MIDDLE EAST TECHNICAL UNIVERSITY

COMPUTER ENGINEERING DEPARTMENT

CENG491 INITIAL DESIGN REPORT

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Table of Contents

1. Introduction

This document contains the overall system architecture and data architecture of "Context Aware User Interface Project" of group "Korsan Yazılım" and indicates descriptions of functions and specifications of this project which will be performed by senior METU Computer Engineering students.

1.1 Problem Definition

In the present day, mobile devices are commonly used by most of the people in any kind of environment and situation. Despite the fact that uses of these devices are so widespread, unfortunately, screens of mobile devices are not legible when we consider some difficult environmental cases. Therefore; we decide that we will develop a system which identifies the environment and state changes and then adapts the graphical user interface to provide convenience to users accordingly in these extreme situations. This system will use images taken by camera of mobile devices as inputs and will process them in order to determine how user interface will change itself for usability.

We decided to customize this problem to military problem because people who generally have to deal with these bad environmental situations we speak of are generally soldiers and we implement this project by sponsorship of Aselsan. We form our problem around a soldier who is a team leader who needs to get and accomplish missions.

1.2 Purpose

Aim of this report is definition of design issues of the overall system architecture and data architecture before getting into deep complex design issues. Audience for this report is Aselsan (our sponsor for this project) and teaching members of course of Computer Engineering Design.

1.3 Scope

This initial design document contains design information about Yaver which is a demonstration of architecture, modules, classes, use cases, functions, features, database model, graphical user interface, tools and special technologies. It describes how Yaver works properly and with safety in detailed and understandable way. The architecture is intended as the basis for more complex and useful versions in the future.

1.4 Overview

The rest of IDR, in appearance order, contains pages generally involve design considerations, data design, system architecture, user interface design, libraries and tools we will most probably use, planning of these and finally conclusion.

1.5 Definitions, Acronyms and Abbreviations

IDR: Initial Design Report

GUI: Graphical User Interface

API: Application Programming Interface

P.K: Primary Key

DB: Database

JDBC: Java Database Connectivity

1.6 References

[1] IEEE Std 1016-1998: IEEE Recommended Practice for Software Design Descriptions

[2] Java Database Connectivity(JDBC) :
http://en.wikipedia.org/wiki/Java_Database_Connectivity

[3] Java Swing:
http://en.wikipedia.org/wiki/Swing_%28Java%29

[4] Java Advanced Imaging API (JAI) :
http://en.wikipedia.org/wiki/Java_Advanced_Imaging

2. System Overview

As we said, Yaver is the application for helping a team leader to find his way in the map and accomplish his missions. In order to provide this, firstly, there will be a map screen which can show where user is, what mission route is and information about surroundings. In addition, there will be a section for taking missions and reading details of them and a section for message communication handling between command center and team leader. Most importantly, our application will adapt changes in environment by changing GUI such as; when user move fast, application will increase size of important sections to make them more visible. User will be able to determine which sections are important in certain environmental cases. We will develop a system which works in mobile devices to determine environmental conditions and to adapt user interface for these cases. Camera is the sensor which provides us to recognize environmental changes. This is a real-time system, since the system should determine environmental conditions immediately and change the user interface according to them. Additionally, we will try to make GUI as functional, understandable and user friendly as possible, because people who will use application must not be suffering from lack of usability of Yaver. We will design it to provide that they must be able to use it in a way that they can find anything they expect from application and adaptation of its' GUI to environment works perfectly, as much as we can.

3. Design Considerations

3.1 Design Assumptions, Dependencies and Constraints

We will design, implement and test our application in our laptops, because we are not given any mobile devices to work on, so we assume that the work we did for computer will be implementable in mobile devices too although there may be some incompatibility. We haven't done any image processing related work in our summer practices, so we will be learning and implementing during the process of doing the project at the same time. Therefore; as we learn, we might change our design and ideas about the project in order to make the application better. On the other hand, we have two general constraints:

3.1.1 Time Constraint:

We have and will have other lessons and we will need to spare time for them too, which is not easy during the process of implementing our project. In order to handle this constraint, we will try to obey our plan as much as we can which is shown by using Gantt Chart in Time Planning section.

3.1.2 Performance Constraint:

Since we are trying to implement an application for mobile devices, we should try to accelerate how our application operates due to fact that mobile devices have limited memory and process capabilities.

3.2 Design Goals and Guidelines

We aim to use memory as less as possible because this project is for mobile devices, but by doing that we will not let quality and correctness of application decrease. We will try to keep this rate at optimum level. Our other goals are:

3.2.1. Security:

Network communication should be made in encrypted way in order to avoid network attacks in the system. Therefore, assignments and messages are sent after data is encrypted. This system guarantees that any information will not be stolen by unauthorized people.

3.2.2. Maintainability:

The application should be banned for modification by users and allowed for extensions by developers. It should be implemented in a way that modification will not be necessary. However, it should be open for extensions such as keeping database for the past locations of the users, newer network connection technologies or its simulations, newer communication technologies. In other words, our system should accept common interface for all service it uses, the new ones should implement these interfaces in order not to modify previously coded parts.

3.2.3. Portability:

The application should be platform independent. It should work in Windows and Linux successfully and also in mobile devices. By using Java for implementing this application we handle most of this issue.

3.2.4. Availability/Reliability:

The application should represent all the information which comes from server in the map, message and assignment sections instantly, allowing dynamic changes whenever it executes. User and command center should be available to communicate with command center. Application guarantees that wrong information comes from users will not cause software crashes.

3.2.5. Scalability:

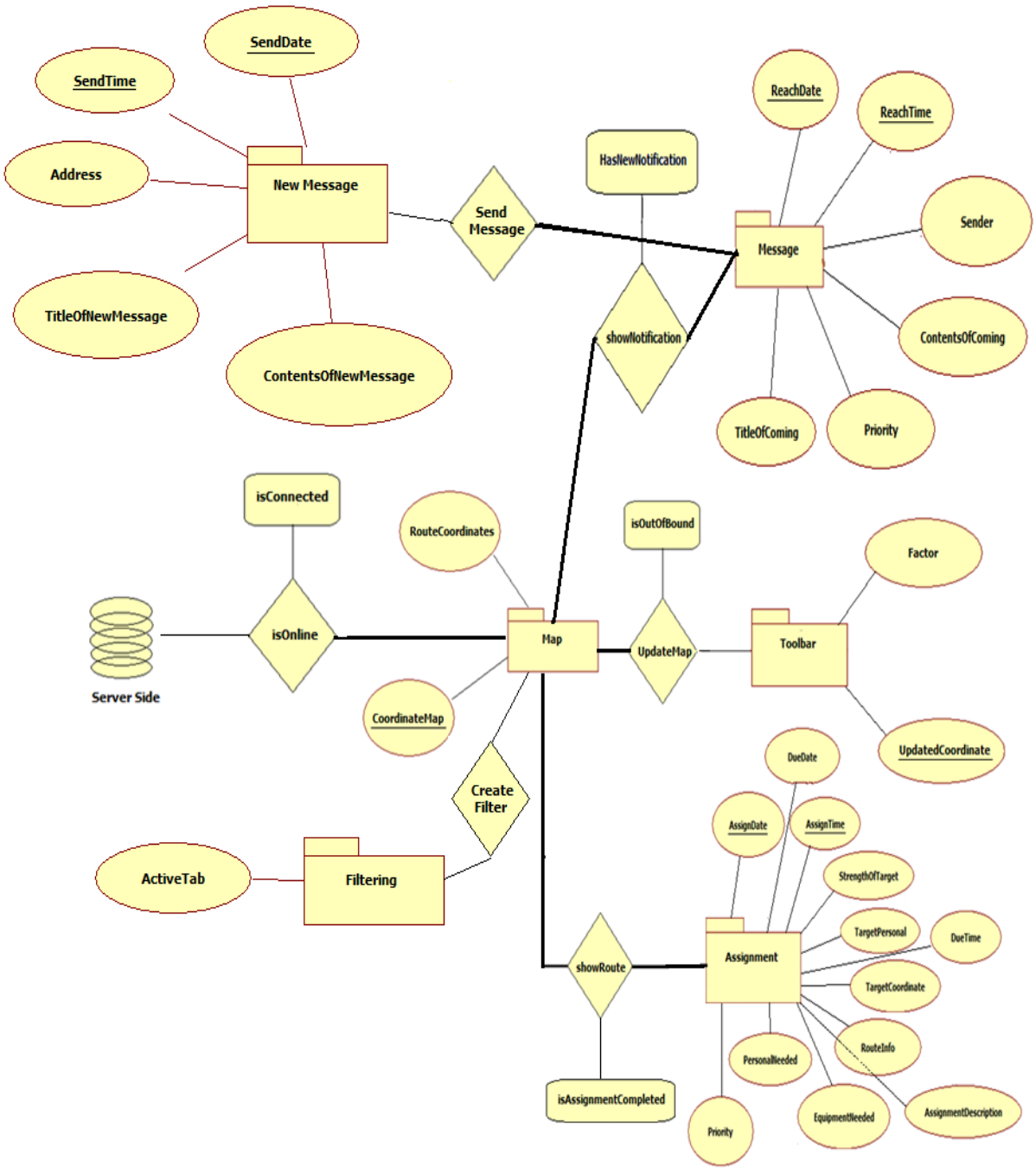
Since available network management algorithms are designed to work on fixed or relatively small wireless networks and our communication technology has not been decided yet the exact number can vary. Our application is for using of one military team leader. However, this system is not an application such that many users cannot connect to device simultaneously. Application is suitable for all soldiers who are commanded.

4. Data Design

4.1 Data Description

This section shows attributes of data objects, and relationship between data and functions by using diagrams and tables. These data objects are made under the consideration of getting rid of unnecessary attributes and normalization factors.

4.1.1 Complete ER Diagram



4.1.2 Data Objects

Map:

This table is heart of the Yaver. Mainly, it shows the map related to the coordinate values and route coordinates of the assignments. This part is connected to the server to take map by using given coordinates. Detailed information will be seen at section 6.1.3.

Field	Type	Null	Foreign Key	References
CoordinateMap (P.K)	Varchar(24)	No	No	No
RouteCoordinates	Varchar(24)	No	No	No

Toolbar

Users can change coordinate values by using move left, move right, move up, move down. Therefore, this new coordinate values are set coordinate of Map objects. Similarly users can change visibility amount of map by using zoom in, zoom out features. In order to change this feature, Factor can be incremented or decremented with special values with respect to the zoom in or zoom out. Detailed information will be seen at section 6.1.2.

