminating central router dependencies. AC cooling levels (scaled 0–5) are computed in real-time via an embedded Fuzzy Sugeno Logic algorithm based on inputs from DHT22 (temperature) and PIR (crowd volume) sensors. Field testing results show that the mesh network successfully establishes a balanced tree topology, achieving a 100% Packet Delivery Ratio. The self-healing mechanism reliably reroutes data paths during node failure scenarios. Furthermore, the validation of the Fuzzy Sugeno algorithm demonstrates absolute accuracy with a 100% validation rate compared to manual calculations. The system effectively locks the optimal temperature during congregational prayers and automatically deactivates the AC units 30 minutes after the prayer ends.

Keywords: *Wireless Mesh Network, ESP32, Fuzzy Sugeno Logic, AC Automation, Thermal Comfort.*