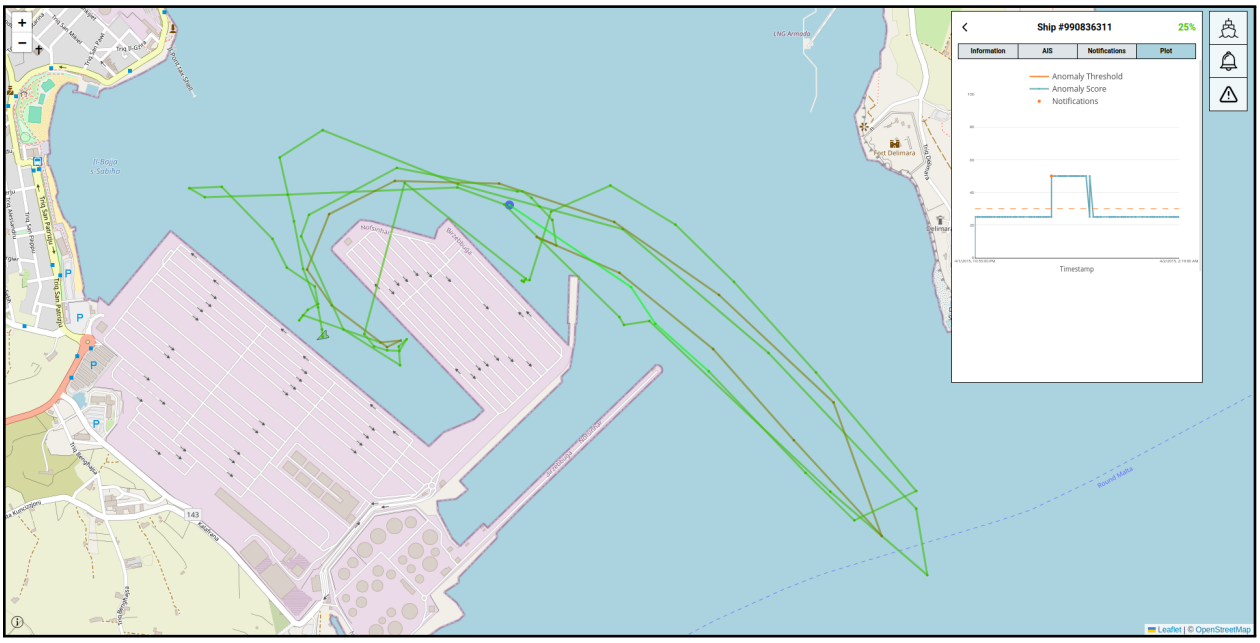
User Manual

Track Anomaly Detection



User Manual submitted as the final delivarable for course:

Software Project (CSE2000)

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Chapter 1

Overview

This manual aims to explain how the users should use the website part Track Anomaly Detection application.

The anomaly score given by the application should only be taken as the recommendation which ships to look at. Final choice should be made by also evaluating the situation manually.

1.1 Terminology

- **Track** - the ship's path from the departure port to the destination.
- **AIS** - Automatic Identification System
- **AIS signal** - the signal that ships must frequently send. Such a signal contains information about the vessel: its position, rotation, destination, etc.
- **Anomaly score** - the score between 0% and 100% given by the application to a certain track. It tries to represent how suspiciously the ship is behaving in its track. However, note that it should not be taken as some "ground truth", and should only be taken as the suggestion what ships to look at, but further evaluation should be done manually.

1.2 General View of the Website

When the website is opened the view looks as in the Figure 1.1. The components that are visible are marked in the Figure 1.2.

The components that you see are:

- **Map**. The main component of the website. It displays the current ship positions, orientation, and the anomaly score (denoted by colour).
- **Information button**. The button for getting more information about what is displayed currently on the screen.
- **Sidebar**. The component containing functionality for displaying ships and notifications, as well as software errors occurred.

More information on how to use all the components is presented below.