Field	Type	Null	Foreign Key	References
UpdatedCoordinate (P.K)	Varchar(24)	No	No	No
Factor	Integer	No	No	No

Message

It's so similar to general purpose mail program. Simply, it provides connection between command centre and user. Coming messages are listed and user chooses whatever s/he wants. These messages are stored at internal database. Users can delete message from database using Message interface. Coming messages are listed with respect to the priority by default. Detailed information will be seen at section 6.1.4.

Field	Type	Null	Foreign Key	References
ReachDate (P.K)	DateTime	No	No	No
ReachTime	DateTime	No	No	No
Sender	Varchar(100)	No	No	No
TitleOfComing	Varchar(100)	No	No	No
Priority	Integer	No	No	No
ContentsOfComing	Varchar(500)	No	No	No

Assignment

One of the Yaver's facilities is showing the assignment assigned by command centre. When a duty is assigned, then user sees properties of this assignment by using this application. Each assigned assignments are listed. User can change order of the listed assignments with respect to the entities. Priority is default entity to order all uncompleted assignments. Detailed information will be seen at section 6.1.5.

Field	Type	Null	Foreign Key	References
AssignDate (P.K)	DateTime	No	No	No
AssignTime (P.K)	DateTime	No	No	No
DueDate	DateTime	No	No	No
DueTime	DateTime	No	No	No
AssignmentDescription	Varchar(500)	No	No	No
Priority	Integer	No	No	No
PersonalNeeded	Integer	No	No	No
EquipmentNeeded	Varchar(100)	No	No	No
RouteInfo	Varchar(500)	No	No	No
TargetCoordinate	Varchar(24)	No	No	No
TargetPersonal	Integer	No	No	No
StrengthOfTarget	Integer	No	No	No

New Message

In order to compose a new message and send it, user chooses new message part. New message part consists of three basic features which are address information, title and contents of the message. It is similar to well-known mail programs' send mail feature. Detailed information will be seen at section 6.1.5.

Field	Type	Null	Foreign Key	References
SendDate (P.K)	DateTime	No	No	No
SendTime (P.K)	DateTime	No	No	No
Address	Varchar(100)	No	No	No
TitleOfNewMessage	Varchar(100)	No	No	No
ContentsOfNewMessage	Varchar(500)	No	No	No

Filtering

Main purpose of the project is being awareness on environmental changes and then dynamically redesigning GUI to provide more usability. In order to do this, some properties are hidden or sizes of the some properties are changed. Default behavior is identified by developers but user may want to change this behavior for own purposes. At this part, user creates own filter and chooses behavior of the properties. Detailed information will be seen at section 6.1.6.

Field	Type	Null	Foreign Key	References
ActiveTab	String	No	No	No

Redesign GUI

This section contains some properties about changing design of the GUI. Contrast values of the screen, current button size and font size dynamically adapted with respect to the environment. Each object (buttons, textfields etc…) has unique id called ObjectId.

Field	Type	Null	Foreign Key	References
ObjectId (P.K.)	Double	No	No	No
ButtonSize	Double	No	No	No
FontSize	Integer	No	No	No
Contrast	Integer	No	No	No

Map – Server Relation (isOnline)

Server sends map with respect to the coordinate value. This relation has an extra entity called isConnected, which shows status of server connection.

Field	Type	Null	Foreign Key	References
CoordinateMap (P.K.)	Varchar(24)	No	No	No
isConnected	Bool	No	No	No

Map – Toolbar Relation (UpdateMap)

Toolbar contains some map-related functions such as Zoom in/out, move left, right, up, down. By using these functions, maps vision capability and area is changed. If obtained coordinate values by using move functions are out of the downloaded map, system wants new map by updated coordinates. This relation has an extra entity called isOutOfBound. Its value depends on whether UpdatedCoordinate is in or out of map.

Field	Type	Null	Foreign Key	References
CoordinateMap (P.K.)	Varchar(24)	No	No	No
UpdatedCoordinate (P.K)	Varchar(24)	No	No	No
isOutOfBound	Bool	No	Yes	Map

Map – Assignment Relation (ShowRoute)

Route of the current assignment and target coordinate is showed on map.

Field	Type	Null	Foreign Key	References
CoordinateMap (P.K.)	Varchar(24)	No	No	No
AssignDate (P.K)	DateTime	No	No	No
AssignTime (P.K)	DateTime	No	No	No
IsAssignmentCompleted	Bool	No	Yes	Assignment

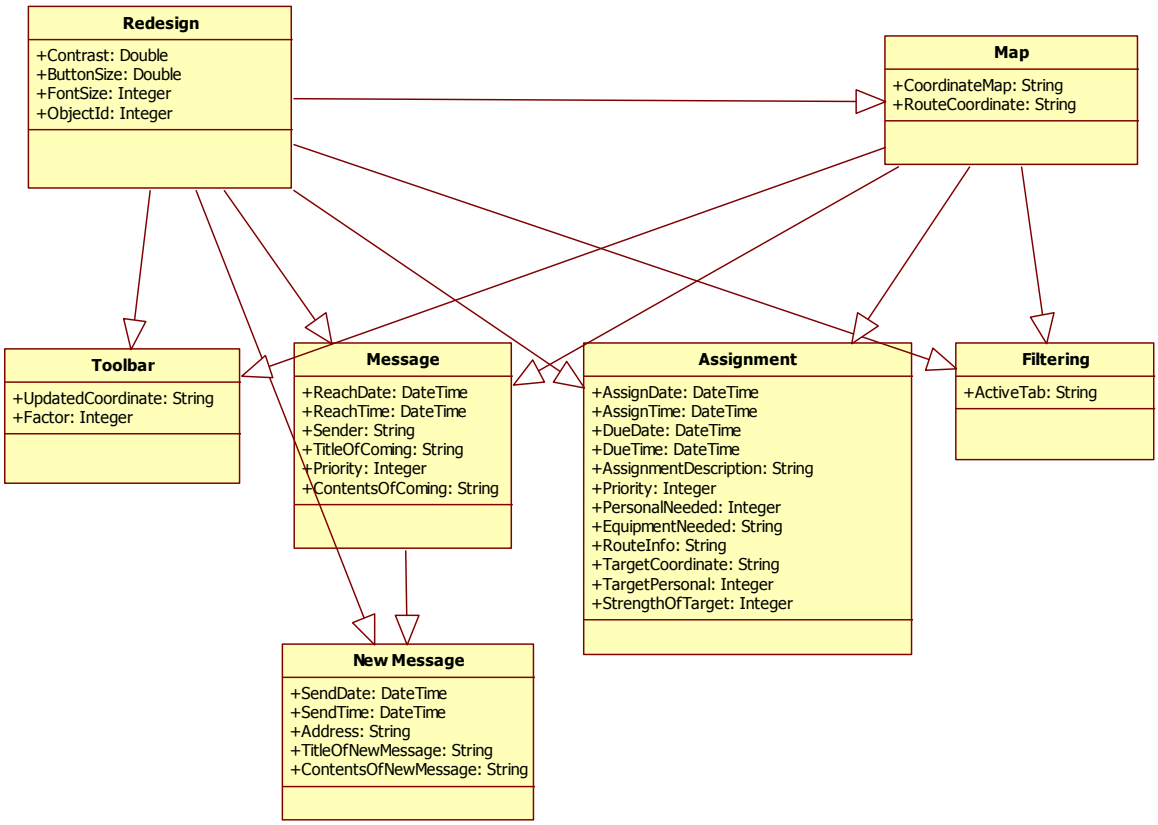
Toolbar – Message Relation (ShowNotification)

When new message comes from command center, a notification is seen on toolbar, and user reaches this message by choosing this notification.

Field	Type	Null	Foreign Key	References
UpdatedCoordinate (P.K.)	Varchar(24)	No	No	No
ReachDate (P.K)	DateTime	No	No	No
ReachTime (P.K)	DateTime	No	No	No
HasNewnotification	Bool	No	Yes	Message

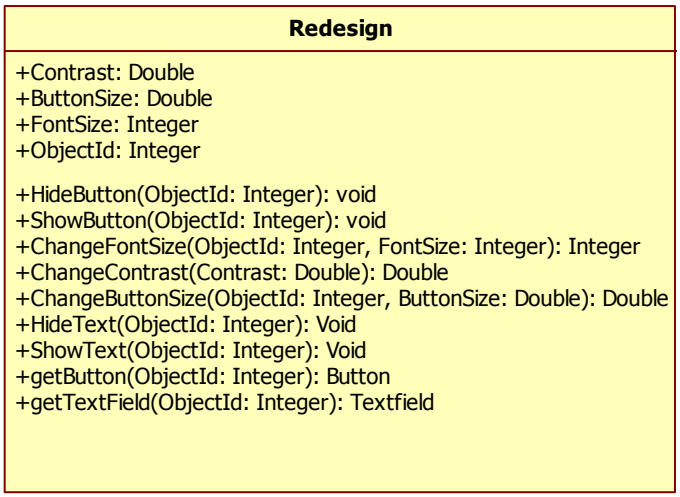
Model Package

Figure xxx shows overall packages and relationship between them with data properties. Since context-awareness is too important it affects all modules. Moreover, New Message modul is submodul of Message i.e. to send a new message, user have to open message part first.

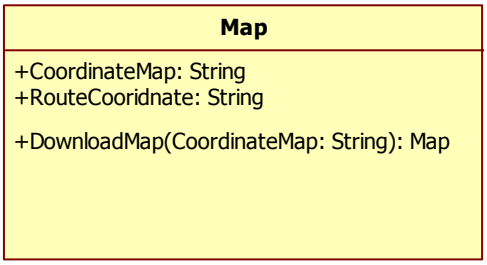


Packages with Functions

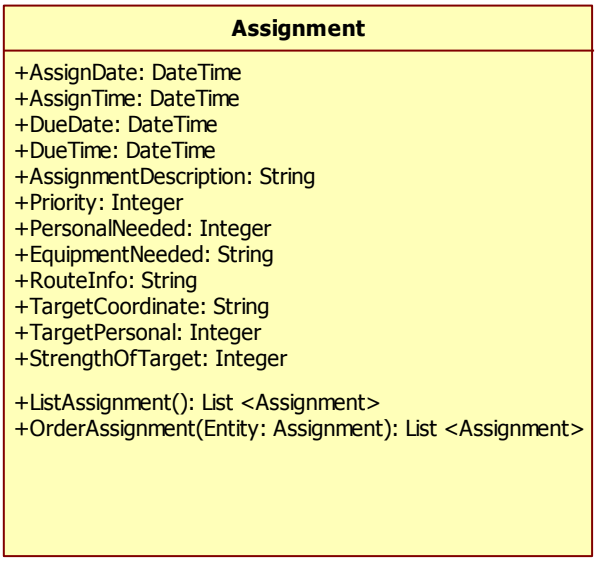
Redesigning GUI has several functions to change GUI's current view. Hide and show button change button status which is visible or not by taking information from filtering part. ChangeFontSize and ChangeButtonSize changes the size of the object having ObjectId given and return new size and sets them to related entity. ChangeContrast function changes the screen contrast, return and set new contrast to contrast entity. Hide and show text changes the visibility of text that has given ObjectId. getButton and getTextfield functions return related entity with respect to the ObjectId.



