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Travlendar+
Design Document
V1

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1 Introduction

1.1 Purpose

TODO

1.2 Scope

TODO

1.3 Definition and Acronyms

1.3.1 Definitions

- **App:** this is the abbreviation for application, in particular this term is used meaning a mobile application.
- **Delay notification function:** this phrase refers to the function which allows to notify the participants of a meeting through an email in case the user is late.
- **Travel:** a travel is any suggested path that goes from the starting point to the meeting location.
- **Route:** this term is used as a synonym of travel.
- **Warning:** warning is the word used to define the conflict between two meetings.
- **Conflict:** a conflict between two or more meetings is what enables the creation of a warning, it means that the set of meetings in conflict are scheduled too close in time in order for the user to be able to attend them all in time.
- **Calendar:** the calendar contains the list of meetings and is grouped by day.
- **Meeting:** is an important keyword of the application, it includes all the informations of an appointment.
- **Reminder:** a reminder is a sort of an alarm triggered at a certain time before an appointment is starting.

1.3.2 Acronyms

- **API:** application programming interface; it is a set of routines, protocols, and tools for building software applications on top of this one.
- **JEE:** Java Enterprise Edition
- **EJB:** Enterprise Java Bean
- **JPA:** Java Persistence API

1.4 Revision

1.5 References

- The document with the assignment for the project
- The RASD document of Travlendar+

1.6 Document Structure

This document is structured in seven sections, here is an overview of the contents of each and every one:

- **Introduction:** This section provides a general introduction and overview of the Design Document and the covered topics that were not previously taken into account by the RASD.
- **Architectural Design:** This section shows the main system components together with sub-components and their relationship. This section is divided into different parts whose focus is mainly on design choices, interactions, used architectural styles and patterns.
- **Algorithm Design:** This section provides a high-level description and details about some of the most crucial and critical algorithms to be implemented in the system-to-be.
- **User Interface Design:** It provides an overview on how the user interface will look like and behave giving a more complete view with respect to those contained in the RASD.
- **Requirements traceability:** This section describes how the requirements defined in the RASD are mapped and are satisfied by the design elements and components defined in this document.
- **Implementation, integration and test plan:** This section is used to explain the strategies for implementations and testing that will be adopted in the development part of the project.
- **Appendix:** Here we provide information about the used software and the effort spent to redact this document.

2 Architectural Design

2.1 Overview

This section of the document gives a detailed view of the physical and logical infrastructure of the system-to-be.

It provides the different types of view over the system as well as the description of the main components and their interactions.

A top down approach will be adopted for the description of the architectural design of the system:

Section 2.2 A description of high-level components and their interactions.

Section 2.3 A detailed insight of the components described in the previous section.

Section 2.4 A set of indications on how to deploy the illustrated components on physical tiers.

Section 2.5 A thorough description of the dynamic behaviour of the software with diagrams for the key-functionalities.

Section 2.6 A description of the different types of interfaces among the various described components.

Section 2.7 A list of the architectural styles, design patterns and paradigms adopted in the design phase.

Section 2.8 A list of all other relevant design decisions that were not mentioned before.

2.2 High-Level components: general architecture identification

The design approach is a JEE Architecture which is based on a client-server 4-tier distributed system.

Here we provide for each tier the definition, choice reasons and used technology:

- **Client Tier:** this tier is responsible of translating user actions and presenting the output of tasks and results into something the user can understand;
- **Web Tier:** it receives the requests from the client tier and forwards the pieces of data collected to the business tier waiting for processed data to be sent to the client tier.
Web Tier is composed by web beans. This tier purpose is the one to interact with the beans in the Business Logic tier and display data according to the user requests.
- **Business Logic Tier:** this tier contains the business logic, it coordinates the application, processes commands, makes logical decisions and evaluations and performs computations.
It is responsible for the communication between the Web Tier and the Persistence Tier. Its components are the EJB Beans.
- **Persistence Tier:** this tier holds the information of the system data model and is in charge of storing and retrieving information from the database.
The persistence tier is composed of the entity beans which represent the entities depicted from our RASD document and then further endorsed in our conceptual design. These entities are fundamental as they represent the connection to our database. Since in JEE we are interested in working in an object oriented environment, they represent a high level object view of the database.
In particular, for Travlendar+ it will be used a relational DBMS: MySQL, and the JPA standards of JEE in order to look and use the database entities in a object oriented way.

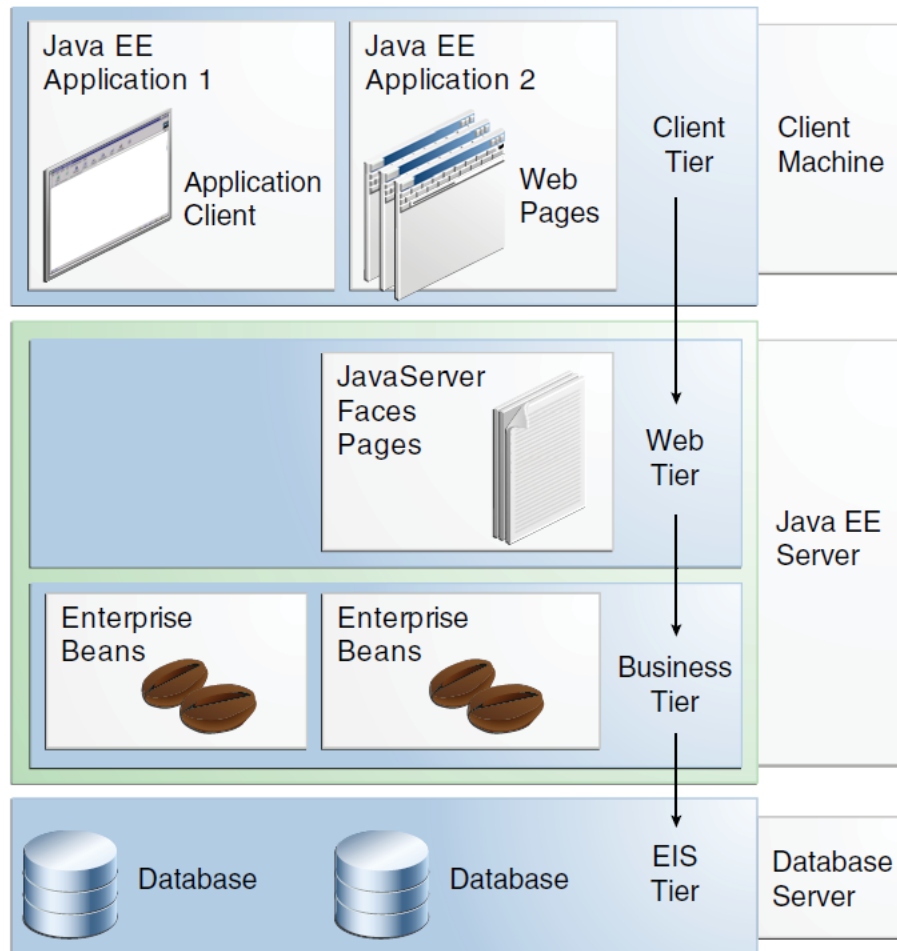


Figure 1: JEE architecture

2.3 Component View

2.3.1 Database

The persistence layer must include a DBMS component, in order to manage the insertion, modification, deletion of data and managing the relative transactions on the database.

Regardless of the implementation, the DBMS must guarantee the correct functioning of concurrent transactions and the ACID properties; it also must be a relational DBMS, since the application needs in terms of data storage do not require a more complex structure than the simple one provided by the relational data structure.

The data layer must only be accessible through the Application Server via a dedicated interface. With respect to this, the Application Server must provide a persistence unit to handle the dynamic behaviour of all of the persistent application data.

Sensible data such as passwords and personal information must be encrypted properly before being stored. Users must be granted access only upon provision of correct and valid credentials.

The E-R diagram illustrates a detailed view over the database schemas and attributes.

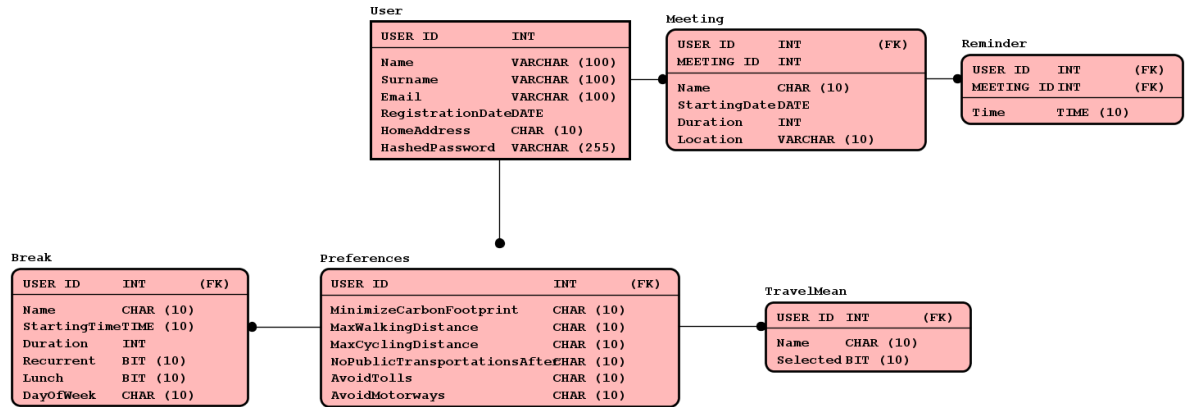


Figure 2: The E-R diagram of the database schema.

