

APPLICATION

# CREDO DETECTOR

User guide

# LIST

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## OF SUBJECTS TO BE DISCUSSED

INSTALLATION

REGISTRATION

WORKING METHOD OF THE APPLICATION

SOLUTIONS TO PROBLEMS

ADDITIONAL MATERIALS



# INSTALLATION

## PHONE APPLICATION 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 application for iPhones is also available at  
<https://cosmicrayapp.com>

# REQUIRED PERMISSIONS

## CAMERA

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To be able to take photos while the app is running, it only works if the sensor is sufficiently covered.

## LOCATION

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This information is needed for offline analysis - e.g. looking for device correlations in a region.

## MEMORY/DISK

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Saving and displaying of detected detections. After 10 days the images are deleted from the device disk.

## NETWORK

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

# REGISTRATION

DATA TO BE COMPLETED



Login  
(user name)



Email



Password x2



Display name



Team

# WHEN REGISTERING, NEVER USE YOUR EMAIL ADDRESS AS YOUR LOGIN

because

The login is used to create a user subpage on the  
api.credo.science website and is available under  
the link: <https://api.credo.science/web/user/login/>

example:

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

Home Change password Create account CREDO project FAQ

**CREDO**  
THE QUEST FOR THE UNEXPECTED

smph-kitkat

Team: [LE](#)

Number of detections: 119906 (16th place)

Time looking for particles: 9597h 46m (29th place)

[User detections](#)

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 DURING REGISTRATION

## LOGIN OR EMAIL ALREADY EXISTS

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If you have not activated your account before, this message means that the login you entered is already taken.

Please try entering a different username.

## NO E-MAIL WITH LINK TO ACTIVATION

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

## ACTIVATION LINK EXPIRED

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Activation is valid for 24 hours after which time you must re-register.

## REGISTRATION NOT SENT

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You need internet access to register.

# PROBLEM WITH ACTIVATION AND RE-REGISTRATION USING THE SAME EMAIL ADDRESS

If someone tries to register an account with the same e-mail, but the previous account has not been activated, the data of the existing account will be overwritten and a new e-mail confirmation link will be generated. It may happen that before the email with a confirmation of registration no. 1 arrives, someone will have already tried to register again and the email confirmation link from the previous registration will be invalid.

The message with the activation link is sent immediately, how quickly it appears in your mailbox depends on the security systems and firewalls of the relevant mailing company.



# POSSIBLE LOGIN PROBLEMS

## THE GIVEN LOGIN OR EMAIL DOES NOT EXIST

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Incorrect login details, usually display  
name instead of user name

## INCORRECT PASSWORD

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The given account exists, however, the  
password is incorrect - remember about  
the case of letters and special characters

## REQUIRED PERMISSIONS

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The application needs to be granted  
permissions to function properly. If they  
were not granted at the first launch, they  
can be granted in  
settings -> applications -> CREDO ->  
Permissions

## LOGIN UNAVAILABLE

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No Wi-Fi turned on or  
no mobile data (internet).

# BEFORE STARTING, REMEMBER ABOUT

## ENVIRONMENT

The operation of the device can be disturbed by the environment in which it is located. It is, therefore, necessary to ensure constant environmental conditions such as light level, temperature and keep away from potential radiation emitting devices (electric appliances). An unstable environment can increase the detection rate and detect "background" instead of the particles we are looking for.

## BATTERY LEVEL

The constant use of the app with the camera will quickly drain the battery, so it is recommended to monitor the battery level or even connect to a charger while the app is running.

# BEFORE STARTING, REMEMBER ABOUT COVERING THE CAMERA

By covering the lens, we eliminate the "background" and make sure that only particles with a high enough energy to break through the veil reach the sensor - all particles of cosmic origin have this feature.

The recommended, easiest, and least problematic way to cover the camera is to use a fridge magnet, placing it between the lens and the case (as in the picture on the right).

