



Novel automated and stand-alone integrated pest management tool for remote count and bioacoustic identification of the Olive Fruit Fly (*Bactrocera oleae*) in the field

ENTOMATIC USER TUTORIAL

Part I – Web platform

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ENTOMATIC: OVERVIEW

The Entomatic web application gives users access to a variety of tools that are grouped in five different web pages: (i) administration, (ii) pest management, (iii) analysis, (iv) network performance and (v) configuration (Figure 1). Depending on the user type, a different set of functionalities is enabled. There are four different user types:

1. **Farmer:** has access to data from the sensors that are assigned to him/her;
2. **Administrator:** can assign sensors to users and perform user administration, when an administrator is assigned to an SME, he/she can view all data from sensors that are assigned to farmers within the SME;
3. **Supervisor:** can view the same data as an administrator but has no rights to edit data;
4. **Super user:** can view all data on the server and has the right to change the behaviour and appearance of the web app through the configuration page.

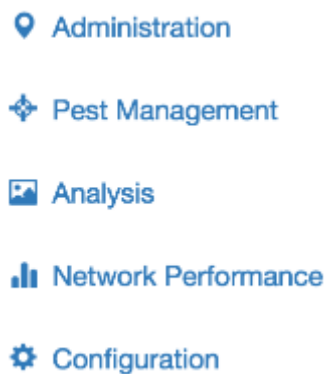


Figure 1: Symbols used to navigate through the different web app functionalities

In this tutorial, a description is given on how to sign-up for a user account and how to work with the tools on the web pages that are shown above.

SIGNING-UP FOR AN ENTOMATIC USER ACCOUNT

When accessing the test.entomatic.upf.edu web page, you can either log-in by clicking on “Log in” in the upper-right corner of the page if you already have an account, or request a user log-in by clicking on the “Request a user log-in” button in the middle of the page.

When requesting a user log-in, one is asked to fill-in a series of text fields (Figure 2). Using the Organization drop-down list, one selects the organization he/she is directly part of (i.e. the lowest level structure from which the user is a member). If a mistake is made, this can still be changed later on by a user with administrator rights in an umbrella organization. Therefore, in case of a mistake, another request for a user log-in must not be made.

The username has to be unique and therefore can only be chosen once. In an attempt to make a second user log-in request, a different username must be chosen.

The e-mail address is used for sending notifications and when one wants to reset his/her password (e.g. when the previous password was lost). Initially, a password can be freely chosen by entering it twice in the respective text fields.

To prevent robots from automatically generating data on the Entomatic database and preventing our system from being used to spread spam e-mails, the symbol that corresponds to the green word in a bold font must be clicked prior to signing-up.

Request a user log-in

First name

Last name

Username

Organisation

Email

Password

Re-enter password

Click or touch the T-Shirt

Figure 2: Questions that are being asked when requesting a user log-in

After signing-up for a user account, an administrator of the organization that you selected, must confirm that you are allowed to use the web platform. As this is not an automated process, this may take some time. In case you don't get an e-mail confirmation of your new account being active, please refer to the system administrator of your organization.

THE HOME SCREEN

The first screen that a user gets to see after successfully logging-in is the home screen. This screen will give summaries of the information that is given on the other pages so the user has a clear overview of the most important data: (i) the number of active gateways and nodes, (ii) the latest recommendations and (iii) alarms.

[Home](#)

System Status Download table as CSV	
Active Gateways	Active Nodes
3	0

Latest Recommendations Download table as CSV			
Date	Type	Comment	Orchard

Latest alarms Download table as CSV			
Date	Sensor	Alarm Type	Value

Figure 3: The home screen shows summaries of the information that is given through the other pages

All tables can be downloaded in a .csv file format by clicking “Download table as CSV”.

ADMINISTRATION

In order for users to be able to select their organization from the dropdown list when requesting a user log-in, organizations must first be added to the Entomatic database. This can only be done by users with administrator or super user rights. By clicking on the “Create new” button, a new row is added to the list with text fields in which the user can specify the name of the organization and the name of the organization to which the new organization belongs to. Also, an existing organization can be edited or deleted. Prior to deleting an organization, all users within that organization must be removed or linked to another organization.

