ABSTRAK

Tingginya mobilitas kunjungan antar perguruan tinggi swasta di Daerah Istimewa Yogyakarta memerlukan sistem optimasi rute yang mampu menghasilkan perjalanan secara efisien. Namun, pendekatan optimasi rute yang hanya mempertimbangkan jarak belum mampu merepresentasikan kondisi perjalanan sebenarnya karena belum memperhitungkan waktu tunda pada lampu lalu lintas. Penelitian ini menerapkan algoritma *Ant Colony Optimization* (ACO) yang diintegrasikan dengan data *Open Source Routing Machine* dan waktu tunda (*delay*) lampu lalu lintas untuk menghasilkan rute *closed loop* yang lebih realistis. Hasil penelitian menunjukkan bahwa kombinasi bobot 0,6 jarak dan 0,4 waktu memberikan hasil paling ideal dengan *cost* 1,81. Parameter ACO paling stabil ditemukan pada nilai α =1, β = 2-3, dan ρ = 0,5. Penggunaan 50 semut menghasilkan rute terbaik dengan waktu komputasi 72,67 detik. Berdasarkan uji *usability* terhadap 33 responden, sistem yang dikembangkan memperoleh skor kepuasan sebesar 96,31% (Sangat Baik). Integrasi variabel lampu merah terbukti mampu menyajikan model rute yang lebih mendekati kondisi riil serta meningkatkan efisiensi mobilitas operasional di wilayah DIY.

Kata Kunci: *Ant Colony Optimization*, Optimasi Rute, Lampu Lalu Lintas, LLDIKTI Wilayah V, OpenStreetMap, Weighted Sum Model, *Usability Testing*.

ABSTRACT

The high volume of travel between private universities in the Special Region of Yogyakarta requires a route optimization system capable of generating efficient travel plans. However, route optimization approaches that consider only distance do not accurately reflect actual travel conditions because they do not account for delays at traffic lights. This study applies the Ant Colony Optimization (ACO) algorithm integrated with Open Source Routing Machine data and traffic light delay times to generate more realistic closed-loop routes. The results show that a weight combination of 0,6 for distance and 0,4 for time yields the most ideal result with a cost of 1.81. The most stable ACO parameters were found at $\alpha = 1$, $\beta = 2–3$, and $\rho = 0,5$. Using 50 ants produced the best route with a computation time of 72.67 seconds. Based on a usability test involving 33 respondents, the developed system achieved a satisfaction score of 96.31% (Very Good). The integration of traffic light variables proved capable of presenting a route model that more closely approximates real-world conditions and improves operational mobility efficiency in the DIY region.

Keywords: Ant Colony Optimization, Route Optimization, Traffic Lights, LLDIKTI Region V, OpenStreetMap, Weighted Sum Model, Usability Testing.