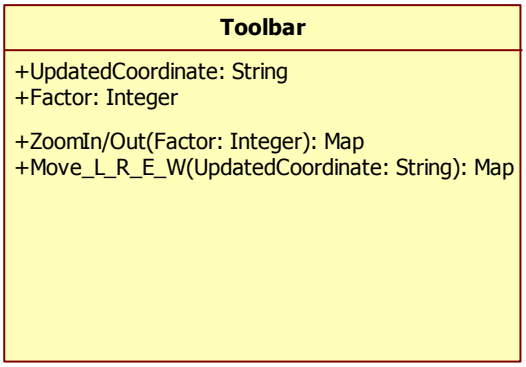
DownloadMap function takes a Coordinate and return a map by downloading a map from server by using this coordinate.



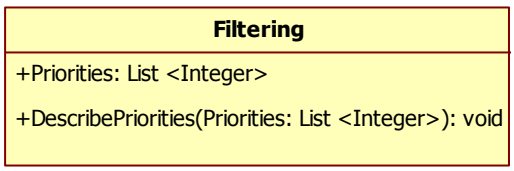
ListAssignment function returns list of assignments that is assigned to user. OrderAssignment function is also return list of assignments. By using desired entity, assignments are listed as sorted.



Zoom In/Out function takes an integer called Factor which changes visibility amount of map.Therefore this function should be return a Map. Similarly, Move Left/Right/Up/Down function takes a coordinate value called UpdatedCoordinate and return a Map.

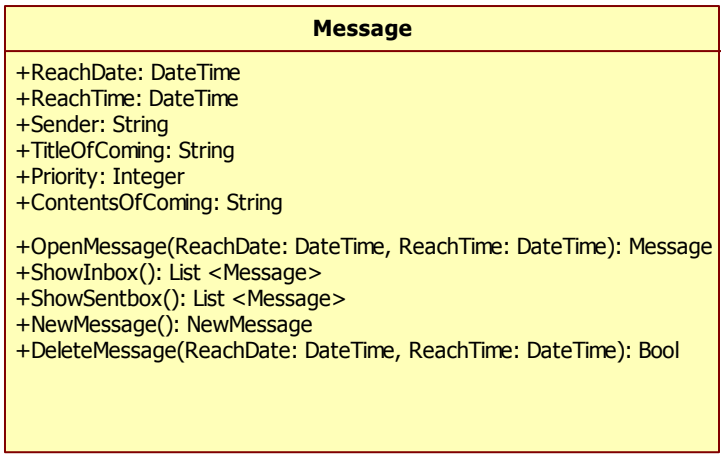


Yaver also provide users to create his/her own filter by Filtering options. User can describe the priority of each attribute with DescribePriorities function.

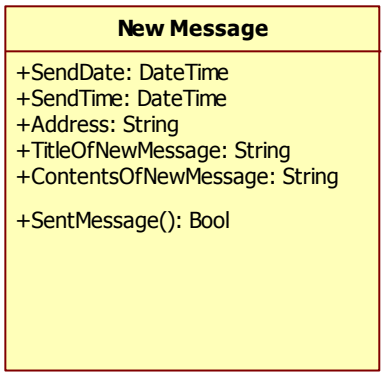


User can communicate with command center by using Yaver. User can see Inbox and Sentbox with ShowInbox and ShowSentbox function. These functions return list of messages.

User can see contents of the message by the method called OpenMessage. In order not to face confliction ReachDate and ReachTime are chosen primary id. Similarly Delete Message is used to delete messages from internal DB. To create and send message user choose New Message and and an instance of New Message class should be created.



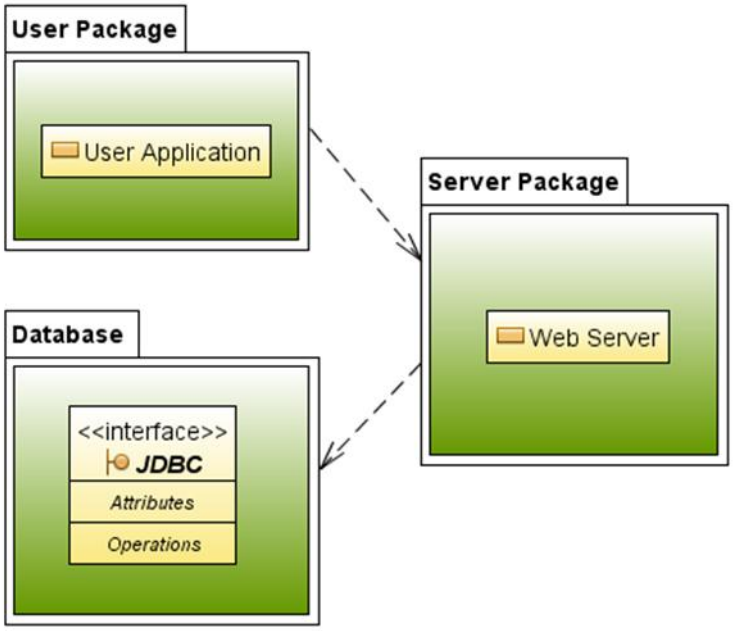
After creating New Message instance user set related entity and system call SentMessage method. Its return value represents whether sending message is successfully or not.



5. System Architecture

5.1 Architectural Design

Yaver consists of three main components namely User Package, Server Package and database. The application connects to server and server connects to database via JDBC interface. Below is the deployment diagram:



Deployment Diagram

Yaver consists of two main packages namely Server Package and User Package. Server package is responsible for responding to user requests. User package is responsible for handling user actions.

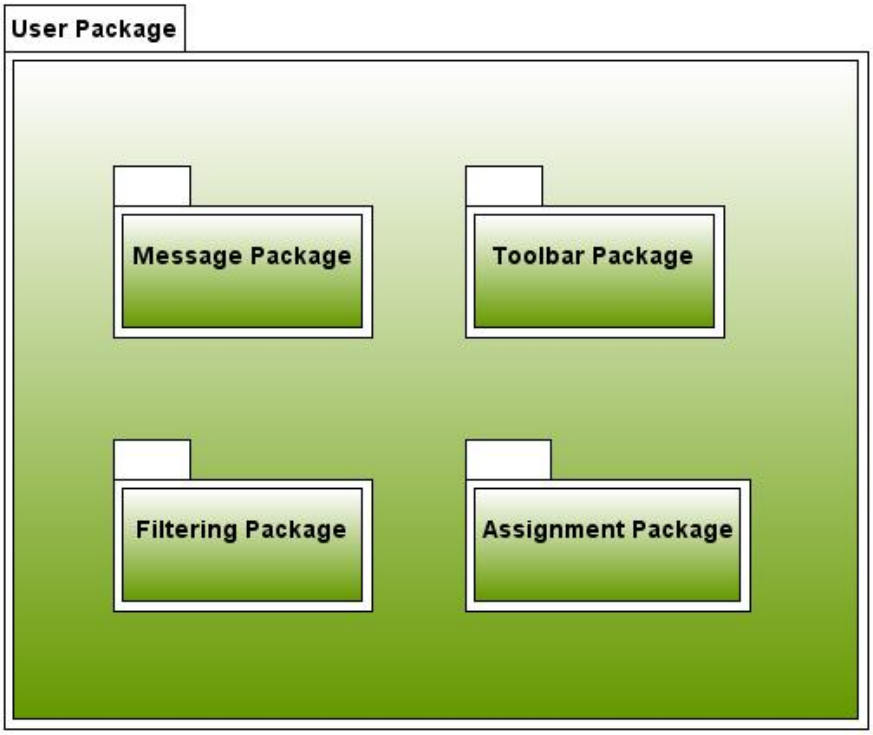
User Package has four sub-packages:

- Message Package
- Toolbar Package
- Filtering Package
- Assignment Package

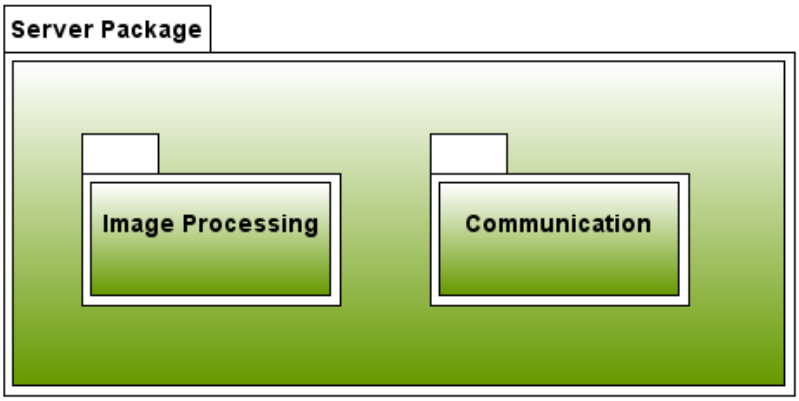
Server Package has two sub-packages:

