CREDO Detector

Android Mobile Application

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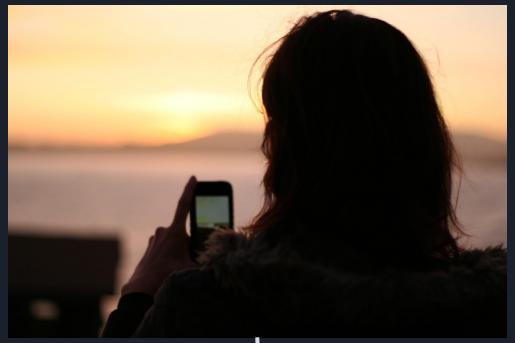
CREDO Project

Mobile Application

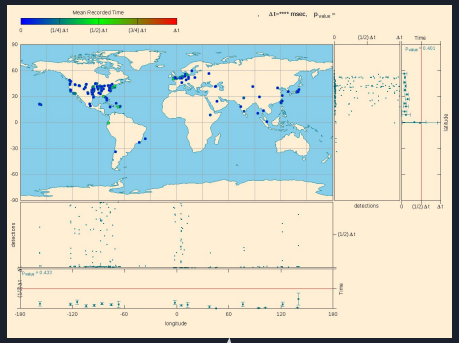


people detect hit and upload to server

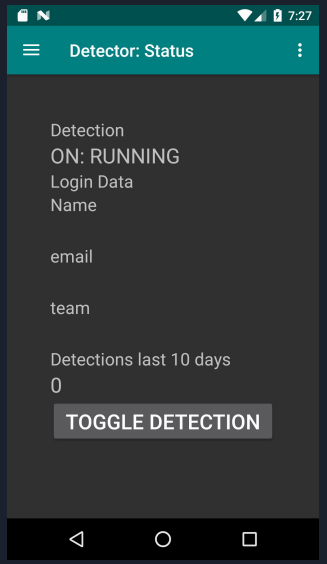
Server collect data

people classify hits and mark features

Zooniverse project



Use case



Prepare to participate in experiment:

1. Install mobile application your android smartphone.
2. Register.

Perform experiment:

1. Launch application and turn on detection.
2. Tightly cover camera and leave id (i.e. during battery charging all night).

Application detects hits and upload it to server. In addiction, application gets device location and orientation from BTS/GPS service and accelerometer sensor.

How it works

1. Particle form deep space hit on camera sensor.
2. Camera sensor detect it as small flashes (approx 5x5 px).
3. Algorithm process each camera frame and finds flashes.
4. When flash is found, algorithm cut it from frame with a close margin and upload to server.

Technical problems

Hardware problems:

1. Long time camera working may hang up device.
2. Charging + camera working + analysis algorithm = heating up the smartphone.
3. More expensive devices (such Galaxy S7) have hardware anti-noise filter.

Human factor:

1. Insufficient coverage of the camera.
2. Forget about turning on detection.
3. If the application is too difficult to use, people do not want to use it.

Problem solving

Long time camera working may hang up device

Hang up is rather device problem. Many cheap devices has unstable ROMs, especially devices with custom ROM. When camera hang up during normal usage then we can’t do a lot.

Proposal solution:

1. Periodically turn off and turn on detection,
   Sometimes camera hang out after few minutes but sometimes users must restart device,
2. Make statistics about hang ups and try to personalize detection periods to more stable,
3. Inform user about problem and encourage to change device,

Problem solving

Charging + camera working + analysis algorithm = heating up the smartphone

Charging heat up device battery but when charging is finished then battery going to cools down. Warming up the battery shortens its lifetime. Camera sensor and SoC heat up when working and causes high power consumption. Smartphone has passive cooling as opposed to active cooling in PC. In addition, covering the camera makes it difficult to dissipate heat. Hot smartphone can hang up, damage or even caught a fire. Power consumption may be higher than provided by charger so device will not be charged.

Proposal solution:

1. Android devices have temperature sensor battery state. We can turn off detection when temperature is too high or battery to low and turn on when temperature has dropped.
2. Inform users how to leave smartphone to avoid heating.

Problem solving

More expensive devices (such Galaxy S7) have hardware anti-noise filter

Cheap devices make worse photos because it has less advanced sensors. High-end devices has advanced anti-noise filter. Thanks to that, they take a great photos but they thwart our experiment. Weaker hits are filtered out by hardware anti-noise filter and can’t turn it by software.

Proposal solution:

1. Camera in the preview mode provides the most RAW-like image frames.

2. Tuning algorithm parameters for a specific device allows to detect something.

Problem solving

Insufficient coverage of the camera

Camera must be tightly covered. Hits will be visible only when camera is fully covered and don’t have any light from environment. User can think that covered good but some light can come through the gaps.

Proposal solution:

1. Algorithm can perform analyse of darkness of image frame. When it is to bright then can inform user by sound or vibration.

2. We are planning to provide dedicated camera covers with CREDO logo.

Problem solving

Forget about turning on detection

When user forget to turn on detection then we no get hits detections. We can turn on detection automatically (i.e. when charging) or notify user about experiment but when we are too pushy then user will be angry and uninstall application. We can use some of Context Awareness methods to inform or turn on and not be pushy.

Proposal solution:

1. Turn on/inform when user is at home and connect to charging device at night.

2. Turn on detection automatically at night when camera is covered i.e. smartphone lies the camera down and battery just charged.

Problem solving

If the application is too difficult to use, people do not want to use it

Usage of application must be easy. Application needs two actions from user: register/login and turn on/off detection with covered camera. In addiction, users want to see what they smartphones detect. A well-designed user interface and localization encourages user to use application.

Proposal solution:

1. Main activity of application:
    a. Login/register new user (only on new installation).
    b. Turn on/off detection button.
    c. Brief information about the experiment (when detection is turn off).
    d. Simple introduction how to cover camera and leave smartphone (when turn on).
    e. Short statistics about detections, and working time.
2. Second activities:
    a. View of detections.
    b. Settings (logout, algorithm parameters, working parameters).