Figure 1.1: *The view of the website when started.*

Figure 1.2: *The view of the website when started with the main visible components marked.*

Chapter 2

Using the Map

Map allows the following functionality:

- **Zooming**. Zooming can be done using the mousewheel or the laptop touchpad. The map zooms based on the position of the mouse cursor. To avoid cluttering the map, some ships are grouped into the clusters.
- **Moving**. You can move in the map by clicking left mouse button and dragging the mouse (analogously, using the laptop touchpad).
- **Selecting the ship**. When the ship is clicked, the map zooms to the ship and ship's details are displayed near the sidebar. If the user does not zoom or move, the website keeps following the selected ship.
- **Clicking on the Cluster**. When the ship cluster is clicked, the map zooms to this cluster, and the view is refreshed.

Note that based on the options that developers set when launching the website, the map displays only the selected amount of most anomalous ships on the screen. To see more ships, the user needs to zoom closer to the region they want.

Chapter 3

Displayed Ships

3.1 Individual Ship Markers


8cm

Figure 3.1: *The ship marker for a stationary ship.*

8cm

Figure 3.2: *The ship marker for a moving ship.*

Figure 3.3: *Ship markers indicate the speed: dot is for stationary ship, and arrow is for moving ship.*

The ship markers represent the locations of ships based on the last sent AIS signal. If the ship's current speed is zero, the ship is displayed as a dot (Figure 3.1). Otherwise the ship is displayed as an arrow (Figure 3.2). Arrow is pointing according to the ship's current heading. If the heading informatino was not given, then the arrow is pointing according to the ship's course. The colour of the ship marker represents the

anomaly score calculated for that ship. The colour is linearly interpolated from green (anomaly score 0%) to red (anomaly score 100%).

3.2 Ship Clusters

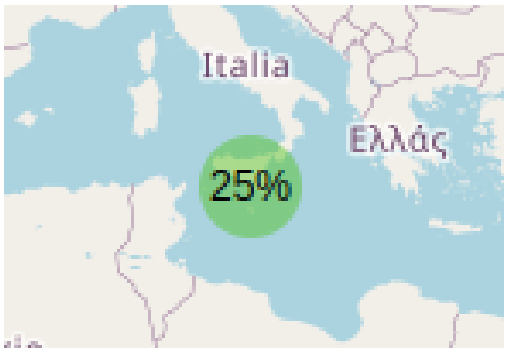
8cm 

Figure 3.4: *The ship cluster which contains ships. The number 25% means that the maximum anomaly score of the ships in the cluster is 25%.*

8cm 

Figure 3.5: *The view zoomed into the area of cluster visible in 3.4. The three ships visible here were grouped into the cluster.*

Figure 3.6: *Ship markers indicate the speed: dot is for stationary ship, and arrow is for moving ship.*

To avoid clutter on the map, ships are grouped into the clusters. An example for that can be seen in Figure 3.6. **The number** on the cluster shows the maximum of the calculated anomaly scores for the ships inside the cluster. **The colour** of the cluster represents the same maximum anomaly score among the ships in the cluster. The colour value is calculated similarly to the ship colours.

3.3 Ship Trajectories

When a ship is selected (either by clicking on it in the map, or in the ships or notifications list), its track trajectory is displayed (for an example see Figure 3.7). The points on the trajectory have the colour representing the anomaly score calculated for the moments when ship was on those points.

If the notifications list is opened (via the sidebar), and some notification is clicked, then the ship trajectory will highlight the point where the ship was at the moment of the notification.

