COMP.SE.110 - Software Design - Group3

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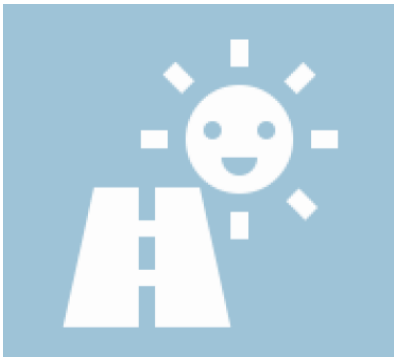
Project RoadCast



September 30th, 2022

Road and Weather Condition Forecasts Monitoring Application

Design Document (v.1)

Fintraffic

ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Document version control

Version release history

VERSION	MODIFICATIONS	DATE
1.0	Added: High-level description Boundaries and interfaces Libraries and features Design solutions	30.09.2022

Table of contents

Introduction & Project Requirements

The following document will go over the specifications of project RoadCast and the design and architecture choices of Group3.

Goal: Develop a desktop application that allows users to access road and weather forecasts according to variables such as location, time, and user preferences.

Functional Specifications:

- The User can choose the Traffic data they want to see (set of options) + Visualizations with Graphs/Plots:
    - Adjust Timeline: hours, days, weeks, months
    - Adjust Coordinates: latitude/longitude GPS
    - Show how weather affects road conditions forecast -> Show for 2, 4, 6 or 12 hours + Select Visibility/Friction/Precipitation/Winter slipperiness/Overall road condition
      -> Detailed Messages

API: https://tie.digitraffic.fi/swagger/#/Data%20v3/roadConditions ;

    - Show required road maintenance -> Show Different Tasks types + Average amount of tasks/day (for given Timeline + Coordinates)
      -> Graph

API: https://tie.digitraffic.fi/swagger/#/Maintenance ;

    - Show traffic messages -> Show Amount of messages (for given Timeline + Coordinates) *-> Detailed Messages*

API: https://tie.digitraffic.fi/swagger/#/Traffic%20message ;

- The User can choose the Weather data they want to see (set of options) + Visualizations with Graphs/Plots:
    - Show and combine:
        - Temperature: Average Daily and Min/Max (in Location + Month)

API: https://opendata.fmi.fi/meta?observableProperty=observation&param=t2m&language=eng

        - Observed wind
        - Observed cloudiness
        - Predicted wind
        - Predicted temperature

API: https://en.ilmatieteenlaitos.fi/open-data-manual ;

- The User can combine Both Data:

    - Weather + Road Maintenance (select Location and Time intervals)
    - Weather + Road Condition (select Location and Time intervals)
    - Select a location from a determined set (at least 5) OR Free coordinates
    - Select a Timeline (the timeline cannot be too short)

- The User can Save Data
    - Save Dataset on Traffic Messages and Weather on a given Day -> User can compare saved and current data/2 days
    - Save Preferences -> ex: 1 Type of Maintenance at one location

The development team will focus on implementing the mandatory functionalities requested by our client, first on the UI and then on the Back-End and data flow.

High-level description & Boundaries and Interfaces

Chosen technologies & libraries

As the team members are more familiar with the Java programming language, the application will be developed using Java rather than C++. Java 17 is the latest long-term support release as of now and delivers improvements to performance and security.

UI

JavaFX: For implementing the GUI.

JavaFX is a framework that developers use to construct rich client applications that work reliably across multiple platforms. It is mostly used for designing, building, testing, debugging, and deploying these applications. We will use it for project RoadCast as it is the most used collection for graphics and media implementation.

Back-End

Java 17 - Libraries: GSON, JUnit5, JDOM2

In order to handle JSON datasets from the APIs and to create JSON documents when saving data from our application, we will use the open-source Java library GSON to convert the JSON strings into Java objects and vice versa (serialization and deserialization).

JDOM2 will be used to handle and parse XML data from the APIs. It will give us Java representations of XML documents.

Finally, in order to test our application, check for any defects/bugs, and overall make our application more reliable for the client, we will use JUnit5. JUnit is an open-source testing framework for Java that is used to write and execute automated tests.

APIs - Digitraffic, Finnish Meteorological Institute

For getting the data on Finnish roads and weather conditions. Digitraffic offers real-time data on road, railway, and marine traffic, however, this project will focus on road traffic. For the weather forecast, the FMI offers services on weather, sea, air, and climate.

