



Application



Overview Video

What the Application Offers

Core Functionality

- Multimodal Planning**
- Comparison of Alternative Routes
- Departure and Arrival Time Planning
- Planning with Intermediate Points
- Advanced Preferences

Bike Features

- Elevation Profile
- Bike Station or Rack Selection
- Option to Change Station or Rack
- Prediction of Available Bikes up to **24 Hours Ahead**

Public Transport Features

- Real-Time Vehicle Positions and Delays
- Changing Connections within a Line
- Historical Delays for the Last 7 Days

Data Source Integration

- Region-Independent Architecture** (Validated on PID, Olomouc, and Switzerland)
- Transport Data:** GTFS, GTFS-RT, Lissy
- Shared Bikes:** GBFS
- Map Data:** OSM, DEM, ESRI
- Weather Data:** OpenWeather API
- Planner:** OTP 2

Application Architecture

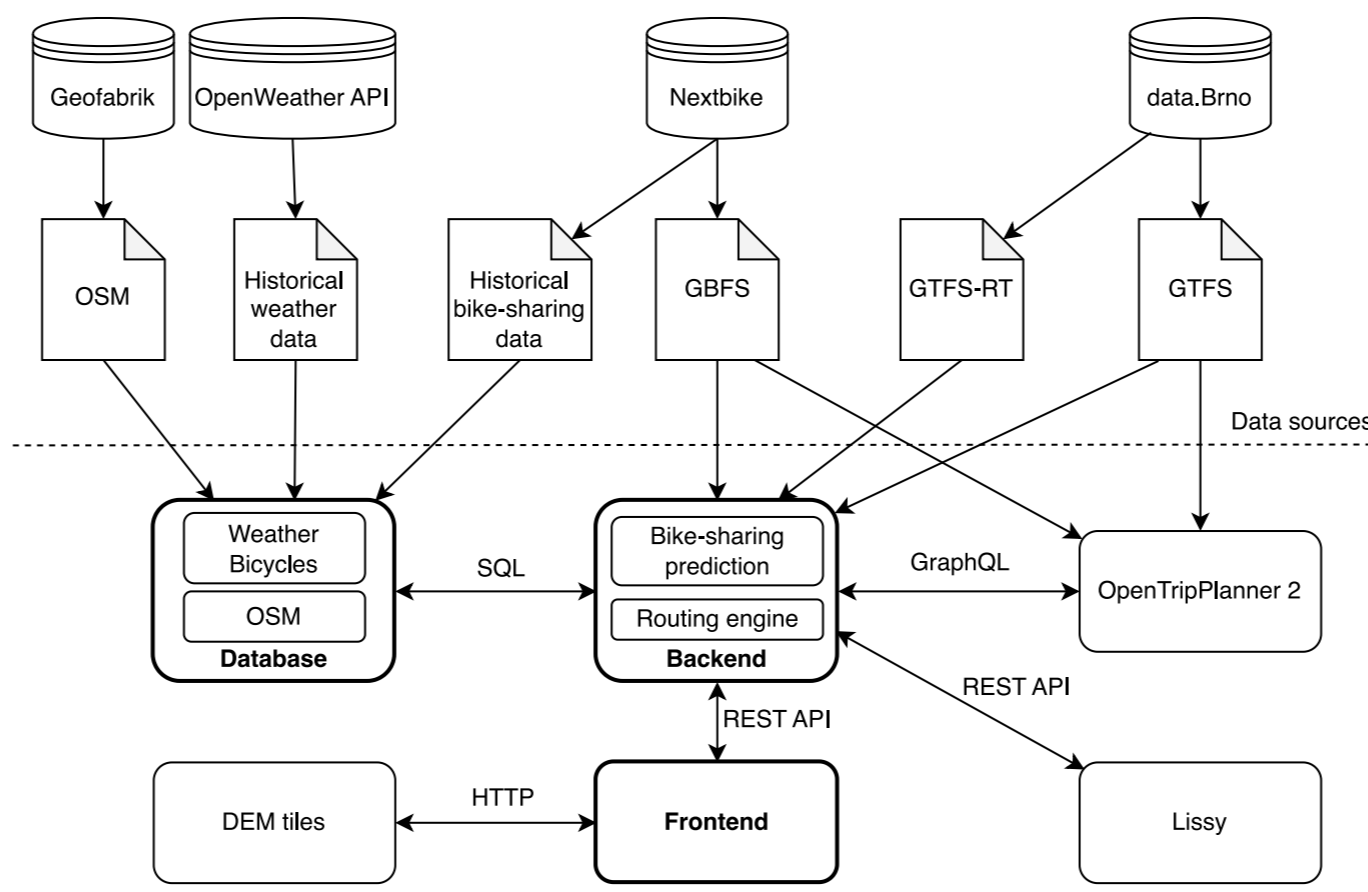


Figure 1: Application Architecture Schema

Routing Engine

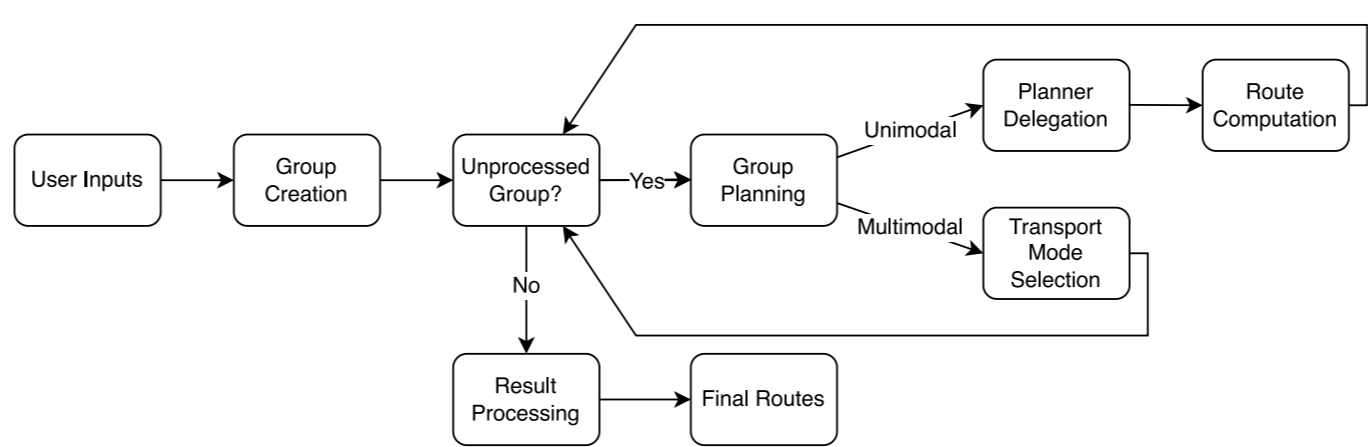
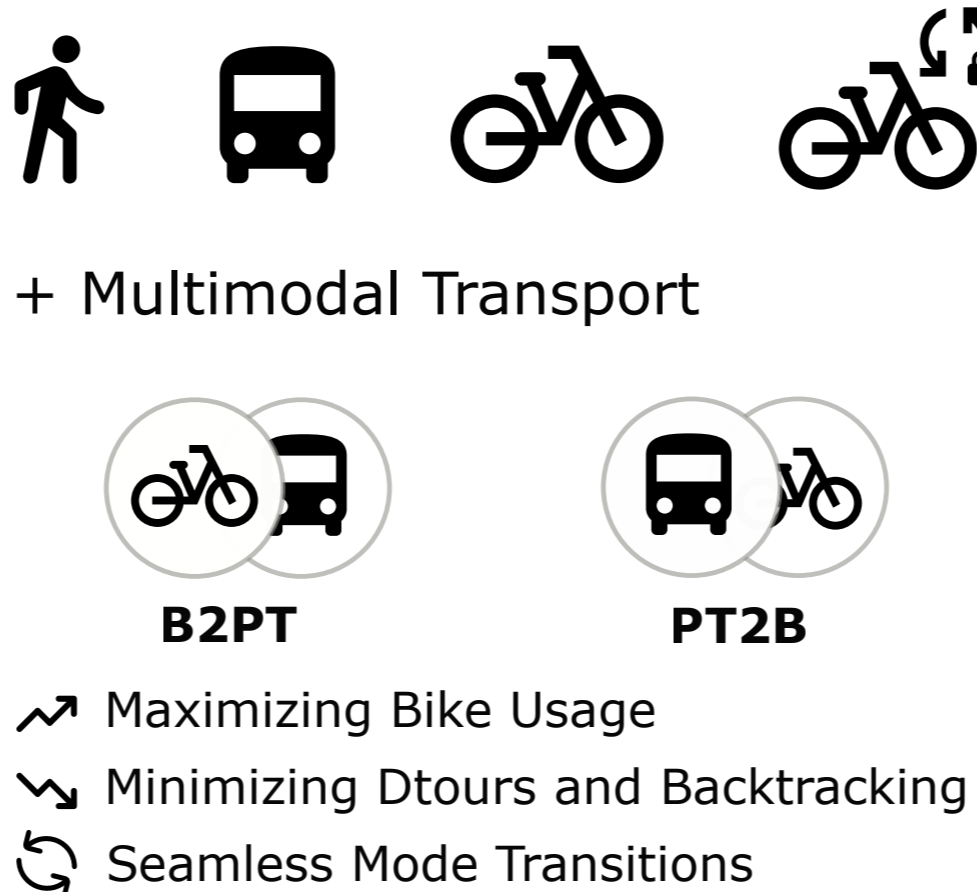