- Image Processing Package
- Communication Package

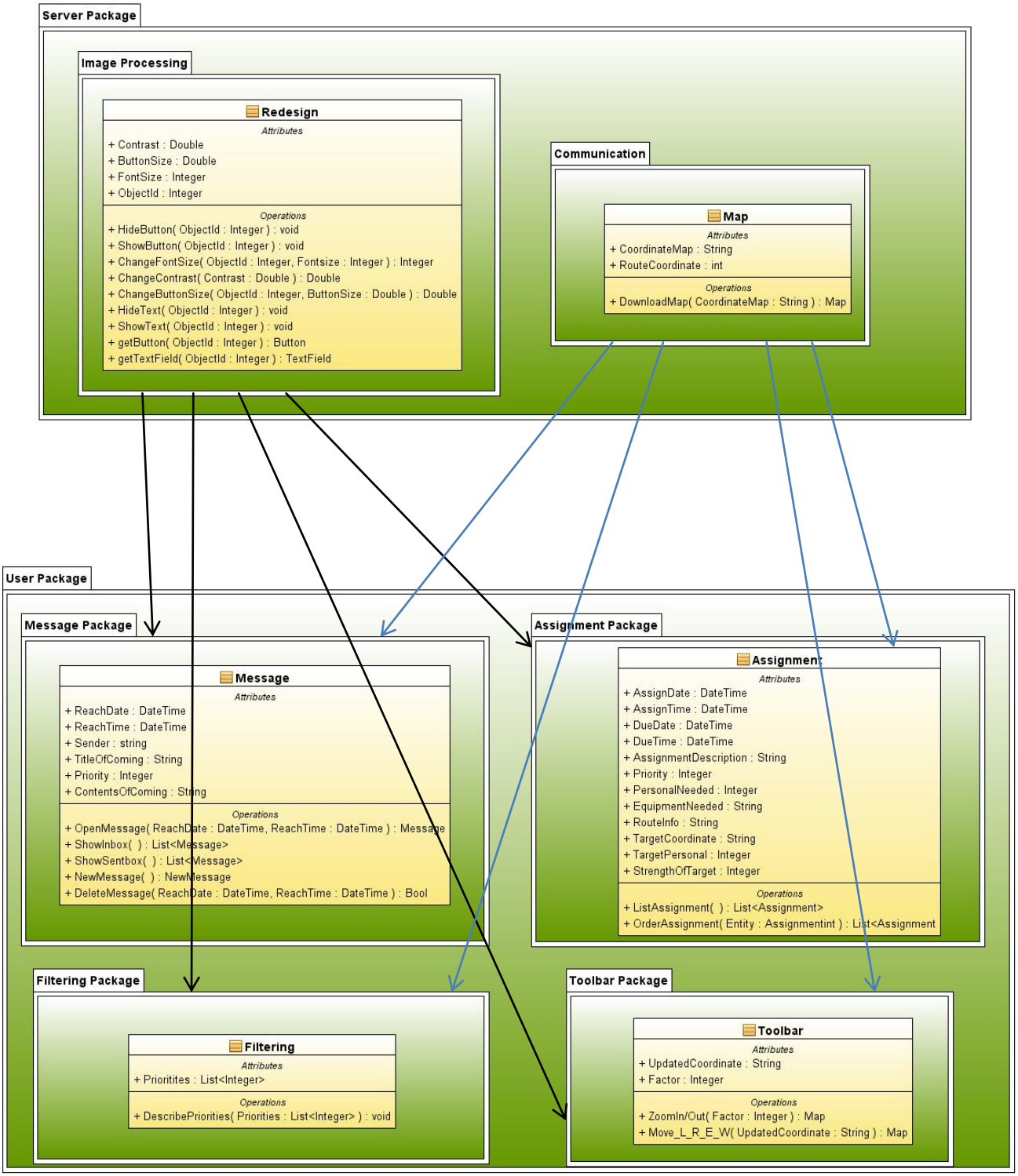
Sub-package diagrams and also top view package diagram are given below:



User Package and Its Subpackages

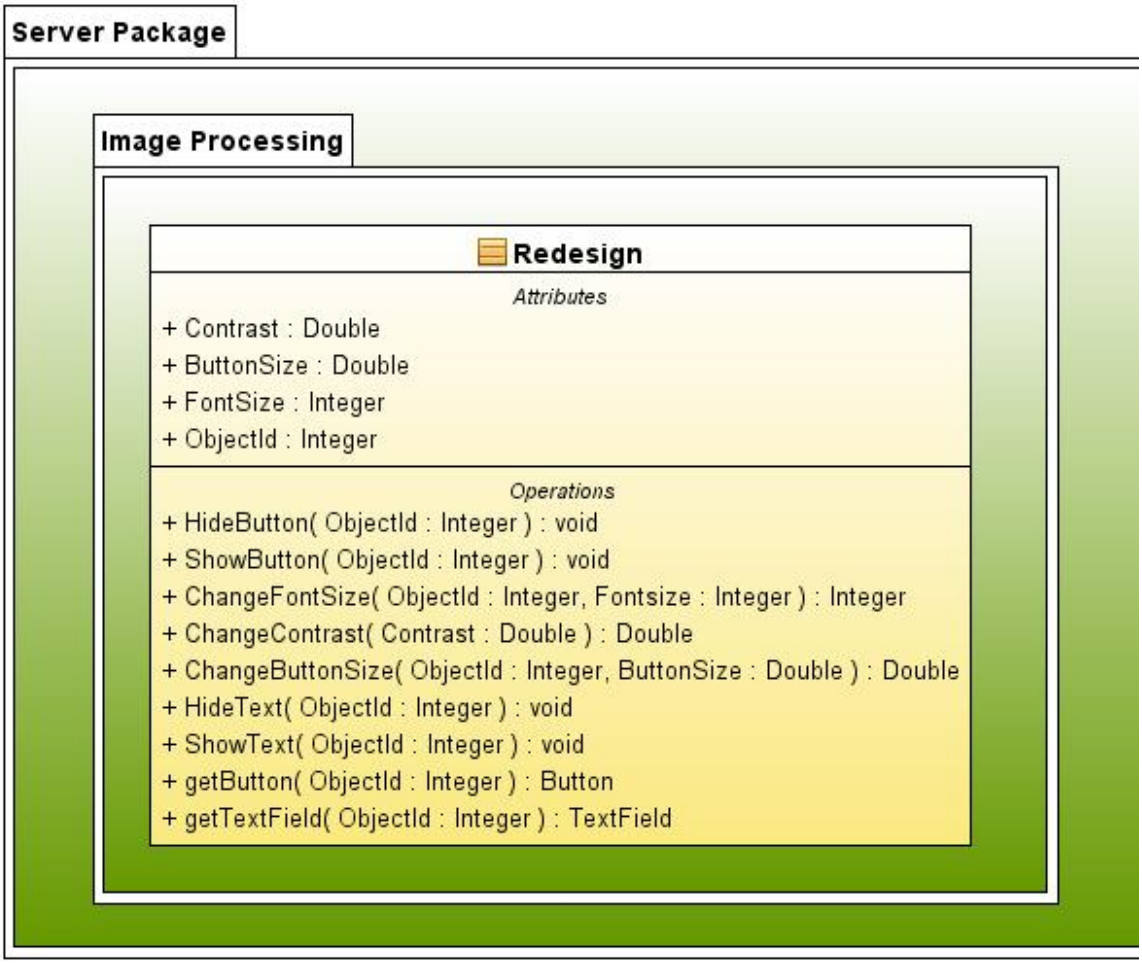


Server Package and Its subpackages

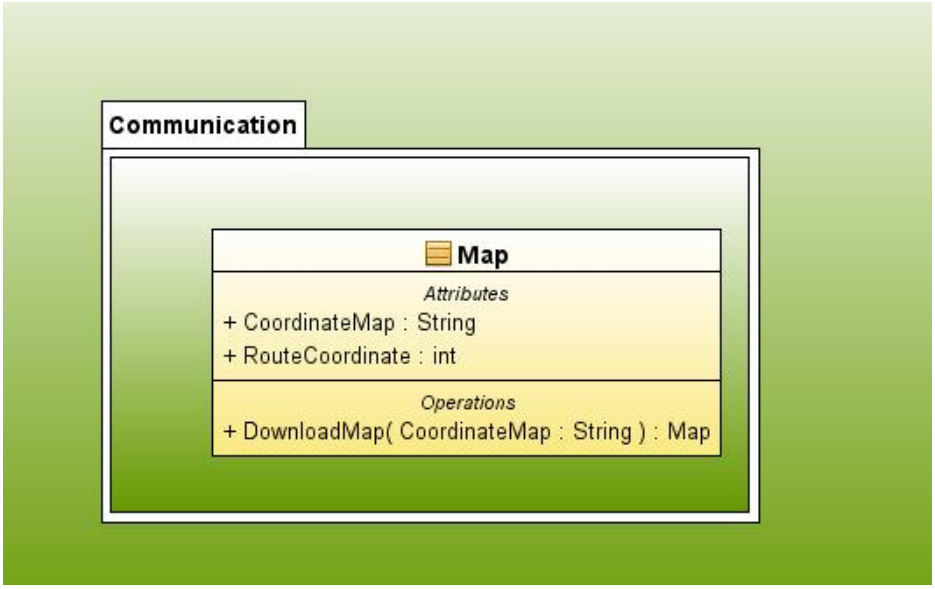


Packages and Classes Top View

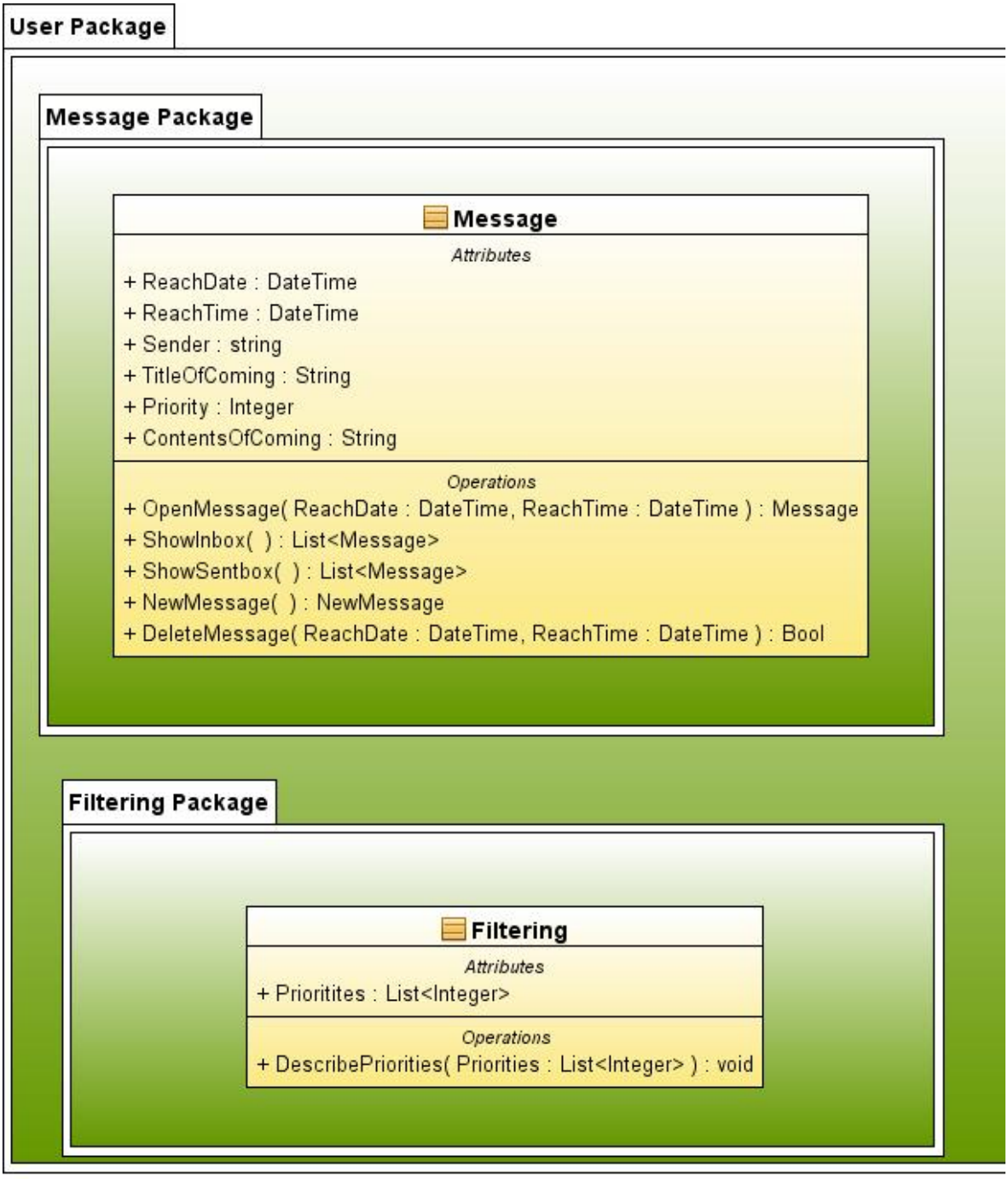
5.2 Description of Components



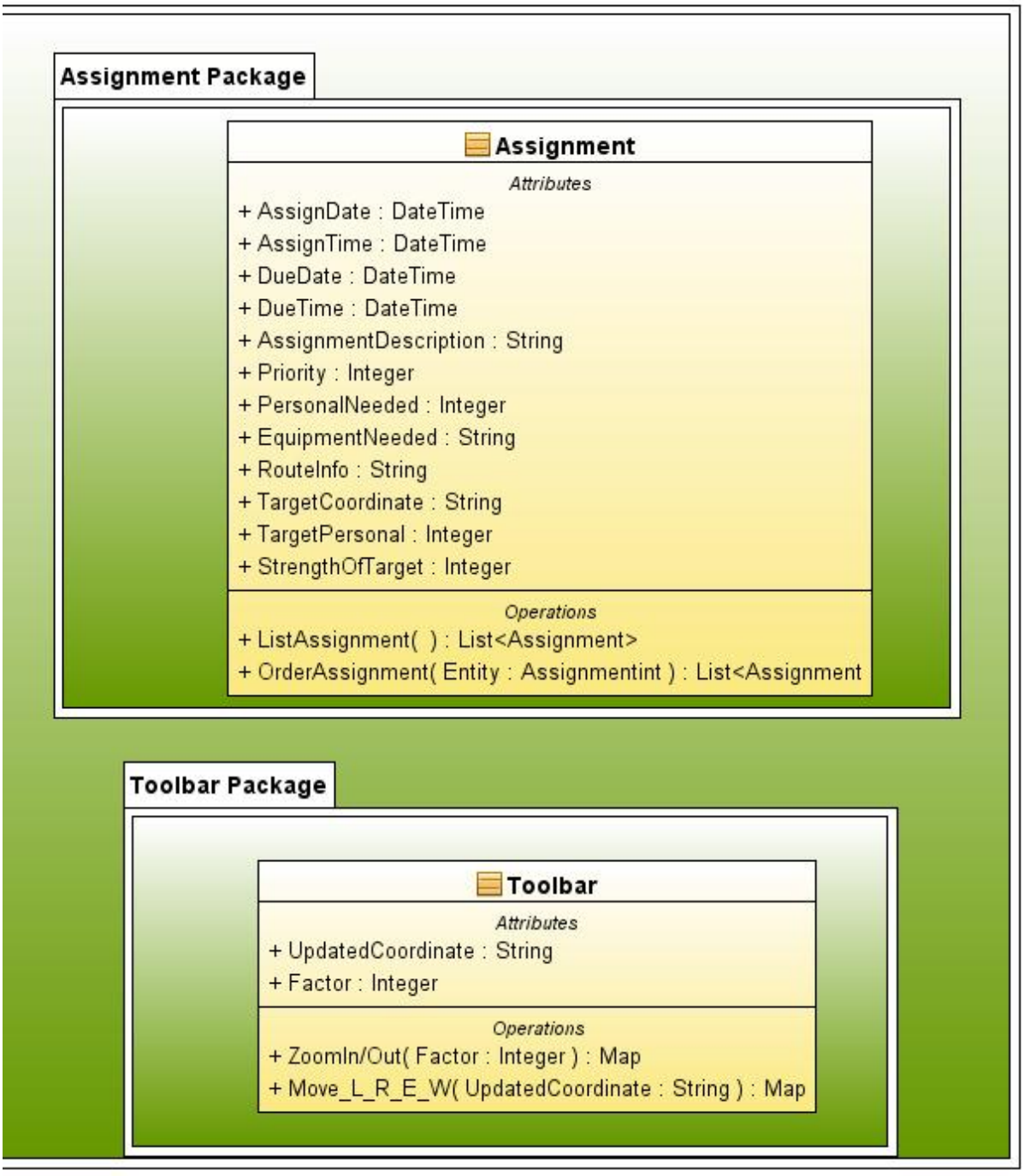
Server Package and Its Classes Part I



Server Package and Its Classes Part 2



User Package and Its Classes Part I



User Package and Its Classes Part 2

- **Server Package**
  - **Redesign Class:**

    This class is responsible for updating the graphical user interface according to the data collected from camera sensors. It is the class where context-aware function of the application is provided.
  - **Map Class:**

    This class is responsible for updating and refreshing the map in the graphical user interface according to the given coordinates.

- **User Package**
  - **Message Class:**

    This class is for sending and getting messages, and manipulation the mail boxes.
  - **Toolbar Class:**

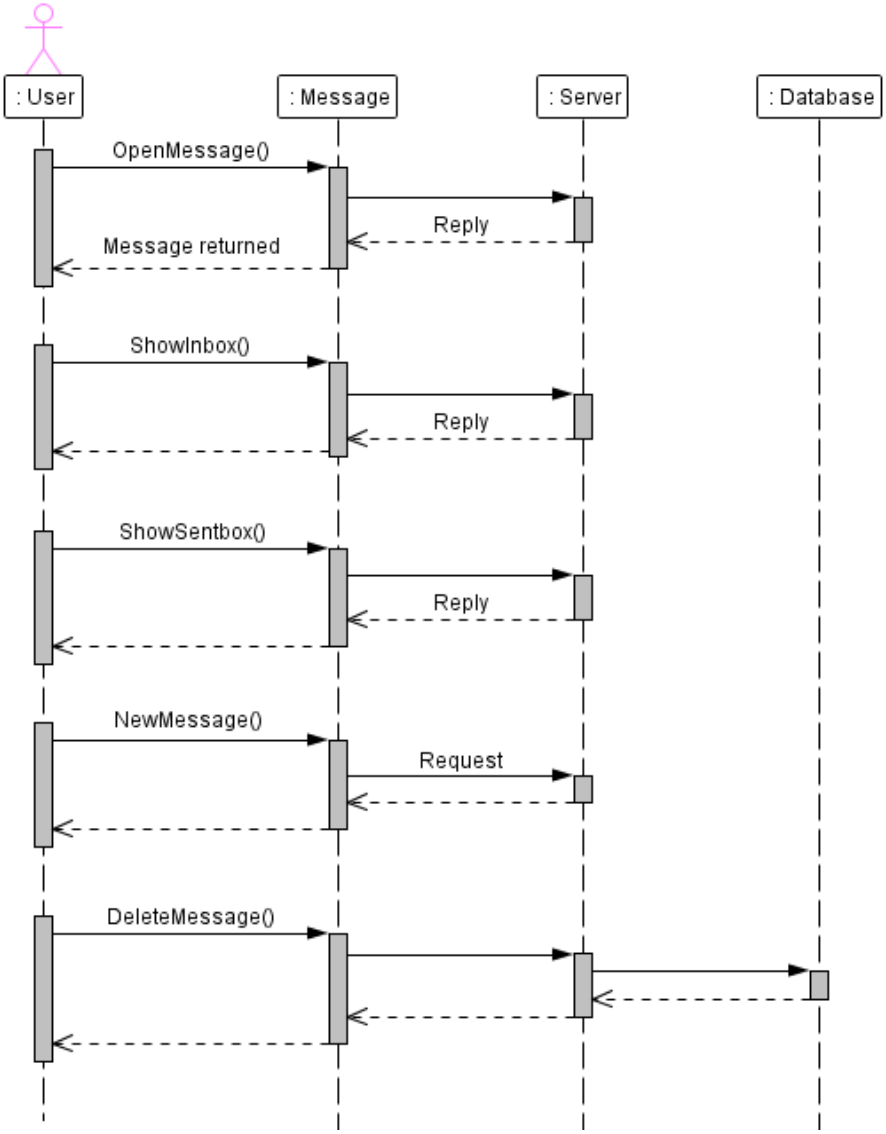
    This class is for enabling the user to manipulate the map window by zooming in and out, moving left, right, up and down.
  - **Assignment Class:**

    This is the class whose responsibility is to provide ordering and listing assignments.
  - **Filtering Class:**

    Filtering class defines which entities will be shown in the application according to application modes.

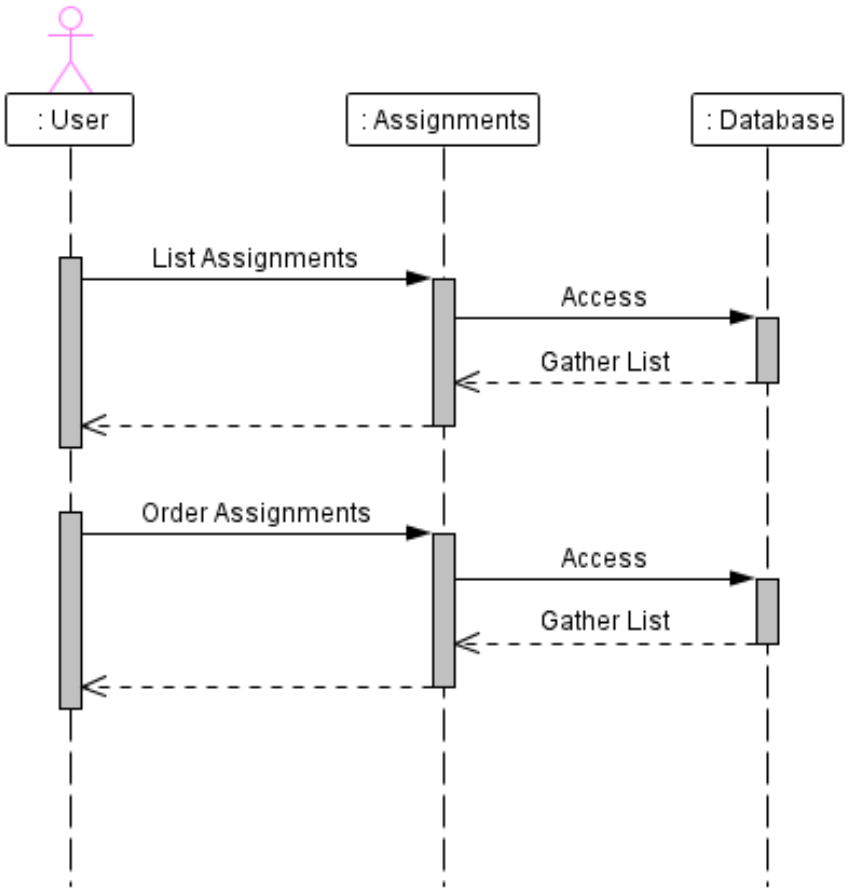
Sequence Diagrams:

- **Message Component**



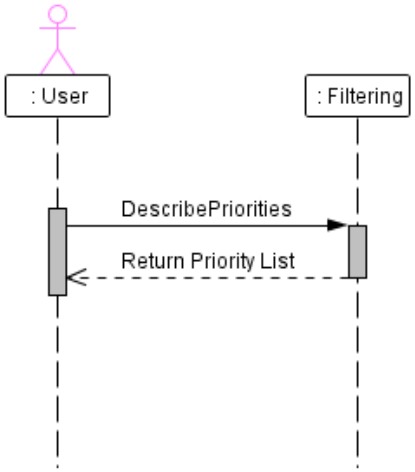
Message Sequence Diagram

- **Assignment Component**

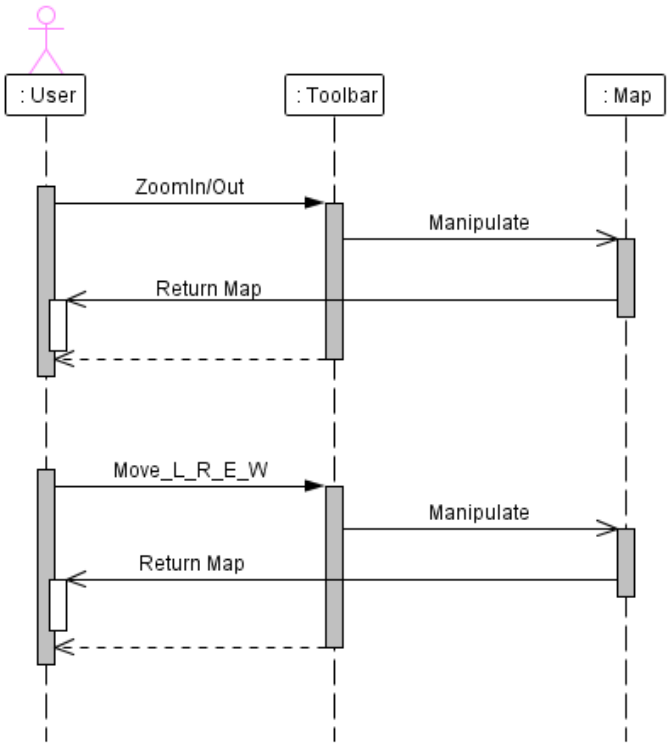


Assignment Sequence Diagram

- **Filtering Component**



- **Toolbar Component**



Toolbar Sequence Diagram

6. User Interface Design

6.1. Overview of User Interface

6.1.1. Main Window

This screenshot shows the main window of our system "Yaver". This window mainly consists of map screen and toolbar screen. The physical map of environment which user stands is shown in the upper part of window. At the bottom of this screen, there is a toolbar which has features to manage the map screen and the main window. Toolbar has some buttons to manage the window and map screen. These are zoom-in/out tool, move-left/right/up/down tool, open messages button, list the assignments button, go to the specified coordinate button, and filtering button. Furthermore, if the user opens a new window such as messages or

assignments window, the map screen becomes smaller and new window is located right of the main window.

6.1.2. Toolbar Screen

This screen is displayed at the bottom of the map area in the main window. As it was mentioned, there are several buttons and tools in this screen. Zoom tool and move tool are used for traveling on the map. There is a slider for zoom operations and there are four arrows for moving operations. These tools are on the left of toolbar. There are two text boxes to write X and Y coordinates and one button namely go to. User can go to desired coordinates by pressing this button after describing the coordinates. Messages button opens a window which has properties to read or send messages. After being pressed this button, user sees a new window on the right. Assignments button opens a window which displays assignments like messages button. This screen is also located on the right. Filtering button also opens a new window. This filtering screen is for setting the filters.

6.1.3. Map Screen

The physical map of environment which user stands is shown in this screen. Required information to represent the map is downloaded via the internet connection. This download operation is conducted by the system as independent from user. Specific coordinates that user wants to see can be seen by helping marker. User determines these by writing coordinates into text box in the toolbar. Moreover, routes and some objects (buildings, units etc.) whose coordinates sent by command centre can be displayed on the map. User travels on the map by dragging mouse. Traveling operation is also done by using the tools in the toolbar. This screen becomes smaller when the user opens a new window such as assignments and messages window. Furthermore, if the user wants to learn more about objects on the map, s/he can click on the object and see a small information window which displays properties of clicked object.

6.1.4. Messages Screen

This screen is a simple program resembling Thunderbird which user can read messages sent by command and send messages. There are several tools in this window which are inbox, sentbox, new message and delete message tools. User sees messages sent by command centre by using inbox tool with title and name of the sender. Unread messages titles are shown as bold. After the user clicks the inbox tool, the messages which are sent by

command centre can be seen on the bottom right of this screen. To read messages user should click the title of message which s/he wants to see. Moreover, user sees messages sent by him/her to the command centre by using sentbox tool. This tool displays the sent messages with titles on the bottom right of screen. User clicks on the title of message and see the content of message. Also new message tool opens a new window to write a new message. New window has also some features which are one send message button, one text plain and two text boxes. Text boxes are for mail address and title. After message is written into text plain, this button is pressed and the message is sent. There are also some features in this window such as font size and font style. User can change text properties by using these tools. If user wants to delete a message, s/he selects message that is wanted to be deleted by clicking the message title, and then press the delete button.

6.1.5. Assignments Screen

Assignments which are assigned by command centre via internet connection are shown in this window as a table. Uninvestigated assignments are shown as bold. Table has some features about the assignment. These are assign date, due date, description, priority, personal need, equipment need, route, target coordinate, target personal and strength of target. Also, each assignment has a name and these features are represented next to the name as a table. User can arrange assignments in order with respect to some features which are due date, priority, target coordinate and strength of target. User click on the feature name and table contents are arranged according to this entity.

6.1.6. Filtering Screen

In this window, user defines filters for all other windows buttons and entities. There are three tabs for each window in this system. Each tab has all buttons or entities in the specified window. Firstly, toolbar tab has only buttons of toolbar window, since entities are not important as buttons are, and three check boxes next to name of the button. These check boxes are the same in all three tabs and they are stationary, walking and running. These indicate the status of user. If user ticks one of them or more, this means that user sees this button during only these statuses. For instance; user ticks stationary box of “filtering” button in the toolbar, then user sees this button only in stationary mode, while running or walking s/he doesn’t see this button. Secondly, tab for message screen has all buttons and entities in this window with check boxes. Thirdly, Assignments tab has only entities in this window with

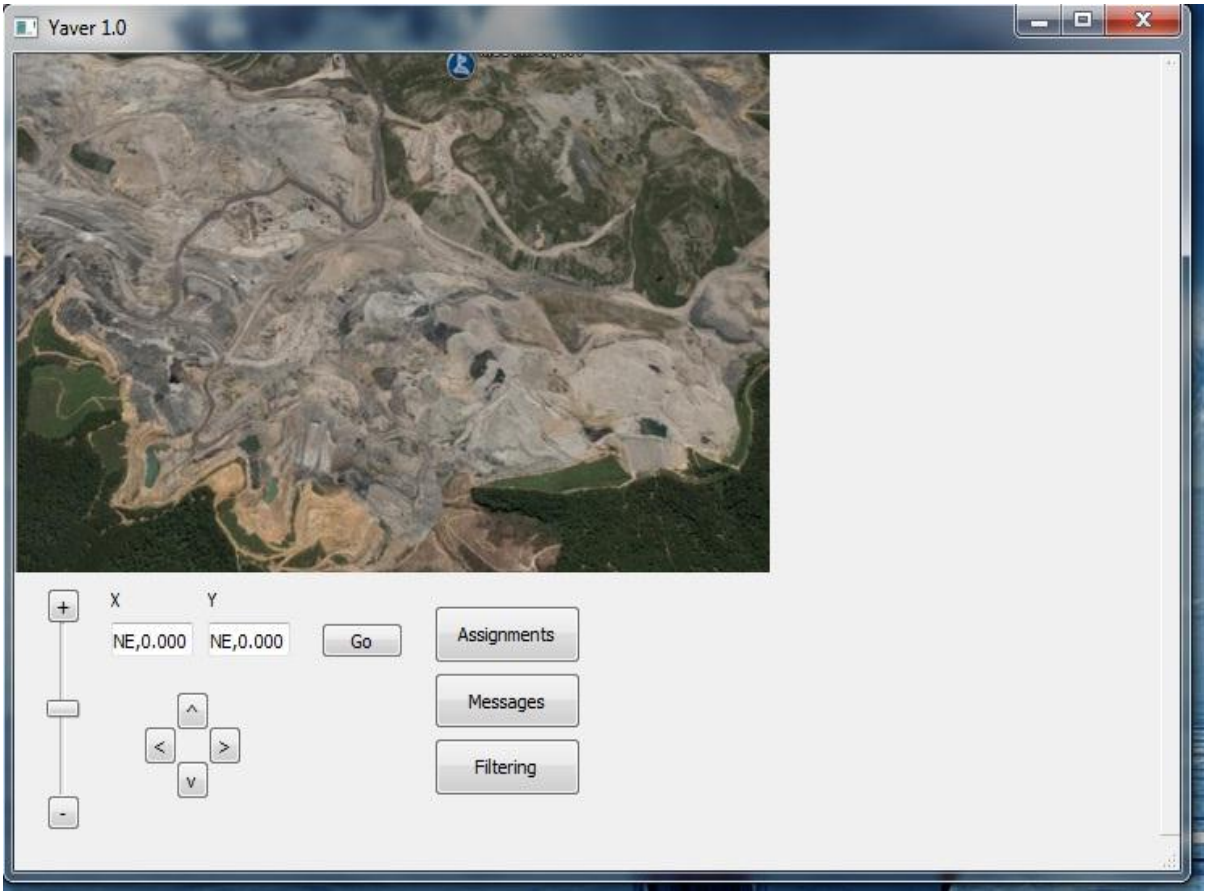
check boxes, since there is no button there. Moreover, end of the entities or buttons list there is a check box to set filters as a default. After user selects the status of entities or buttons, s/he should press the Set Filter button.

