Software Design Project

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Software Design Document

Version History

Version	Date	Description
1	20.02.2022	Initial version of document

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1 INTRODUCTION

The document describes the design and system specification of the desktop application built during the spring 2022 implementation of Software design course in Tampere University. The document provides high level description of the design describing major components used for creating software and their interfaces.

1.1 PURPOSE AND SCOPE OF PROJECT

The aim of the project is to design and develop software for monitoring real-time data on greenhouse gases and comparing current data with historical data on greenhouse gases. During this project, the group shall create a standalone desktop application for visualizing and monitoring greenhouse gases utilizing the database and API provided by SMEAR and Statistics Finland STATFI. The scope of project includes monitoring real-time data from SMEAR, checking historical values provided by statistics Finland, comparing historical data to current data, and visualizing the trends of greenhouse gas from history to present.

1.2 SYSTEM OVERVIEW

The desktop application will be built using Java and its libraries. The software will be built using Model-View-Presenter (MVP) architecture pattern, an architecture pattern which divides application into three layers model, view, and presenter. Java Swing, which is a graphical user interface (GUI) widget toolkit for Java will be used for the graphical user interface needed for the visualization of the data.

The software utilizes the data from the two different sources SMEAR and STATFI and is visualized and monitored in the application. The model component stores the data from the sources and communicates with the sources. The view provides visualization of the data as per the requirements and built prototype. Finally, the presenter fetches the data from the model and applies the UI logic to decide what to display. Since, the application focuses on UI components and the requirements consists of particularly four main use case, MVP pattern makes convenient to build logic with each use case. The loose coupling between view and model helps to manipulate the data without the change in model.

1.3 DEFINITIONS, ACRONYMS AND ABBREVIATIONS

GUI	Graphical User Interface
MVP	Model-View-Presenter
STATFI	Statistics Finland
API	Application Programming Interface
Class Diagram	Describes the structure of the system and interfaces between classes
UI	User Interface

2 DESIGN CONSIDERATION

The section explains some of the restricted development methods as per the course requirement along with explaining system features and architectural strategies explaining the reasons for choosing the preferred language and design patterns as mentioned in section 1.2 as well.

2.1 DEVELOPMENT CONSTRAINT

The software is supposed to be developed using any of the four-programming language Java, C++, C#, and Python as per the course requirements. In addition, the software should be standalone, or desktop application. Java being extremely portable which allows the application to run on any computer regardless of hardware features or operating system and the familiarity of the team members with the language made it the choice to use Java.

Moreover, web application being not permitted, UI compatible with Java needed to be chosen. Java Swing is a lightweight GUI toolkit which has a variety of widgets for building optimized window-based applications. Swing is built on top of the AWT API and entirely written in java. It is platform independent unlike AWT. Moreover, the javax.swing package provides classes for java swing API such as JButton, JTextField, JTextArea, JRadioButton, JCheckbox, JMenu etc. The compatibility with Java language and already defined components like button, checkbox makes the language easier to integrate and develop user interface as well.

2.2 SYSTEM FEATURES

1. Users can select four options to view data from the software. Each option can be selected from the nav bar. The options are:
    - Monitoring real-time data from SMEAR (Tab name: Real-Time Data)
    - Checking historical values from STATFI (Tab name: Historical Values)
    - Comparing the current situation to history (Tab name: Comparison)
    - Breaking down averages (Tab name: averages)
2. In Real-Time data window, user can select which monitoring station's (one or more) data they are interested in.
3. In Real-Time data window, user can select which greenhouse gas / data variable they are interested in (minimum options: CO2, SO2, NOx)
4. In Real-Time data window, user can set a time-period from which data is shown
5. In Real-time data window, in addition to viewing raw data, user can ask for a minimum, maximum and average values of the selected data
    a) For a given time-period for a given station
    b) For several stations for a given time
    c) For several stations for a defined time-period
6. In Real-Time data window, users should not be able to select time range where data is not available, null values should be handled.
7. In Historical values window, the user can select a time range for viewing data from STATFI
8. In Historical values window, user selects one or more available datasets: CO2 (in tonnes), CO2 intensity, CO2 indexed, or CO2 intensity indexed (one or more).
9. In Historical values window, user is shown a visualization of the data based on selection.
10. In Comparison window, user is given a visualization of the CO2, SO2 and NOx values from SMEAR for a time-period specified by the user, for the station(s) selected by the user