When one of the organizations is selected from the Organizations-section, the users that are linked to that organization or to its “children” appear in the Users-section. When no organization is selected, the Users-section remains empty. All attributes from a user can be edited by an administrator or super user after clicking on the button that has a pencil. Changes can be confirmed using the confirm button on the right of the row that is being edited, or cancelled by clicking on the cancel button. When no changes are made in the edit mode, only the cancel button can be used to return out of the edit mode. The “Active” field contains a checkbox that is unchecked by default when a new user log-in request is made. Before the new user can access the application, this checkbox must be checked by the administrator.

The Sensors-section shows all sensors for which data has been received by the Entomatic database. This includes sensors that were powered-on but not yet assigned to a user. It is up to the administrator to assign new sensors to users by editing the data and selecting a user from the dropdown list. Also users can be changed in case a sensor is moved from one user to another. The “View on Map” button allows the user to see where the sensor is located on a map together with the locations of other sensors that may or may not be assigned already to a user (Figure 5).

Administration

Organisations Download table as CSV

Name ^	Parent	
<input type="text" value="Asprolithi"/>	<input type="text" value="National"/>	<input type="checkbox"/> <input type="checkbox"/>
National	No parent organisation assigned	<input type="checkbox"/> <input type="checkbox"/>
TEI of Crete	National	<input type="checkbox"/> <input type="checkbox"/>
		<input type="button" value="Create new"/>

Users Download table as CSV

Name ^	Surname ^	Username ^	Email ^	Organisation	Role	Active	
							<input type="button" value="Create new"/>

Sensors Download table as CSV

ID ^	Date of Last Power-On ^	User ^	Orchard	Action	
1	01/06/2016 - 10h56	tmatheussen	Avia-GIS	<input type="button" value="View on Map"/>	<input type="checkbox"/>
4	11/06/2016 - 15h10	lpotamitis	testH	<input type="button" value="View on Map"/>	<input type="checkbox"/>
2	11/06/2016 - 15h16	lpotamitis	Unassigned	<input type="button" value="View on Map"/>	<input type="checkbox"/>
3	02/06/2016 - 13h28	lpotamitis	Unassigned	<input type="button" value="View on Map"/>	<input type="checkbox"/>
5	22/07/2016 - 11h10	Unassigned	Unassigned	<input type="button" value="View on Map"/>	<input type="checkbox"/>

Figure 4: The administration page allows to create new organizations, change user data and assign sensors to users

After selecting an organization and user, a new section is shown on the administration page, which is called "Orchards". Orchards need to be created first, before a user that has been assigned sensors, can assign these sensors himself to a specific orchard. The only information that is needed to create a new orchard is a unique name. After this is done, one can select the orchard and click the "View Sensors" button which brings the user to the orchard's administration page. For getting back to the main administration page, one has to click the "Back" button on the upper right corner (Figure 6).

