

# Application CREDO Detector

User's Guide



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# Agenda

TOPICS  
DISCUSSED



## INSTALLATION

Where to download the applications, permissions and what is required

## REGISTRATION

Methods and stages of account creation

## HOW IT WORKS

Application settings and how to detect particle tracks

## PROBLEM SOLUTIONS

Most common problems and their causes

## ADDITIONAL MATERIAL

Additional sources of knowledge and capacity



# INSTALLATION OF APPLICATIONS

Preliminary information

**CREDO**  
THE QUEST FOR THE UNEXPECTED



## PHONE REQUIREMENTS

Android, version 4.0 +  
Working camera, Wi-Fi

## DOWNLOADING THE APPLICATION

<https://play.google.com/store/apps/details?id=science.credo.mobiledetector>

## NO ANDROID?

An iPhone app (Beta) is also available

<https://apps.apple.com/pl/app/credo-detector/id1598629085>

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# INSTALLATION OF APPLICATIONS

Required system rights

## CAMERA

To be able to take pictures while the application is running, it only works when the matrix is sufficiently covered.

## LOCATION

Information about this is needed for offline analyzes - e.g. searching for device correlations in a given region.

## MEMORY/DISK

Saving and displaying detected detections. After 10 days, the images are deleted from the device's hard drive.

## NETWORK

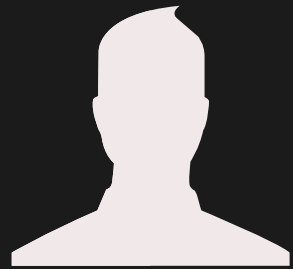
Communication with the base every 10 minutes, the so-called ping (confirmation that the application is still working) and sending detections.

## DISPLAY OVER OTHER APPLICATIONS

The application cannot run in the background



# Data to be completed



Login  
(username)



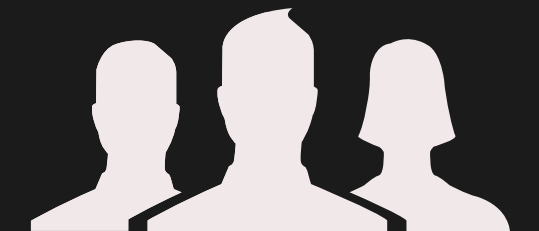
Email



Password x2



Display name



Team

# When registering, never enter your Email address as your login because

The login (username) is used to create a user subpage on [api.credo.science](https://api.credo.science) and can be accessed via the link:

<https://api.credo.science/web/user/username/>

example:

<https://api.credo.science/web/user/smph-kitkat/>

The screenshot shows the user profile page for 'smph-kitkat' on the CREDO website. The page includes a navigation bar with links for Home, Change password, Create account, CREDO project, and FAQ. The user's team is listed as 'IFJ'. The profile shows 'Number of detections: 119906 (16th place)' and 'Time looking for particles: 9597h 46m (29th place)'. Below this, there is a section for 'User detections' with a table listing individual detection events.

date	img
2021-03-29 15:34:58.636	
2021-03-29 15:17:30.536	
2021-03-29 14:58:53.027	
2021-03-29 14:55:54.956	
2021-03-29 14:53:47.878	
2021-03-29 14:51:24.539	
2021-03-29 14:43:16.842	
2021-03-29 14:41:22.997	
2021-03-29 14:29:21.770	
2021-03-29 13:46:55.737	



# Possible problems

with registration

## LOGIN OR E-MAIL EXISTS

If the user has not activated the account before, this message means that the login you entered already exists. Please try entering a different username.

## NO ACTIVATION MAIL

The activation link is sent by the server, so please check carefully all messages in your mail including the SPAM tab.

## ACTIVATION LINK EXPIRED

Activation is valid for 24 hours after which time registration must be renewed.

## REGISTRATION NOT SENT

To be able to register, access to the internet is required.



# Activation problem and re-registration using the same Email address

If someone tries to register an account with the same email, but the previous account has not been activated then the (temporary) details of the existing account (awaiting confirmation) will be overwritten by generating a new activation link to confirm the email.

It may happen that by the time registration confirmation email No. 1 arrives, someone has already tried to register again and the registration confirmation link to the email provided from the previous registration is invalid.

