EGNSS4CAP

Enabling the digitalisation of agri-government controls through Galileo & EGNOS

European
Global Navigation
Satellite Systems
Agency

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Implementing Framework Contract
GSA/OP/09/16/Lot 2/SC 8

Coordinated by

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1. MOBILE APPLICATION

1.1 Installation

The application for Android phones is distributed via Google Play Store service. (https://support.google.com/googleplay/answer/113409?hl=en&ref_topic=2450266).

The application is currently in the Closed Testing Alpha channel (status 11/01/2021). Each user has to be registered with their Google Account.

The production version will be released to the production channel in the future without the limitation mentioned above.

1.2 Application Start and Permissions

The application can be run on Android devices by selecting it in the list of applications (Fig. 1).

Fig. 1 Application icon

Upon the first start of the application, user permissions will be requested, which are required to correctly run the application.

- Location services
  - to assign location data to photos
  - to distinguish between various types of location data or signals on the device
  - to use the path tracking feature
- Camera and Video
  - to use the device camera for the snapshot capturing feature
- Make and manage calls
  - to assign data of the mobile network or the WIFI network to captured snapshots as input to geotagged information

In the case that any of mentioned permissions is not allowed by the user, the application is not able to work properly. Thus, the dialog requesting such permissions is shown to the user (Fig. 2).

A user is able to invoke the Android system permissions dialog again by clicking the "*Confirm Permissions*" button. If these dialogs have been banned by the user, there is still the possibility to set permissions in the System settings before the application start. This procedure may vary on different Android devices and system versions.

Fig. 2 Permissions request

1.2.1 Login

After the first launch of the application and granting all the necessary permissions to the application, the user will be presented with a login screen (Fig. 3), where the assigned login and password will need to be filled out. Click the *Sign In* button to complete the login.

To successfully log in, all data most be entered correctly and the device should be connected to the Internet at the time of login. The login details will be remembered for future uses of the app. Re-login will be required only after explicit logout of the user. After each login, the synchronization process (*Main screen*) starts automatically.

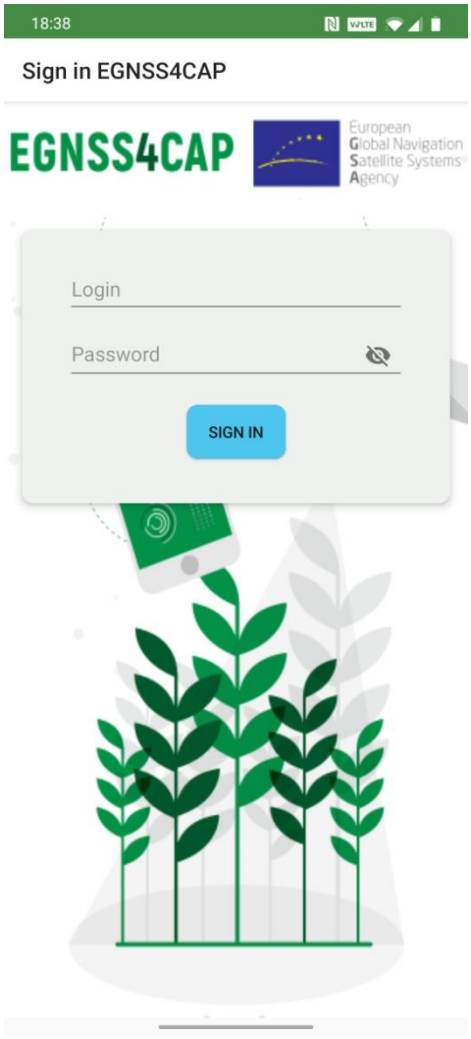


Fig. 3 Login screen

1.3 Main Screen

In the upper section of the Main screen, the “Logged in user” field can be found, which provides information about the currently logged in user.

The attributes of the host device are displayed in the middle of the “Basic Information” section. Traffic lights are displayed next to some of the attributes. Their detailed description is given below and can also be found in the *About screen*.

- Device capabilities show the current ability of the device to receive location data.
  - The green color indicates the active ability of the phone to determine its current location.
  - Red means an inability to determine your current position. If this is the case, location services on the device may be disabled.
- Device vendor
- Device model

Other attributes use the green or yellow color.

Green indicates that the device has that particular property. Yellow indicates that the device does not have the given property or has not yet been able to verify the given availability and may change to green over time.

Such a distribution of information is chosen because the availability of these properties cannot be determined immediately, but only with a small delay based on the signals that the application receives from the device.

- Compass and gyroscope
  - Checks if the device is equipped with compass and gyroscope sensors and the application is able to read their data.
- Galileo capability
  - Checks if the device is capable to read Galileo signals
- Dual frequency support
  - Checks if the device is capable of receiving GNSS dual frequency signals (i.e. is it capable of receiving L1 / L2 signals for GPS or E1 / E2 for Galileo).
- EGNOS
  - Checks if the device is capable of receiving signals from EGNOS / SBAS satellites.
- Galileo Navigation messages
  - Checks if the device is able to receive raw GNSS data, specifically I / NAV messages, in order to be able to use the authentication technology of the OS-NMA navigation messages.

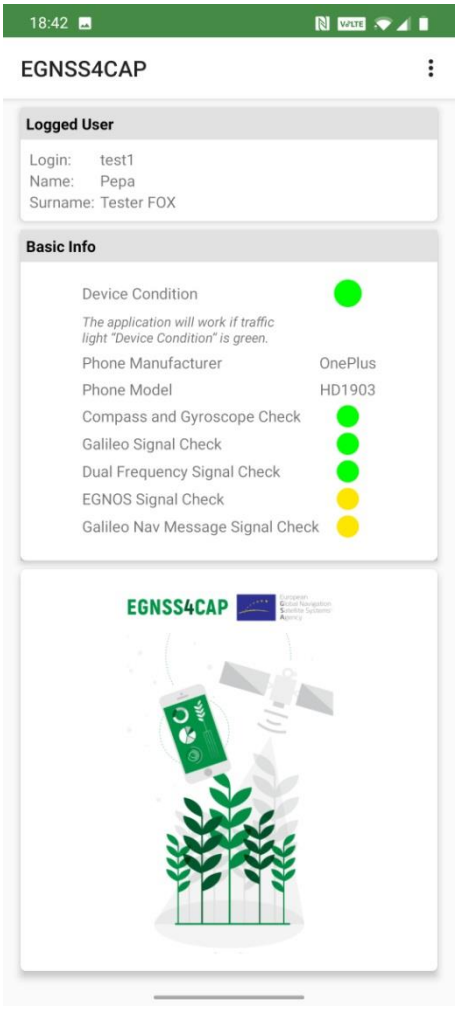


Fig. 4 Main screen

To navigate between the different application modules, a main menu opens when you click on the three dots in the upper right corner of the screen. The context menu has the following options:

- Task synchronisation
  - Starts the process of synchronizing data with the server. You cannot use the application during synchronization and you must be connected to the internet.
- Task list
  - Displays the task list screen
- Standalone photos
  - Displays the list of standalone photos, which are not assigned to the specific task
- Map
  - Changes the screen to the map view
- Settings
  - Allows the user to change the settings
- GNSS Raw Data
  - Displays an overview of currently received GNSS data
- About
  - Shows basic information about the application
- Log out
  - User log out, reverts to the login screen

1.3.1 Task List

In the task overview (Fig. 5), user tasks are listed by name, status, number of captured images, creation date and due date. By clicking on a specific task, a screen with details and options to edit is displayed.