6.1.7. Information Window

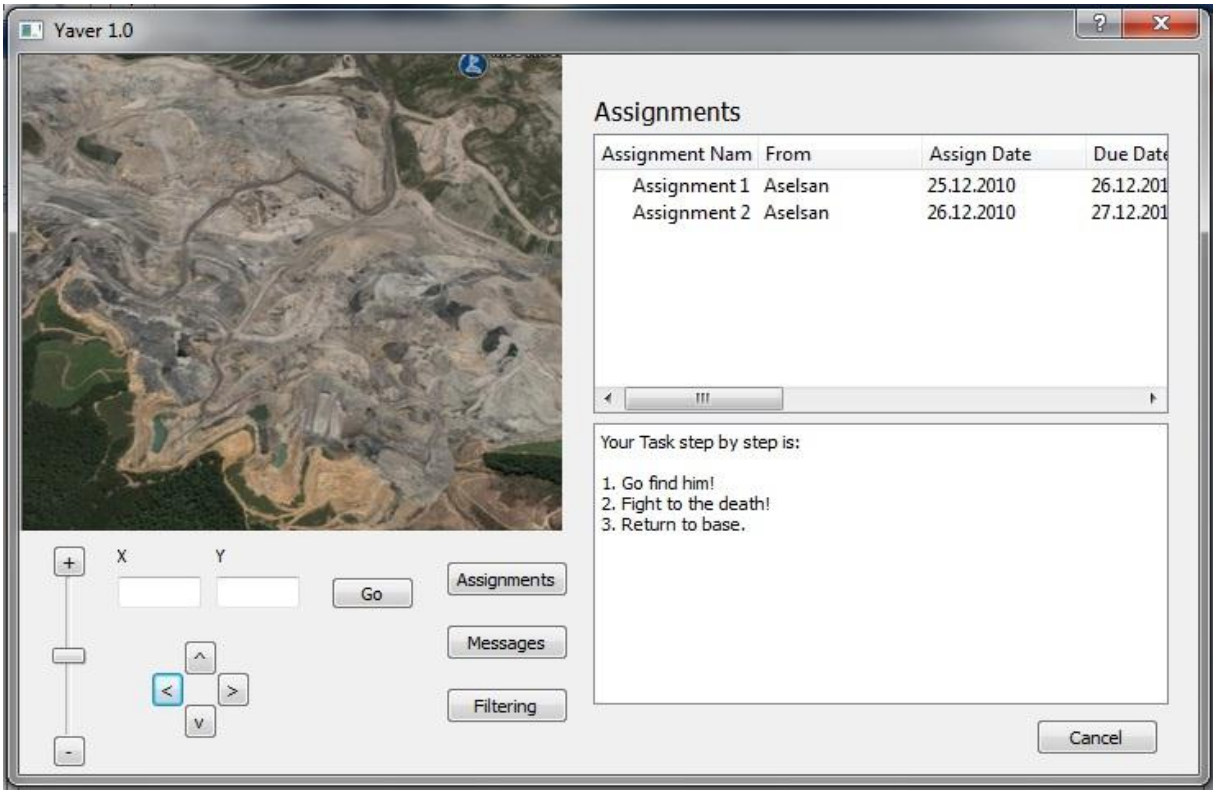
This window is popped up when the user clicks an object on the map. This screen shows information about clicked object. When the user clicks an object on the map screen this screen is displayed. Information window shows some properties of object. These properties can be length of road or characteristics of a building. This screen shows these properties as a text.

6.2. Screen Images

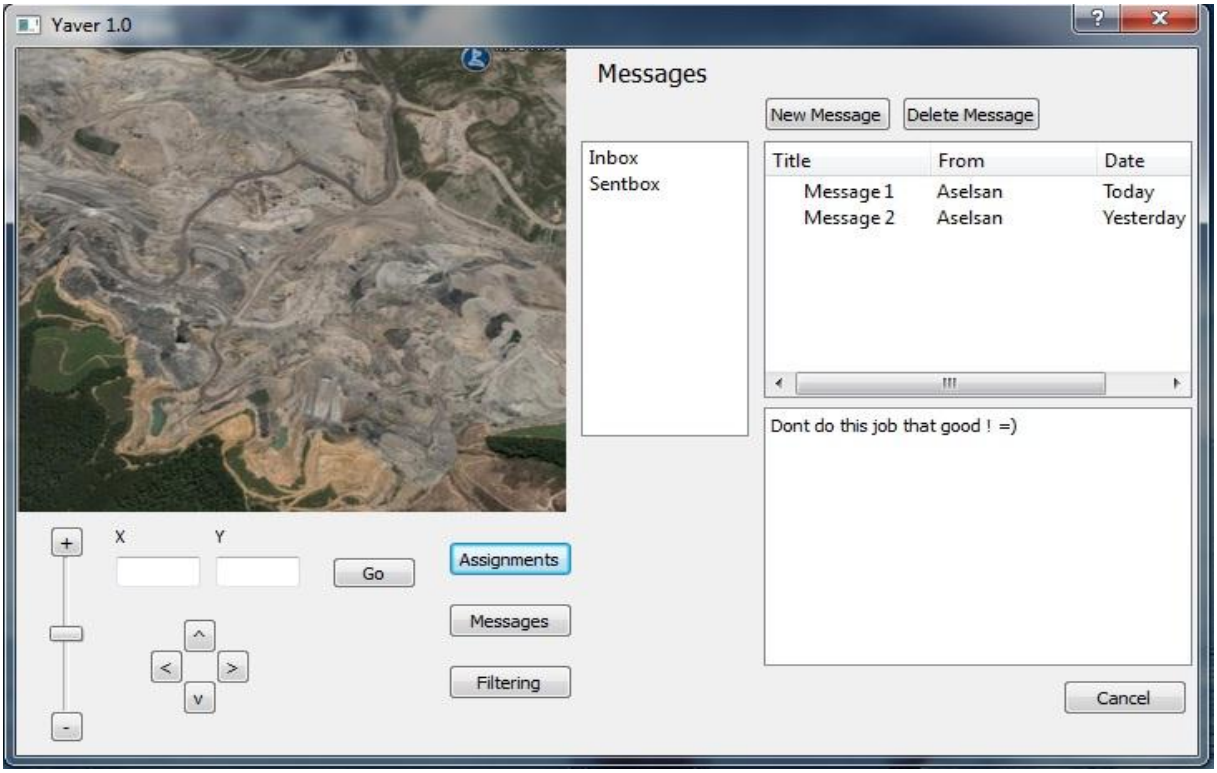
6.2.1. Main Window (Toolbar Screen and Map Screen)