We also provide a projection of the E-R diagram in the form of a class diagram:

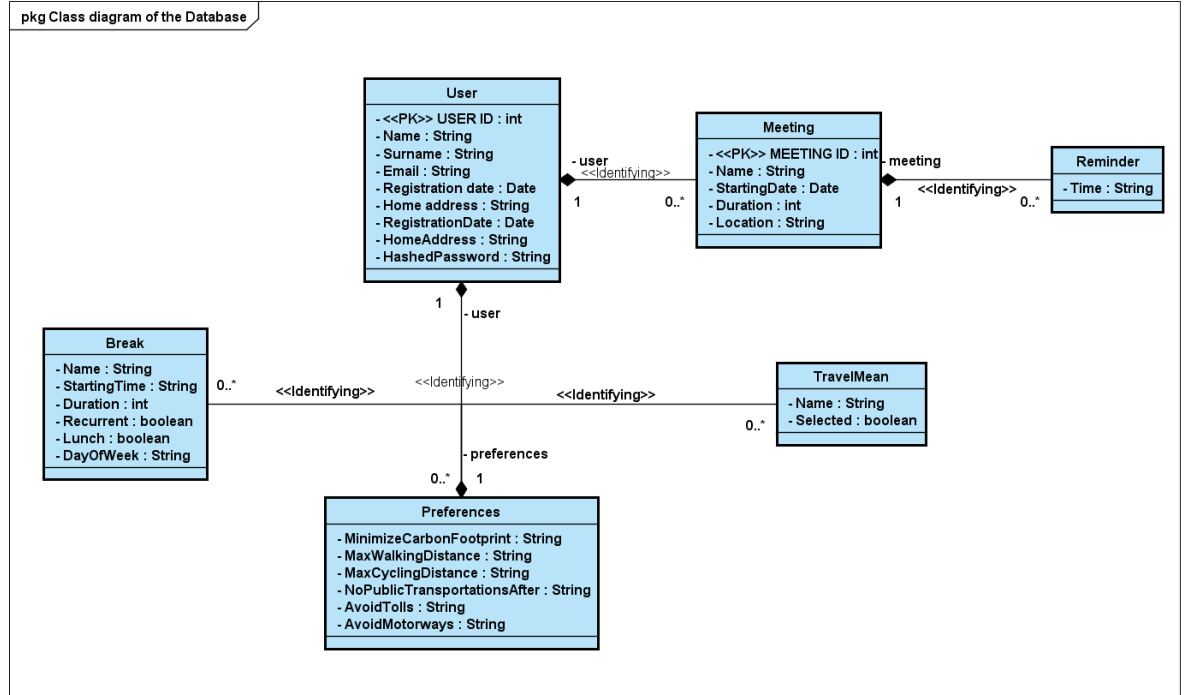


Figure 3: The E-R diagram of the database schema.