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





# APPLICATION AND DEVICE STATUS

Research for the CREDO project using as many devices as possible is very important. However, the most important thing is the condition of your device. Therefore, it is recommended to monitor the status of the phones while the application is running.

The two main factors to be monitored are

- **Battery status** - The most ideal moment (looking from the battery life side) is to use the app while the phone is charging regularly (when the battery is low through daily use of the phone) - when you need to charge the phone anyway. Also, keep in mind that continuous charging at 100% battery can negatively affect the battery - especially on devices that do not have support for this case.
- **Device temperature** - It is recommended to check if the temperature of the battery and the device case is not too high. For this purpose, it is possible to set the max temperature in the application settings a few degrees lower than the maximum acceptable temperature for a given phone model. Information about acceptable temperature should be in documentation of the device during which the application works.

# APPLICATION WORKING STAGES

## CHECKING THAT THE CAMERA COVER IS PROPERLY

This stage consists of checking the brightness 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 is below the "Average Factor" and the number of pixels below the "Black Factor" threshold is higher than the "Black Count" then the frame(camera matrix) is considered to be correctly covered and goes to hit (detection) search.

## SEARCHING FOR PARTICLE TRACKS

The second step is to find the brightest pixel on the whole frame (single photo), then compare its value to the "Max Factor" value given in the settings.

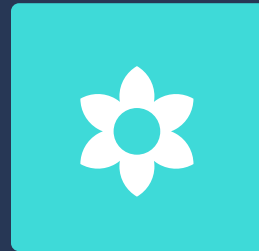
If this pixel is brighter than the value mentioned above, it is considered a hit (particle detection), then it is cut together with a margin (so that a 60x60px slice is created) and sent to the server.

After this operation, the fragment after the detection is cut out is darkened (assigned the value 0) and the algorithm starts again from the beginning (search for the brightest pixel).

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

# DETECTOR ALGORITHM PARAMETERS

Edit settings



## CROP SIZE

Defines how large the image slice containing the detected event should be (default value: 60). If the event is larger than the "crop size" value, two slices from one event are created.



## MAX FACTOR [0 - 255]

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

(Decreasing the Max Factor value increases the chance of classifying an image as an event - but be careful not to start counting the background as a detection).

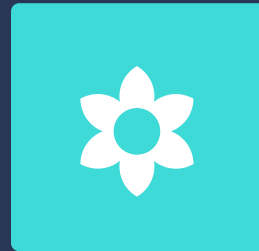


## AVERAGE FACTOR [0 - 255]

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 slice with detection (black background).

# DETECTOR ALGORITHM PARAMETERS

Edit settings



## BLACK FACTOR [0-255]

Specifies the value below which a pixel is considered dark (black). Condition used to check a properly covered camera.



## BLACK COUNT [0 - 1000]

Specifies the minimum number (in per mille) of black pixels - if there is less than this value on the whole frame, it will be ignored

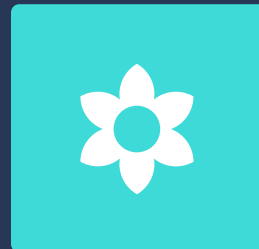


## AUTOCALIBRATION

Allows setting all threshold values automatically before running the application. The values are determined by analyzing 500 frames. If for some reason it does not work properly (e.g. setting too strict thresholds) it is recommended to do a manual calibration - which will be explained later in this guide.

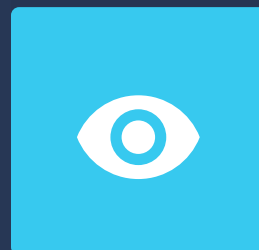
# GENERAL PARAMETERS DETECTOR

Edit settings



## USE THE 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 leads to too long calculations and displays a "cover camera" error.



## MAX TEMPERATURE [C]

Specifies the maximum acceptable device temperature - it is recommended that you check the acceptable device temperature for your model or leave the default (safe) value : 60 C.