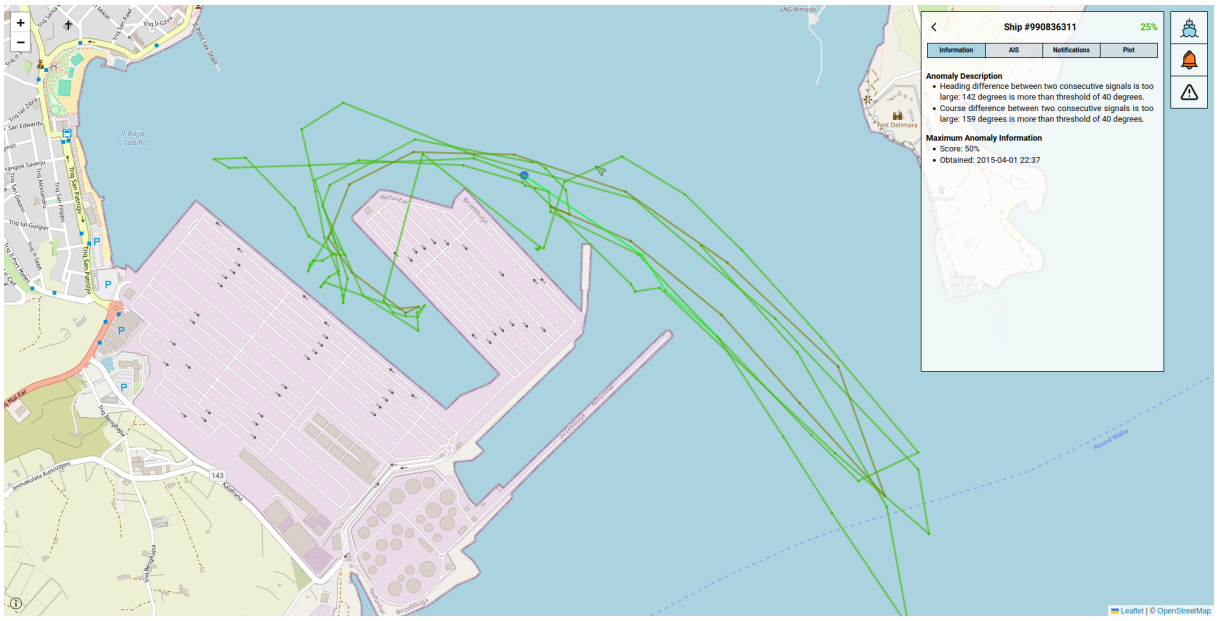


Figure 3.7: *The trajectory of the selected ship. Colour represents the anomaly at each point of the trajectory.*

Chapter 4

Using the Sidebar and Information window

Figure 4.1: *The sidebar. It contains buttons for opening anomaly list, notifications list, and software errors list.*

The sidebar (Figure 4.1) contains the following sections, all of which open the corresponding information window when clicked:

- Ships (Section 4.1)
- Notifications (Section 4.2)
- Software errors (Section 4.3)

4.1 Ships

When Ships section is selected from the sidebar, the ship list is seen (Figure 4.2). The shown ships are sorted based on their calculated anomaly score. Using the threshold slider you can select the threshold you want to use. Ships that have the anomaly value below the threshold will not be shown.

When a ship is clicked in the list, that ship is centered in the map, and its details are shown. In the details window you see the following sections:

- **Information** section (Figure 4.3) contains the description for the current anomaly score, and the information about the maximum anomaly score obtained throughout ship's journey.
- **AIS** section (Figure 4.4) contains details about the ship's last AIS signal data. It contains information, such as the time of the last signal, the departure port, the course and the heading, the latitude and the longitude, and the speed of the ship.