High-level component diagram

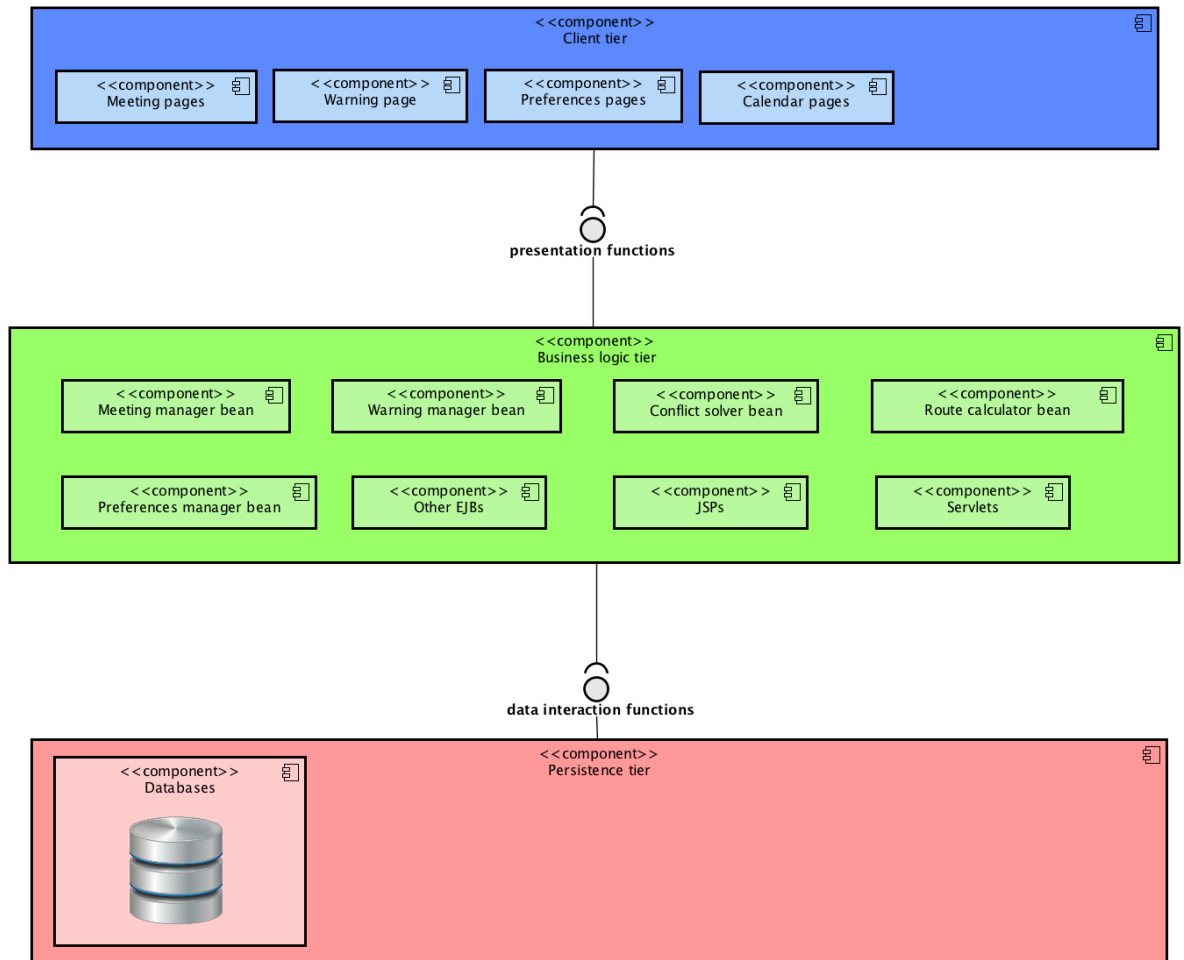


Figure 4: High-level component diagram

Low-level component diagram

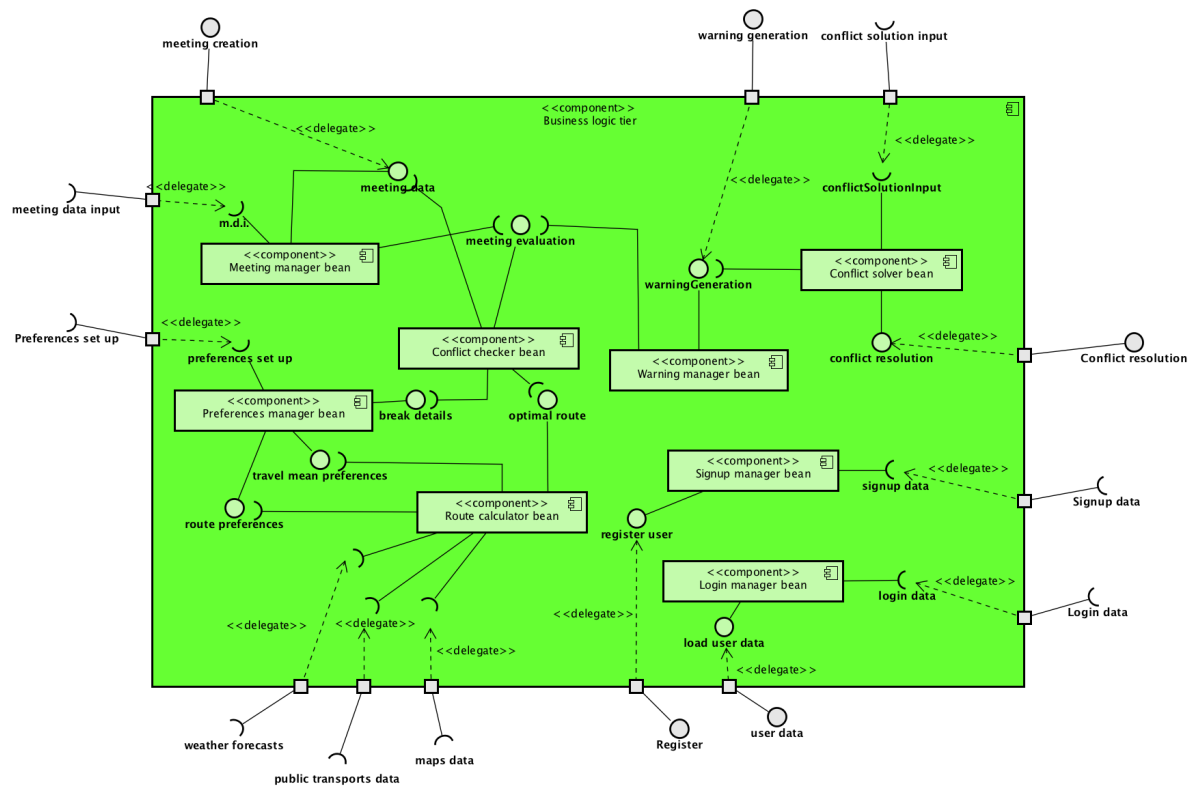


Figure 5: Low-level component diagram

Component	analysis
Name	Meeting manager bean
Input interfaces	<ul style="list-style-type: none"> • Meeting data input. • Meeting evaluation.
Output interfaces	Meeting details
Description	This is the component responsible for managing the insertion of meeting data by the user, it also provides these details to the meeting evaluator bean and to conflict evaluator bean.

Table 1: Meeting manager table

Component	analysis
Name	Conflict checker bean
Input interfaces	<ul style="list-style-type: none"> • Meeting data • Break details • Optimal route.
Output interfaces	Meeting evaluation
Description	The Conflict checker bean has the role to evaluate if a meeting can be scheduled with respect to the adjacent meetings and the breaks. To execute this critical computation it needs information about the breaks, the new meeting and the time to reach the meetings which precede and follow it. The result of the conflict checker bean is required by the conflict evaluator to establish whether it is necessary to generate a conflict or not.

Table 2: Conflict checker table

Component	analysis
Name	Warning manager bean
Input interfaces	Meeting evaluation
Output interfaces	Warning generation
Description	This component represents the bean which is responsible to generate a warning and submit it to the user if the meeting evaluator notify a conflict.

Table 3: Warning manager table

Component	analysis
Name	Conflict solver bean
Input interfaces	Warning generation
Output interfaces	Conflict resolution
Description	The conflict solver is the component that manages the resolution of conflicts, thus it is called by a new warning and his functions are to ask the user whether ignore or modify the meetings involved in a conflict and to apply his choice.

Table 4: Conflict solver table

Component	analysis
Name	Preferences manager bean
Input interfaces	Preferences set up
Output interfaces	<ul style="list-style-type: none"> • Route preferences • Travel mean preferences • Break details
Description	This is the component designed to assolve all the functions related to the preferences. Hence, it manages the insertion, update and deletion of the preferences about routes, travel means and breaks, furthermore it provides preferences details to other components when it is necessary.

Table 5: Preferences manager table

Component	analysis
Name	Route calculator bean
Input interfaces	<ul style="list-style-type: none"> • Travel mean preferences • Route preferences • Weather forecasts • Public transport data • Maps data
Output interfaces	Optimal route
Description	This is the component designed to assolve all the functions related to the preferences. Hence, it manages the insertion, update and deletion of the preferences about routes, travel means and breaks, furthermore it provides preferences details to other components when it is necessary.

Table 6: Route calculator table

Component	analysis
Name	Signup manager bean
Input interfaces	Signup data
Output interfaces	Registration
Description	This is the component which manages the user signup process, from the insertion of personal data, through their storage on the database, to the account verification.

Table 7: Signup manager table

Component	analysis
Name	Login manager bean
Input interfaces	Login data
Output interfaces	User data
Description	This is the component dedicated to all the login steps. When the user insert in the apposite area his name and password, this component takes the data and provides the computations needed to verify the credentials and load the user's content.

Table 8: Login manager table

2.4 Deployment View

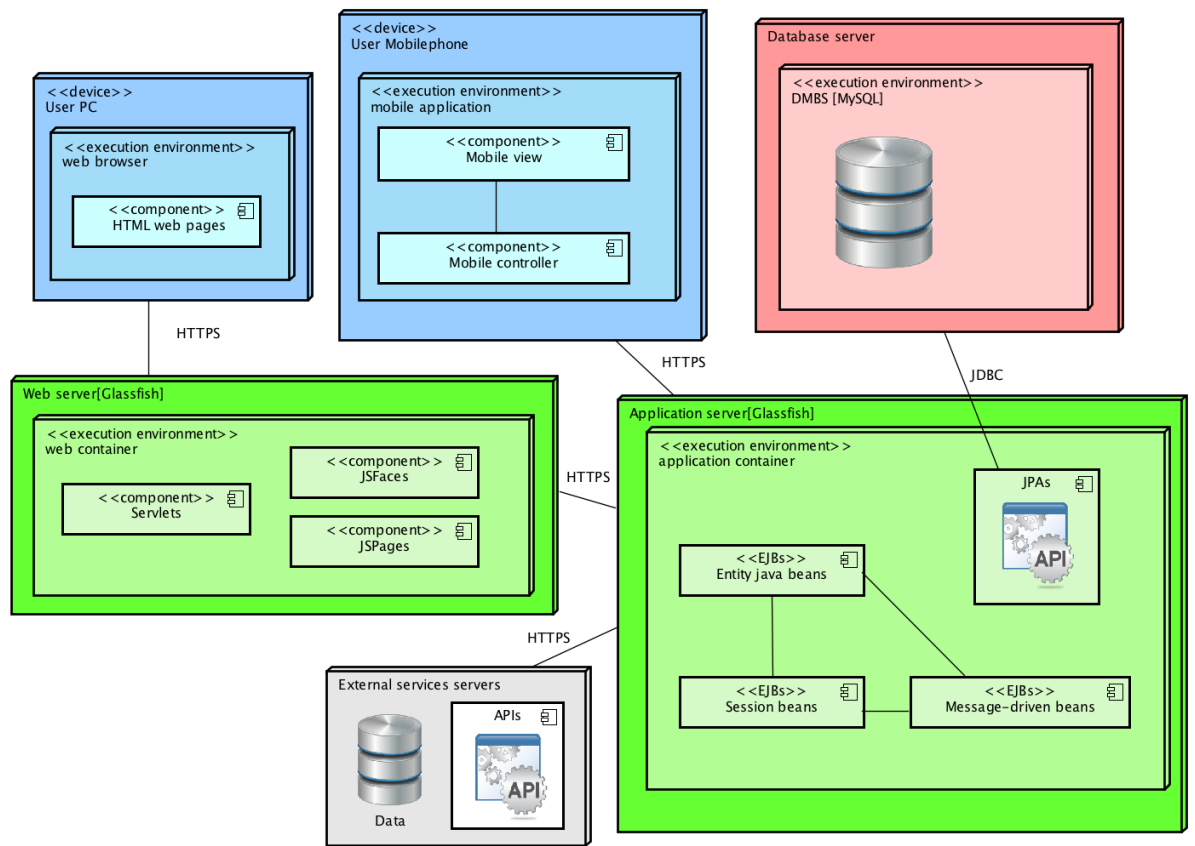


Figure 6: Deployment diagram

2.5 Runtime View

The Signup and Login runtime view includes, as the name suggests, both the signup and the login (and also the password recovery), since they are intended related concepts with a slight impact on the application behaviour.

A registered user who wants to log in himself must fill the login form until he insert correctly his username and password, at this point the Login manager bean manages to identify him and then to load his data.

On the other hand, when an unregistered user shows the intention to sign up himself, the Signup manager bean is called and submits the user a registration form, and, once the user has completed and sent back it, manages to verify the consistency of the inserted data.

If a registered user has forgotten his password, the Login manager component is called and requires the user email to send him a link where a new email can be created, then the login can eventually be performed by the user.