Management

GitLab: For version control

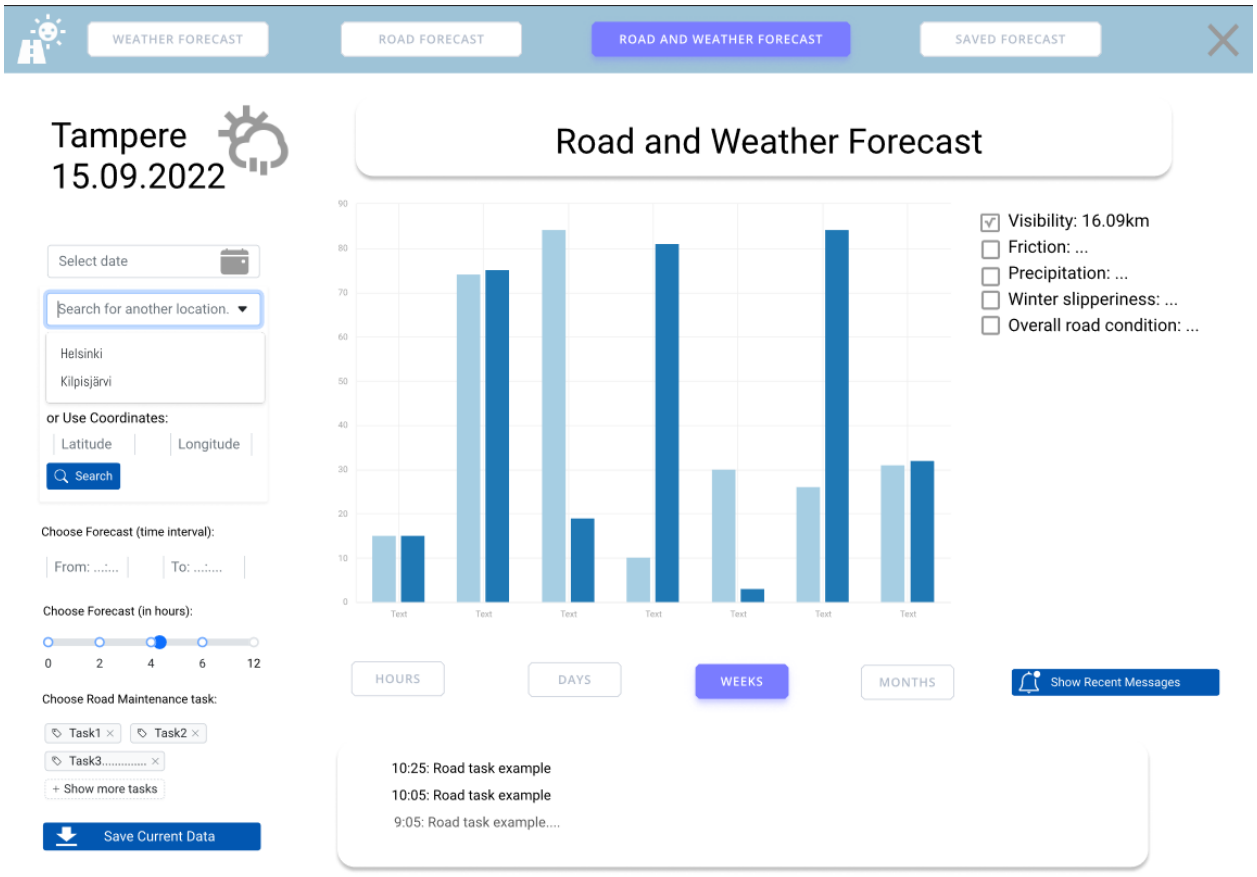
GitLab is the open repository given to us by our client for this project. It is a comprehensive DevOps platform that can help our development team to carry out project RoadMap (planning, managing source code, and monitoring). We can easily share our code and work on different branches to avoid conflicts when merging them later on.