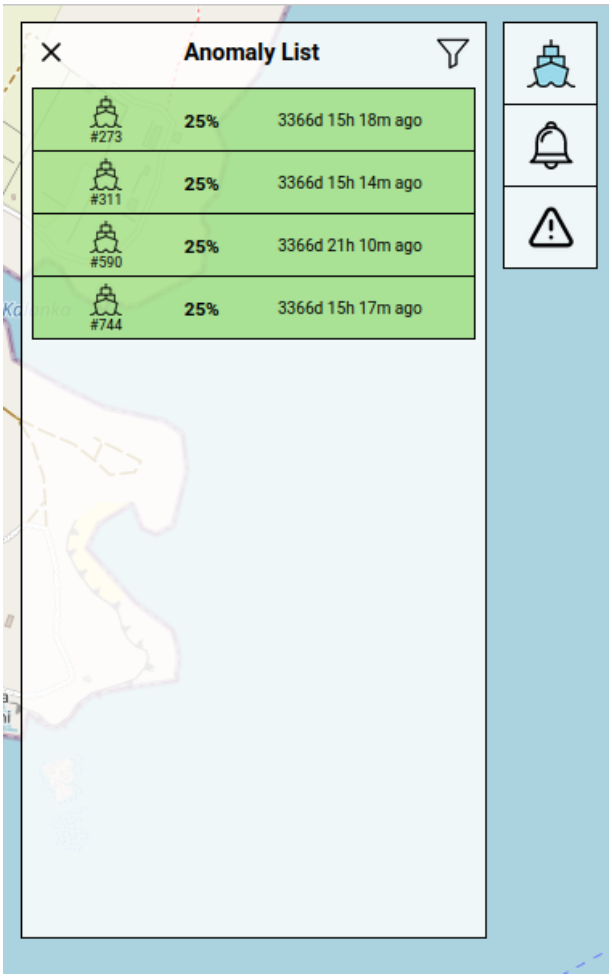


Figure 4.2: *Opened ship anomaly list. The ships are shown in decreasing order of calculated anomaly scores.*

- **Notifications** section (Figure 4.5) contains a list of notifications sent about the selected ship.
- **Plot** section (Figure 4.6) shows a plot of the current ship's anomaly score changes throughout the journey. Points where notifications were sent are also marked in this plot.

4.1.1 Note on ship anomaly score explanations

Once the anomaly score is calculated, the explanation is generated as well. It can be found in the Information section of the ship details (Figure 4.3). The explanations contain the relevant data why the score was given.

4.2 Notifications

When the bell icon is clicked, the notification list appears (Figure 4.8). When clicked on the notification, its corresponding ship is centered in the map.

Notifications are sent when the calculated anomaly score becomes bigger than 90%. Notifications can be marked as read when clicked on them, or the user can mark all notifications as read by clicking on the checkmark button.

4.3 Software Errors

Similarly to the notifications, when the warning icon is clicked, the software error list appears (Figure 4.9). These software error messages contain the information about the errors occurred in the software, such as lost connection to the web server.

These software error messages are of three severity levels: errors, warnings and information. If only a warning or information is got, it usually indicates that only some minor issue appeared, and the application can continue to function normally. However, if the error appears, it indicates that a serious software issue happened that impacts the application.