11. In Comparison window, the user can select data available from STATFI on historical averages
12. In Comparison window, the user can specify the time range to view data
13. In Comparison window, the historical values are shown alongside real data in a comparable way.
14. In Averages window, the user selects a time range for viewing data from STATFI
15. In Averages window, user selects data from CO2 (in tonnes), CO2 intensity, CO2 indexed, or CO2 intensity indexed.
16. In Averages window, user is shown a visualization of the data according to the data selected.
17. In Averages window, the user can choose real time data from SMEAR
18. In Averages window, breakdown of the historical average to the selected year based on SMEAR data is visualized.
19. The user can save preferences (e.g. certain stations, certain time period in history, which greenhouse gas(es) from SMEAR, which statistics from STAT FI) and apply them when using the software later.

2.3 ARCHITECTURAL STRATEGIES

Model-View-Presenter (MVP), the main goal is the separation of concerns between the user interface (UI), the Model deals with application data, View is for displaying data and reacting to user input and the Presenter handles business or presentation logic. In MVP, View does not actively update itself, instead choosing to allow the presenter to handle that task. Presenter also allows for Model and View to communicate with each other.

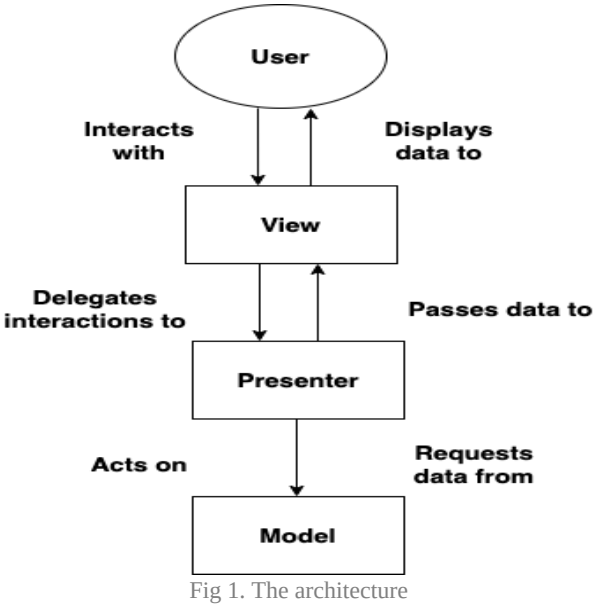

Fig 1. The architecture

As we can see in figure 1, the Presenter listens for any user interaction through the View. The Presenter then fetches the relevant info from a particular service or APIs. After that the Presenter updates both the View as well as the Model. Thus, the model and the view layers are completely isolated from each other.

3 SYSTEM DESIGN

The section includes the detail description of the application. The class diagram describing high level components and interfaces is included along with details of use environment, programming standards and so on.

3.1 CLASS DIAGRAM

The application is divided into four main components with respect to the user interface designed according to the use case requirement. The components are Realtime, History, Comparison and Averages. Each component has model, view, and presenter class of its own. In addition, each model includes communicator object for the communication with external API. Separating the UI components into four parts enables the model to not change frequently and handles the application logic in convenient way.