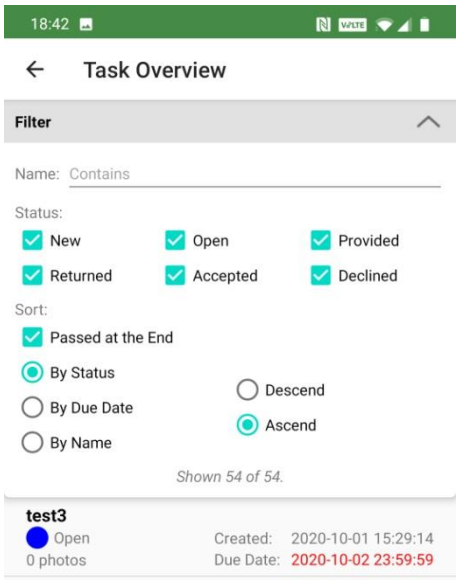


Fig. 5 Task list

The drop-down filter (by tapping the Filter bar at the top of the screen) restricts the task list by task name and status. In the filter, you can also set the sorting of images in the list according to the options offered. When the *Expired* option is selected, the sort is divided into two depending on whether the due date has passed or not. The sorted list of tasks will be displayed for each group independently. The group of tasks with expired due dates (*Due date* marked in red in each item in the list) will be included at the end.

The filter settings are retained even after the application is closed.

Tasks can be set in following states, which also determine their editability:

Description	Editable
New A new task	YES
Open A new task, which has been already displayed by the user. The user is aware of the task.	YES
Returned The has been returned by the officer to the farmer with an additional information request.	YES
Data provided The task which was completed and sent by the farmer to the PA	NO
Data confirmed (approved task) The completed task has been approved.	NO
Data checked (rejected) The completed tsk has been rejected.	NO
Closed The task has been closed is not active.	NO

To ensure that all tasks are current, you must manually start the synchronization process (M).

1.3.2 Task detail

The task detail (Fig. 6) shows the data attributes of the task, including all captured images. Depending on the status of the task, the task can either be edited or viewed.

- The upper section lists the basic data attributes of the task.
- The *Instructions* section shows the description needed to complete the task given by an authorized staff member of the Paying Agency.
- The *Reason for return* section describes the reason for the Paying Agency why the task was returned for a new performance.
- The *Note* section is completed by the user as part of completing the task before it is submitted.
- The photo section shows thumbnails of photos taken. The user takes photos by clicking the button  , which enters the camera mode for shooting (Camera Mode). Tap to delete the currently displayed photo  . Use the buttons  and  to move between photo previews.

A photo cannot be deleted if it has been already sent to the server, even if the task is in an editable state.

Click the *Submit button* to send the message. After successful submission, the task can no longer be edited. If an error occurs during sending process, for example if the Internet connection was not strong enough at the time of sending, the task will be locked. In the locked state, the task is non-editable and the user can only retry its successful submission, or remove this locked state by starting the synchronization process.

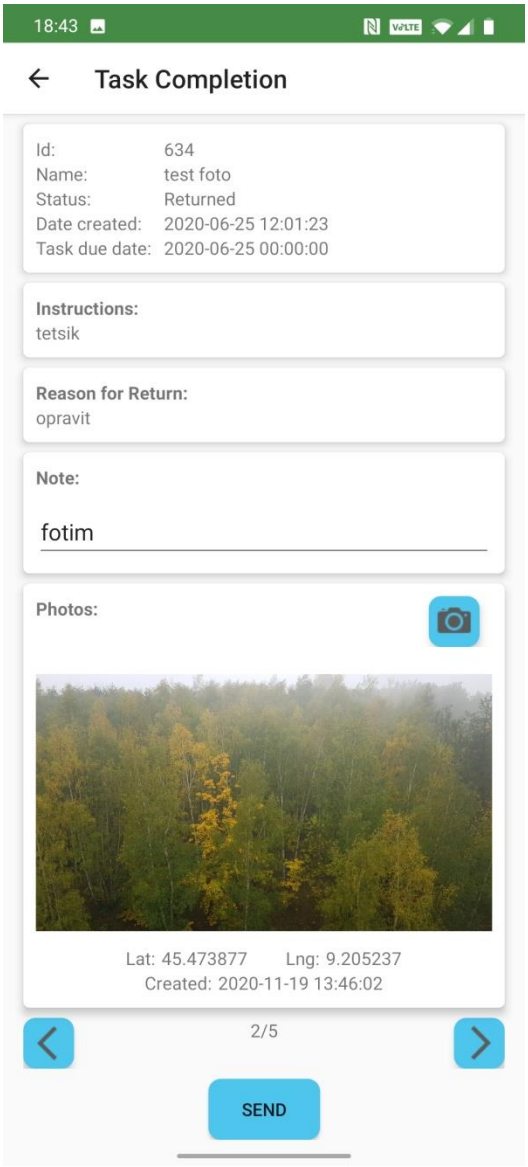


Fig. 6 Task edit

Clicking on the photo preview will open a window with its detail (Fig. 7). The basic attributes of the photo are displayed in the upper left corner. In this view, you can switch views between all photos of the task using the buttons and , or by swiping your finger on the photo to the right or left. The screen *Detail* supports displaying in portrait or in landscape mode. If possible, the photo can also be deleted from this view with the button .

Fig. 7 Photo detail

1.3.3 Standalone Snapshots

Screen showing photos in the list (Fig. 8) taken separately outside the task. In each list item, on the left is a preview of the photo and on the right a list of basic metadata.

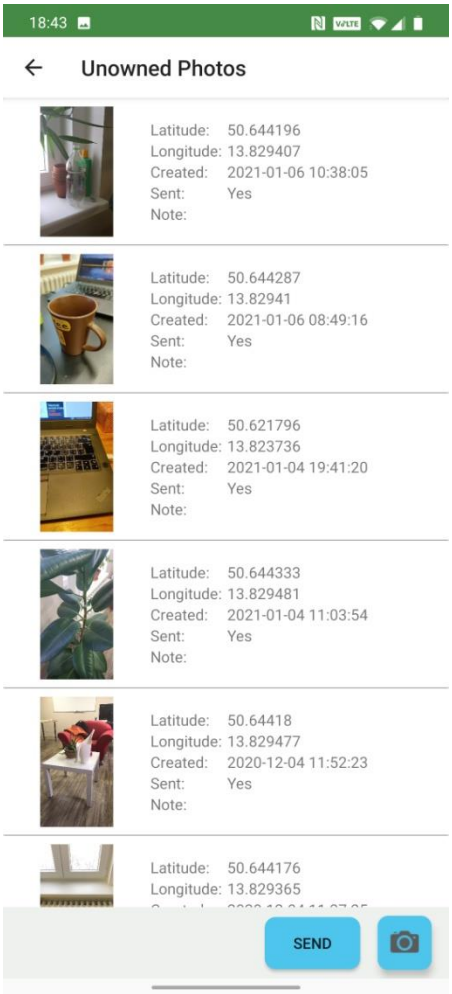
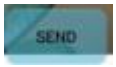


Fig. 8 Overview of standalone photos

From this screen, new photos are taken by touching of a button  , which enters the user to take camera mode (Camera Mode). Click the *Upload* button to send all newly taken unsent photos in the list.

Clicking on a photo item in the list opens its detail (Fig. 9), where the editing is performed using the buttons at the bottom of the screen.

Fig. 9 Detail of a standalone photo

-  opens a dialog for editing a note on a specific photo.
-  deletes the displayed photo.
-  uploads the displayed photo to the server.

After sending, the photo becomes non-editable. If an error occurs during uploading, the photo will be set to locked mode. The same rules apply to this mode as for submitting a task.

1.3.4 Camera Mode

A camera screen interface is used to take a single photo or a photo for a task (Fig. 10).

Fig. 10 Camera mode screen

The basic location data is displayed in the upper left corner:

- *Latitude* indicates the latitude in degrees.
- *Longitude* indicates longitude in degrees.
- *Altitude* indicates the height above the reference surface of the WGS 84 ellipsoid.
- *Accuracy* is an estimate of horizontal accuracy as the radius of reliability.
- Image *azimuth* indicates the azimuth of the horizon the camera captures.
- The *angle* expresses, in degrees, the tilt of the vertical axis of the screen to project on the horizontal surface of the earth.