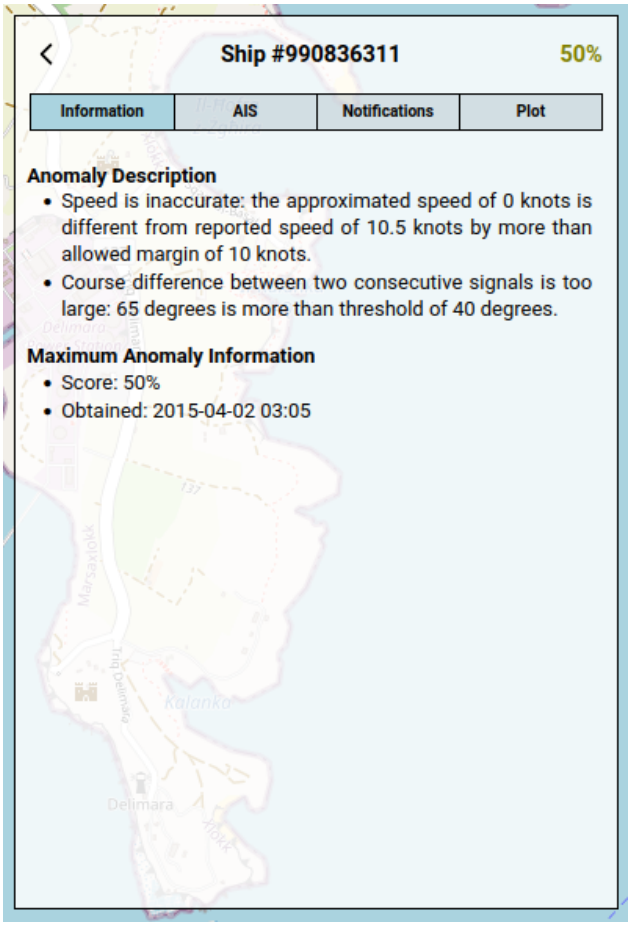
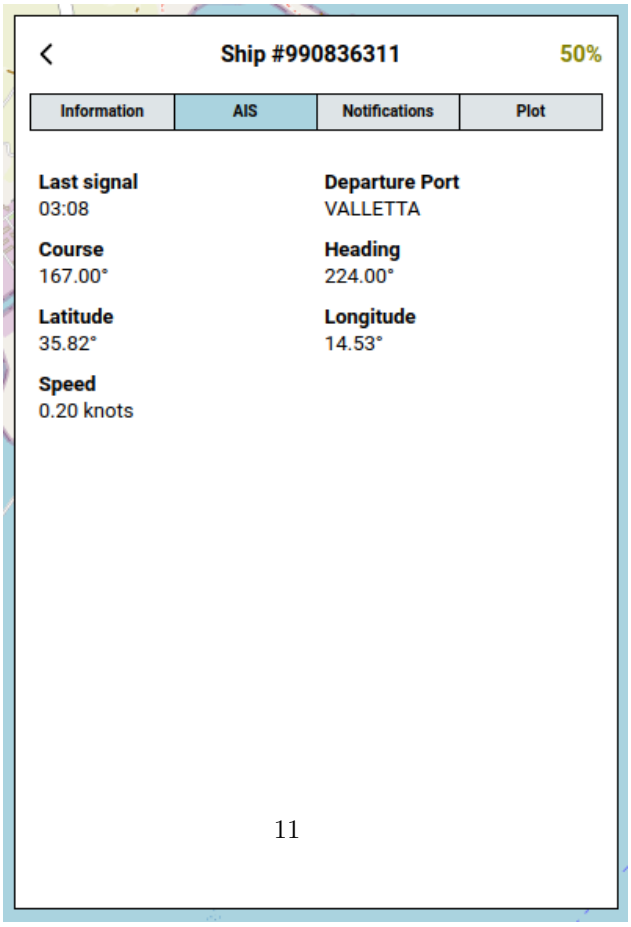
8cm 

