Deusto
Facultad de Ingeniería
Ingeniaritza Fakultatea

Ecoembes Project Description

The mail objective of this project is to work on the following course competences:

- GC: Teamworking
- SC1: Design software solutions, exploring different alternatives and identifying suitable patterns, accordingly.
- SC2: Document software designs using UML diagrams.
- SC3: Use and implementation of software patterns.
- SC4: Produce a distributed application in Java, implementing an object-relations mapping for data management.

To do this, the starting point is this brief initial description that will be rounded off by each team as the project progresses. We intend to build a distributed system that implements a reduced version of a **packaging recycling solution**. The development process will be incremental and 3 prototypes will be released:

- **Instructions for Submission 1 - Prototype TW1 (10% final grade)**: Initial UML class diagram and one sequence diagram at component level (to illustrate the API behaviour), the first version of the central server and server API validation, by means of http requests from a browser or using Postman).
- **Instructions for Submission 2 - Prototype TW2 (20% final grade)**: UML class diagram (updated) and detailed sequence diagram (adding persistency) and patterns for communication with external servers (external recycling plants), updating the central server and the implementation of the recycling plant services. The new prototype must be fully functional.
- **Instructions for Submission 3 - Prototype TW3 (14% final grade)**: UML class diagram (final version) and one sequence diagram (integration of the client side), GUI development using Java Swing or a web client based on Thymeleaf. The final prototype must be fully functional.

The 3 prototypes will be developed in an incremental way: each prototype will include the previous one, refining and correcting possible faults, errors and mistakes. Additionally, all the process will be under a continuous assessment process based on in-person formal technical reviews:

Application Domain Description

Ecoembes is an association that aggregates and represents organizations and companies linked to packaging recycling. Its aim is to deploy a smart solution that engages all stakeholders involved in recycling, from citizens to recycling plants, including the management of kerbside recycling dumpsters and garbage trucks.

Kerbside dumpsters have a special device (a Recyclobin Ultraeye sensor ®) that provides an estimate of the dumpster's fill level and transmits that information daily to the central server.

Dumpster information (location and fill level) is used as input to a route generator, which returns a list of optimal routes for dumpster emptying. Routes are assigned to garbage trucks.

Trucks have their own smart tablet to display routes, as well as the estimated duration each section of the route takes. Recycling plants are notified daily indicating the number of dumpsters and number of packaging waste they will receive, so that they can plan their daily work.

Kerbside recycling dumpster

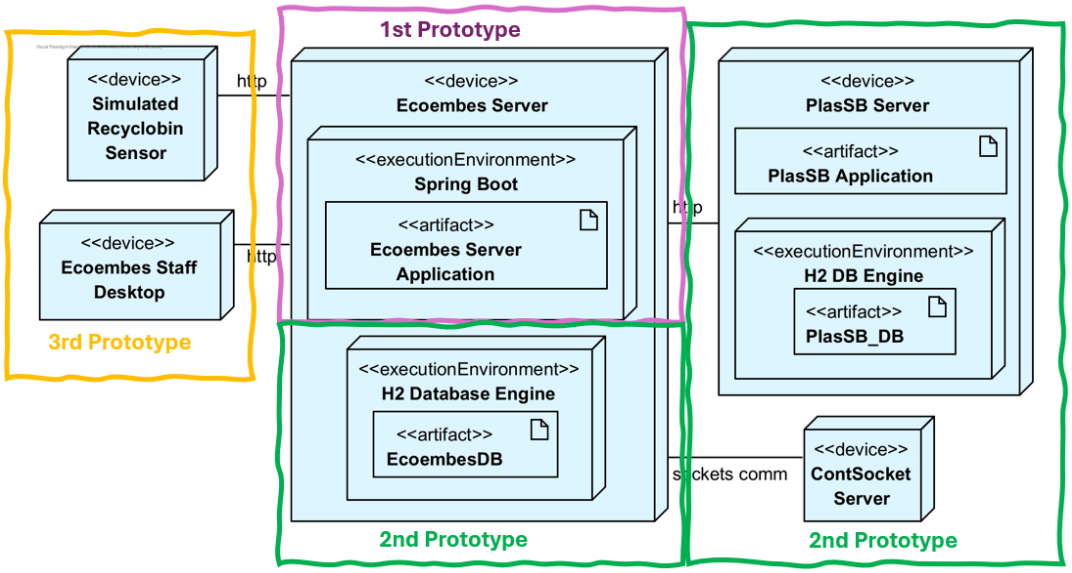
Currently, two recycling plants are engaged in this solution: *PlasSB Ltd*. and *ContSocket Ltd*. For any given a date, both plants will provide their recycling capacity in tons (this data is always available 10 days in advance). Attention: the solution should be designed to accommodate more recycling plants in a flexible and transparent way.