Figure 2: Routing Engine Schema

Supported Transport Modes



Proposed Multimodal Algorithms

Example of Variant 1

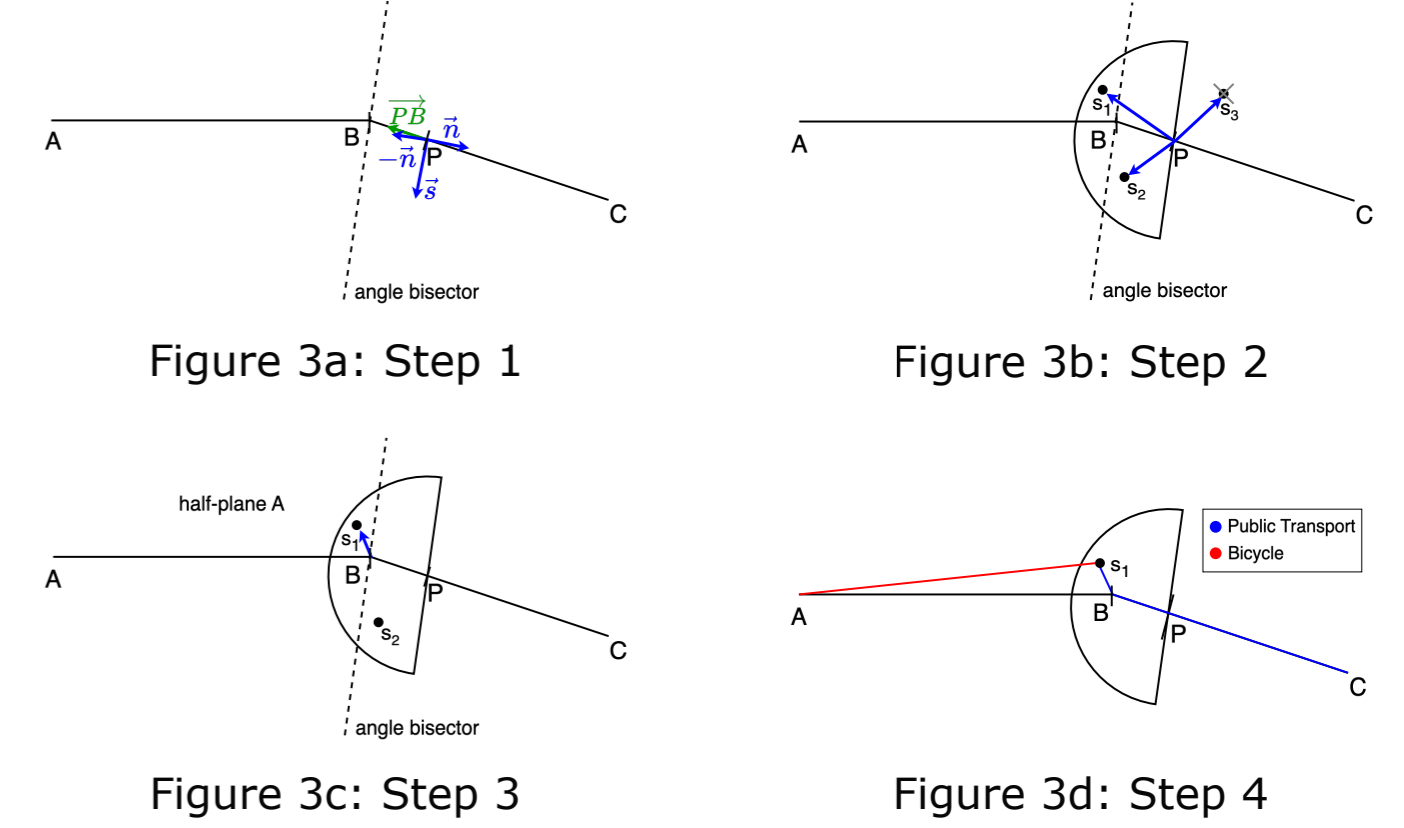


Figure 3: Steps of the Proposed Algorithm

Station Selection

Origin station:

- C_1 - Predicted bike availability
- C_2 - Walking distance
- C_3 - Route deviation angle

Destination station:

- C_1 - Station/rack capacity
- C_2 - Walking distance
- C_3 - Route deviation angle