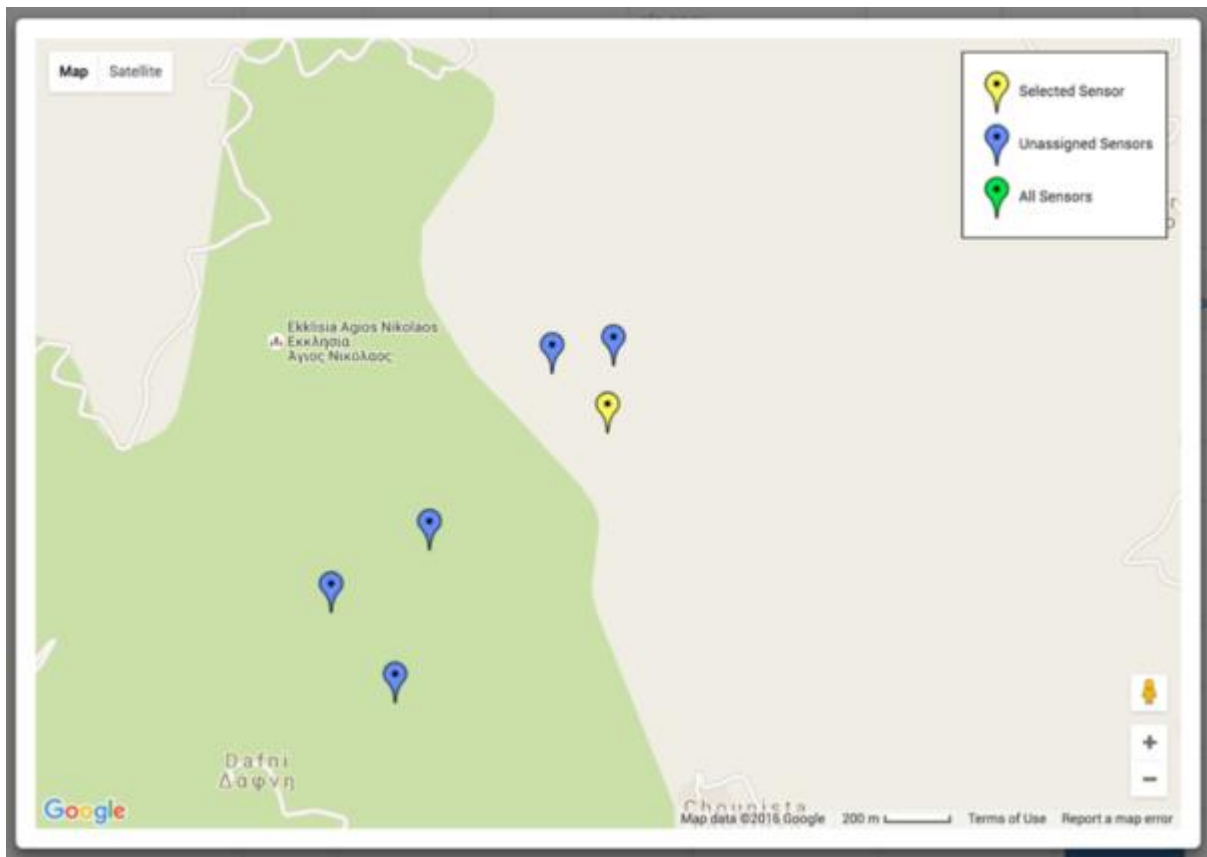


Figure 5: When clicking "View on Map" it becomes clear where the sensor is located, together with other sensors that may or may not be assigned already to a user

In the main administration page, a farmer, administrator and super user are allowed to assign sensors to orchards after which they will appear on the orchard administration page.

In the orchard's administration page there are three different sections: (i) a Sensors section, (ii) a map that shows the orchard's sensors and (iii) a Last sensor readings section. Once a sensor is selected from the Sensors-section, this sensor is marked on the map and its sensor readings are given in the Last sensor readings-section.

The label of a sensor can be changed to a text which is more easy to remember than the Mac address (specific to the sensor hardware) or the ID (linked to the Entomatic database). The text that is chosen to enter in this field could, for example, also be written on a physical label that can be attached to the trap for easy reference.

The Last sensor readings-section shows all sensor readings for the selected sensor. As there can be many readings that make it hard to interpret the data, readings can be filtered by checking or unchecking the boxes in front of the different variables that are being monitored. For each reading the date and time of acquisition is given, as well as the Measurement Type and the Sensor Reading itself.

Sensors Download table as CSV

ID	Label	Mac	Gateway ID	
5	<input type="text" value="East_002"/>	F5:75:55:C4:04:0E	4	<input checked="" type="checkbox"/> <input type="checkbox"/>
6	East_001	EF:F2:88:70:4D:34	4	<input type="checkbox"/> <input checked="" type="checkbox"/>

Map Satellite

Sensor label: East_001
 Sensor ID: 6
 Sensor MAC: EFF2:88:70:4D:34

Selected Sensor
 All Sensors

Map data ©2016 Google 50 m Terms of Use Report a map error

Last sensor readings Download table as CSV

<input checked="" type="checkbox"/> Temperature	<input checked="" type="checkbox"/> Insects	<input checked="" type="checkbox"/> B.oleae	<input checked="" type="checkbox"/> BatteryLevel
<input checked="" type="checkbox"/> Olive Fly			

Figure 6: The orchard administration page shows which sensors are assigned to the orchard and sensor readings for the selected sensor

A super user has the rights to disable certain Measurement Types in the configuration page. Once disabled, they will still be stored in the Entomatic database but users will no longer be able to see their Sensor Readings until it is enabled again.