If shooting with *position center of gravity* calculation is enabled in the settings, a window with data on the currently calculated position center of gravity is also displayed:

- *Latitude* indicates the latitude of the center of gravity in degrees.
- *Longitude* indicates the longitude of the center of gravity in degrees.
- *Samples* indicates the current number of processed samples to the total number specified in the application settings.

If manual brightness correction is enabled in the settings, this button is available . Click this button to display a slider to adjust the darkening or lightening of the image, as needed. The setting of this correction is retained even after the application is closed. Clicking in the middle area of this bar resets the brightness lock.

If the camera does not respond to a change in brightness and the image is too dark or too bright, the camera hardware is not compatible with this application. In this case, it may help to turn off manual correction in the application settings (*Settings*).

The camera supports both portrait and landscape shooting.

The photo is taken by tapping the camera button  , or by pressing the hardware button on the device defined in the application settings (*Settings*). Then the auto shutter will release with a countdown of approximately 5 seconds. The following conditions must be met to take a photo:

- The device must have a sufficiently good reception of location data.
- The user must not move and must stand still.

In addition, if center-of-gravity photography is permitted:

- The center of gravity of the position must already be calculated or a predetermined number of samples must be collected for its calculation.

If any of these conditions are not met, a warning message will be displayed, shooting will not be enabled and the shooting button will not be available. If any of these conditions are violated during auto shutter release, the image will also be rejected.

Click the button  to close the Camera mode and return to the previous screen.

1.3.5 Map

The map shows all images of the logged in user (standalone photos and photos within all tasks) and the currently recorded or already recorded path.

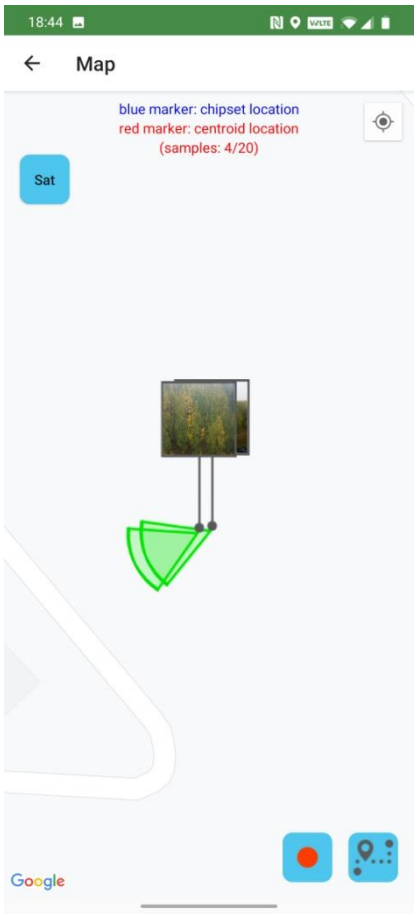


Fig. 11 The map photos and tracked paths

There is a black dot on the map at the location where the image was taken, with a small icon above it. The green circle determines the azimuth direction of the mobile device's screen at the time the photo was taken. Press the image icon to display an overview of the basic attributes of the image. If it is a photo within a task, pressing this report will take the user to the detail of the task to which the image belongs. (Fig. 12)

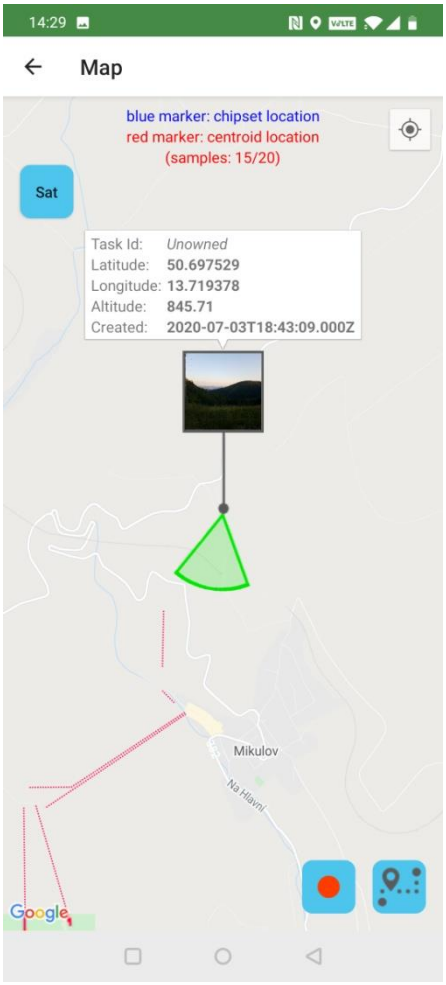


Fig. 12 Preview of the photo on the map

If location data is available, the current position will be marked on the map in the form of a blue dot , which can be navigated on the map by tapping the button . The current position calculated from GNSS as the center of gravity of the positions is indicated by a red dot . This position is always updated after the collection of all samples necessary for the calculation of the center of gravity, the number of which is defined in the application settings (*Settings*) by the parameter *Number of samples for the center of gravity*.

Button Sat / Map switches the map view to a satellite or a map view.

You can record a route in the map view. Click the button , the dialog opens for entering a path name, which is optional. When this dialog is confirmed, the path will be recorded. The user can switch the application screens at will when recording the path, but the application must remain active and in the forefront of Android processes. The path is recorded in the form of points, between which there is an approximate recording interval of 1 second. When recording, the path is simultaneously drawn on the map in the form of a black linearly angled curve. Each point on the curve is represented by a pin icon . When you click on it, an overview of its geolocation data is displayed. Click to end the recording and the path is drawn as a polygon, where the first and last points of the path are connected. Click the button to go to the list of already recorded routes (*Routes*), where you can select a route to draw it on the map. Fields *id* and *name* of the drawn route on the map (currently recorded or already recorded) are displayed in the overview next to the buttons for recording the route. Clicking in this report will move the map view to this path.

With a sufficiently large zoom above the map, plots with their identifiers will begin to appear as red polygons.

Fig. 13 Map with parcels displayed

1.3.6 Paths

This list shows all recorded routes (Fig. 14). Clicking on a specific road will draw it on the map (M). Each path already sent to the server is assigned its ID (*identification number*). If the route has not yet been sent, it can be deleted by clicking on the button  . All unposted paths are sent to the server as part of task synchronization (M).

- The *Area* attribute is an approximation of the area of a polygon formed by a path in square meters.
- The *By the center of gravity* attribute determines whether waypoints were taken as the center of gravity of the positions.

Fig. 14 Recorded paths list

1.3.7 GNSS Raw Data

In this screen (Fig. 15) the user sees the current raw GNSS data received from the satellites with a basic overview of the device, the same as on the main screen (M). Most of the data is obtained from NMEA message records.

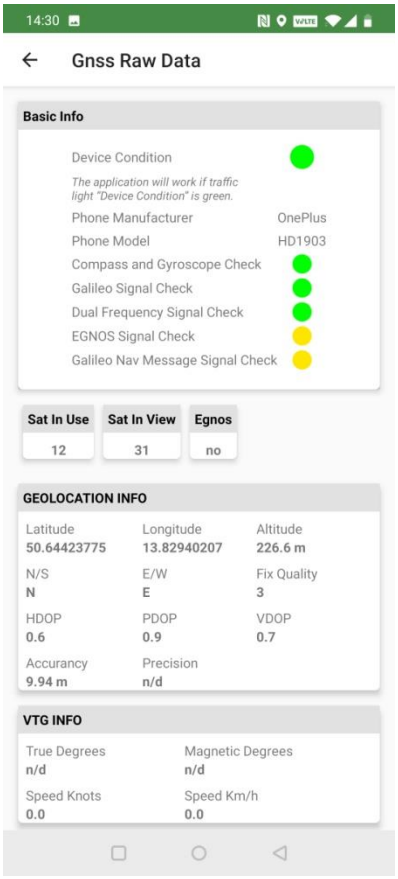


Fig. 15 GNSS Raw Data

- *Used satellites*
  - Number of satellites used
- *Satellites visible*
  - Number of visible satellites sending the SNR.
- *EGNOS*
  - Marked positive if the GPS Quality indicator value of the GGA sentence is equal to 2, marked negative if it is equal to 1, and marked as undecided in other cases.
- *Geolocation information*
  - The *Latitude*, *Elevation*, *Altitude*, *N / S*, and *E / W* attributes are taken from the GSA sentences.
  - The attributes *HDOP, PDOP, VDOP*, and *Quality Assessment* are taken from the GSA sentence.
  - The *Accuracy* attribute is an estimate of horizontal accuracy as the radius of 68% reliability. It is obtained from the location service.
  - The *Accuracy* in meters attribute is calculated above the center of gravity of the position. The calculation parameters are defined by the application settings.
- *VTG info*
  - All attributes are read from the VTG sentence.
- *RMC Info*
  - All attributes are read from the RMC sentence.
- *SNR*
  - *Mean SNR of the last detected satellites.*
- List of satellites
  - *GALILEO SATs*, *GPS SATs*, *GLONASS SATs*, *BEIDOU SATs* display satellites sending the SNR.