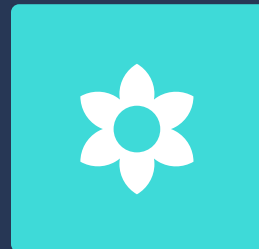
## SWITCH ON THE DETECTOR WHILE CHARGING

Allows the application to start and run only if a battery charge is detected.



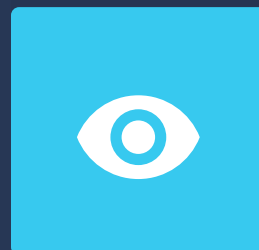
# GENERAL PARAMETERS DETECTOR

Edit settings



## BATTERY LEVEL [0-100]

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



## MAX CAMERA ON TIME [MIN]

It defines the maximum allowable working time of the application using the camera (without interruption). By default it works all the time.



## PAUSE CAMERA TIME [MIN]

Determines the duration of the application interruption after the applications have worked the maximum working time without interruption. By default, no break.

# COVER CAMERA

## CAUSES

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

An object is considered uncovered when the resulting camera frames are not dark enough.

Sometimes on some models the problem appears when we use the "use full resolution" option, in this case the reason is: the device and its components are limited, or more precisely, the analysis of the entire frame at high resolution is too long.

# COVER CAMERA

## SOLUTION

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The following solutions are for cases where it is 100% certain that the rear camera is covered by a non-transparent material. After each action, go back to the detector, turn on detection and check if the "cover camera" problem still appears.

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

Another step that may help solve the problem is to change the values of the following variables in the application settings:

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

# PROBLEM WITH DETECTIONS

## CAUSES

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

This fact makes that on the newest devices the decrease in the detection of traces in comparison with older models, where the software is not so advanced, is very noticeable.

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



A visual representation of how a photo may look depending on the level of software interference with the image.

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

# PROBLEM WITH DETECTIONS

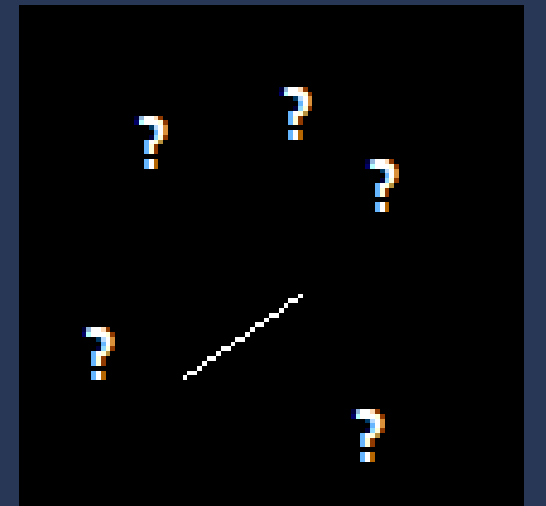
## SOLUTION

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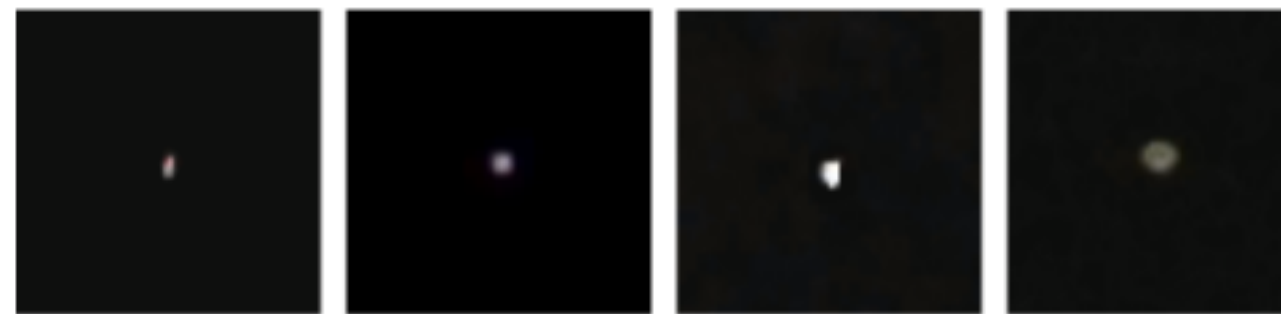
It is possible to try to reduce the "Max Factor" value in the settings, but it should be remembered that the application is able to detect "something" only if in the received image this "something" exists.