The message with the activation link is sent immediately, how quickly it appears in the mailbox depends on the security systems and firewall of the mailing company concerned.  
(addresses from the @gmail.com domain have the fewest problems)





# Possible problems

when logging in

## THE LOGIN OR EMAIL DOES NOT EXIST

Incorrectly entered login data, usually display name instead of username

## AUTHORISATION REQUIRED

The application needs to be granted permissions in order to function properly. If you did not grant them the first time, you can grant them in the settings -> Applications -> CREDO -> Permissions

## INCORRECT PASSWORD

The account entered exists but the password is incorrect - please note the case and special characters

## LOGGING NOT AVAILABLE

No Wi-Fi or mobile data (internet) enabled.



# Before Starting Be aware of the ENVIRONMENT

The operation of the unit may be affected by the environment in which it is located.

Therefore, care should be taken to ensure (as far as possible) constant ambient conditions such as:

1) Light level and temperature - do not place the equipment in a sunny place, e.g. by a window.

More sunlight also increases the temperature of the unit and destabilises it.

2) Keep away from potential radiation emitting devices (electrical appliances).

An unstable environment can affect

increase/decrease in detection and detect "background" instead of the particles we are looking for.

# Before starting Keep in mind **BATTERY LEVEL AND CONDITION**

The application consumes energy at a similar level to using the camera/camera (in movie recording mode). Because of this, rapid battery consumption occurs, so it is recommended to connect the device to a charger.

Continuous charging of the battery can reduce battery life, so remember to check the battery status and temperature regularly. For more advanced users, we recommend using additional applications such as the Battery Charge Limit to check the state of charge.

Battery Charge Limit.

# Before starting Remember to **COVER THE CAMERA**

By covering the lens, we eliminate the 'background' and 'noise' and ensure that only particles of high enough energy to penetrate the veil will reach the sensor - a characteristic that all particles of cosmic origin have.

The recommended, easiest and least problematic way to obscure the camera is to use a fridge magnet by placing it between the lens and the case (see photo opposite).

An alternative way is, for example, to use a piece of black tape or cardboard.



# APPLICATION AND DEVICE STATUS

The user is obliged to take care of the condition of the device when using the app. Therefore, it is recommended that you monitor the status of your phones while the app is running.

One such factor to monitor is

## **BATTERY STATUS**

The most ideal time (looking from the battery life side) is to use the app while your phone is charging regularly (when the battery is low through daily use of the phone) - when you need to charge the phone anyway.

It is also important to remember that continuous charging at 100% battery can affect the battery negatively. This is one of the reasons why it is advisable to use older devices for longer jobs

# APPLICATION AND DEVICE STATUS

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## DEVICE TEMPERATURE

It is advisable to control whether the temperature of the battery and the device casing is too high. To do this, you can set the max temperature in the app settings a few degrees lower than the maximum temperature acceptable for your particular phone model (battery temperature preferably < 40).

It is recommended to use passive cooling during longer app runs.

Note: The application automatically stops working at high temperatures - however, it is not able to stop charging the battery (one of the reasons for the heating of the equipment) and this can lead to battery damage if the high temperature persists.



# APPLICATION WORK PHASES

Phase 1



## CHECKING THE CORRECT CAMERA COVERING

This stage consists of checking the brightness (in greyscale) of a single image(frame) pixel by pixel and counting:

- (a) the average brightness of all pixels,
- (b) the number of pixels below the 'Black Factor' threshold.

If the average brightness of the pixels is below the 'Average Factor' and the Promille Count of the pixels below the 'Black Factor' threshold is higher than the 'Black Count' then the frame(camera matrix) is considered to be correctly obscured and proceeds to hit search (detection).

*Grey scale pixels can take a value from 0 to 255, where  
0 - corresponds to full black,  
255 - corresponds to the maximum value - pure white*

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# APPLICATION WORK PHASES

Phase 2

## SEARCHING FOR TRACES OF PARTICLES

The second stage involves searching for the brightest pixel in the entire frame (single image), then comparing its value to the 'Max Factor' value given in the settings.

If this pixel is brighter than the above-mentioned value, it is considered to be a hit (particle detection), it is then cropped together with the margin (so that the resulting slice is 64 x 64 pixels, in the older version 60 x 60 px) and sent to the server.

After this step, the fragment after the hit is cut is darkened (assigning a value of 0). In order not to miss cases where there is more than 1 hit on one frame, the algorithm starts again from the beginning (looking for the brightest pixel) .

On the other hand, if the value of a pixel is less than the "Max Factor", the application considers that the frame has no particles (hits) and finishes its work by moving on to the next frame.