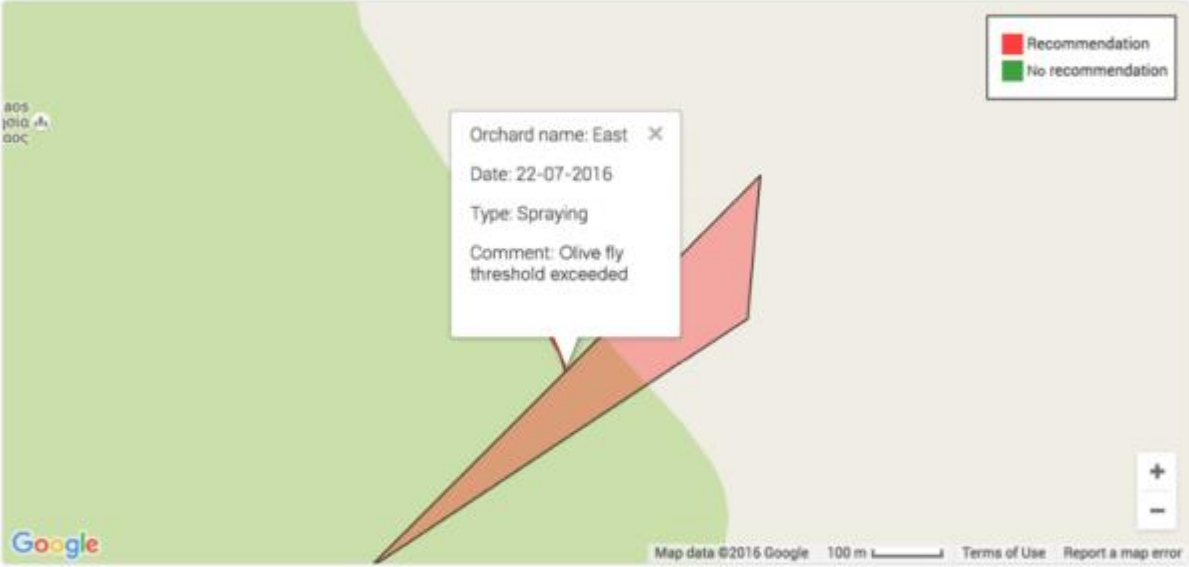
PEST MANAGEMENT

The pest management page shows all information related to Recommendations that are automatically generated by the Entomatic spatial decision support system (SDSS) and Control Actions that are manually entered by the user (Figure 7).

➤ Pest Management

Recommendations
[Download table as CSV](#)

Date	Type	Comment	Orchard
22-07-2016	Spraying	Olive fly threshold exceeded	East



Control Actions
[Download table as CSV](#)

Date	Type	Comment	Orchard	
22-07-2016	Spraying	Spraying was done when rain stopped	East	<input type="text"/> <input type="button" value="✖"/>

Figure 7: The pest management page shows recommendations that are automatically generated by the Entomatic spatial decision support system (SDSS) and control actions that are manually entered by the user

The Recommendations-section shows following information:

1. **Date:** the date on which the recommendation was generated. The Entomatic system runs an algorithm each day to decide whether new recommendations should be given;
2. **Type:** the type of control action that is recommended at the moment;
3. **Comment:** a brief text describing why a certain recommendation was given;

4. **Orchard**: the orchard to which a recommendation applies.


While the Recommendations-section reflects the data that was generated by the Entomatic system and visible to administrators, supervisors and super users, the Control Actions-section shows only information that was manually entered by the farmer. The information the farmer enters is not visible to other farmers, administrators, supervisors and super users.


While the information on Control Actions can be edited or deleted, this cannot be done for Recommendations.


