**Route Optimization for Capacitated Vehicles**

**Introduction**

Efficient route planning is essential for logistics companies to manage fleet operations effectively. The **Route Optimization for Capacitated Vehicles** project aims to provide a smart, automated solution for optimizing delivery routes based on vehicle capacity constraints. This system helps reduce operational costs, improve delivery efficiency, and streamline supply chain management.

**Project Objective**

The primary goal of this project is to enhance route planning by ensuring optimal vehicle utilization while meeting delivery constraints. By analyzing vehicle capacities, delivery locations, and constraints, the system generates optimized routes that minimize distance and fuel consumption.

**Key Features**

✅ **User Authentication** – Secure user login and registration system.  
✅ **Vehicle Management** – Add, update, and delete vehicle details, including type and capacity.  
✅ **Location Management** – Input delivery locations with addresses, demand capacity, longitude, and latitude.  
✅ **Route Optimization** – Implementation of a modified Clarke-Wright savings algorithm to generate optimized routes.  
✅ **Interactive Map Visualization** – Display optimized routes using **Google Maps API** or **Leaflet.js**.  
✅ **Data Storage** – Store vehicle, location, and route details in a structured database.  
✅ **CRUD Operations** – Perform create, read, update, and delete operations on stored data.  
✅ **Export & Analysis** – Save and analyze optimized routes in **JSON format** for further review.

**Technology Stack**

* **Frontend:** React.js (for an interactive and responsive user interface).
* **Backend:** Node.js with Express.js (for handling server-side logic and API requests).
* **Database:** MongoDB (for efficient data storage and retrieval).
* **API Integration:** Google Maps API or Leaflet.js (for visualizing routes and locations).
* **Authentication:** JWT (JSON Web Token) for secure user login and session management.

**How It Works**

1️ **User Authentication:** The user signs up or logs in securely.  
2️ **Vehicle Input:** The user adds vehicle details, including type, capacity, and fleet size.  
3️ **Location Input:** Delivery locations, along with demand capacities, longitude, and latitude, are entered.  
4️ **Optimization Algorithm:** The system processes the input and applies an optimization algorithm.  
5️ R**oute Visualization:** Optimized routes are displayed on an interactive map for easy understanding.  
6️⃣ **Modification & Export:** Users can modify constraints, re-run optimization, and export results.

**Conclusion**

This project provides an intelligent and scalable solution for logistics and fleet management companies. By optimizing delivery routes based on vehicle capacity constraints, businesses can achieve significant cost savings, minimize fuel consumption, and enhance overall efficiency. Future enhancements may include **real-time tracking, AI-powered predictive analytics, and dynamic re-routing capabilities** for further optimization.

🚀 **Empowering logistics with smart route planning!**