1.4 About

This screen contains basic information about the application (Fig. 16).

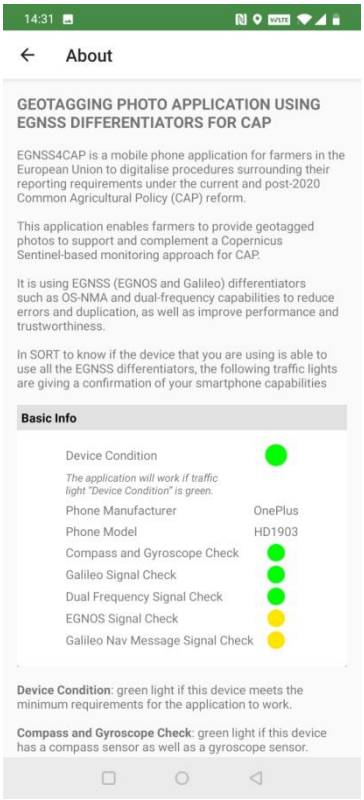


Fig. 16 About screen

1.5 Settings

The screen provides the main settings of the entire application (Fig. 17).

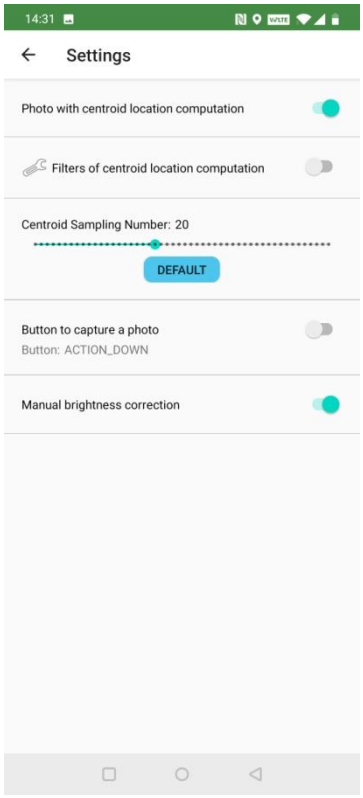


Fig. 17 Settings

- *Shooting with the calculation of the center of gravity of positions*
  - When capturing an image, location center of gravity information will be added to its metadata.
- *Position center of gravity calculation filters*
  - Activates filters above the samples when calculating the position center of gravity. After clicking in the right area of this item, you will go to the settings of these filters (Fig. 18).
- *Number of samples for the center of gravity*
  - Sets the number of samples required to calculate the position center of gravity.
  - Click the *Default* button to set the default number.
- *Button to take a photo*
  - Defines a hardware button for taking a photo in camera mode (C).
  - If activated, the dialog for setting the hardware button on the device is displayed. The setting is made by pressing the desired button when this dialog is displayed.
  - Not all buttons on the device are suitable or usable. E.g. suitable buttons are for volume control. E.g. the screen lock button cannot be used.
- *Manual brightness correction*
  - Activates the manual brightness correction option in camera mode (C).

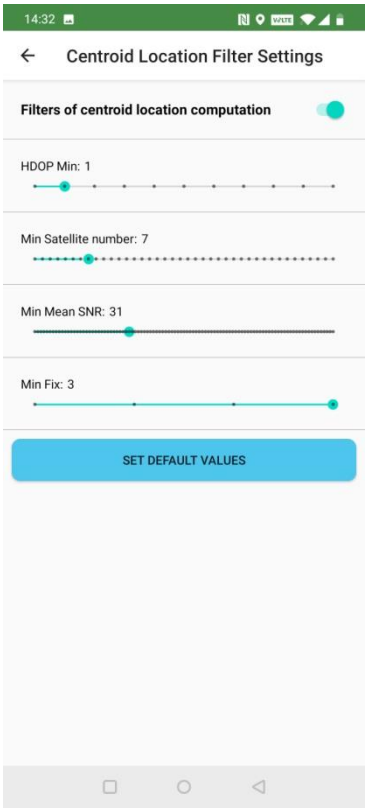


Fig. 18 Position center of gravity calculation filters

The position center of gravity filters (Fig. 18) for each sample received decide whether or not to include it in the center of gravity calculation.

- Min HDOP
  - the HDOP value greater than or equal to a defined value.
- Min. number of satellites
  - The data comes from a greater or equal defined number.
- Min. mean h. SNR
  - The minimum mean SNR value of the satellites used is greater than or equal to the defined value.
- Min. fix
  - The value of the Fix type (according to the GSA record) is greater than or equal to the defined value.

Clicking the *Set Defaults* button returns all filter values to the default.

2. WEB CONSOLE INTERFACE

The web console is accessible through the following link: https://egnss4cap-uat.foxcom.eu/login.php

To log in to the web interface, enter your login details.

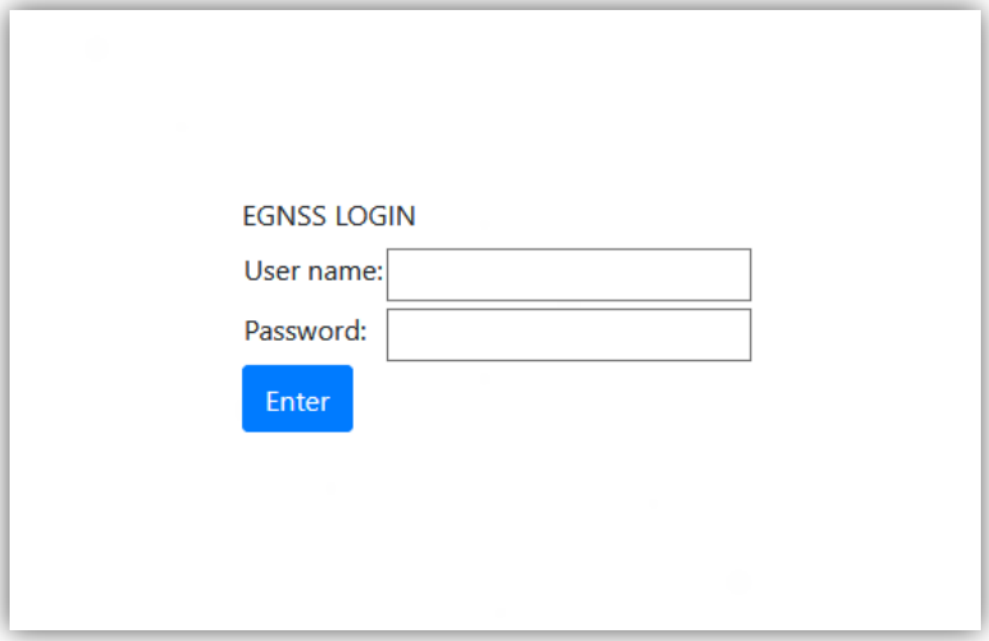


Fig. 19 Web Console login

2.1 Farmer access

The default page after login is the Task list.