ANALYSIS


 Analysis

Data parameters

Start date 

End date 

Your Data Orchard Sensor 

Comparison Range Neighbors 

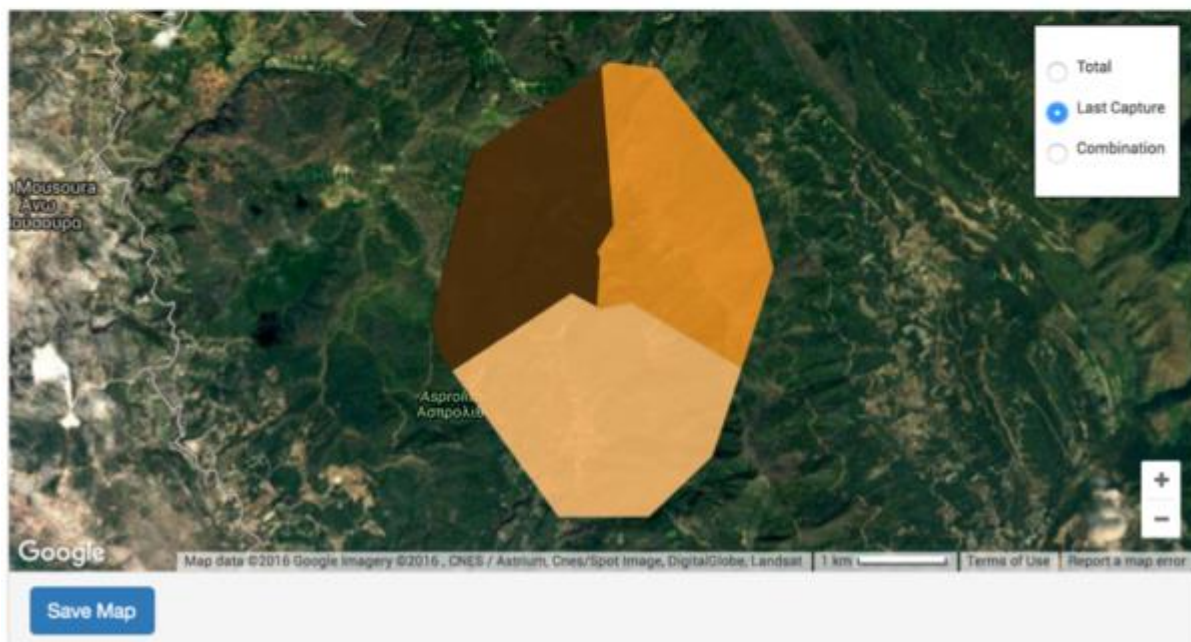


Figure 8: The analysis page allows the user to compare data from his own orchards or sensors to data from the nearest sensors (also from other users) and sensors within a given radius

For those users that are not just interested in viewing recommendations, the web platform also offers opportunities to analyse sensor readings both in space and time.

In the Data parameters-section the data can be loaded for analysis, based on a timeframe and sensor selection. The sensor selection is done for the own data by selecting one orchard or one sensor. After clicking one of these radio buttons, the name of the orchard or sensor can be selected from the drop-down list. The data the user wants to compare his own data to, can be selected either based on a range around the selected own data, or by giving a number of nearest sensors that must be taken into consideration. After clicking the “Load Data” button, the map and graph are updated. Both the map and the graph can be saved locally as a .png image.

The map shows the total number of captured olive flies on the last full day, the number of days since the last olive flies were captured or a combination of both metrics. When “Combination” is selected, the number of olive flies captured on the last day that olive flies were captured, is given using different colours, the number of days since the last olive flies were captured is represented by a range of different opacity levels.

