

# ByteXL Guided Project: Garbage Fleet Management

## About the Project

Garbage Fleet GPS Tracking is a fleet management solution designed to enhance the efficiency and accountability of waste collection services. By equipping garbage trucks with GPS devices, this system enables real-time tracking of vehicle locations, optimal route planning, driver behaviour monitoring, and proactive maintenance alerts.

The system aims to reduce operational costs by minimizing fuel consumption and idling time, while improving driver safety and compliance with municipal regulations. Additionally, GPS tracking facilitates accurate reporting and data-driven insights, allowing waste management teams to streamline operations, respond dynamically to service needs, and ensure timely waste collection, ultimately improving service quality for communities.

## Prerequisites

- Knowledge of GPS device and Vendor specification to incorporate features to keep track of activities in Fleet software.
- Familiar with Java programming, and advance java-based framework such as Hibernate, Spring, and Spring Boot.

## Learning Outcomes

- Using GPS devices in fleet management, particularly in waste collection and garbage fleet operations, provides valuable insights and skills for both technical and operational efficiency.

## Skills Practiced

- Setup GPS and their configuration in each truck
- Collect the online data to keep track of vehicle location, route planning, vehicle health and proactive maintenance, and driver behaviour monitoring which cause reduce operational costs by minimizing fuel consumption and idling time
- Generate optimal report to improve the fleet operation.

# Course Structure:

## 1. Course Overview :

- Develop proficiency in GPS tracking, and data analytics as applied to fleet management.
- Equip learners with route optimization techniques to improve efficiency and reduce fuel consumption.
- Provide insights into predictive maintenance and vehicle health monitoring for effective fleet upkeep.
- Emphasize safety practices, compliance, and the integration of sustainability goals within fleet operations.

## Task-1 Requirement Gathering and Analysis

- Review current fleet operations and collection schedules.
- Identify the key challenges in route planning, fleet visibility, and fuel usage.
- Define success criteria, such as reduced route time, minimized idle times, and improved collection punctuality.

## Task-2 System Setup and GPS Hardware Installation

- Select GPS tracking devices compatible with the fleet vehicles.
- Schedule GPS hardware installation on each vehicle.
- Test devices to ensure they transmit accurate real-time location data to the central system.

## Task-3 Route Optimization Algorithm Development

- Develop or integrate a route optimization algorithm to identify the shortest and most efficient routes.
- Set up the algorithm to consider traffic conditions, bin fullness, and priority areas (e.g., areas with higher waste generation).
- Ensure the algorithm dynamically updates routes based on real-time data from GPS and smart bins.

## Task-4 Data Collection and Integration

- Connect GPS data to a centralized dashboard for real-time monitoring.
- Integrate smart bin data, if available, to influence route decisions.
- Set up cloud storage for storing and retrieving GPS logs, route history, and bin data.

## Task-5 Develop Real-Time Monitoring Dashboard

- Design a user-friendly interface displaying vehicle location, status, route progress, and collection history.
- Implement notifications for delays, deviations, or vehicle maintenance needs.
- Allow supervisors to adjust routes manually in case of unexpected changes.

## Training and Implementation

- Conduct training sessions for fleet operators and managers on using the GPS and monitoring system.
- Implement a pilot phase in one or two areas to test route optimization and GPS tracking efficiency.
- Collect feedback and make adjustments before full-scale implementation.

## Performance Monitoring and Reporting

- Monitor key performance metrics like fuel consumption, collection time, and route efficiency.
- Generate weekly and monthly reports on fleet performance and GPS utilization.
- Use insights to further refine routes, reduce costs, and enhance overall fleet management.

## 2. Project Structure:

```

v FleetManagement [boot] [devtools]
  v src/main/java
    > com.garbagefleet
    > com.garbagefleet.controller
    > com.garbagefleet.model
    > com.garbagefleet.repository
    > com.garbagefleet.service
  v src/main/resources
    static
    templates
    application.properties
  > src/test/java
  > JRE System Library [JavaSE-17]
  > Maven Dependencies
  target/generated-sources/annotations
  target/generated-test-sources/test-annotations
  > src
  > target
  HELP.md
  mvnw
  mvnw.cmd
  pom.xml
```

### 3. Key Modules

- **Vehicle Management:**  
Handles vehicle tracking, maintenance scheduling, and operational status.
- **Route Optimization:**  
Plans efficient routes, adjusting dynamically for traffic or route updates.
- **GPS and Real-Time Monitoring:**  
Tracks live vehicle location and provides immediate route updates.
- **Maintenance Scheduling:**  
Manages predictive maintenance to avoid downtime.
- **User Access Control:**  
Manages authentication and access control for different roles.
- **Data Analytics and Reporting:**  
Monitors fleet performance, fuel usage, and route efficiency.

### 4. Technology Stack

- **Backend:**  
Hibernate, Spring, and Spring Boot
- **Frontend:**  
Template engine ( ThymeLeaf )
- **Database:**  
MySQL
- **GPS Integration:**  
Google Maps API, Mapbox, or similar
- **Authentication:**  
JWT and OAuth for secure access