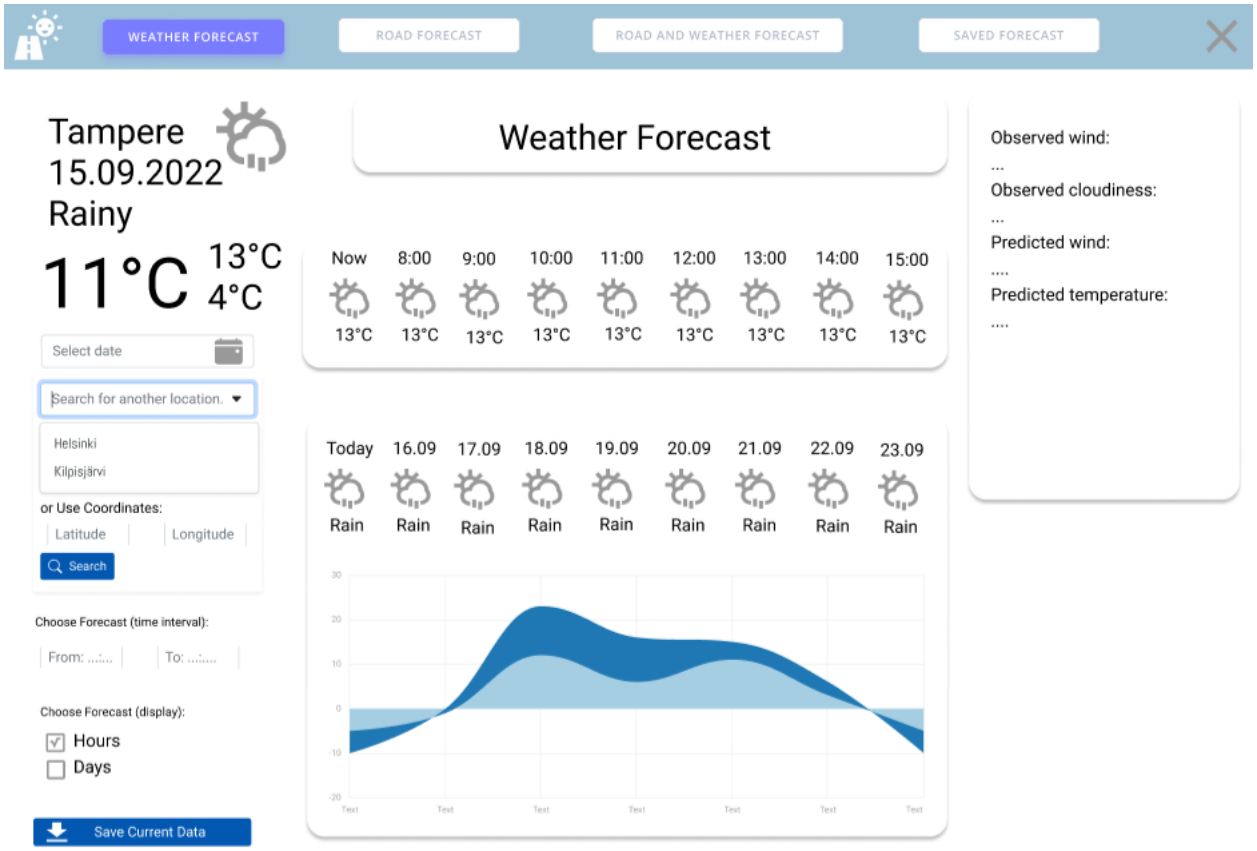
Java NetBeans: Maven

For project management. It is the tool the team members have the most experience using. Maven is a tool that is used for application builds, dependencies, and deployments based on POM (project object model). It will help us with criteria such as reusability and maintainability.

Figma Mockups

We first started a prototype sketch using Figma, a collaborative design tool used for creating designs for mobile and desktop interfaces.



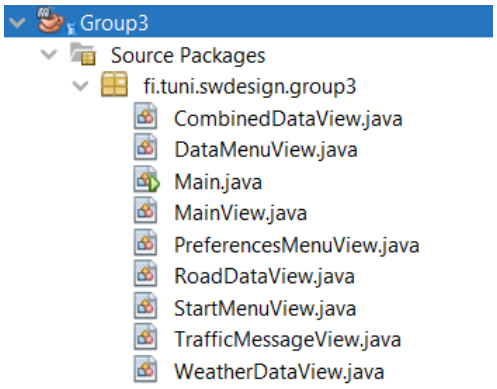


This first sketch can be found in our git repository as well as in our Figma team project:
https://course-gitlab.tuni.fi/comp-se-110-software-design_2022-2023/group-3.git
https://www.figma.com/file/sVrAbAr26B0PWMXTxgbjHk/Project---Prototype-sketch-(AD)?node-id=1%3A2

After learning more about how to design an UI in JavaNetBeans with JavaFX, we decided to switch to a simpler UI design and directly continue the prototype by coding it. The rest of this report will go further in detail about our design choices.

Architecture and Detailed Design

MVVM pattern implementation



Current architecture of the code (will be updated in the future).

What is MVVM and Why did we choose this pattern?

MVVM is a variant of MVC (Model-View-Controller).

The project will be implemented using the MVVM (Model-View-ViewModel) design pattern. The team members chose the pattern for its separation of UI and the rest of the software. This way team members can focus and work on GUI, ViewModel, and Model separately without depending on the progress of one another. Using MVVM will also make unit testing easier.