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# Parameters of the Detector Algorithm

Editing of settings



## CROP SIZE

Specifies how large the image slice containing the detected event is to be (default value: 64). If the event occupies a larger area than the 'crop size' value then two slices are created from 1 event.

## MAX FACTOR [0 - 255]

Threshold above which a pixel is considered bright - an image with at least one bright pixel is considered to be a frame containing an event.

(Decreasing the Max Factor value increases the chance of an image being classified as an event - however, care must be taken to ensure that the application does not start counting the background as a detection). Recommended value: min. 70

## AVERAGE FACTOR [0 - 255]

Determines the maximum acceptable value of average image brightness needed to consider the camera sensor as covered. The lower the brightness, the higher the quality of the image and the clipping (black background).



# Parameters of the Detector Algorithm

Editing of settings



## BLACK FACTOR [0-255]

Specifies a value below which a pixel is considered dark(black).  
Condition used in checking a correctly covered camera.

## BLACK COUNT [0 - 1000]

Specifies the minimum number (in per mille) of black pixels - if there are less than the mentioned value in the whole frame then it will be skipped.

## AUTOCALIBRATION

Allows all threshold values to be set automatically before the next run of the application. The values are determined by analysing 500 frames.  
If for some reason the autocalibration does not work correctly, it is recommended to set the values manually - as will be explained later in this tutorial.



# Parameters of the Detector Algorithm

Editing of settings



## USE FULL RESOLUTION

It uses the full resolution of the camera to take photos. Unfortunately, often due to poor device statistics or too high a photo resolution, it leads to too long calculations and displays a "cover camera" error.

## MAX TEMPERATURE [C]

Specifies the maximum acceptable battery temperature - it is recommended not to specify a value greater than 40.

## TURN ON DETECTOR WHILE CHARGING

Allows the application to start and run only if the battery charging process is detected.



# Parameters of the Detector Algorithm

Editing of settings



## BATTERY LEVEL [0-100]

Specifies the minimum battery level at which the application can work.  
Default value: 60%.

## MAX CAMERA ON TIME [MIN]

Specifies the maximum time allowed for the application to work with the camera (without interruption). By default, it works all the time.

## PAUSE CAMERA TIME [MIN]

Specifies the break time of the application after the applications have worked for the maximum time without a break. The default is without a break.

# WARNING COVER CAMERA

## REASONS

The most common and reported problem in the current application. It appears at the stage of checking the correct camera coverage and is caused by the failure to meet the requirements and conditions necessary to consider the lens as covered.

The object is considered unobscured when the received frames from the camera are not dark enough.

Sometimes on some models the problem arises when you use the option "use full resolution" in such a case the reason is: the limitations of the device and its components, or more precisely, too long time to analyze the entire frame at high resolution.

# COVER CAMERA

## SOLUTION

The following solutions are for cases where you are 100% sure that the rear camera is covered by an impervious material. After each step, go back to the detector, turn on detection and see if the "cover camera" problem still appears.

First, go into the app settings and check if you have the "use full resolution" option turned on. - if so, turn it off.

The next step, which can help solve the problem, is to change the values of the following variables in the application settings:

- **Average factor, Black Factor** - increase the values keeping in mind, however, that increasing these values too much will make the application start detecting background and noise from the device.
- **Black count** - manually set a low value, e.g. 0, 10.

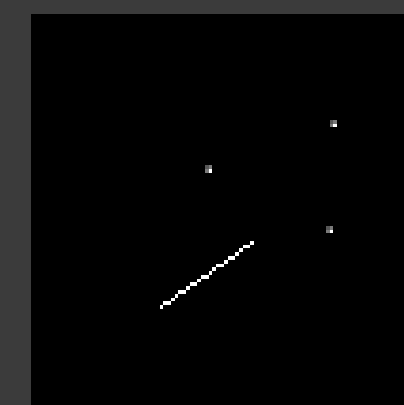
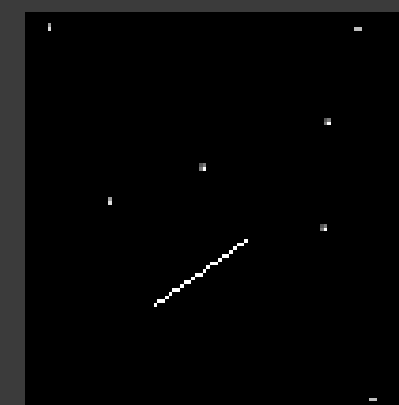
# PROBLEM WITH DETECTS

## REASON

With the development of technology, camera software becomes more sophisticated and removes from the frames (images) all the individual small traces that do not match the environment. This process is carried out before the image is transmitted to the user. As a result, the application gets the photo after the software filter and, depending on the level of interference, the image has all the traces that will be created on it or is somehow or completely cleared of them.