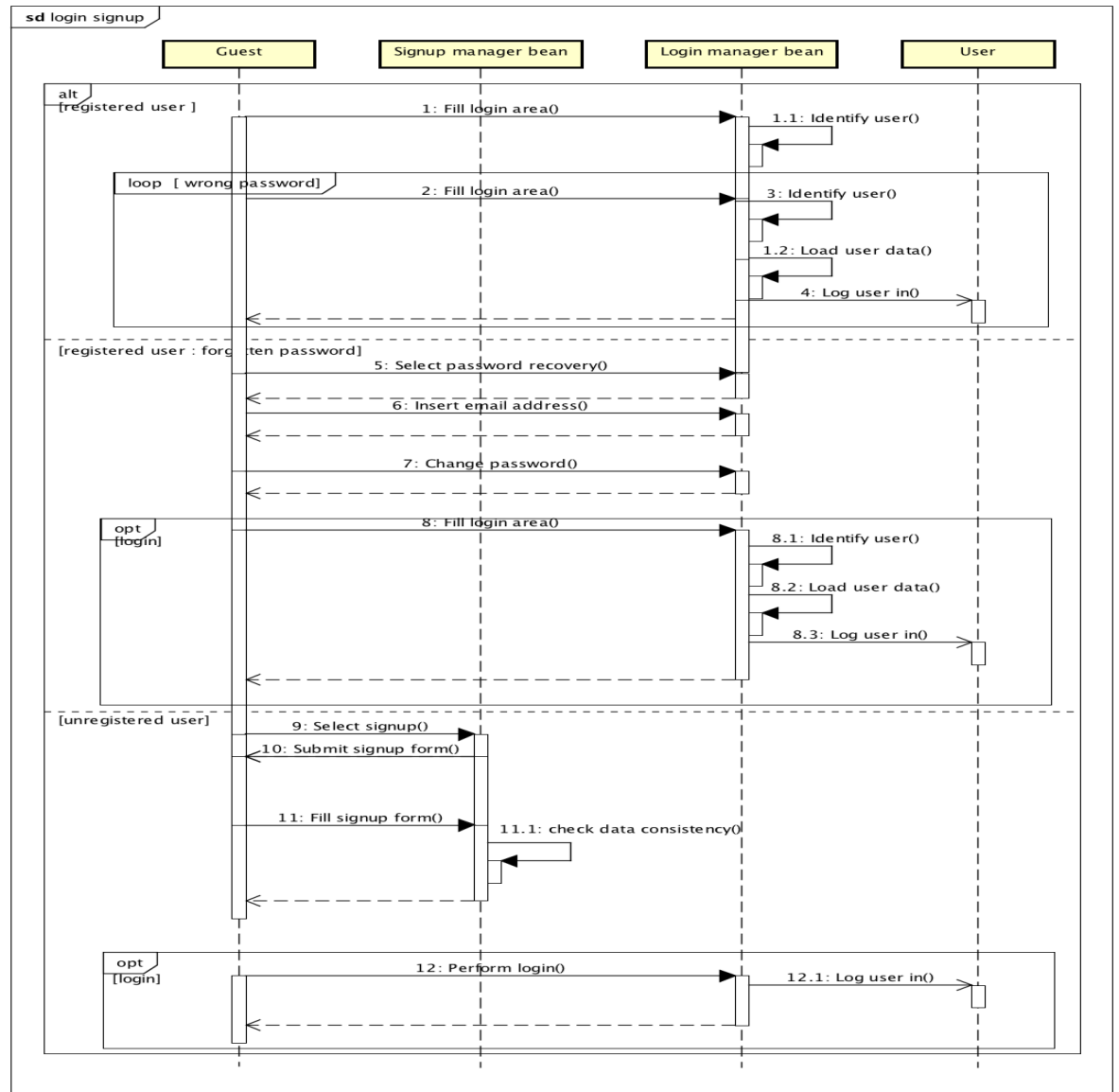


Figure 7: Signup/login sequence diagram

The meeting creation runtime view, explained through an apposite sequence diagram, summarize all the computations needed to allow the creation of a meeting.

This scenario starts when a user select to create a meeting, this intention is dispatched by the application server to the Meeting manager bean, which is in charge of submitting a meeting creation form to the user and holding its resubmission.

Taken the meeting details, the Meeting manager sends them to the conflict checker, this component must control whether a meeting is feasible or not, considering both the breaks set by the user and other meetings.

To assolve this function, this bean needs thee break details from the preferences manager bean and some routes from the google maps server in order to evaluate the time among adjacent meetings.

Collected the information, the conflict checker computes to find overlaps and if it is not the case, the negative verification outcome reaches the user, who is notified about the correct insertion. In case overlaps are present, if they are caused by conflicts with breaks that can be flexibly rescheduled during their range not to be overlapping the meeting will be accepted without any consequence. Otherwise, if either this is not the case or the conflict is beetween meetings, the conflict checker will generate a conflict and notify the user through the meeting manager.

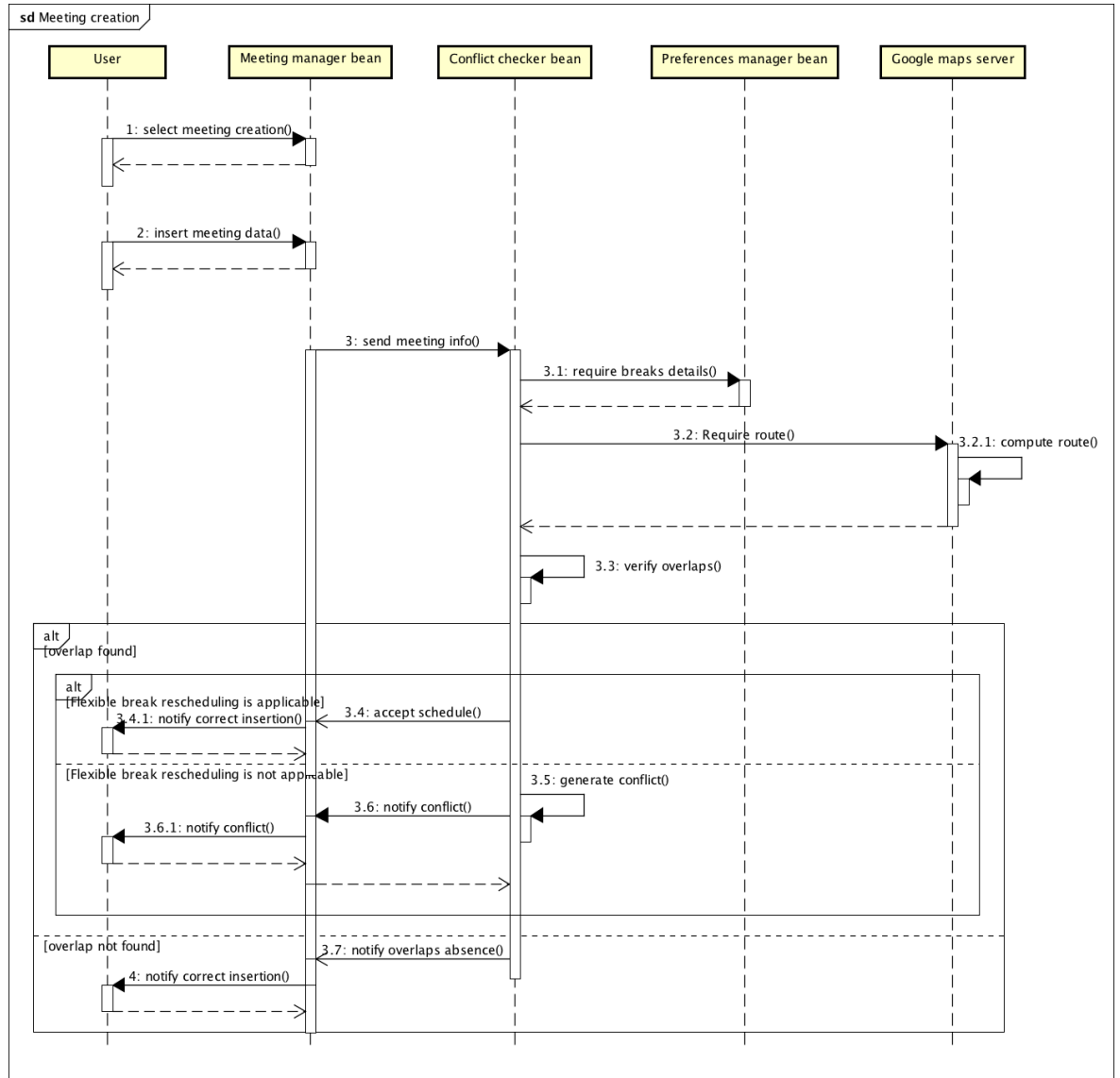


Figure 8: Meeting creation sequence diagram

The conflict management runtime view refers to every situation in which a conflict is generated even if in the provided sequence diagrams the computations start with a meeting insertion. We have already discussed the positive outcome that simply ends with a notification to the user, now we want to deeply analyze the presence and the management of a conflict.

When a conflict is found, the conflict checker notifies the warning manager which generates a warning in the system and notifies the conflict solver component, that is in charge of asking the user in which way he/she intend to solve the conflict and is in charge of applying the user choice.

Firstly, the conflict solver manages to ask the user whether ignore the conflict or modify the involved meetings to solve it. Then, it holds the user decision and computes to make it effective in the system.

If the conflict is ignored, it is deleted and the system behaves like it isn't any conflict. Otherwise, if the conflict is solved by the user, the conflict solver sends an updated calendar to the meeting evaluator which computes to verify overlaps.