2.1.1 Task List

The left part shows the assigned tasks, which can be sorted, filtered and searched. In the right part, points representing individual tasks are displayed on the map.

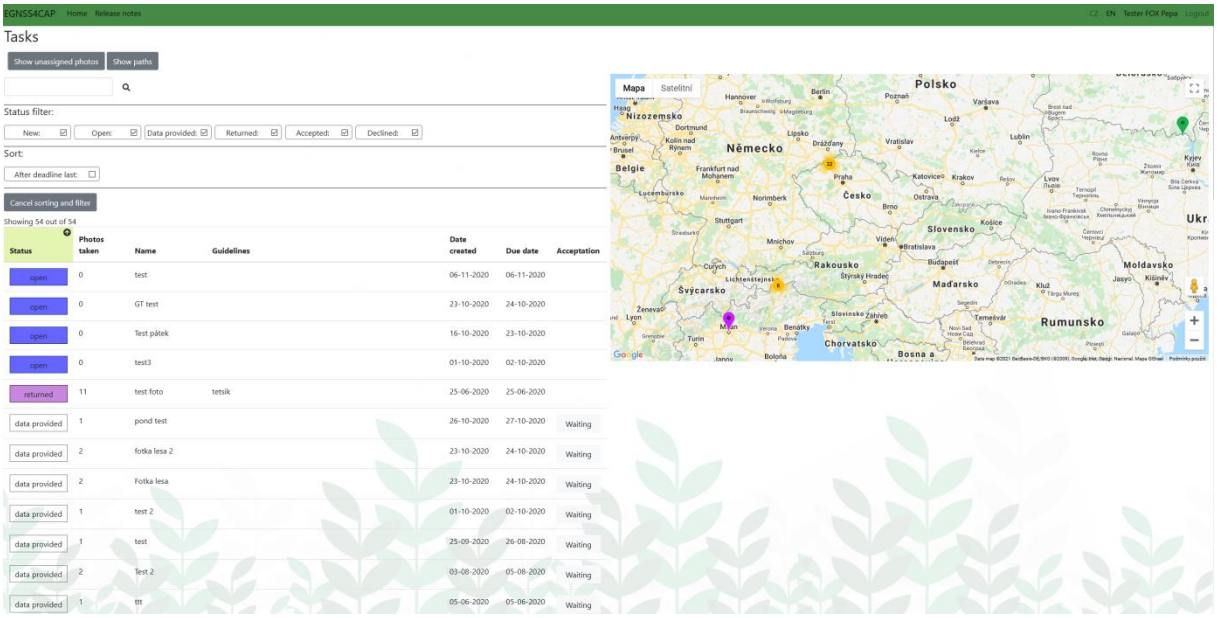


Fig. 20 Tasks and Map

The following options are available for the user:

1. Open task detail (by clicking on the selected row in the list)

2. Search for tasks by the specific text

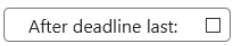
3. Filter tasks by status (by clicking on the selected status)

Status filter:

4. Sort tasks in a list by the selected column (by clicking on the column heading)

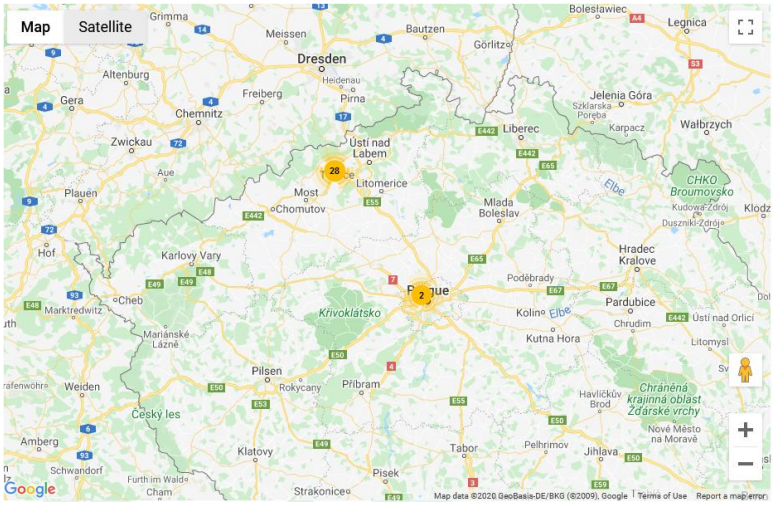
or according to the date of completion of the task (with the button "Passed to the end")

Sort:



5. Display a page with unassigned photos

6. Browse the map and open the task detail by clicking on a point on the map



2.1.2 Task Detail page

This page contains detailed information about the task, as well as photos that were taken for the task. The map shows the position of the photos, the viewing radius of the camera and the direction of the photo. The map can be viewed.

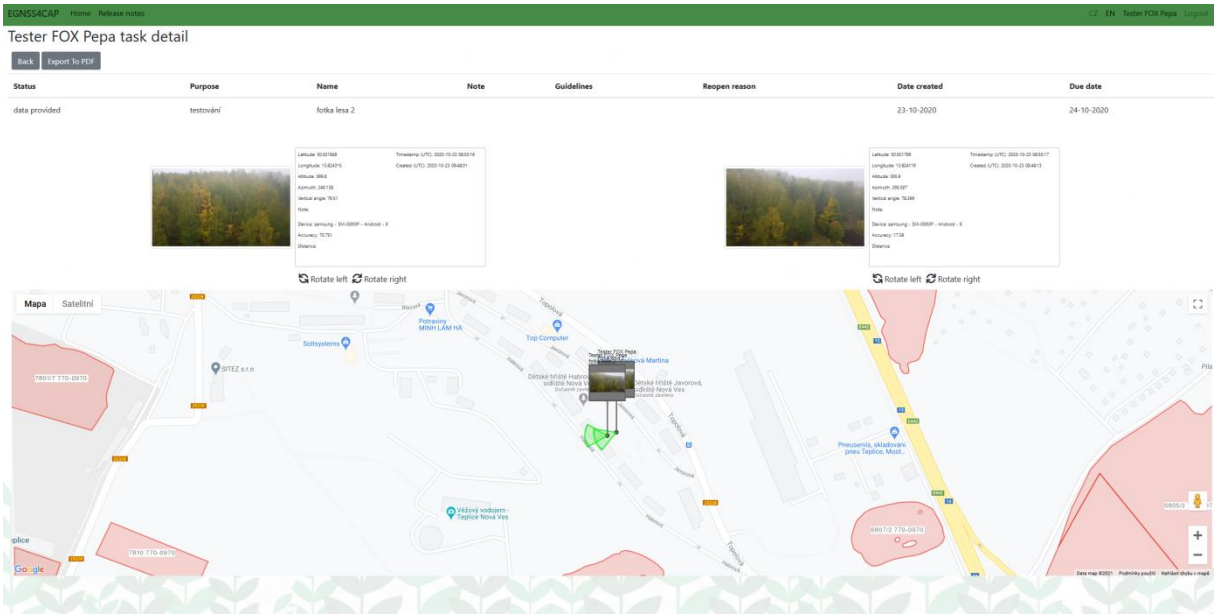


Fig. 21 Task detail

Photos can be rotated here using the buttons:

Click on the photo to open the Photo Gallery (see below).

A table with source data is placed next to each photo.

2.1.3 Standalone photos gallery

At the top of the page, a map is displayed, where the position of individual unassigned photos is marked.