Ecoembes staff will have a desktop application for their dumpster, truck and recycling plant management tasks, as well as a dashboard for statistics.

Employees will have access to several key functions within the system. First, they can download up-to-date information about the dumpsters, including their locations, the number of containers they hold, and their current fill levels. Next, employees can select any recycling plant and check its available capacity (in tons) for the current day. Based on this information, they can then choose one or more dumpsters and assign them to the selected recycling plant for processing. Once the assignment is completed, the chosen recycling plant automatically receives a notification detailing the total number of dumpsters being sent and the combined number of containers they contain. The identity of the employee who performed the assignment will be recorded for auditing purposes.

All information about dumpsters, recycling plants and employee details is stored in a repository hosted on the central server.

Deployment diagram (3 prototypes)



The initial and basic functionality that the system to be developed must include is described below:

Dumpsters

- **Update dumpster info**: Each dumpsters will have a unique identifier and a location (address); the dumpster sensor will transmit daily updates to the central server at 3 AM (to be simulated in the prototypes), including the dumpster id, the estimated number of containers and fill level. The fill levels are clasified into three statuses: green (there is room for more containers), orange (limited space) and red (indicating dumpster full). This information will be stored in the centrar server's database.

Employee Functions

- **Login**: Using the email address of the employees and password. When login, a *token* is generated (for simplicity we will use the timestamp of the moment the login process is processed on the server side) that is returned to the client side and it is used as a parameter in the rest of the interactions with the server. This token guarantees that the login has been performed before executing any other functionality. The server must store "in memory" the list of tokens and employees' data who are logged in, in order to minimize accesses to the database. This information represents the concept of server "state" and its goal is to reduce the amount of information exchanged between the server and the client.

- **Logout**: the logout process basically consists of deleting a token (and the rest of the associated information). From the moment the logout process is carried out, the employee can no longer request any other functionality, unless the login process is executed again.

- **Create a New Dumpster**: Employees can add new dumpsters to the system, providing details such as a dumpster identifier, its location and initial capacity. (Optional: the employee who adds a new dumpster gets a confirmation email).

- **Query Dumpster Usage**: Employees can check how a specific dumpster has been used over a period of time, between a chosen start date and end date. This helps track trends and monitor usage patterns.

- **Check Dumpster Status**: Employees can see the status of dumpsters in a particular area (identified by postal code) on a specific day. This provides a snapshot of dumpster activity in different locations.

- **Check Recycling Plant Capacity**: Employees can view the available capacity at recycling plants for a given date, ensuring that packaging containers are only sent where there is enough space to process them.

- **Assign Dumpsters to Recycling Plants**: The system allows employees to allocate dumpsters to the appropriate recycling plants based on the total number of packaging containers and the plant's capacity. The plant is notified of the expected number of dumpsters and packages, and the system keeps a record of which employee performed the assignment.

- **(Optional) Saturation Indicator**: If more than 80% of dumpsters reach a high fill level ("orange"), the system automatically sends an email alert to all employees. This helps prevent overfilled containers and ensures timely collection.