If conflicts are found this cycle of operations is repeated, else the user is notified that his schedule is consistent.

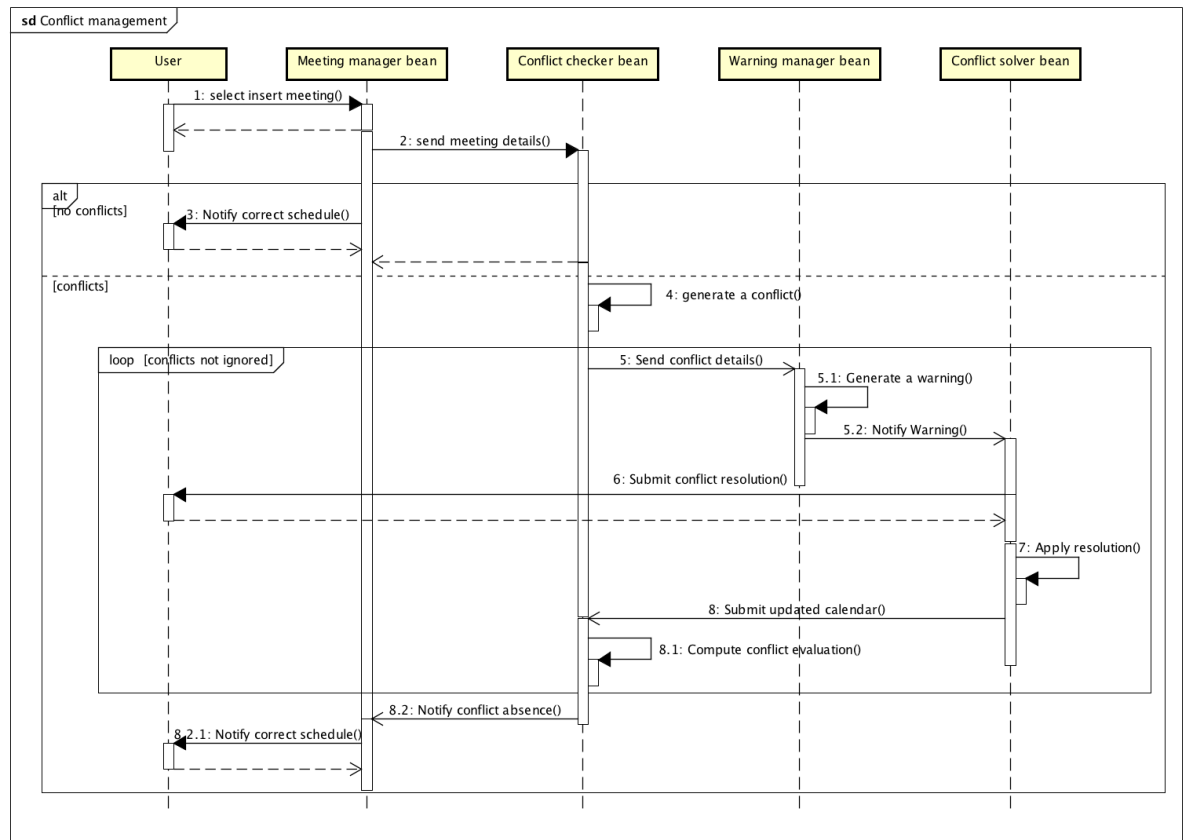


Figure 9: Conflict management sequence diagram

Figure 10:

The break insertion runtime view is conceptually similar to the meeting insertion even if it involves less components and requires less controls. When the user express the intention to insert a break, the preferences manager bean is called and manages to submit the user a form to get the break details. At this point, the preferences manager sends this details to the meeting evaluator which plays the role to search conflicts by verifying overlaps. If it finds conflicts, it generates a conflict in the system otherwise nothing is done and in both cases the user is notified. Please note that in the break insertion the only possible conflict refers to a situation where the new break overlaps completely one or more meetings which has the only implication of generating a conflict in the system.

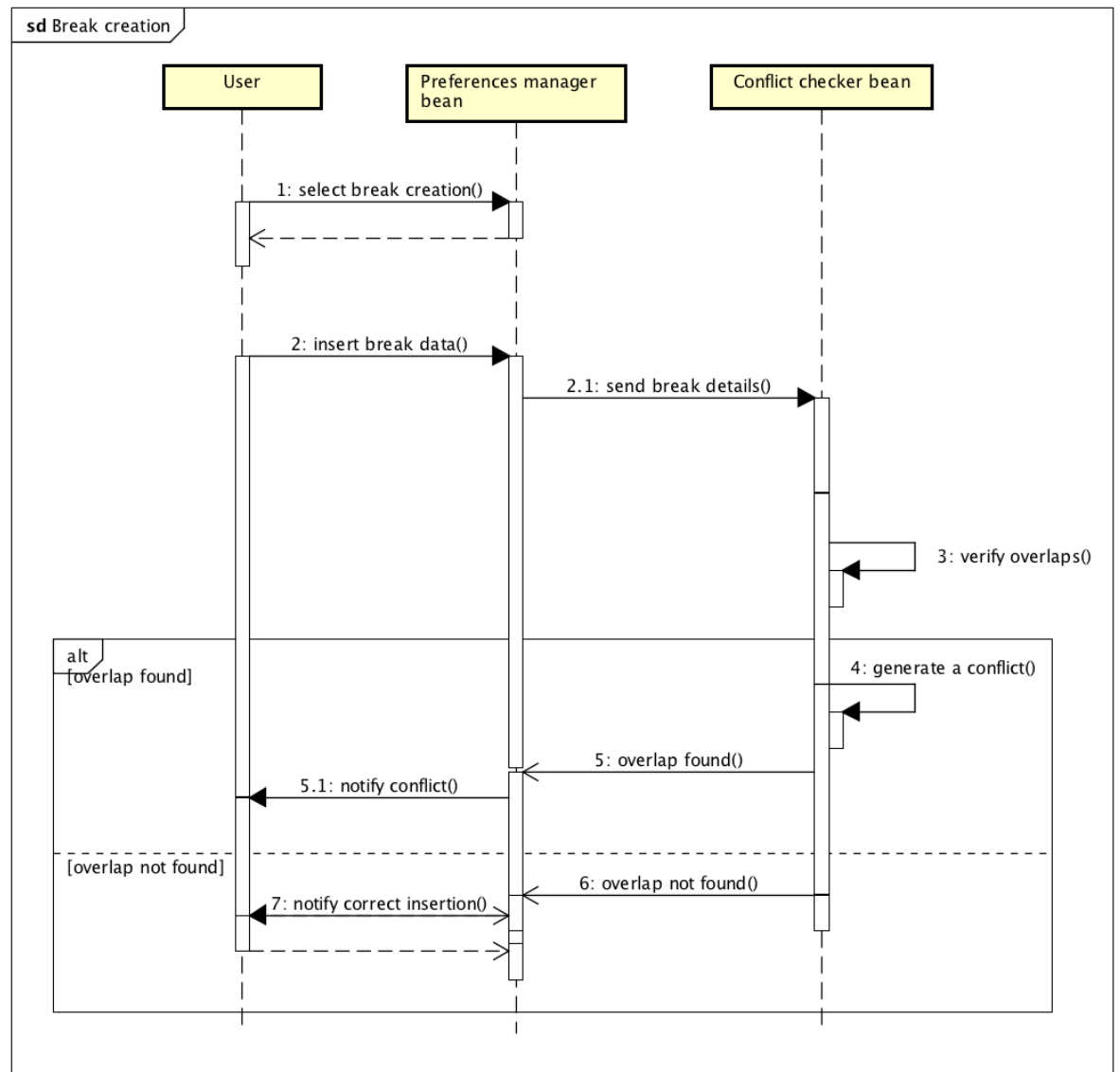


Figure 11: Break creation sequence diagram

The preferences insertion runtime view aims to provide a representation of how a user can set up all the customizable settings of Travlendar+.

Firstly, it is relevant to notice that the breaks preferences are considered in a different sequence diagram.

This said, the user still can activate or deactivate travel means, to allow or prevent them to be used in the routes for his meetings, clearly at least one travel mean must be activated, this explains the travel means deactivation loop and its condition.

Moreover a user can eventually activate or deactivate routes, in the sense that a user can decide to have the fastest route, the shortest route etc. As far as the routes are concerned, there aren't constraints referring to have at least one route activated, indeed in that case it is expected that a default route is adopted.