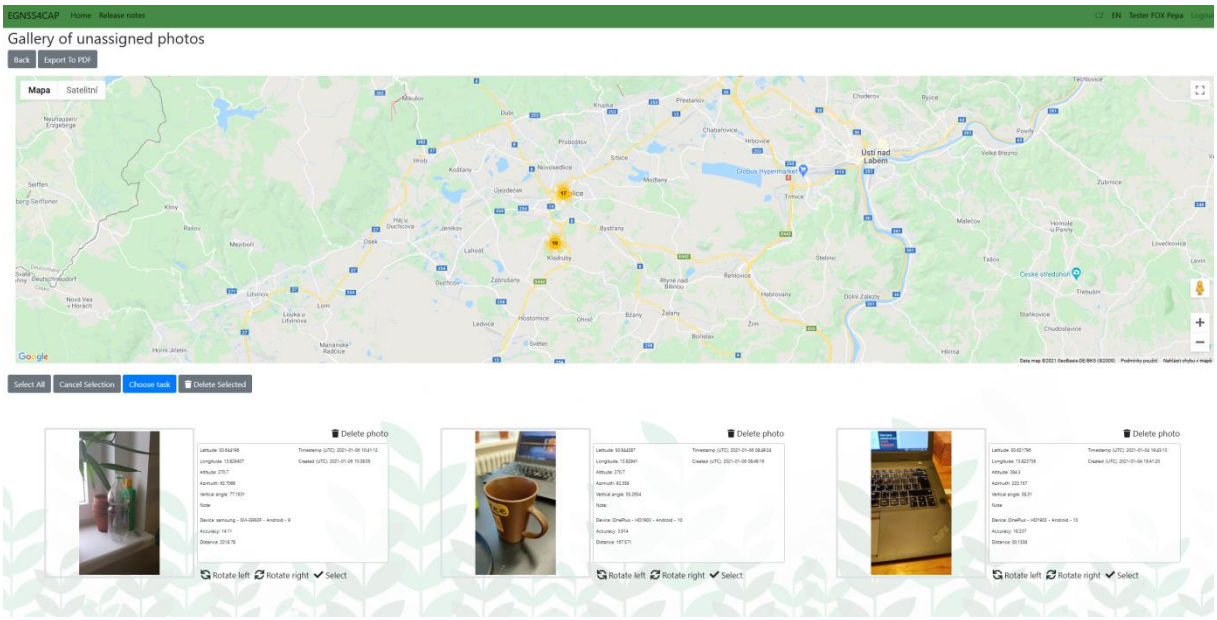


Fig. 22 Standalone task unassigned photos

Below are photos that are not assigned to any task. A table with source data is placed next to each photo.

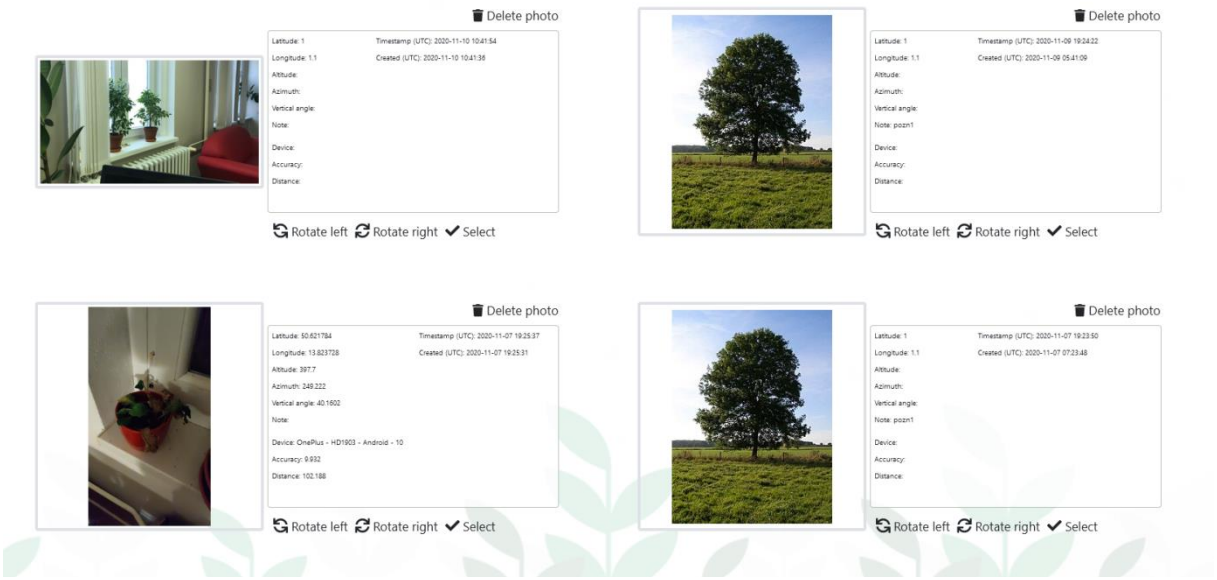


Fig. 23 Unassigned photos

Several options are available to edit the photos:

1. Rotation 

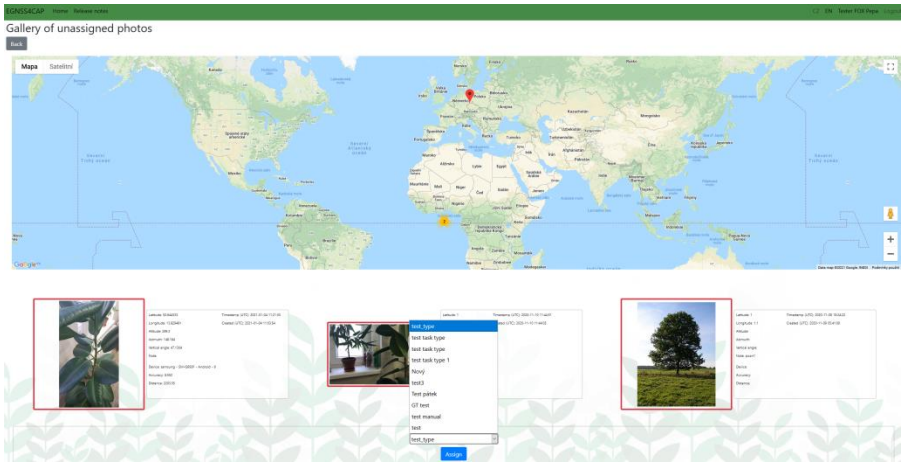
2. Delete 

3. Select for an action 

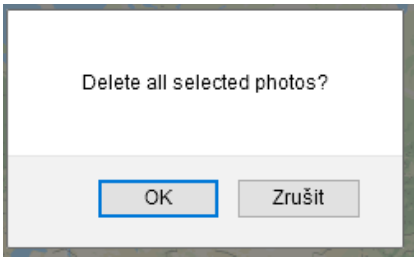
    - By clicking the Select button, the photo is marked for the bulk assignment to a task or to a bulk delete 
    - Selected photos are marked by the red rectangle.
4. Open photo gallery – click on the photo (see below)

When selecting bulk actions, the following options are available:

1. Select all
    - Selects all unassigned photos
2. Cancel selection
    - Cancels current selection
3. Select task
    - Displays a page where you can select the task to which the selected photos are to be assigned. For recapitulation, the photos that were marked on the previous page are displayed here. Below the photos, a selection box is available, where it is necessary to select the target task. The map is displayed at the top of the page.
    - After clicking the *Confirm button*, a dialog box will appear, where by pressing the *OK* button, the process of assigning photos will be completed.



    - Once finished, the user is navigated back to the Task list screen.
4. Delete selected photos
    - Displays a dialog box where, after confirmation by pressing OK, the marked photos will be deleted



2.1.4 Photo gallery

The gallery is accessible from various places in the application, always by clicking on the photo.

Fig. 24 Photo gallery

At the bottom is the control panel, where you can rotate the photo and jump between photos using the arrows.

Clicking on a photo in the gallery opens a new window in which the photo is loaded in its maximum size and it is possible to zoom in (Zoom in) or zoom out (Zoom out), or set the default size (Reset zoom). Zoom change is for preview only, and will not be saved.

