

ABSTRAK

Penentuan rute pengiriman produk minuman herbal pada PT XYZ masih dilakukan secara manual berdasarkan pengalaman pihak operasional, sehingga berpotensi menghasilkan rute yang tidak efisien serta mengabaikan batasan waktu operasional pelanggan. Penelitian ini bertujuan merancang dan mengimplementasikan sistem optimasi rute pengiriman berbasis *Vehicle Routing Problem with Time Windows* (VRPTW) dengan algoritma *Nearest Neighbor*. Sistem dikembangkan dalam bentuk aplikasi Android yang terintegrasi dengan *pipeline* pemrosesan data, meliputi *geocoding* menggunakan *Google Maps API*, *clustering* pelanggan, optimasi rute, evaluasi performa, dan visualisasi hasil menggunakan *FastAPI*. Hasil pengujian pada tiga *cluster* pengiriman menunjukkan bahwa algoritma *Nearest Neighbor* pada VRPTW mampu menghasilkan rute yang lebih cepat dibandingkan metode manual. Rata-rata penghematan jarak tempuh mencapai 21,49%, dengan pengurangan masing-masing sebesar 15,79% pada *Cluster A1*, 7,69% pada *Cluster H*, dan 30% pada *Cluster J*. Selain itu, waktu pengiriman berkurang sekitar 20–25% pada setiap rute yang diuji. Pengujian fungsional aplikasi melalui 39 skenario *blackbox* testing dan 24 skenario *User Acceptance Testing* (UAT) memperoleh tingkat keberhasilan 100%. Hasil penelitian menunjukkan bahwa sistem yang dikembangkan efektif dalam meningkatkan kecepatan pengiriman barang dan mendukung operasional pengiriman yang lebih optimal.

Kata Kunci: Optimasi Rute Distribusi, *Nearest Neighbor*, *Vehicle Routing Problem*, *Time Windows*, Aplikasi Android

ABSTRACT

The delivery route planning process for herbal beverage products at PT XYZ is currently performed manually based on the operational staff's experience, which may result in inefficient routes and disregard customer operating time constraints. This study aims to design and implement a delivery route optimization system based on the Vehicle Routing Problem with Time Windows (VRPTW) using the Nearest Neighbor algorithm. The system was developed as an Android application integrated with a data processing pipeline consisting of geocoding using the Google Maps API, customer clustering, route optimization, performance evaluation, and result visualization through FastAPI. Testing on three delivery clusters demonstrated that the proposed approach was able to generate more efficient routes than the manual method. The average distance reduction achieved was 21.49%, with improvements of 15.79% in Cluster A1, 7.69% in Cluster H, and 30.00% in Cluster J. In addition, delivery times were reduced by approximately 20–25% across all tested routes. Functional testing of the Android application, consisting of 39 black-box testing scenarios and 24 User Acceptance Testing (UAT) scenarios, achieved a 100% success rate. The results indicate that the developed system effectively improves delivery efficiency and supports more optimal distribution operations.

Keyword: *Distribution Route Optimization, Nearest Neighbor, Vehicle Routing Problem, Time Windows, Android Application*