This fact makes on the latest devices strongly visible a decrease in trace detection compared to older models where the software is not as advanced.

It is worth taking into account the fact that the purpose of the camera software is to create the best possible photo and not to faithfully (accurately) convey what it obtains at the "input".



A visual representation of what a picture might look like depending on the level of software interference with the image.

- Top: no interference,
- Left: removing points where only one out of 8 adjacent pixels is bright,
- Right: removing cases where bright points only form a point.

# MOST COMMON SHAPES OF GOOD PARTICLE TRACES

## Features of good traces

- Dark image, predominance of dark (black) pixels and a small number of bright pixels,
- Visible contrast between background and trace,
- Shape dependent on the way the dies are struck
  - *Perpendicular - dot (spots),*
  - *at an angle - dash (tracks),*
  - *reflection - curved track (worms),*
- *Possible occurrence of two particles in one slice.*

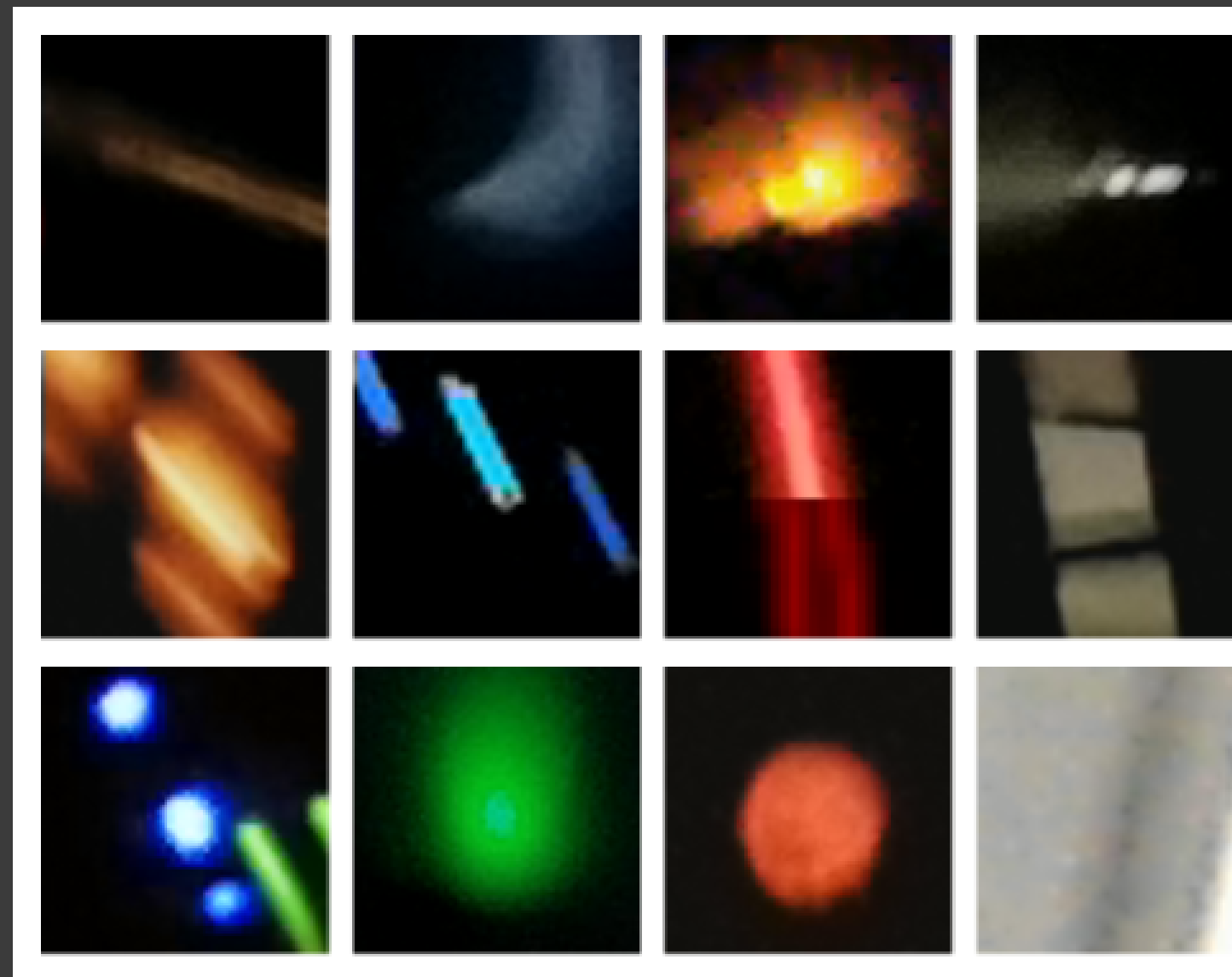




# EXAMPLES OF BAD TRACES ARTIFACTS

## REASONS FOR ARTIFACTS

- *The main reason is user interference by not covering the camera, manipulating settings and application thresholds,*
- *Close location of radiation source, emissions,*
- *Unstable environment (sudden changes in lighting, etc.).*





# CREDO Detection Base



## DATA STORAGE

The detection database from the CREDO Detector application is located on the servers of the Academic Computer Center Cyfronet AGH.

## DETECTION PREVIEW

Possible from the website - mainly image viewing, general statistics viewing: <https://api.credo.science/web/>

## DOWNLOAD DETECTION

- Access granted by writing an email to [contact@credo.science](mailto:contact@credo.science) or [credodetector@credo.science](mailto:credodetector@credo.science)
  - In the email (used for registration) you should write why and for what you want to use the data and your account information.
- Once granted, you will be able to download detections using the appropriate scripts available in the project's repository on GitHub: <https://github.com/credo-science/credo-api-tools>

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# Additional materials and useful information



## HOW TO START

<https://credo.science/#/how-to-start>

## TUTORIAL

<https://credo.science/#/detector/tutorial>

## WEBSITE

<https://credo.science>

## INTERNALL

<https://redmine.credo.science>