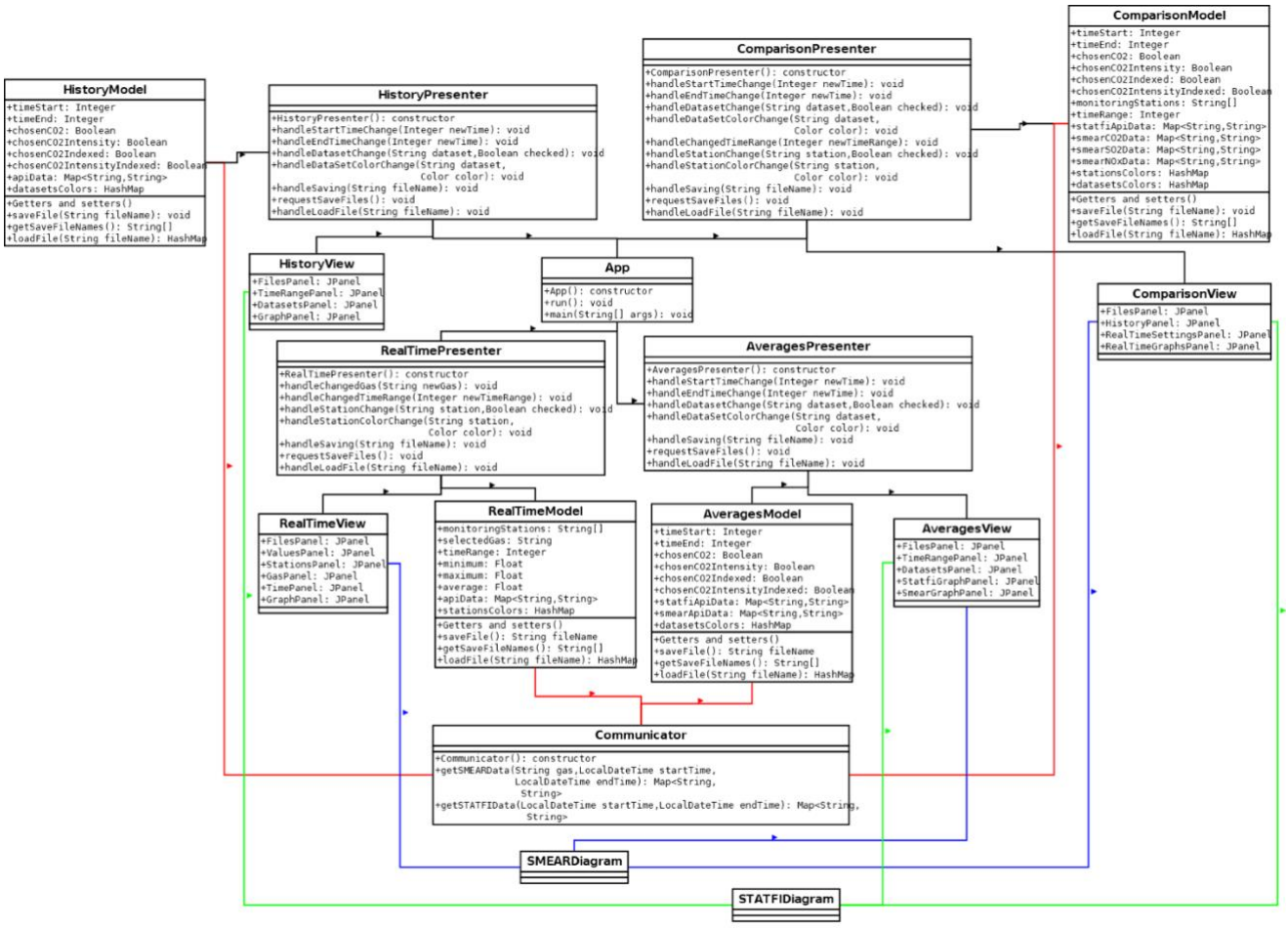

Fig 2. Class Diagram of application

Figure 2 highlights the main classes and their methods. The “App”- class is the main class of the application. It contains four different presenters. These four presenters hold references to their own views and models. Each model contains a Communicator object which handles everything related to connecting to the external APIs. The RealTimeView, ComparisonView and AveragesView classes use SMEARDiagram objects to display the data from SMEAR. The HistoryView, ComparisonView and AveragesView use STATFIDiagram to display the data from STATFI.

3.2 PROGRAMMING STANDARDS

The software is developed using Java version 17. Java being the object-oriented programming language, the conventions of OOP concept and java coding standards shall be followed.

3.3 NAMING CONVENTIONS

The standard naming conventions of Java shall be followed. The packages name in lowercase, class, interface name in CamelCase, methods, variables in mixedcase and constants in uppercase.

3.4 SOFTWARE DEVELOPMENT TOOLS

- **Java** is used for development
- **Java Swing** is used for GUI
- **Figma** is used for creating UI prototype
- **NetBeans** is used as an editor for writing java code
- **Gitlab** is used for codebase and version control management
- **Gitlab Issues and Boards** is used for tracking tasks and features completion

3.5 OUTSTANDING ISSUES

The prototype of the application is built. The problem can arise when using MVP architecture pattern if the UI components needs to change in future which can lead to change in presenter logic as well. The model defined currently can change due to user interface components. The time-range for real-time data can change in accordance with the SMEAR API.