Bike Availability Prediction

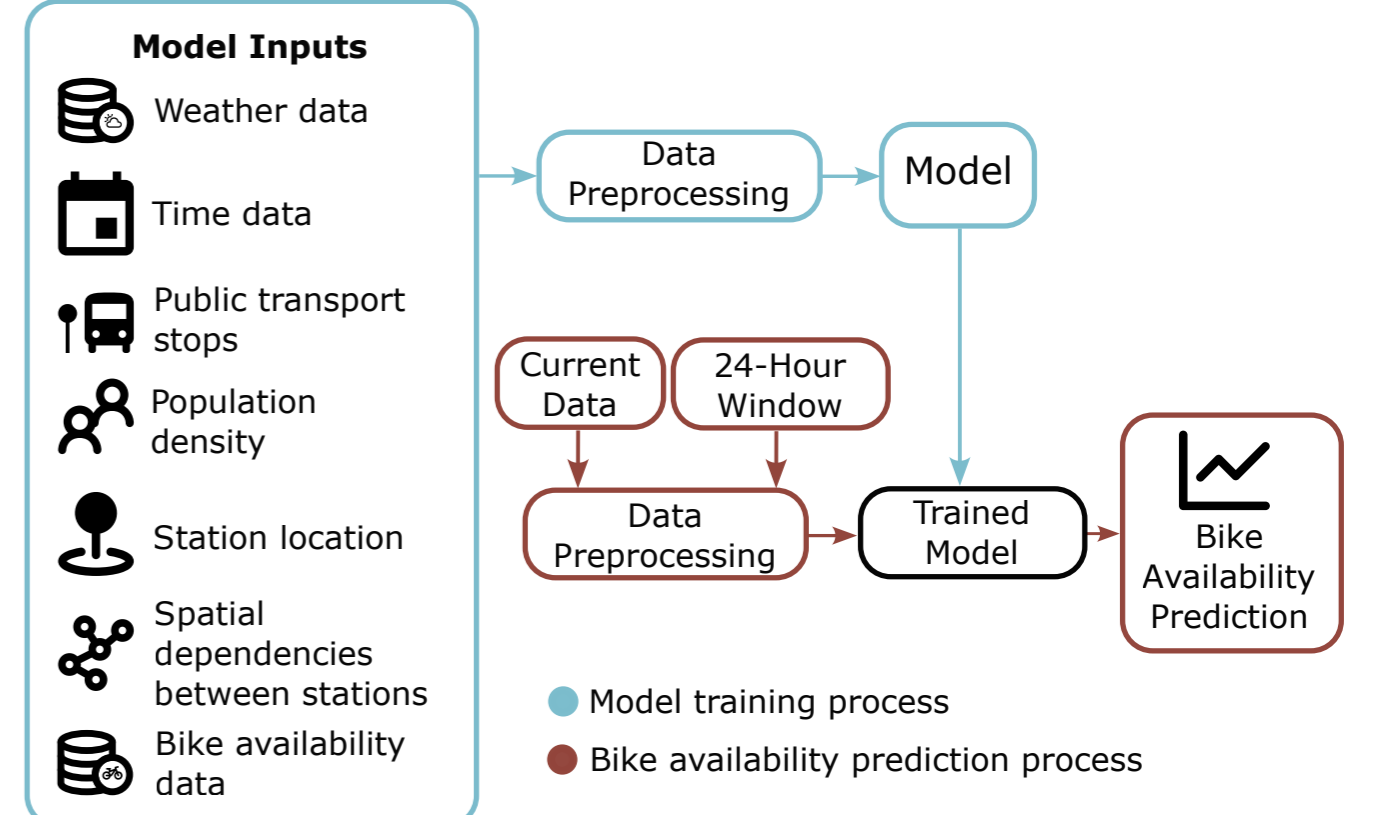