## FANPAGE

<https://www.facebook.com/credo.science>

# **ADDITIONAL MATERIALS**

ANSWERS TO USERS' QUESTIONS

# IS THE CREDO DETECTOR 2 APPLICATION ALREADY IN A WORKING PHASE OR JUST A TEST PHASE?

Credo Detector 2 is a working version whose detections reach the base but is the **ONLY** test version of the application that was intended to replace the first version and that was supposed to solve the detection problem on newer devices.

Due to the fact that the application solves the problem only on a small group of problematic devices the application remains in the test phase.

There are no plans to replace the official version with this version.

# WHICH VERSION OF THE APPLICATION SHOULD I INSTALL CREDO DETECTOR OR CREDO DETECTOR 2?

We recommend using the Credo Detector application,  
it is for this moment (2023) the only official version .

You can use the Credo Detector 2 version ,  
however, please note that it is a test version with no plans for its development.

Both versions send data to the CREDO Detector database,  
but only the official version measures the operating time of the device

# WHY DOES THE APP NEED TO HAVE CONTINUOUS ACCESS TO WIFI, WHETHER WIFI CAN BE TURNED OFF WHILE THE DEVICE IS RUNNING.

WiFi access is needed for the application to communicate with the base. Communication occurs when a trace is detected or every 10 minutes (since the last detection).

In case of lack of WiFi access or communication problems with the base  
The application will save what has not been sent in the device's memory  
and will send when WiFi access is obtained.

The mere fact that there is no internet should not stop the application from working.

WiFi access is necessary at the stage of accessing your account before starting a trace search.

# WHAT TO USE TO COVER THE CAMERA MATRICES? CAN I USE CARDBOARD FROM A TETRAPACK? (WITH ALUMINUM FOIL UNDERNEATH)

The most proven methods of covering the matrix are  
Fridge magnets, black tape.

The main purpose of covering the lens is to cut off the matrix from the light,  
if a given material does this, does not disturb and does not create any "background particles" in the  
process  
then it is ok and can be used.

In the most economical version, you can use a sheet of paper folded several times  
and put it between the lens and the case of the device.

You can ask representatives of the project about refrigerator magnets with the CREDO logo  
At various popular science events such as the  
Night of Scientists or Science Festival.