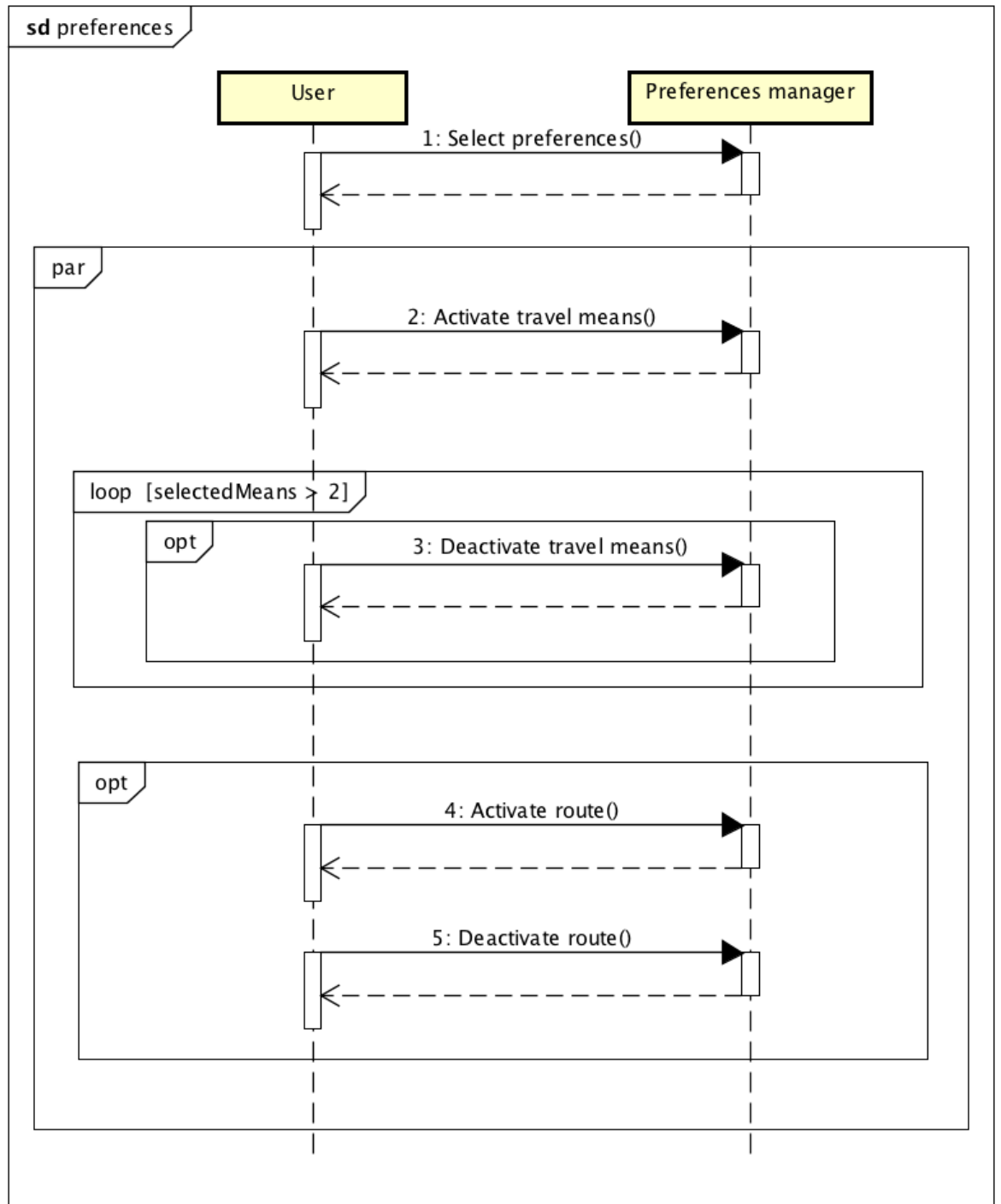


Figure 12: Preferences set up sequence diagram

- 2.6 Component Interfaces
- 2.7 Selected architectural styles and patterns
- 2.8 Other design decisions

3 Algorithm Design

4 User Interface Design

4.1 UX Diagram

As a way to show the navigation among the different pages and define the visual flow of screens we redesigned a completed User Experience diagram starting from the draft that was introduced in the RASD document.

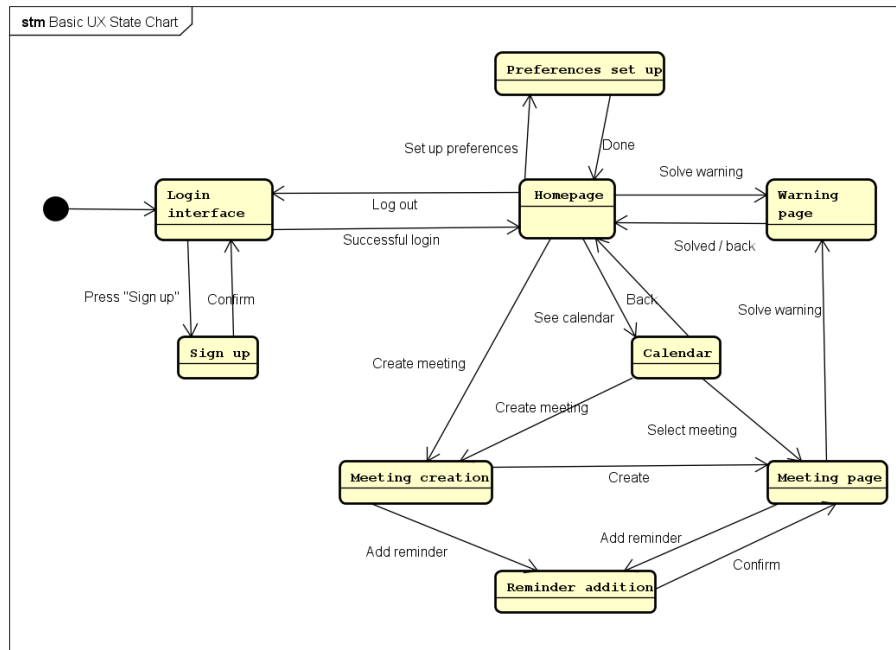


Figure 13: The initial UX diagram

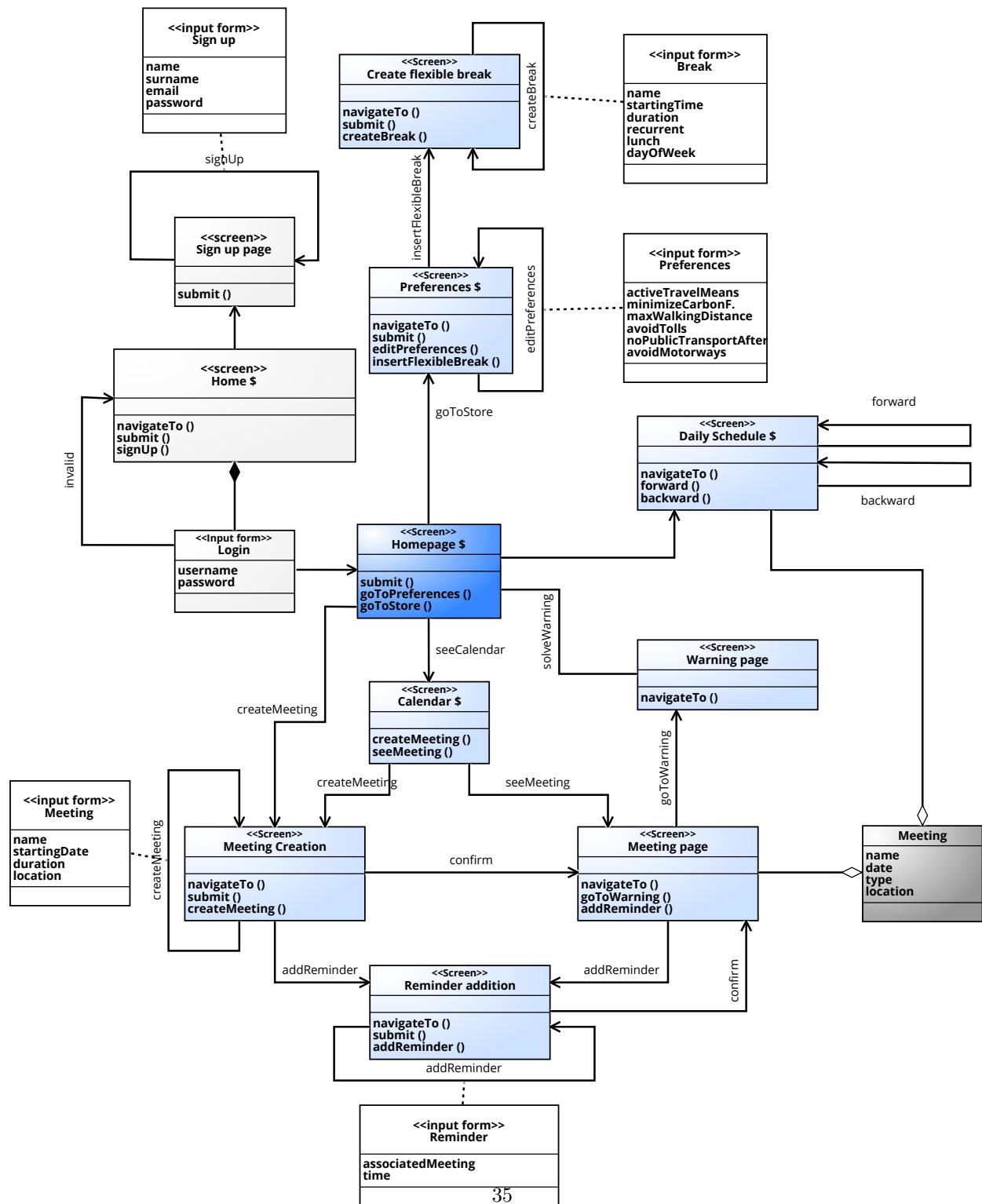


Figure 14: The complete User Experience diagram of the application

4.2 Mockups of the User Interface

Concerning the user interface requirements, we established to directly provide information about the application screens and layout through several mockups. We designed the sketch of the main pages of Travlendar+ following our aim to make a light and user friendly product but, at the same time, we have pursued an attractive and impressive style.

