

Development of an Application for Bogotá's TransMilenio: Route Planning and Trip Management

1st Juan Esteban Bedoya Lautero *Engineering Department*
Universidad Distrital Francisco José de Caldas
Bogotá, Colombia
jebedoyal@udistrital.edu.co

2nd David Felipe Garcia Leon *Engineering Department*
Universidad Distrital Francisco José de Caldas
Bogotá, Colombia
dfgarcial@udistrital.edu.co

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Abstract—This paper presents the development of a application designed to assist users of TransMilenio systems in Bogotá. The application offers functionalities such as route search, bus stop consultation, card recharge, and trip planning. It aims to provide a practical solution for users who seek efficient navigation through the city's public transport network. The app saves the user's search history and personalized locations, enhancing usability over time. This project outlines the design process, key features, and technical decisions that led to the final solution.

I. INTRODUCTION

Bogotá's TransMilenio system, a key component of urban mobility, presents complex route planning challenges for its users. This project addresses two fundamental needs: intelligent route calculation and electronic toll management. We developed a modular solution using design patterns in Python and Java, implementing a JSON-based data layer, a flexible route planning strategy, and a scalable card recharge system. The architecture combines data processing with transaction pattern management, following principles of clean architecture and domain-driven design.

II. PROBLEM DEFINITION

The main problems identified are:

- Complex route planning with multiple transfers between 12 trunk lines and 138 stations
- Lack of centralized information about 6,500 daily bus operations
- Inefficient management of 2.5 million active recharge transactions monthly
- Difficulty adapting to frequent changes in routes and fares

Fig. 1. Simulation Results

III. PROPOSED SOLUTIONS

A. JSON Database with Repository Template

We implemented a manually database in JSON format, containing:

- 148 stations
- 12 trunk routes and 130 feeder routes
- Transfer points and average waiting times

B. Strategy Pattern for Route Planning

The routing service uses interchangeable algorithms:

- Minimum Transfers
- Accessibility Priority

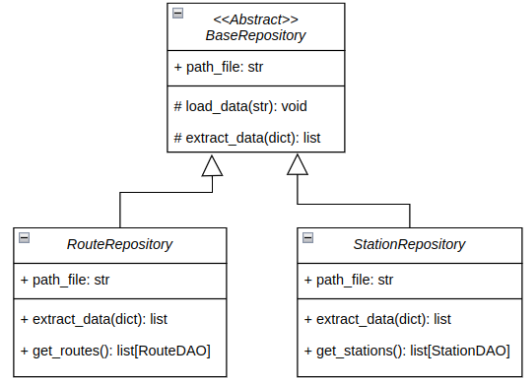


Fig. 2. Template pattern to view Transmilenio stations and routes

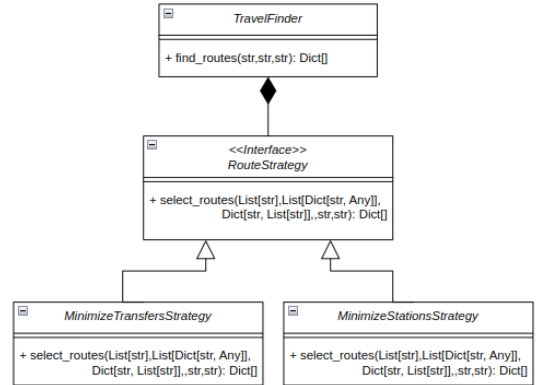


Fig. 3. Strategy Pattern Implementation

C. Chain of Responsibility for Card Recharge

Java implementation for handling multiple payment methods:

IV. CRITERIA FOR ASSESSING SOLUTIONS

- **Response Time:** Less than 2 sec for route calculations
- **Data Accuracy:** Similar to the official API

V. RESEARCH METHODOLOGY

We conducted:

- Code quality analysis with Pylint
- Comparative testing with Google Maps API and Moovit API

VI. ANALYSIS AND INTERPRETATION

The Strategy pattern showed flexibility but required optimization for complex routes. Chain of Responsibility demonstrated perfect adherence to Open/Closed principle. JSON storage proved adequate for initial phase but showed limitations in query efficiency.

VII. CONCLUSIONS AND RECOMMENDATIONS

The implemented patterns successfully of the requirements. Key recommendations:

- Add a database with geolocation
- Implement a pattern for external payments

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