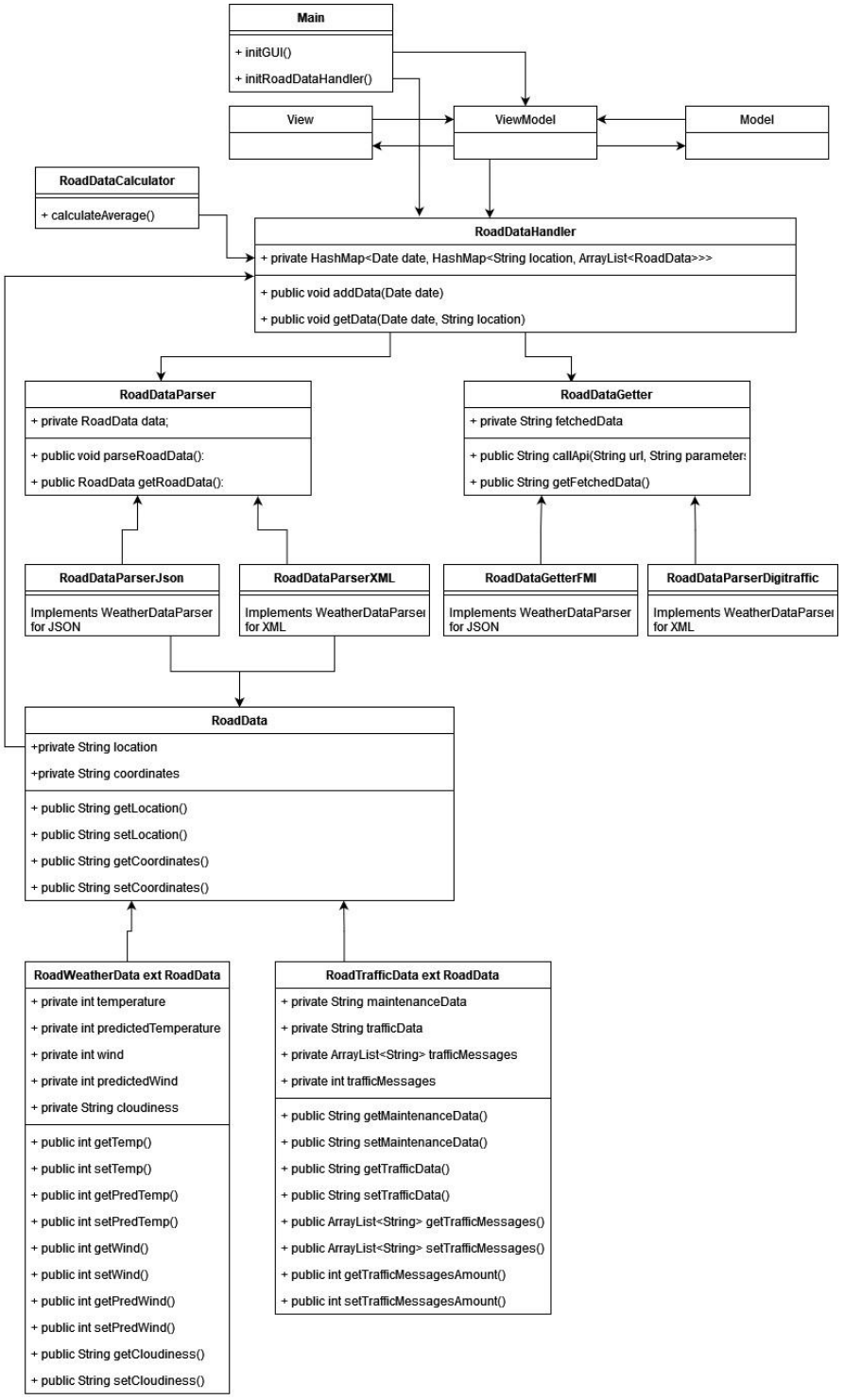
Factory Model

What is the Factory model and Why did we choose it?

In order to follow good practices and SOLID principles in design making, we can use design patterns to handle Object Creations. For the moment, we chose to use the Factory model as we are not yet sure about the exact types and dependencies our code will have. This pattern enables us to avoid tight coupling between Creator and Concrete products (thus following the SRP and OCP SOLID principles when creating and extending objects).

UML Diagrams UI/Back-End

MVVM implementation UML



The mother class is RoadDataHandler (data keeping and flow related).

API calls: RoadDataGetter fetches the data and its subclasses handle the different APIs.