Apparently, the coding phase could affect our desing. Hence, these sketches are not definitive, their aim is to give an idea of the application design.

For this reason, if we notice that some changes are necessary due to either app. improvement or obstacles in realization, we would be ready to modify them.

4.2.1 Homepage

To pursue our aim of realizing a user-friendly and light app, we decided to provide the main functions directly in the homepage. Indeed, from this page, a guest can reach the sign up form, a user can log himself in, can insert a meeting by tapping onto a day in the calendar, can manage his preferences and even access the warnings.

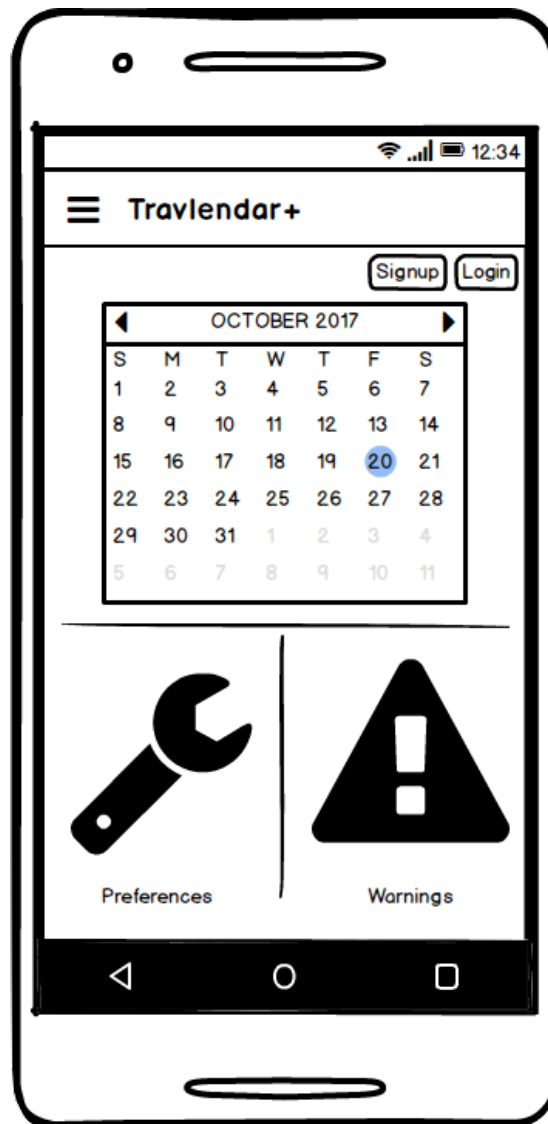


Figure 15: Travlendar+ homepage.

4.2.2 Quick Menu

We thought about a quick menu to collect some secondary functions, to make them easily reachable. By tapping on the top-left corner of the app people have the opportunity to either register or log in themselves, to only view meetings of the current day, to access the reminders they set up, to manage the warnings and to logout if they are already logged in.

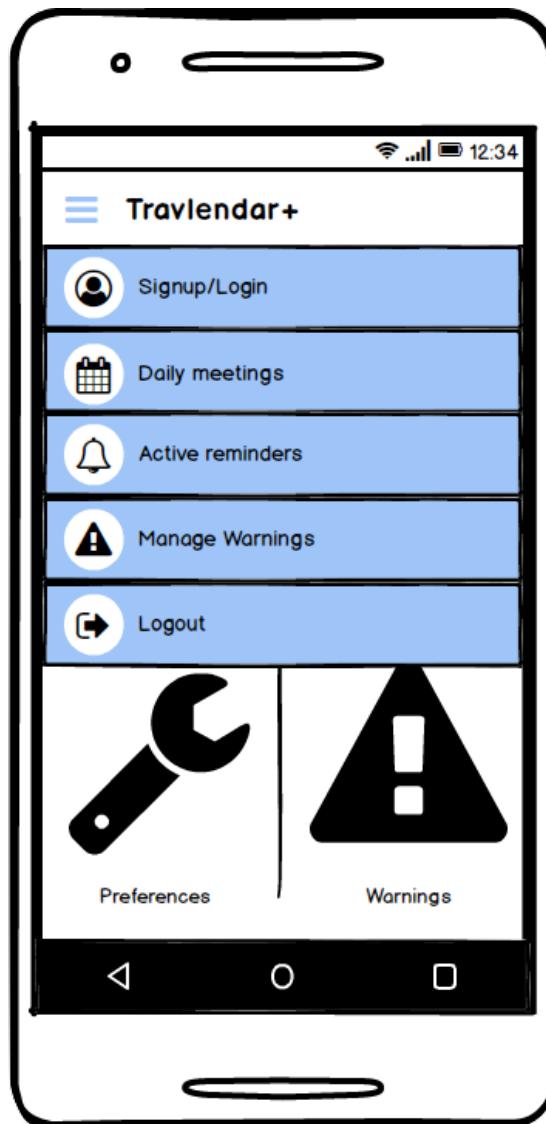


Figure 16: Quick access menu.

4.2.3 Meeting Creation

This page is a very simple form, which allows the user to finalize the creation of a meeting by filling it in all its fields. The house-logo in the right corner, on the top band and near the application name, represents the return-to-homepage icon.

The image shows a hand-drawn sketch of a smartphone screen displaying a 'Create a meeting' form. The form is titled 'Create a meeting' and contains several input fields with placeholder text:

- Description: e.g. Course presentation
- Location: e.g. via Golgi 20
- cap: e.g. 20131
- City: e.g. Milan
- Telephone: e.g. 0278563214
- Starting point address: e.g. via Monti

There are two circular icons on the right side of the form: a bell icon next to the Telephone field and a checkmark icon next to the Starting point address field. The top status bar shows signal strength, battery level, and the time 12:34. The top navigation bar shows a hamburger menu icon, the app name 'Travlendar+', a house icon, and a user profile icon. The bottom navigation bar shows back, home, and recent apps icons.

Figure 17: Meeting creation page.

4.2.4 Meeting Page

This screen wants to provide all the useful information related to a meeting already registered in the system. First details provided, in the highest portion of the page, regard the meeting location and the route to reach the appointment, further information are located below. In addition, on the right part of the screen, there are quick access buttons: the "plus" icon allows the user to add a reminder for the event, the "pencil" icon is to change meeting details and the "x" button provides deletion function.



Figure 18: Meeting view page.

4.2.5 Warning Page

The warnings page has the role to summarize and notify all the conflicts among meetings which involve the user's appointments. Every warning is represented by a dialog which points out the meetings that generate the conflict and which has two buttons, one to ignore the warning and other one to solve it by modifying the conflictual meetings. To prevent too much user's clicks, an "ignore all" button is provided, which is equivalent to tap "ignore" for each warning in the list.

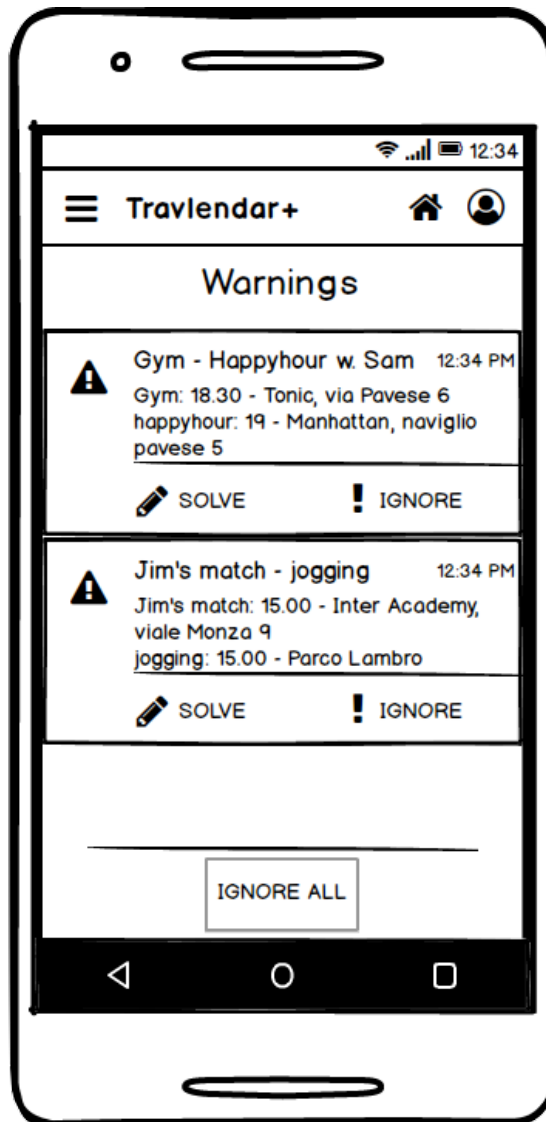


Figure 19: Warnings page

4.2.6 Travel means preferences

This is a very simple page with a minimalistic design, not to uselessly load the application. However, this basic view provides all the functions which the user needs to select his preferences related to the transports for his travels. Please notice that the preferences section can be changed by tapping on an specific topic just below the "Preferences" bar.