App developers are testing different solutions to make the app usable for everyone - if they are successful we will update as soon as possible.

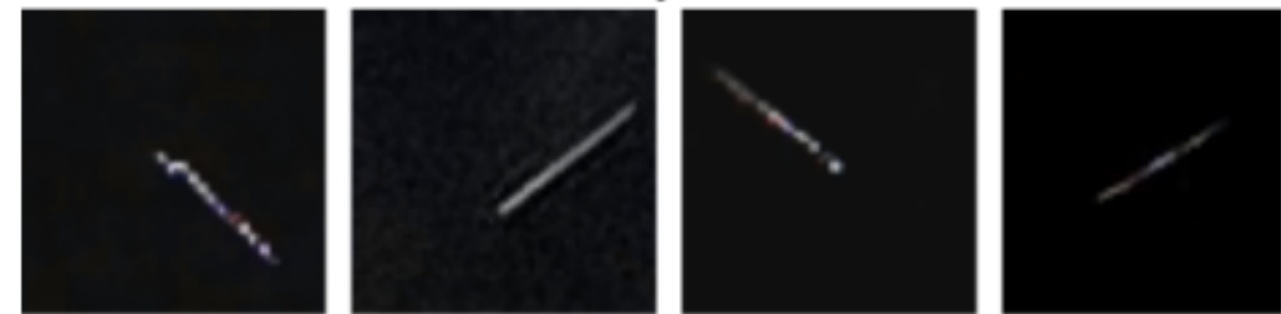
If you are a developer of Android applications and you are familiar with the topic of capturing images from the device's camera, we invite you to contact us ([credodetector@credo.science](mailto:credodetector@credo.science)).