Figure 4.3: *The anomaly description and maximum anomaly information section.*

8cm 

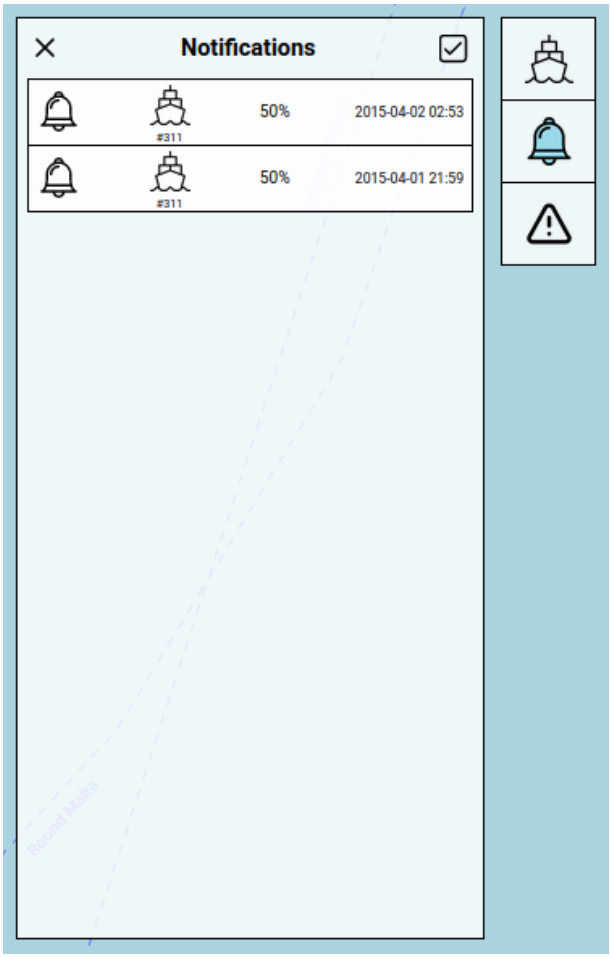


Figure 4.8: *The opened notifications list.*

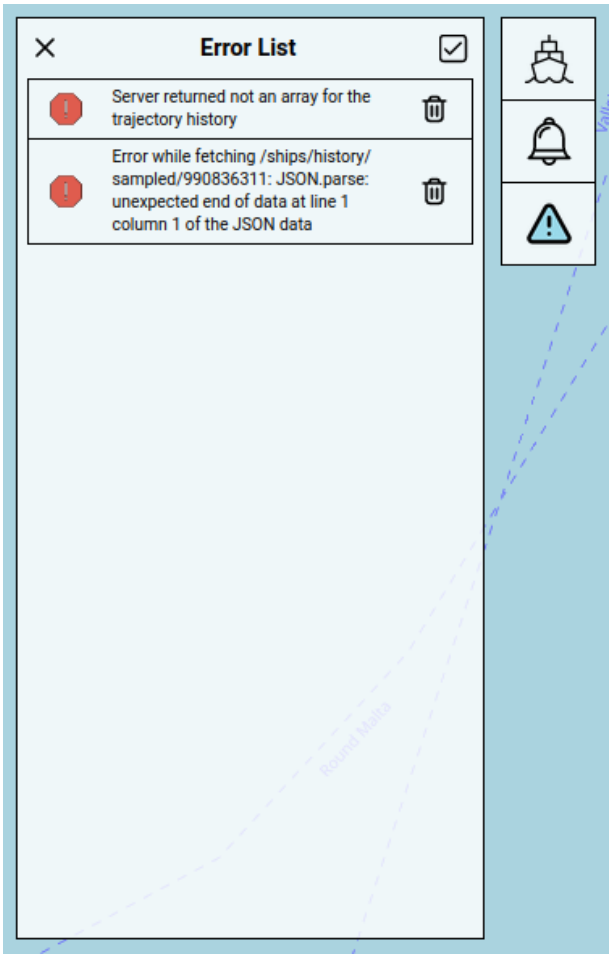


Figure 4.9: *The opened software errors list.*

Chapter 5

Using the Information Button

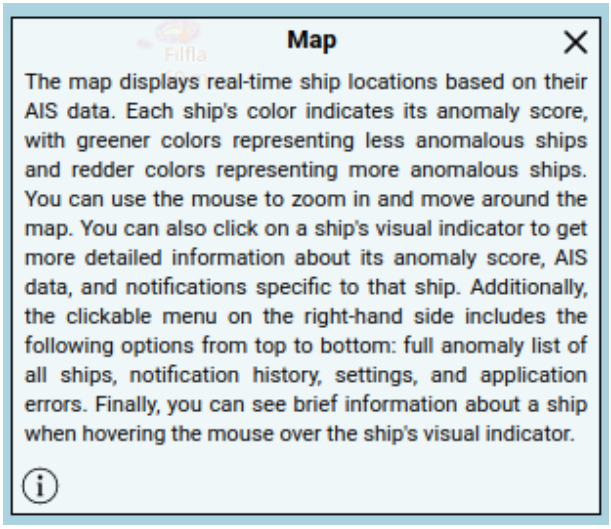


Figure 5.1: *The opened information container.*

On the left bottom corner of the screen, there is an information button. When you click it, it opens the information text (an example of this can be found in Figure 5.1). This information text gives information about the components that are seen on the screen.

The information text is adaptive. If the user selects a different sidebar item, the information text changes to give information about that item.