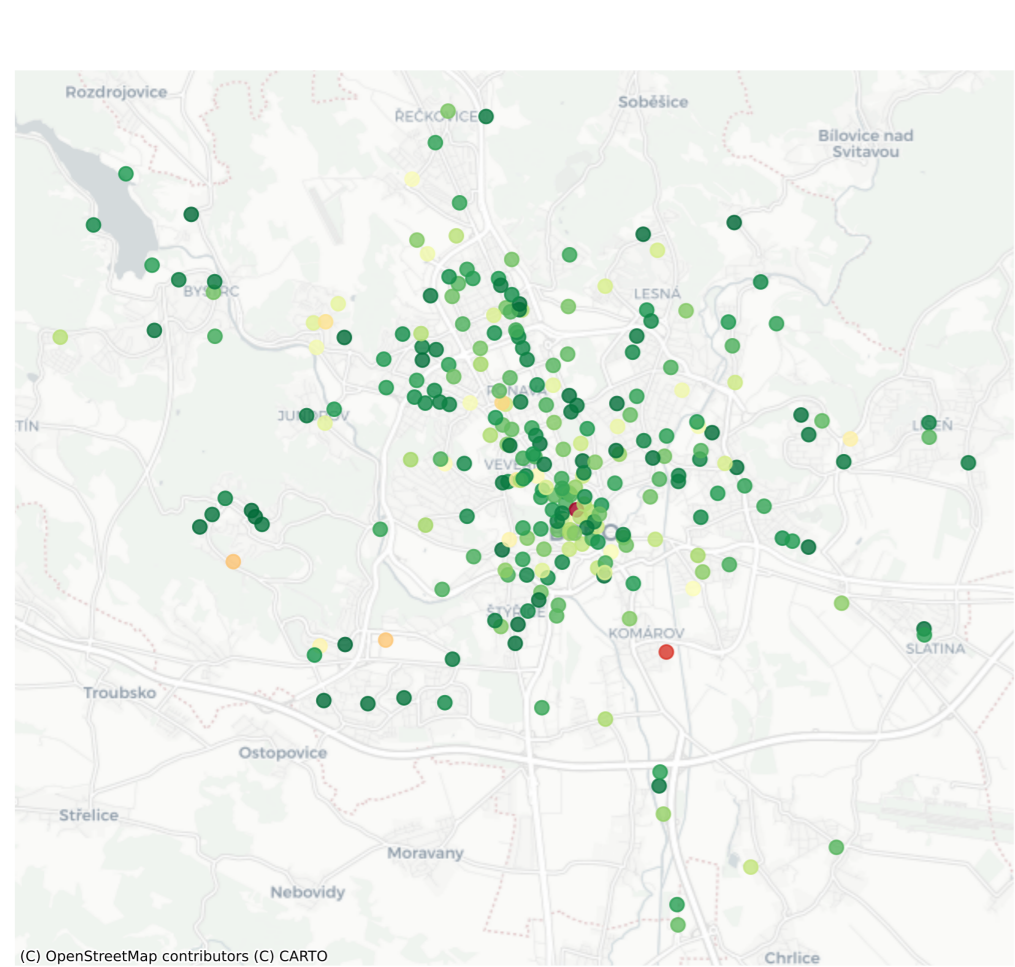