# IS IT POSSIBLE TO DEDUCE FROM THE MAIN SCREEN OF THE APPLICATION (NUMBER OF DETECTIONS IN THE LAST 10 DAYS) WHAT WILL BE THE AVERAGE WAITING TIME FOR A HIT?

No.

The mentioned information only shows the number of all detections of the last 10 calendar days and not 10 days of non-stop operation.

The information itself about the average time to wait for a hit is not in the application.

You can try to estimate how often detections occur e.g. by observing your account at [api.credo.science](https://api.credo.science)

BUT

For the average time calculation to be reliable you would need statistics from a sufficiently long time of operation of a given model (taking into account the time of day and year).

# THE DEVICE HAS PROBLEMS WITH THE OPERATION OF THE APPLICATION ITSELF - NON-OBVIOUS STOPPING OF THE APPLICATION. WHAT COULD BE THE REASONS FOR THIS?

The application usually stops for the following reasons:

- **Battery temperature has exceeded the maximum temperature allowed for the application to work** in the settings you can specify, (safe below 40) is due to the fact that some devices heat up a lot when charging and using the camera at the same time - then it is worth thinking about some passive cooling (it is also worth remembering that the application, even when it stops, does not turn off the process of charging the battery - which can still keep the temperature high)
- **Screen lock** (Recommended to use the "turn off screen" button, which reduces the pixel light to a minimum and to black - this is not such a "real" screen off because it will always turn off the device's camera.
- **Background apps** - when running apps, it is best if nothing is running in the background.
- **Too low battery** - recommended continuous charging or cycling.

# IS IT POSSIBLE TO POSSIBLY CHANGE THE DETECTION TEAM, E.G. JOIN A NEWLY CREATED TEAM?

In the CREDO Detecor app for Android, you can make changes  
In the upper right corner, click on the three-dash button,  
then on the options "Team and name" and enter the name of the team

Currently (2023) there is no such option on IOS therefore you can use the form  
[https://user.credo.science/user-interface/new/#/change\\_team](https://user.credo.science/user-interface/new/#/change_team)

In the form It is necessary to provide  
username, password, display\_name and the new team name

After the change, the update should be visible on the subpage of the user in question.

# WHAT IS THE DIFFERENCE BETWEEN USERNAME AND DISPLAYNAME?

Username is a unique account name, often used to identify an account .

It is used to create / preview the user's subpage on api.credo.science

[https://api.credo.science/web/user/\[username\]/](https://api.credo.science/web/user/[username]/)

e.g. for an account where the username is "test"

<https://api.credo.science/web/user/test/>

Whereas displayname is the account name visible to other people,

It is used in rankings or user lists, e.g. on [https://api.credo.science/web/user\\_list/](https://api.credo.science/web/user_list/).

The display name does not have to be unique.

# DOES CHANGING THE VALUE IN THE SETTINGS (TO INCREASE THE NUMBER OF HITS) WILL NOT REDUCE THE SCIENTIFIC VALUE OF THE DETECTIONS RECEIVED?

It is possible and even recommended to test and change the values in the settings - even if artifacts fall into the server, you do not have to worry too much about it - offline filters (used before analysis) should cope with detections that do not match the rest.

Make sure that the traces obtained in the application are visible and significantly distinctive from the background - then you should be ok.

It is also important not to underestimate the max-factor value (brightest pixel) too much, because if the trace is too weak, so that even one pixel does not have a brightness, for example, greater than 60 / 70 (on a scale of 0-255), then offline filters during analysis may not let them through, considering that there is no trace (or it is too weak, dark) on a given slice.

# IS IT BETTER TO KEEP THE DETECTOR BY THE WINDOW (ON THE WINDOWSILL)?

For constant operation: better not.

The most important thing during the work of the application is to ensure a fairly constant environment,

Therefore, the windowsill, next to the window is not a good place.

Leaving it on the windowsill by the window can lead to rapidly changing operating parameters of the device like temperature or lighting.

At night darker and cooler, during the day higher temperature, more brightness at the window.

There is also the issue of what the window sill is made of, some window sills can be a source of light (not dangerous) radiation, (which the application will pick up due to the proximity of the source)

## FROM AN EXPERIMENTAL STANDPOINT, DOES IT MAKE MORE SENSE TO KEEP THE DEVICE OUTDOORS OR INDOORS?

Ideally, the data is provided from a single location with as constant conditions as possible. For example, in a room where the room temperature, ambient conditions do not change rapidly. Outside, the number of detections will vary noticeably from time of day or weather. If the device will be in operation, for example, for a year where conditions change every now and then, it can strongly distort the results of statistics for such a device.