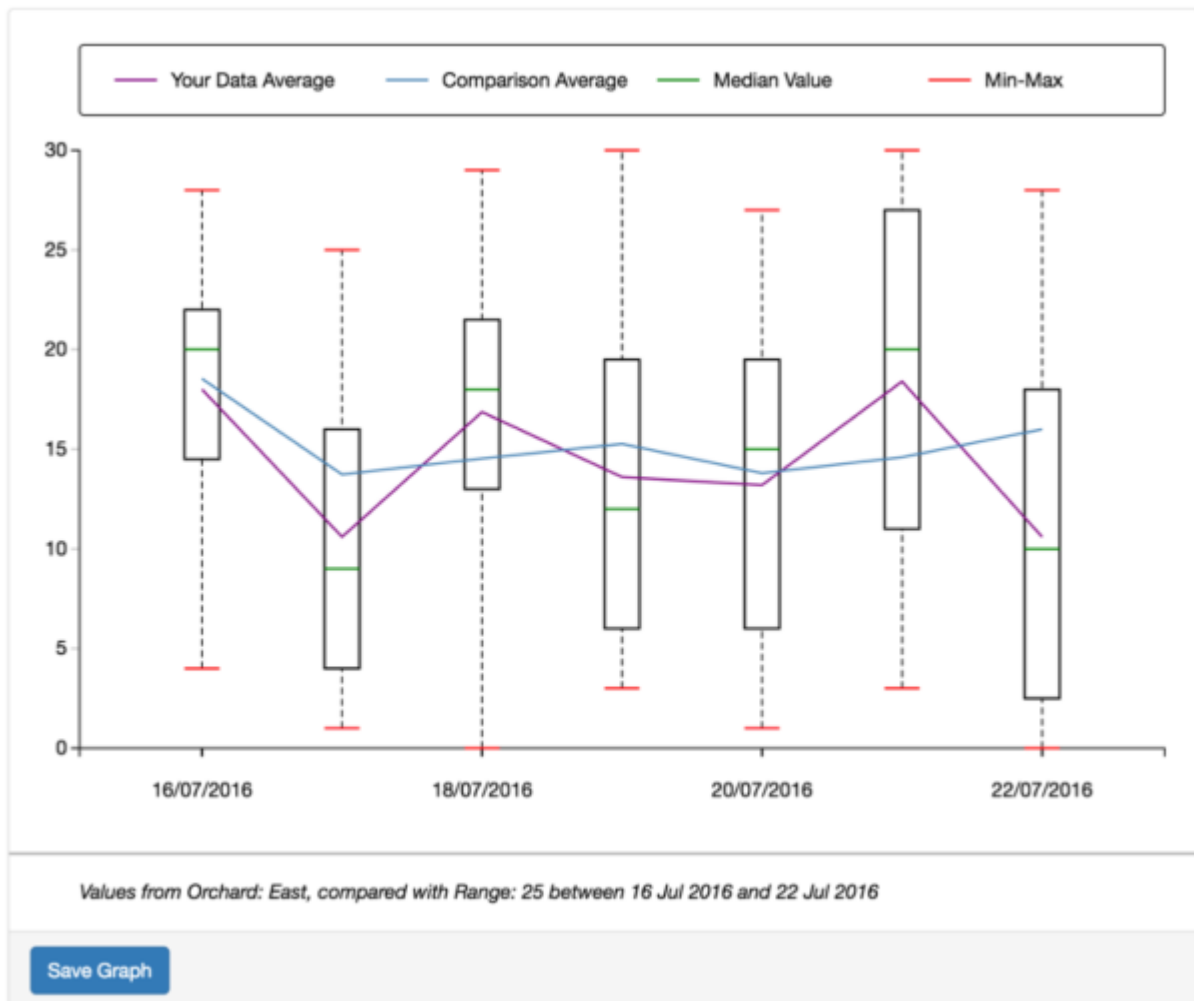


Figure 9: Graphical representation of sensor readings on a timeline. The users’ own data are shown using both boxplots as averages. The average of the comparison data is also given

The graph shows a time-series of boxplots that represent the distribution of sensor reading values that were registered for the day given on the X-axis or the period around it. The amount of days for which data is aggregated in one box depends on the length of the timeframe that was selected to keep the graph easy to interpret.

If one would prefer to have graph types other than this boxplot to visualize own data, data on sensor level can be saved in a .csv file format from the orchard administration page. The data can then be opened in e.g. Microsoft Excel.

NETWORK PERFORMANCE

In the network performance page users can monitor the status of their sensors in terms of e.g. battery level. When the battery voltage drops below a certain level, the user receives a warning so he/she knows that batteries need to be replaced.