Figure 4: Prediction Pipeline

Results



RMSE

per Station

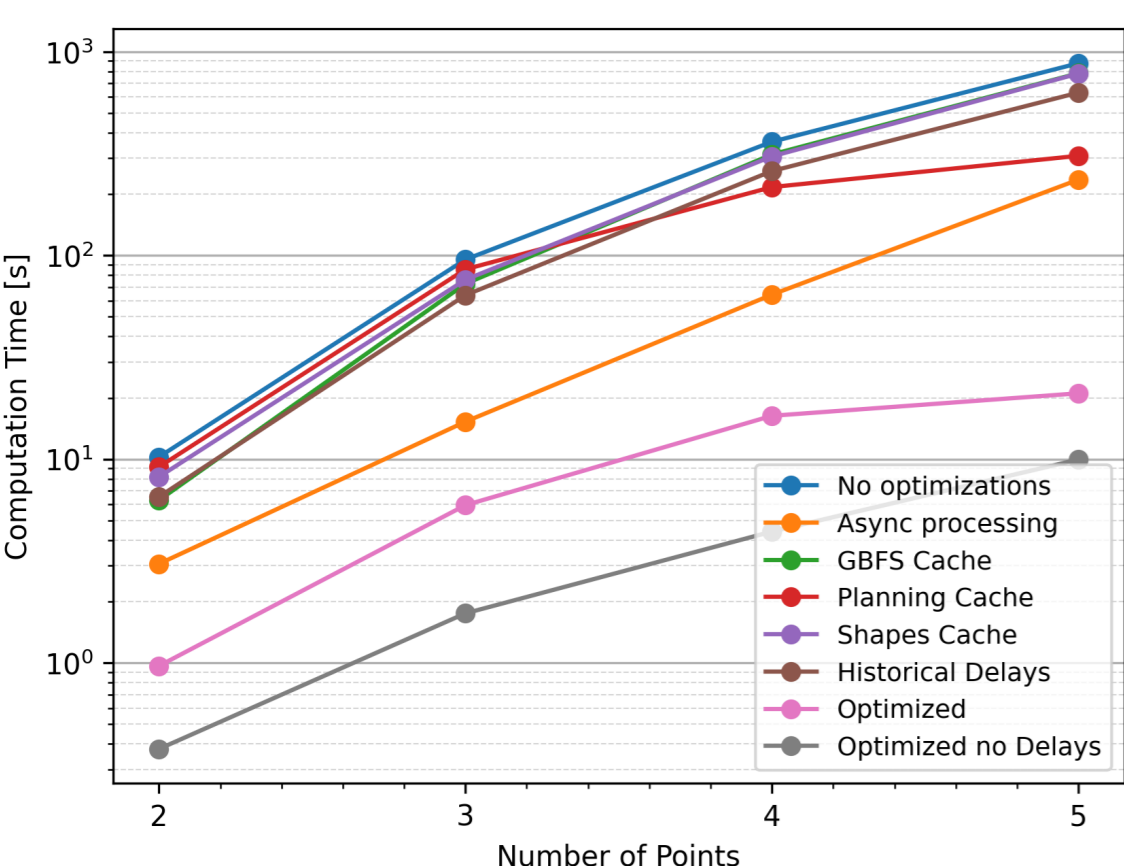
Figure 5: Spatial RMSE distribution for a 24-Hour Horizon