# THE MOST COMMON SHAPES OF GOOD PARTICLE TRACKS



(a) spots



(b) tracks

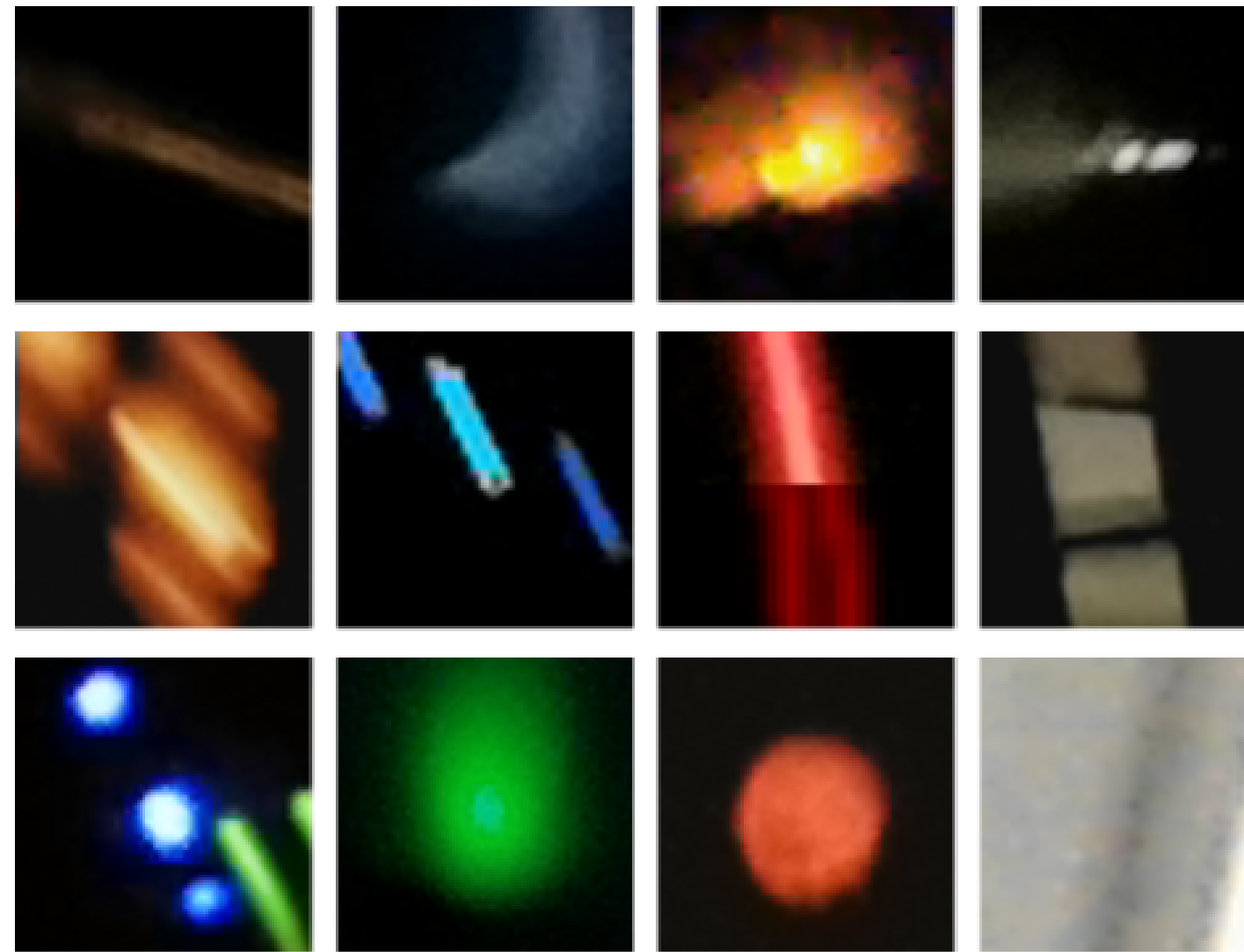


(c) worms

## FEATURES OF GOOD TRACES

- Dark image, the predominance of dark (black) pixels and a small number of light pixels,
- Visible contrast between background and track
- Shape depending on the impact on the matrices
  - perpendicular - dot (spots)
  - at an angle - tracks
  - reflection - curved line (worms)
- Possible occurrence of two particles in one slice

# EXAMPLES OF BAD TRACES OF DETECTION - ARTIFACTS



## REASONS FOR THE CREATION OF ARTIFACTS

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

# CREDO DETECTION BASE

## DATA STORAGE

- The detection database of the CREDO application (for Android) is located on the servers of the Academic Computer Centre Cyfronet AGH.

## DETECTION PREVIEW

- Possible from the website level - mainly images and statistics preview:  
<https://api.credo.science/web/>

## DETECTION DOWNLOAD

- Access granted by contacting the project helpdesk by e-mail: [credodetector@credo.science](mailto:credodetector@credo.science).
- In the e-mail (used for registration) it is necessary to write why and for what purpose one wants to use the data and information about one's account.
- Once granted, it will be possible to download the detections using the appropriate scripts available in the project repository on GitHub:  
<https://github.com/credo-science/credo-api-tools>



# Additional Material And Useful Information

**CREDO**

## HOW TO START

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

## TUTORIAL

<https://credo.science/credo-detector-mobile-app/>

## PROJECT WEBSITE

<https://credo.science>

## INTERNALL

<https://credo2.cyfronet.pl/redmine/>

## FANPAGE

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