Network Performance

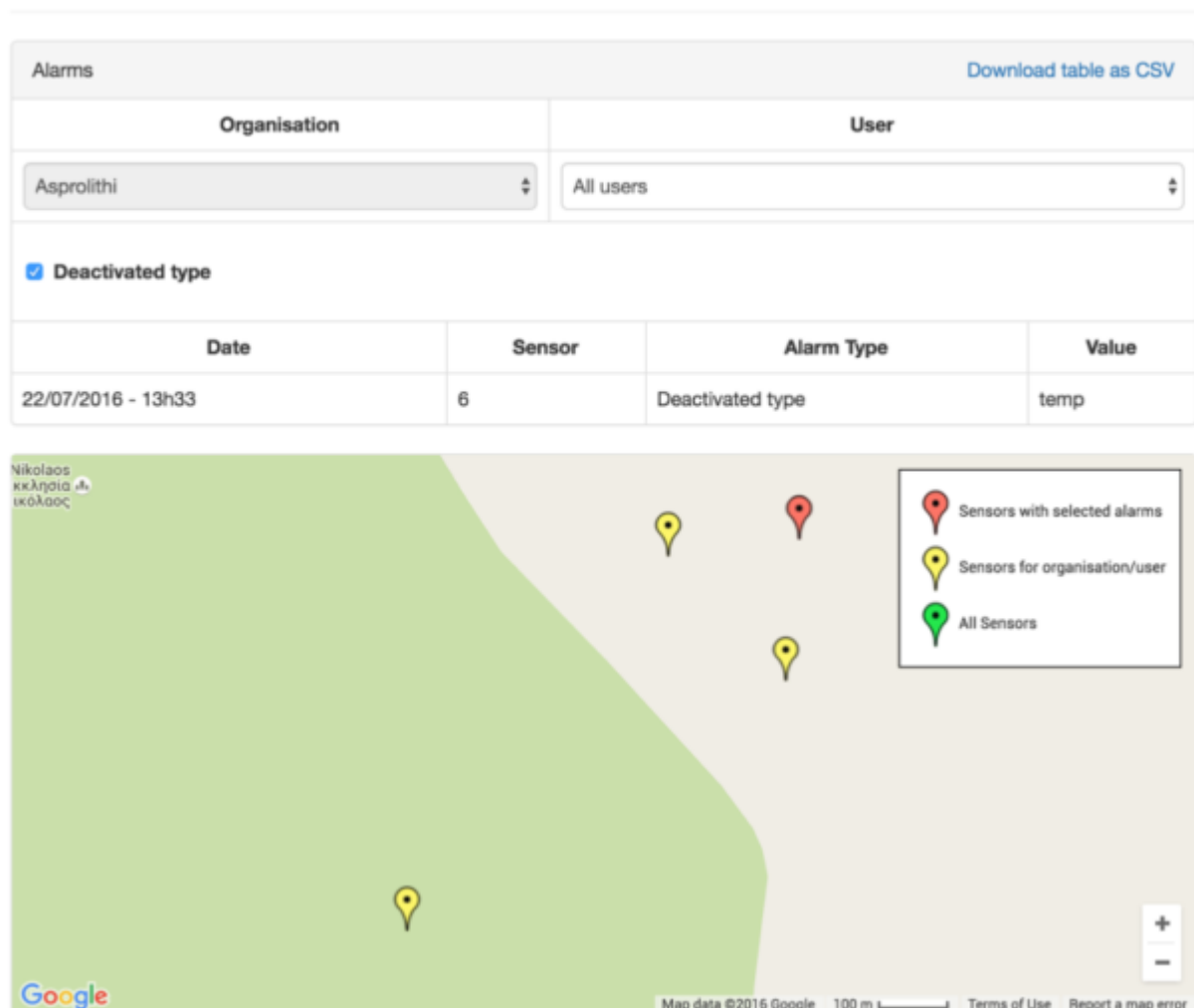


Figure 10: The Network Performance page showing alarms and the sensors that have the selected alarm

Administrators, supervisors and super user can see alarms from all sensors of farmers that are member of the organization they are administrator, supervisor or super user of.

The “Deactivated type” is a special case of alarm and shows that data was received for a measurement type that is deactivated. The value column specifies the measurement type the alarm is referring to.

As an administrator, supervisor and super user, you can also see an Error log-section (Figure 11) that shows all alarms from sensors that are not assigned to a user. Using this error log, it is possible to troubleshoot erroneous sensors. Sensors that were powered on at the time given in the error log, were able to contact the server but for some other reason, could not be registered in the database in order to assign it to a user.



Figure 11: Error log of sensors that are not assigned to users

CONFIGURATION

The main configuration page shows three list sections: (i) Alarm Type, (ii) Control Action Type and (iii) Measurement Type, and a section to alter parameters (Figure 12).