30min Horizon

RMSE	R ²	Fatal
0.437	0.996	1.2%

24h Horizon

RMSE	R ²	Fatal
1.769	0.635	11.3%



Computation Optimization

Figure 6: Computation Time with Increasing Route Points for Different Optimization Strategies

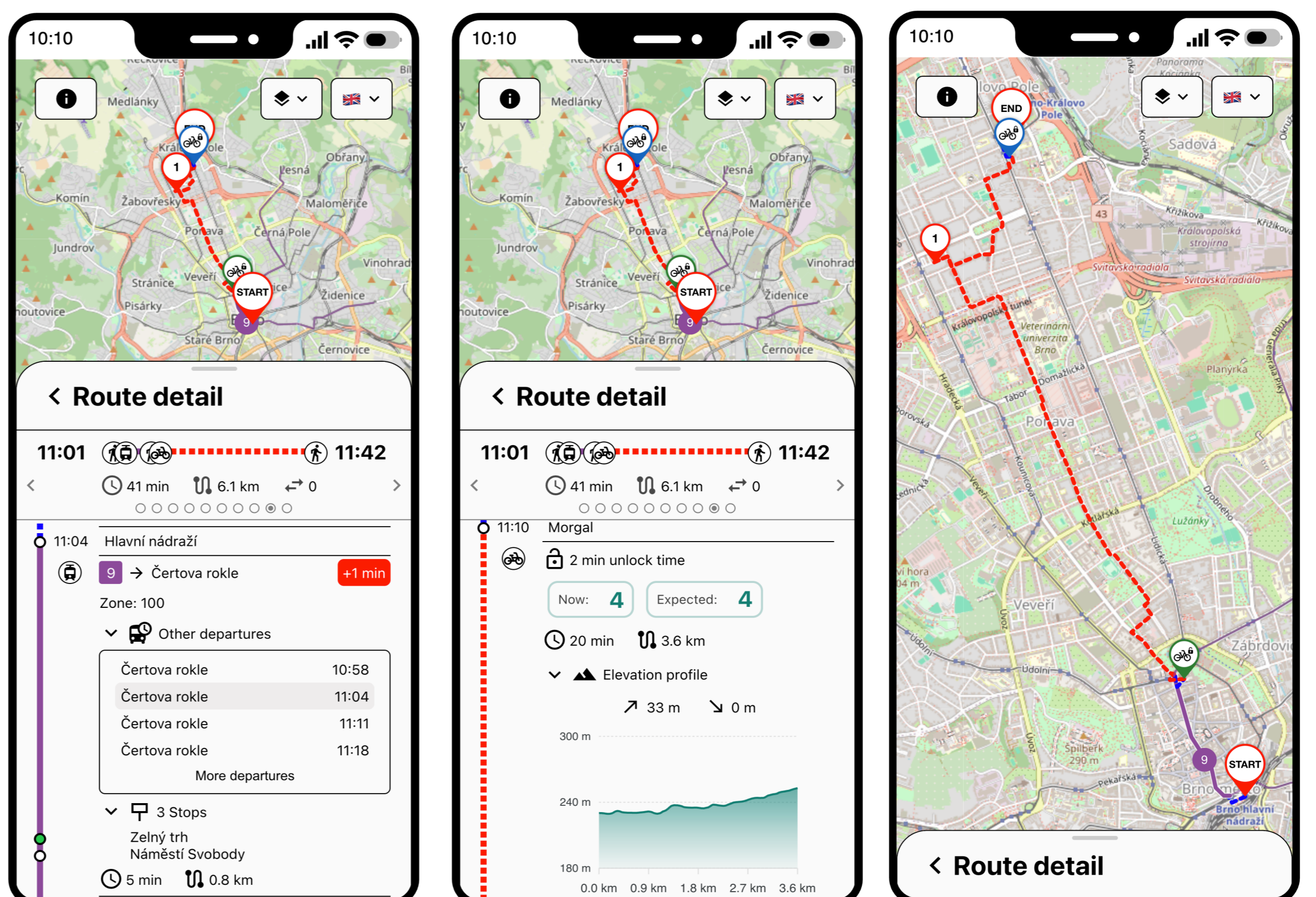


Figure 7: Routio Application UI