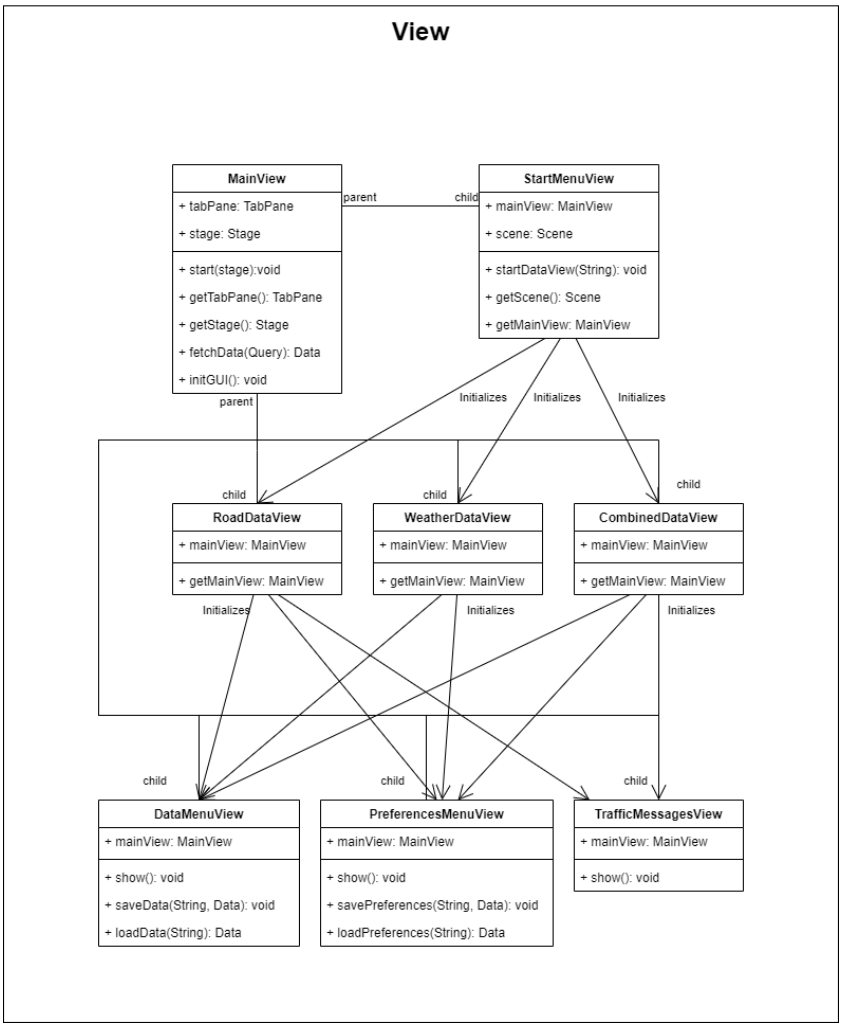
RoadDataParser handles the JSON and XML parsing for the data from the APIs and makes them as RoadData classes.

Concrete classes:

RoadWeatherData and RoadTrafficData extending from the abstract RoadData class (data fetching).

All dependencies are shown through

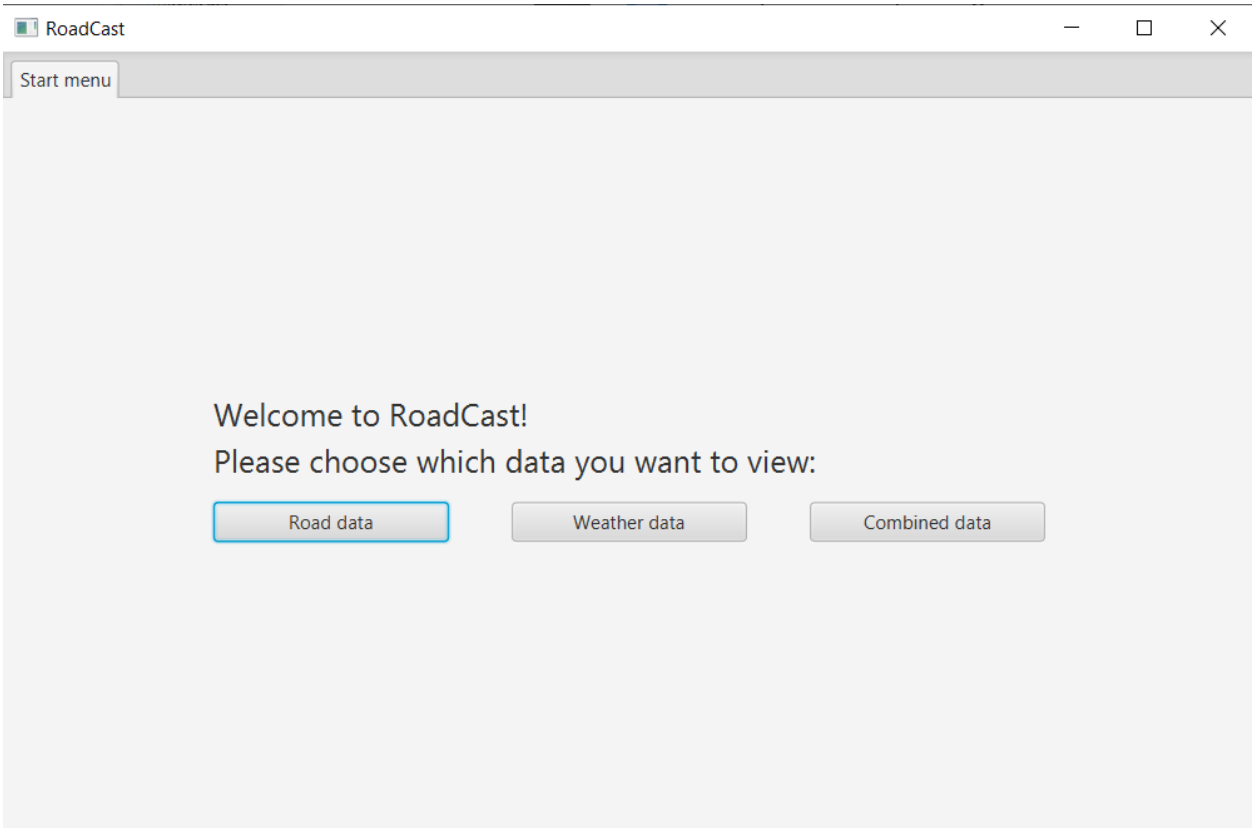
->



The UML diagram of the View component consists of the different classes and their associations. The MainView-class acts as a parent to all the other View-classes and they are connected through the parent. All the other View-classes' responsibilities are the events of their respective views. On top of that StartMenuView initializes the Road-, Weather- and CombinedDataView. The Road-, Weather- and CombinedDataView-classes also initialize the Data- and PreferencesMenuViews. RoadDataView and CombinedDataView also initialize the TrafficMessagesView. All the communication with other parts of the software happens through the MainView-class.