Zoom in | Zoom out | Reset zoom

2.1.5 Map

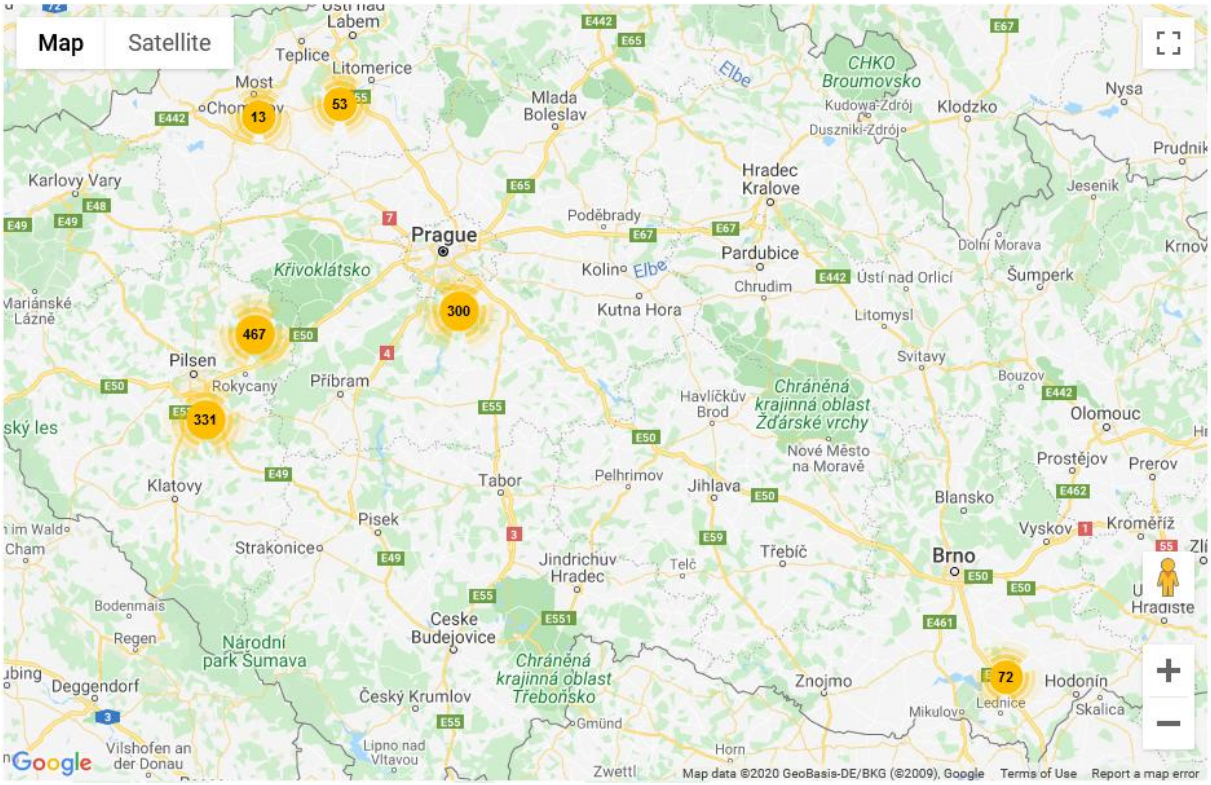


Fig. 25 Map

Points that represent photos or tasks displayed on the currently open page are always displayed on the map.

The zoom of the map is automatically set so that all points are visible in the displayed area of the map. The zoom can be adjusted manually (with the mouse wheel or using the control panel on the map).

The points are colour-coded according to the active status of the task. The colour of the points corresponds to the colour of the status in the task list. Points representing unassigned photos are not colour-coded.

Fig. 26 Task status list

Click on a map point to open the task detail..

Fig. 27 Map - a middle zoom

Due to the possible high concentration of points in a small area, the points are grouped into one group with a numerical expression of the number of points in a given place. Click on the group icon to zoom in on the group position.

As you zoom in greatly on the map, points are changed to preview banners that display a specific user, the name of the task, the photo and the radius of the camera view at the time the photo was taken. Clicking on this banner opens the following task detail.

Polygons of existing plots and their names are also shown.

Fig. 28 Map – detail zoom in

2.2 Administrator

After logging in, the user management page is displayed. Graphically and functionally, the application is the same as in the approach for users.

In the administrator access, controls are added as described below.

2.2.1 User management

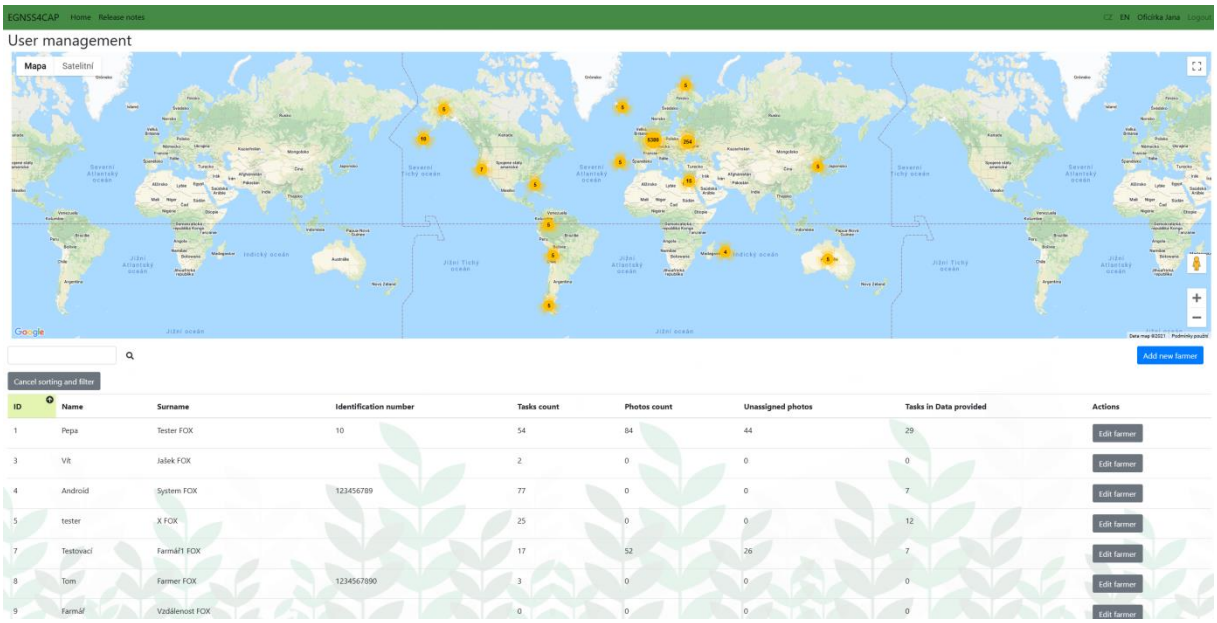


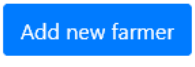
Fig. 29 User management

At the top is a map with all the tasks of all farmers. At the bottom is a list of farmers.

The following options can be used:

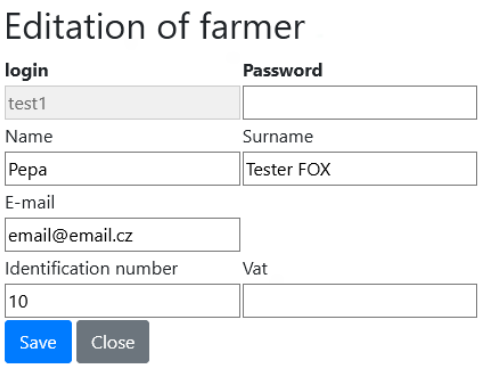
1. Search for a farmer according to the entered text 
2. Sort farmers in the list by the selected column (by clicking on the column heading)

3. Open farmer detail

4. Add a new farmer 

    - By clicking on the button, a table is displayed in which it is necessary to fill in the data of the new farmer. The creation of a new farmer is confirmed by pressing the *Save* button.

- The entered login and password will be used by the farmer to access the application.