BUT

such a solution would be good for devices that work periodically (no chance for long-term statistics) or generally for tests, experiments e.g. to gather preliminary information on how a particular factor affects the results.

# WHAT EXERCISES / EXPERIMENTS CAN I DO ON MY OWN AT HOME?

The easiest exercise/experiment to do on your own is to observe the frequency of detection under changes in environmental parameters. It is best to use more devices for observation (decrease, increase detection on several devices gives us greater statistical accuracy).

Example locations of devices:

- 1) one away from the window and light VS one near the window VS one outside.
- 2) one by the window covered with blinds VS one by the window uncovered
- 3) one on the side where the sun is until noon VS one on the side when the sun is after noon
- 4) daytime work VS nighttime work
- 5) sunny day VS rainy VS foggy day
- 6) compare the average number of data winter VS spring VS summer

Doing experiments on your own, it is also a good idea to collect additional information such as ambient temperature at the device, sunshine, humidity - and regularly record e.g. google document, excell and then make graphs.



# WHY THE TIME REPORTED BY THE SERVER (AFTER SEVERAL DAYS OF OPERATION) IS DIFFERENT FROM THE TIME THAT HAS PASSED.

The working time of the application is calculated on the basis of requests (pings) which are sent every 10 minutes (or when detection is detected) - if the device works all the time, the working time should correspond to the actual time of the enabled application. Differences in time can be due to

- **Interruption of the application before sending.**

For example, the last ping was sent today at 12:00 and we turned off the application at 12:05 - in this case the system has no information about the last few minutes of operation.

- **Application interruptions when the battery has a high temperature**

If the device has a temperature higher than the maximum temperature specified in the settings then the application will wait until the temperature drops below this temperature.

The "waiting" time does not count towards the application's operating time.

## THE APPLICATION FREQUENTLY FREEZES - WHY?

The most common reason for apps stopping on a device with a well-covered matrix is the device's high temperature - or more precisely, the battery temperature exceeding the maximum temperature at which we agree to run apps.  
*(The maximum temperature can be changed in the application settings).*

It is generally accepted that the battery temperature should not be higher than 40 degrees. However, from numerous tests we can see that only "fresh" phones in the first months / years are able to with continuous and long charging (even without using any application) have a temperature lower than 40.

Older devices are rather rarely able without additional cooling to have such a temperature on a long charge.

It also doesn't help that old devices are often charged with new chargers with higher amperage (old usually 1A, new 2-3A).

# HOW TO CHECK THE MAXIMUM BATTERY TEMPERATURE REACHED BY THE DEVICE WHEN IT IS NOT USING THE APPLICATION.

In order to determine to what temperature our device heats up during charging, it is necessary to take temperature measurements using an additional application.

Example:

We assume that our device will work 15 hours each day.

So we run a temperature measurement app (preferably one that creates graphs - such as bamowi) and then we connect the device to charge for 15 hours.

After that time, we check the battery temperature graph, look for the maximum and in the CREDO Detector app we set the temperature a few degrees higher from the maximum obtained with charging only.

If the maximum temperature on charging exceeds the value we don't want to exceed, the only solution will be to take care of passive cooling (such as the kind for laptops).

It is also a good idea to check on the first (longer, e.g., 15 hours ) run of the application, what temperatures will be reached.

# HOW TO SOLVE THE PROBLEM OF HIGH BATTERY TEMPERATURE IN THE DEVICE

The way to deal with high temperatures during charging or application operation is to  
Ensuring adequate cooling of the device.

This can be done by using:  
passive cooling (heat sinks)  
active cooling (external cooling system like for laptops)

You can also try to provide more air circulation by using pads to make the device not lie with its entire  
surface on the table.

# HOW TO ACCESS THE DATA? AND HOW TO DOWNLOAD AND READ DETECTION DATA?

You should contact CREDO Science Coordinator ([credodetector@credo.science](mailto:credodetector@credo.science)) and describe why do you want access and what are you going to do with the data. Remember to include your username and send the message from email address you used during registration.

Documentation on how to download detection data and how to start reading the data can be found at:  
[https://user.credo.science/user-interface/credo\\_data\\_tools/doc/download\\_detections/](https://user.credo.science/user-interface/credo_data_tools/doc/download_detections/)