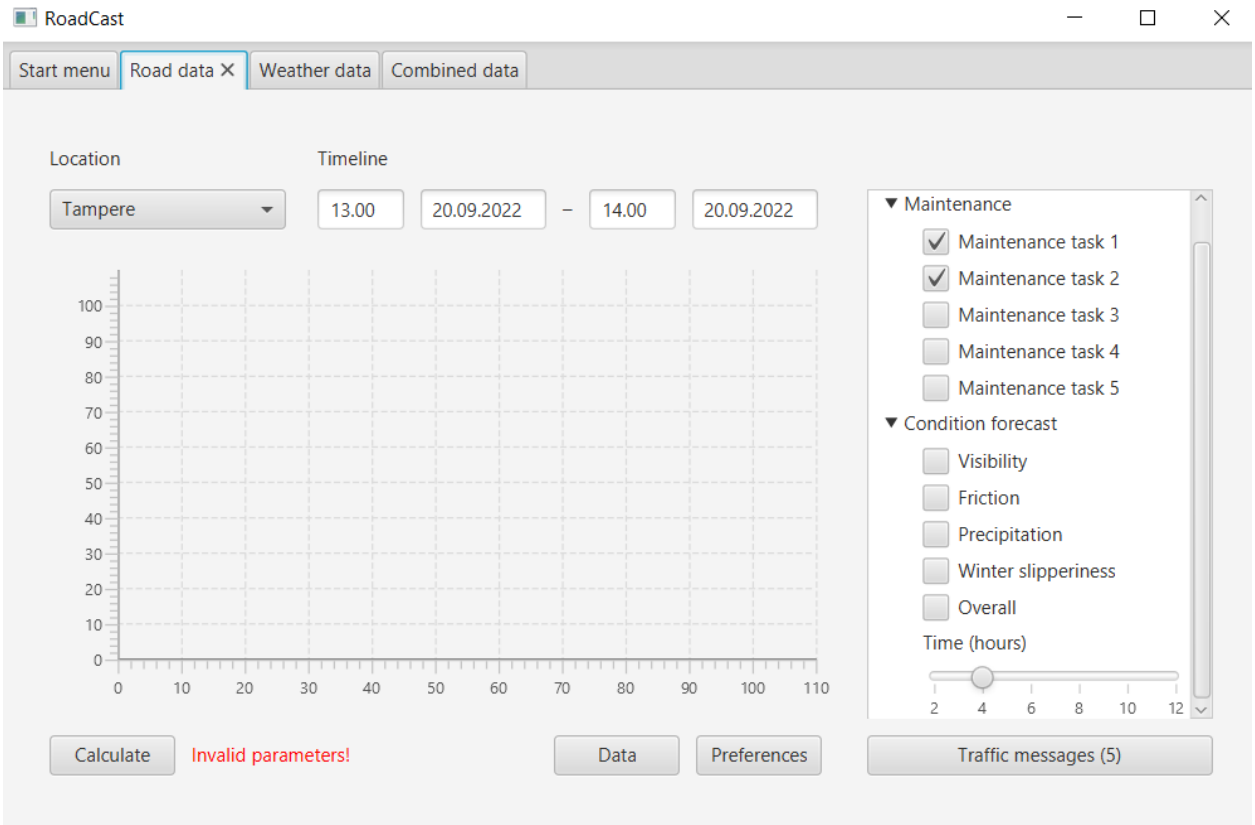
User Manual

Main menu



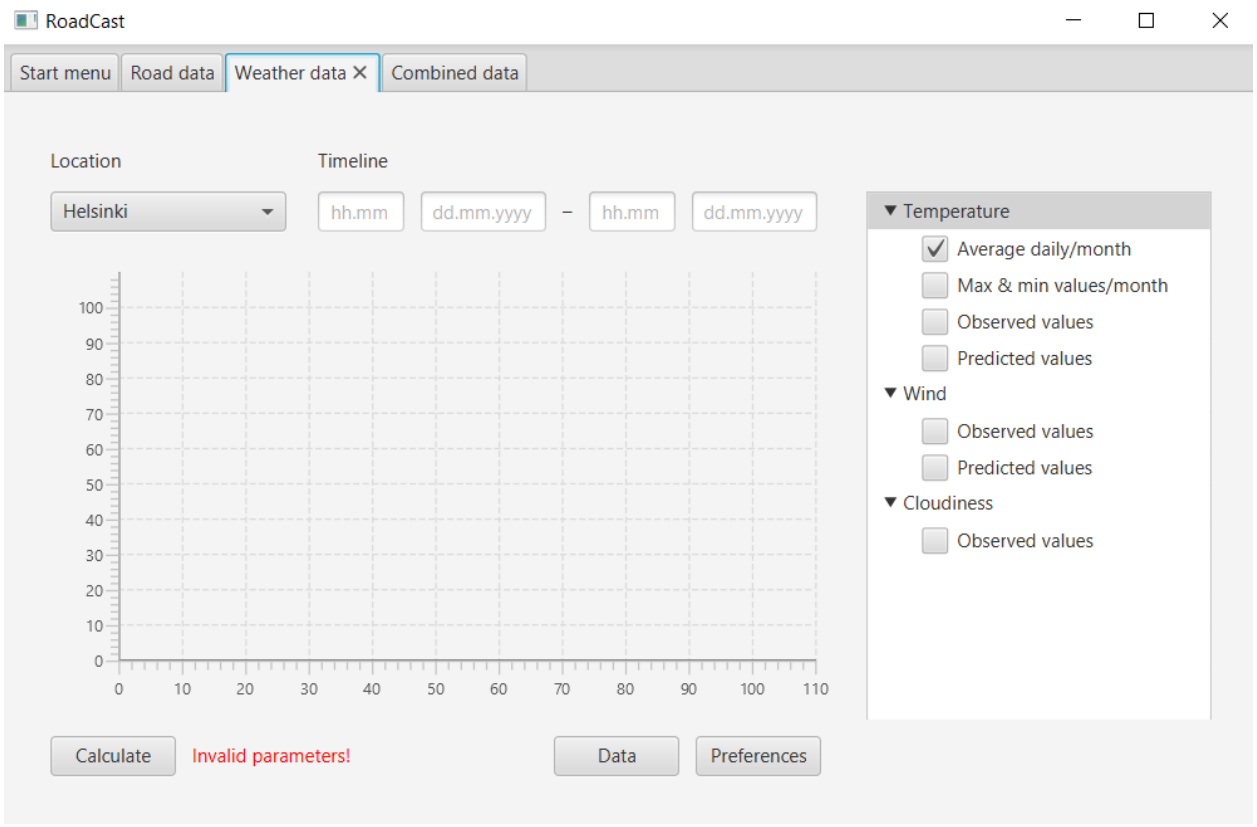
When first starting the software you will be greeted with the start menu. In the start menu, you can choose between three options: road, weather, and combined data. Choosing road data will create a new tab with tools and data visualization for data on Finnish roads. Choosing weather data will create a new tab with tools and data visualization for data on Finnish weather. Choosing combined data will create a new tab with tools and data visualization for both road and weather data simultaneously. The application can be closed by pressing the x on the top right corner.