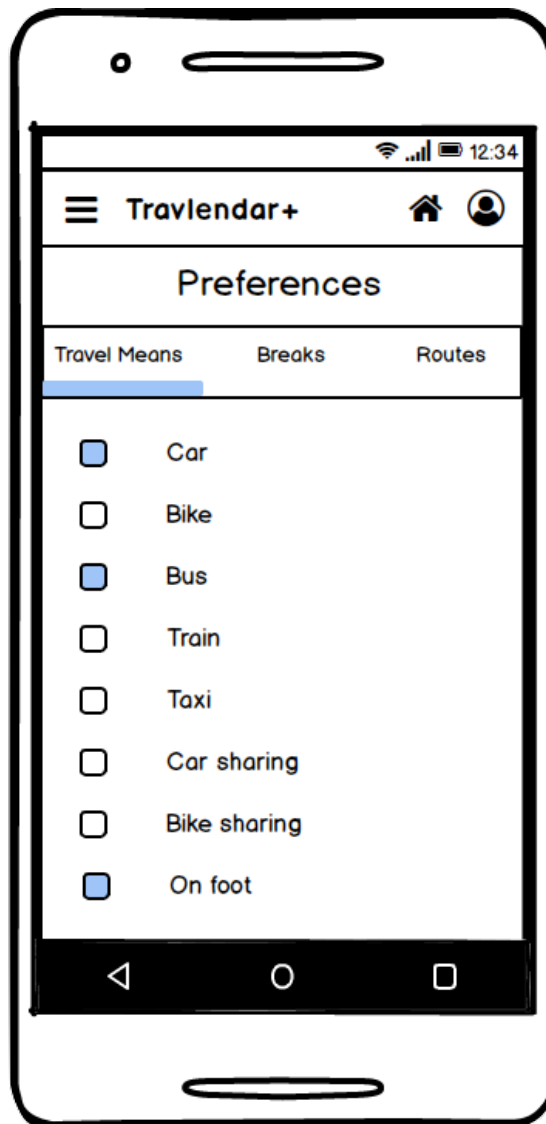


Figure 20: Travel mean preferences page.

4.2.7 Breaks preferences

The breaks page consists in a list of events, that represent pauses, organized in order of creation and labeled by the type of the break. For every break both the starting and the ending time, a "pencil" button to allow modifications and a "x" button, to remove it, are provided. In addition, thanks to the fact that we decided to make the breaks general, that means not related to a specific day, the user has the faculty to either flag or unflag them to activate or deactivate them.

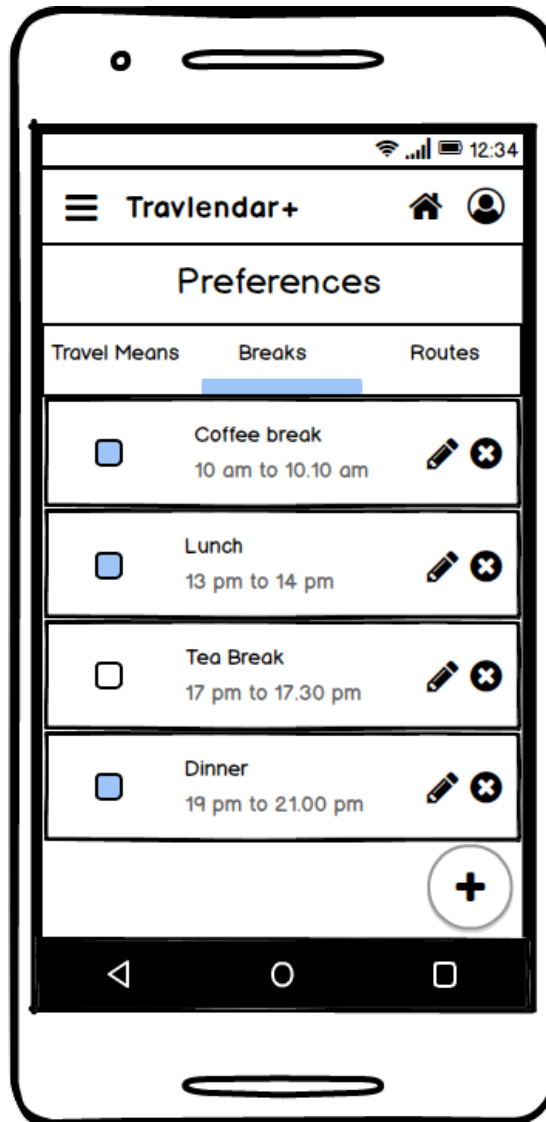


Figure 21: Break preferences page.

4.2.8 Route preferences

The route preferences page is very similar to the Travel mean preferences page. The style is the same and the opportunity to flag or unflag elements too, however there are differences. Some of the preferences in this section are mutual exclusive, so the user is prevented to select more than one of them (for instance a user can select either the shortest route or the fastest). Moreover, some selection element has customizable details, they are represented with a pencil logo on the right, and can be managed by the user to best fit his preferences (for example the user can select after which hour he does not want to use public transportations).

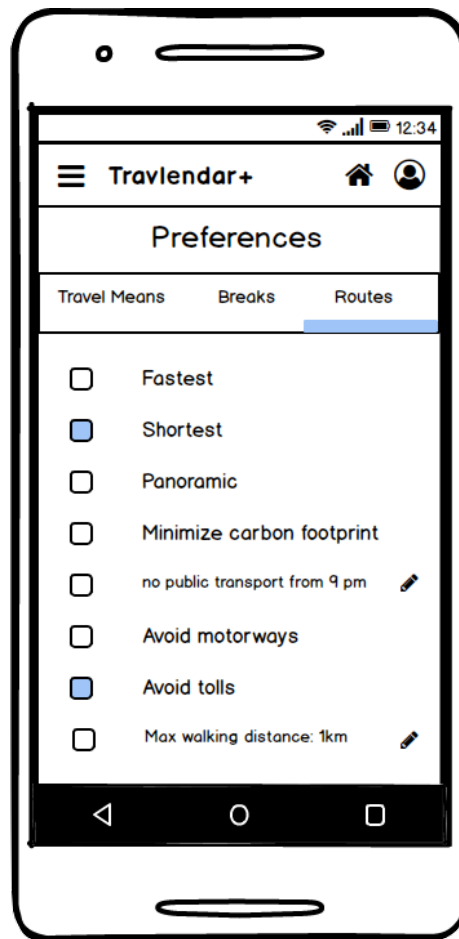


Figure 22: Route preferences page

5 Requirements Traceability

6 Implementation, Integration and Test Plan

6.1 Implementation Order

The implementation will start trying to understand if the chosen technologies are actually the best match to create the software.

To be able to determine if that is actually the case the first small goal is to create a very simple communication protocol between the Application Server and the Application Client (Android app), then integrate this with a simple database and trying to store and get information from it.

After this we will be able to enlarge the overall software by adding one small functionality at a time. At the beginning we will concentrate more on the server side and start building some EJB which encapsulates the main functions which the server will have to perform.

When all the essential features work we will start to develop the actual User Interface of the application.

6.2 Integration Testing Strategy

The natural integration testing strategy we came up with and that strictly follows the implementation order is the **Threads** approach. In particular, within a thread the strategy used to integrate and test modules will be the **Bottom-up** one. Thus, we will start by integrating and testing single portions of the modules starting from the ones which do not need any stub.

Simple and small drivers will be created in order to give inputs to the portion of each module till a complete tiny feature is completed, then the other threads will follow the same pattern until the application reaches its completion.

This global strategy will allow us have a working application very early while in the meantime anticipating the testing as much as possible, so as to minimize the cost of repair in case an error were to be found.

7 Appendix

7.1 Used software

Task	Software
Edit and compile L ^A T _E X code	TeXmaker, TeXstudio
UML modelling	Astah Pro, Signavio
Compile and run Alloy	Alloy Analyzer 4.0
Mockup creation	Balsamiq Mockups 3

7.2 Effort spent

- Matteo Marziali working hours: \approx hours
- Mirko Mantovani working hours: \approx hours