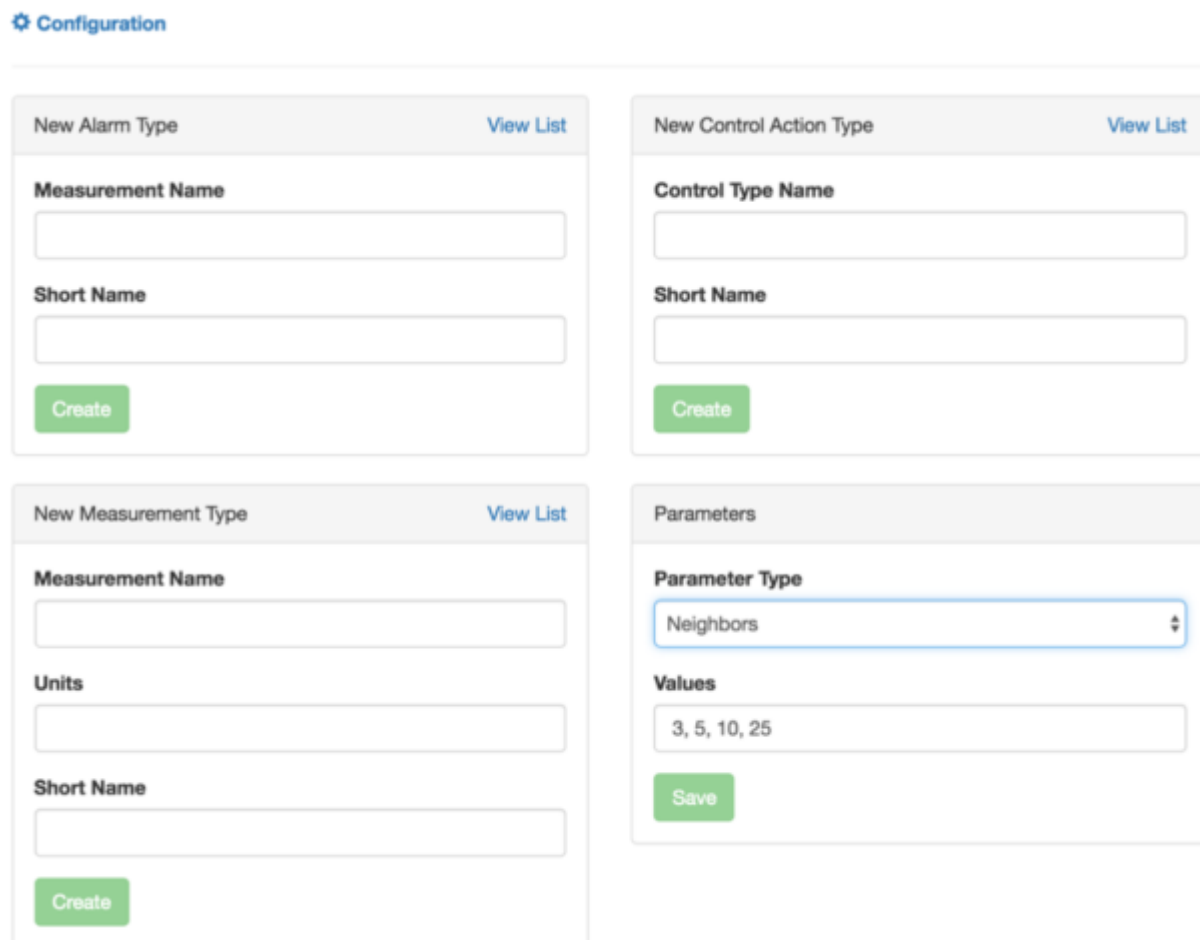


Figure 12: The main configuration page

In the Parameters-section, a parameter can be selected from the drop-down list and a value or multiple values can be given to that parameter (Figure 12). When a parameter requires multiple values, they are separated by a comma. Changing these parameters will alter the behaviour of the web platform such as showing different classes of legend items in the map.

For the different list-sections, new items can be generated quickly by clicking the “Create” button. Existing lists items can also be viewed by clicking on “View List”. After doing so, the list’s configuration page is opened and one can activate and deactivate certain list items (Figure 13). Measurement types will not be visible to the users when deactivated but administrators, supervisors and super users will notice through the error-log on the Network Performance page when values are received for a deactivated measurement type.

⚙ Configuration - List of Measurement Types ← Back

All Types			Download table as CSV
Name ^	Short Name ◊	Units ◊	
B.oleae	fly	Amount	Activate
BatteryLevel	batt	%	Activate
Insects	insects	Amount	Activate
Olive Fly	ofly	Number	Deactivate
Temperature	temp	°C	Activate

Figure 13: The Measurement Type list’s configuration page