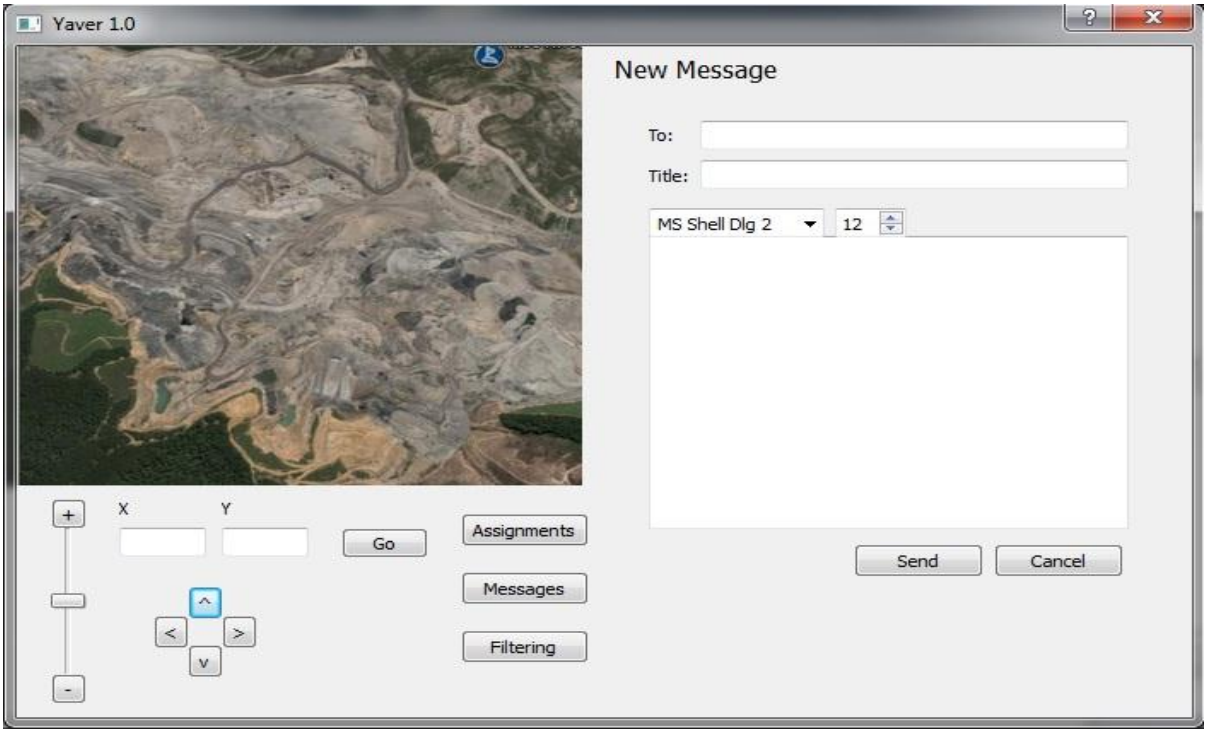
6.2.2. Assignments Screen



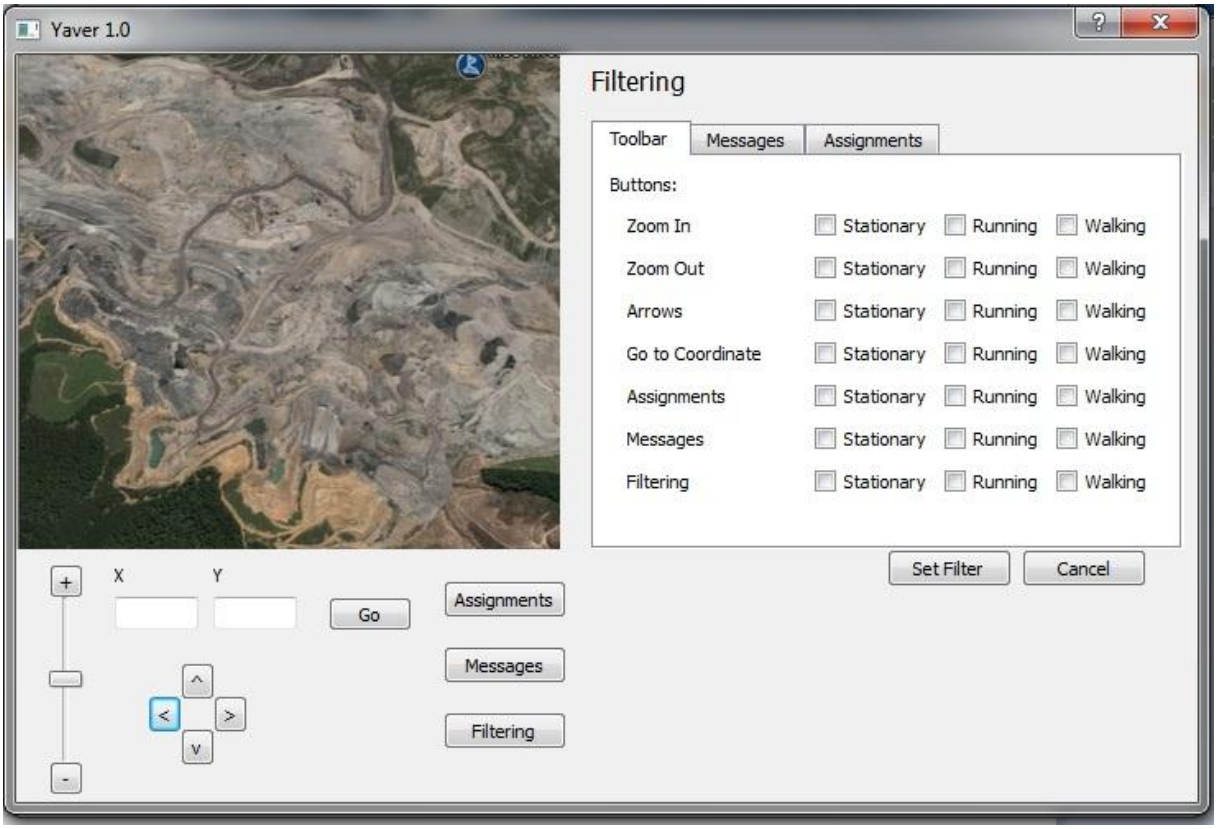
6.2.3. Messages Screen



6.2.5. New Message Screen



6.2.6. Filtering Screen



6.3. Screen Objects and Actions

6.3.1. Map Object

Map object is kept on the database and shown on the map screen. Map screen is in the main window. This object is kept with center coordinate value and on the screen environment of this coordinate value is displayed. Zoom factor determines the size of environment. This zoom factor changes when the user zooms in or zooms out. Moreover, when the user travels on the map, the center coordinate value changes. Physical environment on the map also changes with respect to this value.

6.3.2. Message Object

Each message is an object which was explained in the data design section. In the user interface, contents of message can be seen by clicking on message title in the messages window. Furthermore, user can delete a message object by pressing delete button after select a message.

6.3.3. Assignment Object

Each assignment is an object which was explained in the data design section. In the user interface, assignments can be seen by clicking on assignment title in the assignments window. Furthermore, user can arrange assignments by pressing an entity of assignment. These assignments are kept in a list and display order of these is determined by an entity.

7. Libraries and Tools

7.1 Java Swing

Swing is the primary Java GUI widget toolkit. It is part of Sun Microsystems' Java Foundation Classes an API for providing a graphical user interface (GUI) for Java programs. We chose this toolkit because we are kind of familiar with it, it is easy to use, it is applicable in many platforms (platform-independent) and it has good GUI options.

7.2 Java Advanced Imaging API

The Java Advanced Imaging API extends the Java 2 platform by allowing sophisticated, high-performance image processing to be incorporated into Java applets and applications. It is a set of classes providing imaging functionality beyond that of Java 2D and the Java Foundation classes, though it is designed for compatibility with those APIs. We

chose it because we want to be consistent and using Java again will not cause any time loss probably.

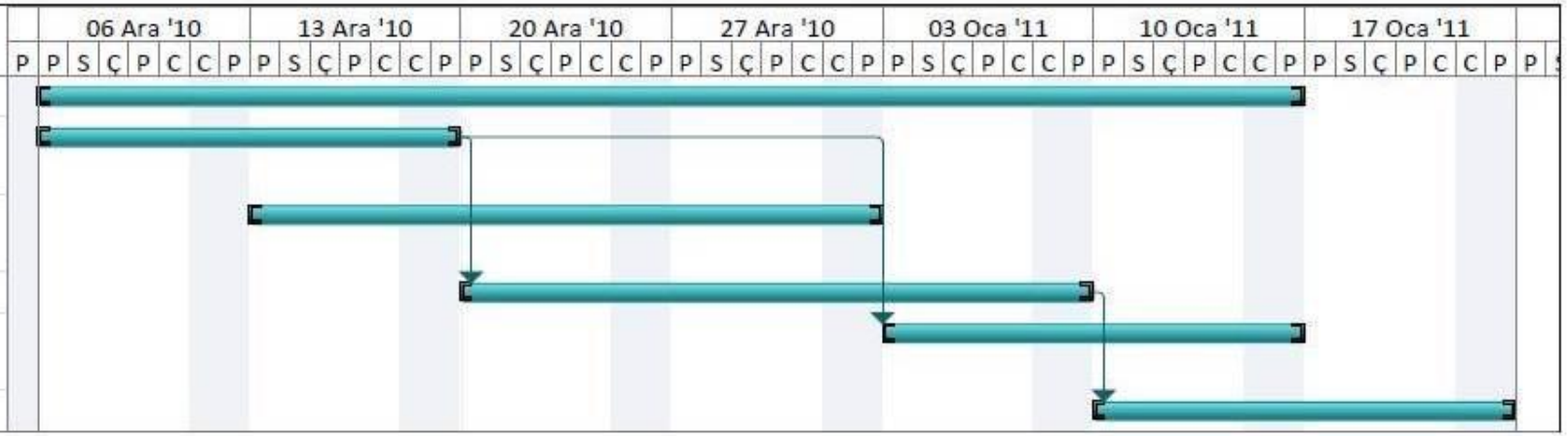
7.3 Netbeans

Netbeans is a free, open-source Integrated Development Environment for software developers. We chose it because we are experienced about using Netbeans and implementing Java applications with it.

8. Time Planning (Gannt Chart)

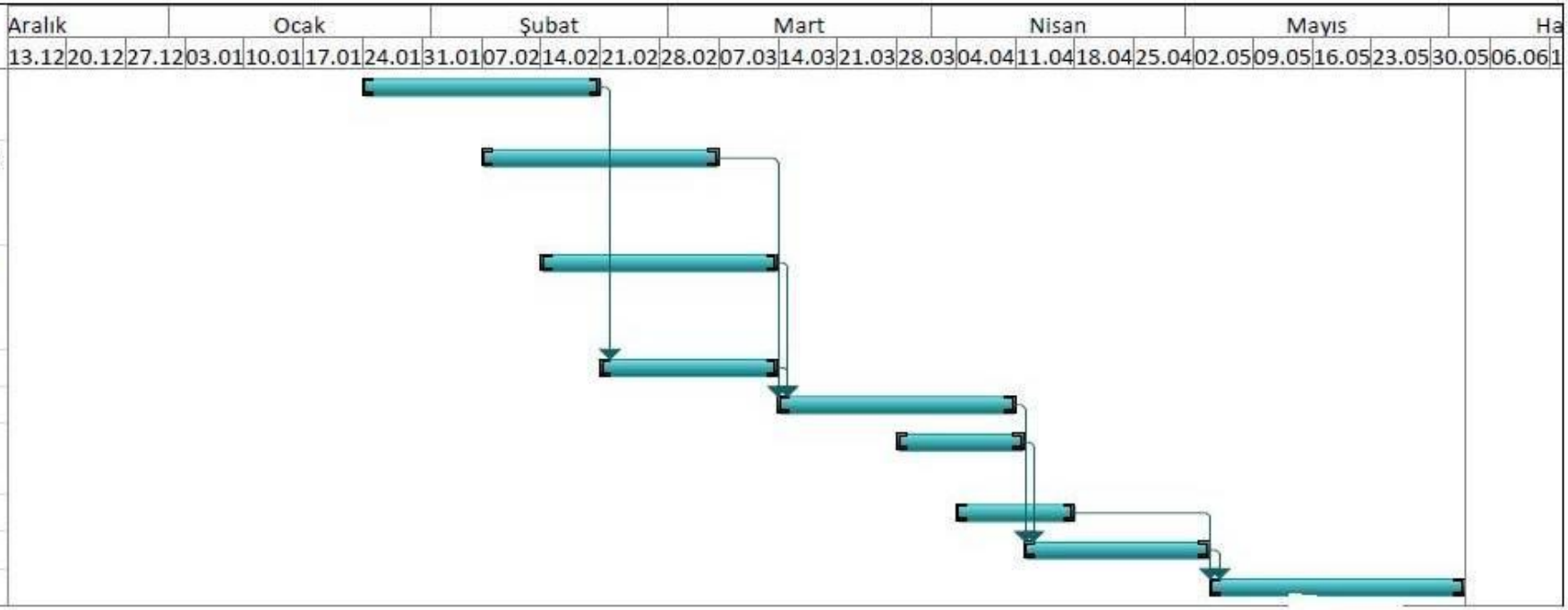
8.1. Term 1 Gannt Chart

Kimlik	Görev Adı	Süre
1	Learn Java Swing	31 gün
2	Prepare Initial Design Report	11 gün
3	Get Ready for Team Presentation	16 gün
4	Design Look of GUI	16 gün
5	Prepare Detailed Design Report	11 gün
6	Prototype Demo	11 gün



8.2. Term 2 Gannt Chart

Kimlik	Görev Adı
1	Implementing GUI Functions
2	Simulate mission,message and map handling
3	Make GUI changeable by using a menu for developers
4	Image Handling
5	Camera Handling
6	Solve Performance Issues
7	Test Application
8	Software Demo
9	Final Presentation



9. Conclusion

This document states the design level approach taken by “Korsan Yazılım” team for the “Context Aware User Interface Project” project. In this document, we make some new statements about design and we got into technical details of project. Our goals are clarified and our work path is started to be drawn. We explained user interface visually. Further information on the technical design is given with detailed explanations of the modules which are supported with class and sequence diagrams. Finally, the progress made by the project team is summarized. We managed to decide many design issues; however we avoid deciding issues which can become very complex, leave that issues to Detailed Design Report. We will start thinking immediately about these deep issues try to clarify what we will do in this and next semester in order to guarantee our success. We will obey our plans as much as possible, although some situations may arise in the process of implementing the project.