Road data options



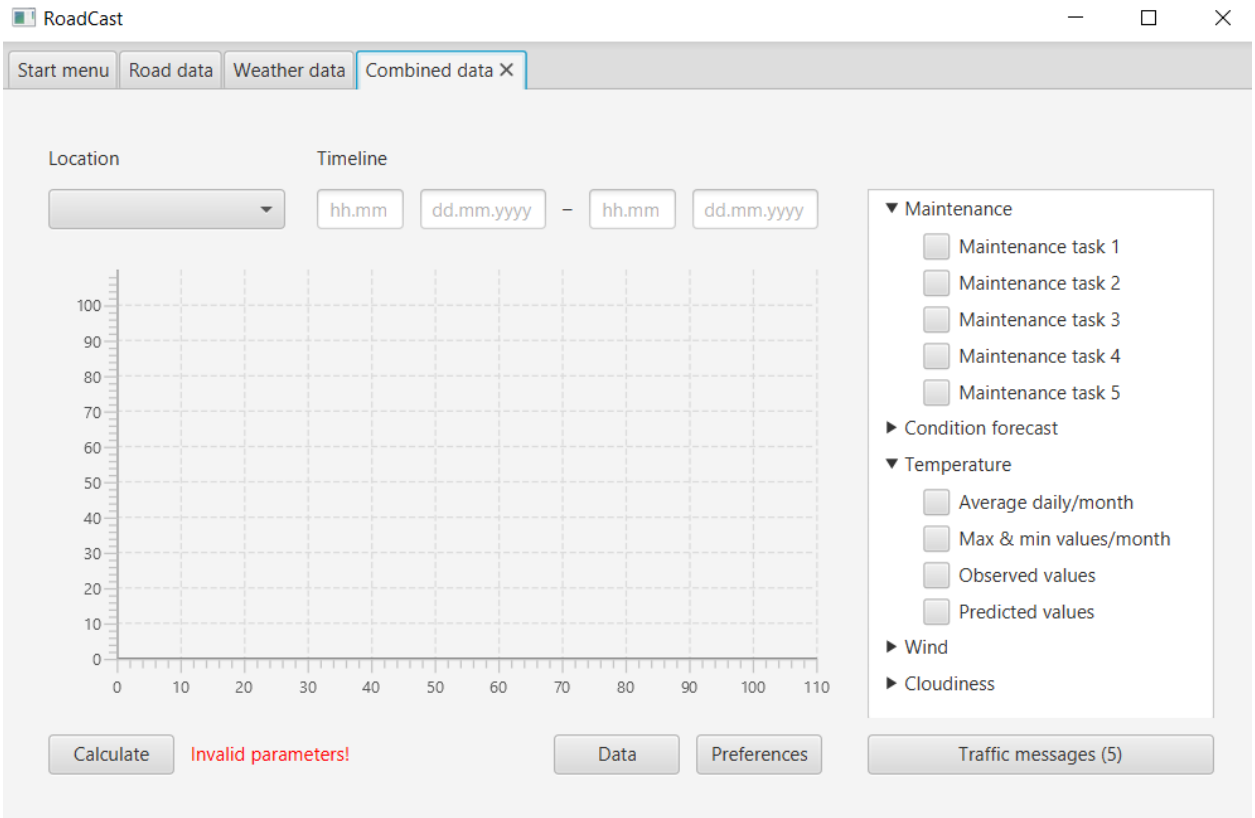
In the road data tab you have to give parameters for the data visualization. First, in the top left corner, you have to choose the location for the data. There are currently five different cities in Finland between which you can choose. Next to the location dropdown menu, you have the timeline fields in which you have to give the starting time and date and ending time and date. The dates and times will have to be valid and typed in hh.mm and dd.mm.yyyy format. On the right side of the window, you have the check box view where you can choose which data types you want to visualize. After choosing the parameters you can start the visualization by clicking the calculate button on the bottom left corner. If some of the parameters are invalid there will be a red text on the right side of the button explaining what went wrong. In the road data view on the bottom right corner, you also have the traffic messages button. The number on the button indicates how many traffic messages were found with the given parameters. Clicking the button will open the traffic messages view, which we will come to later.

Weather data options



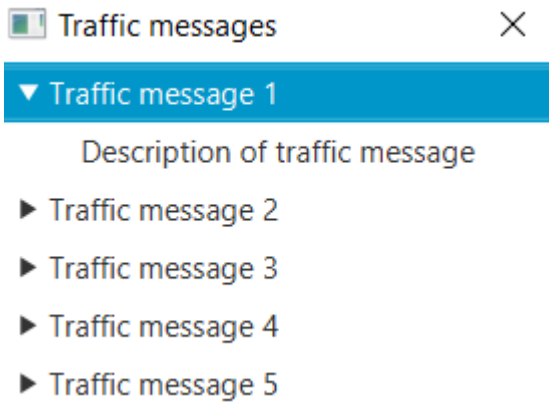
The weather data view is structured the same way as the road data view. The only difference is that there will be no traffic messages button and the checkbox view's content is related to weather data instead of road data.

Combined data options

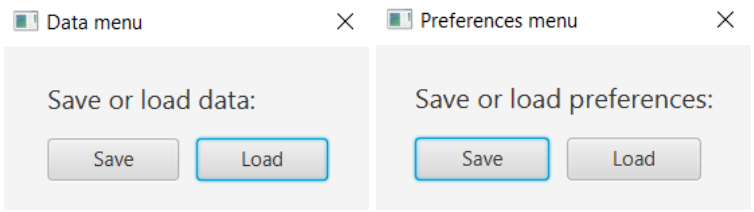


The combined data is a combination of both the road data view and weather data view. The checkbox view now consists of both the road data view's parameters and the weather data view's parameters.

Other



Pressing the traffic messages button will create a new popup window that will show all the current traffic messages. You can click on the messages to read the description related to the message. With the traffic messages window open you can still interact with the main window and you can create multiple traffic messages windows. You can close the traffic messages window by pressing the x on the top right corner.



Pressing the data or preferences buttons will create a new popup window for the data or preferences menus. In these menus, you can either choose to save or load data or preferences. Saving on the data menu will save the current data visualization into the data save file and loading will load the data of your choice to the currently selected tab. Saving on the preferences menu will save the current data visualization parameters to the preferences save file and loading will load the preferences of your choice to the currently selected tab. You cannot interact with the main window until you have closed the data or preferences menu by pressing the x on the top right corner.

What’s next?

Following the design choices explained in this document, we will start the implementation of the functionalities (mainly Back-End API calls, following MVVM code architecture…). The team will check applicability based on the implemented functions and start reflecting on Software refactoring to improve and optimize the application.

This design document will be updated for the next meeting with our client (30.10.2022).