5. Edit an existing farmer 

   - Clicking the button displays the same table as when creating a new farmer. In this case, the table is pre-populated with the data of the selected farmer. The data can be edited in the table (except for the login) and their modification can be confirmed with the *Save* button.
   - If the password field is left blank, the password remains the same.

2.2.2 Farmer Detail

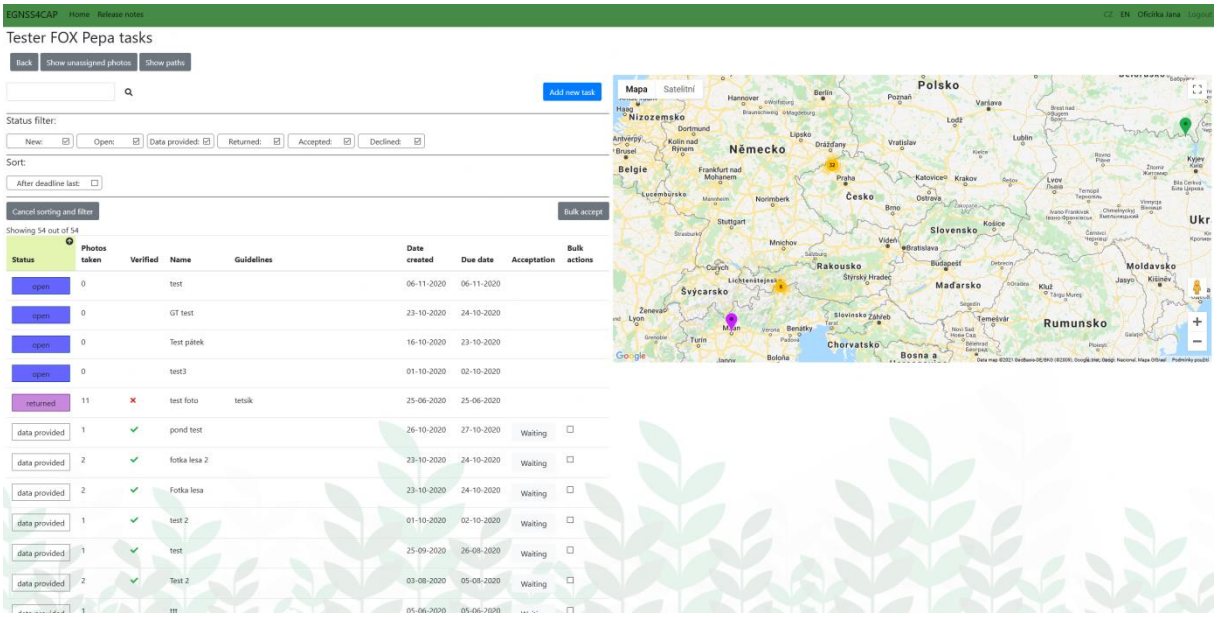
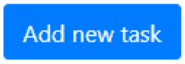


Fig. 30 Tasks - Administrator

This page is the same as in the farmer's approach, extended by the following:

1. New task 

   - Clicking on the button displays a table in which it is necessary to fill in the data of the new task. The creation of a new task is confirmed by pressing the Save button. A new task is

created with the status "*new*".

2. Bulk task approval function
    - To perform a bulk approval, you must first mark the tasks to be approved. By checking the box for the required tasks in the right column of the table.
    - Only tasks with the status "*data provided*" can be approved.
    - After pressing the Approve in bulk button, a dialog box is displayed, where after pressing the OK button, the bulk action will be performed.
    - Approval of tasks changes their status to "*data checked*" and the acceptance status to "*Approved*".
3. Photos
    - The *Examined* column graphically shows whether the photo checks were OK or not.
    - This involves checking the correctness of the position and checking the originality of the photo.
    - Complete control information is displayed in the task detail for each photo.

2.2.3 Task Detail

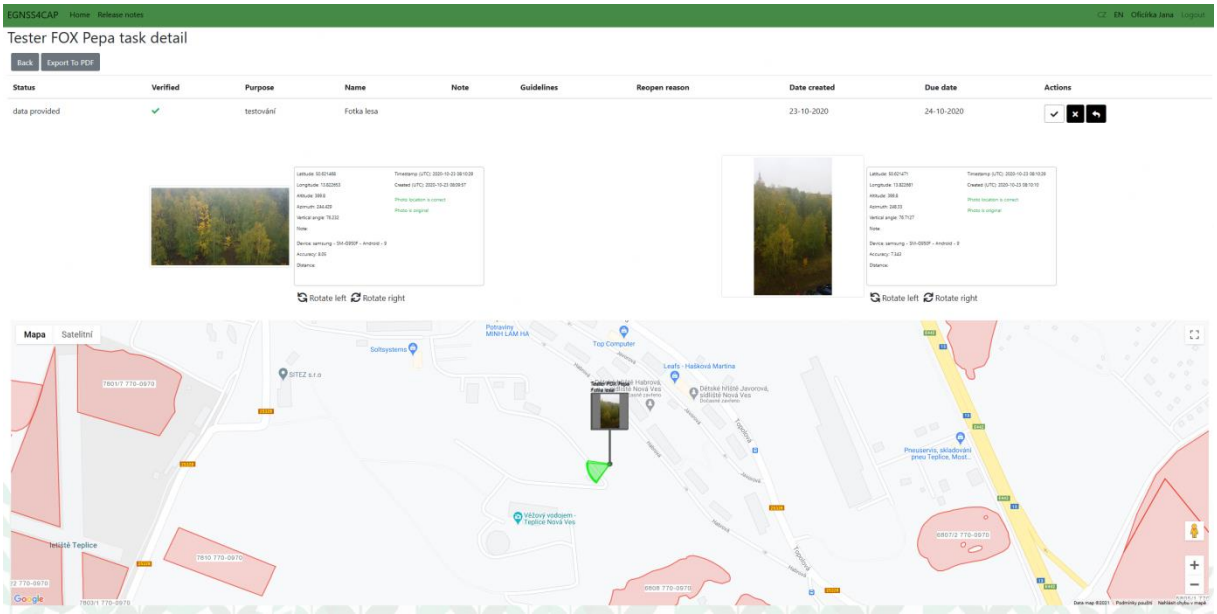


Fig. 31 Task detail – Administrator view

This page is the same as in the farmer's approach, extended by the following:

1. Actions
    a. Approve 
        - This action is available with the status "*data provided*", and allows you to approve a task.

- After pressing the *Approve* button, a dialog box is displayed, where after pressing OK the action is done
- The result of the action is the setting of the status "*data checked*" and the reception status "*Approved*".

b. Reject 
   - This action is available with the status "*data provided*", and results in the rejection of a task.
   - After pressing the *Reject* button, a dialog box is displayed, where it is possible to enter a comment for rejection, and after pressing OK, the action will be performed.
   - The result of the action is the setting of the status "*data checked*" and the acceptance status "*Rejected*".

c. Return to farmer 
   - This action is available with the status "*data provided*". It allows you to return the task to the farmer for completion.
   - After pressing the Undo button, a dialog box is displayed, where it is possible to enter a comment to be undone, and after pressing OK, the action will be performed.
   - The result of the action is the setting of the status "*returned*".

d. Move to "*data provided*" 
   - This event is available with an "*open*" status. It allows you to move the task to "*data provided*" status.
   - After pressing the *Move* button, a dialog box is displayed, where it is possible to enter a comment, and after pressing OK, the action will be performed.
   - The result of the action is the setting of the status "*data provided*".

e. Delete 
   - This action is available with the status "*new*". It allows you to delete a task.
   - After pressing the Delete button, a dialog box is displayed, where after pressing OK the action is performed.
   - The result of the action is deleting of the task.

2. Verification of photos
   - The *Examined* column graphically shows whether the photo checks were OK or not. This involves checking the correctness of the position and checking the originality of the photo.
3. View complete photo review information
   - The table of photo data shows the results of the performed checks in colour.