



VisionLabs
MACHINES CAN SEE

Configuration Guide

written for LUNA SDK Mobile iOS version 5.25.0

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Configuration Guide

Configuration options are specified via `faceengine.conf` file which is basically an XML document with special tag formatting. The document itself is not required to exist, in this case FSDK will fall back to some default settings, which, however, may not be suitable for several tasks.

WARNING! By changing any configuration settings from default ones it is assumed that user understands what these settings do and how they will affect performance and output results of their application. The rule of thumb is this: DO NOT change anything in configuration file unless you really have to.

Always remember that incorrect config may huck the things up very badly. Pay attention to what you configure and how. Always double-check what you deploy.

Some configuration settings may be omitted due to their obscurity and research use case only.

The location where the config file is found varies across different systems but tries to be as consistent as possible.

The config file format is optimized for deserialization of several FSDK types:

- Int1 - scalar 32 bit integral numeric type
- Int2 - 2-d 32 bit integral numeric type (aka Vector2i, Size)
- Int3 - 3-d 32 bit integral numeric type
- Int4 - 4-d 32 bit integral numeric type (aka Rect)
- Float1 - scalar 32 bit floating point numeric type
- Float2 - 2-d 32 bit floating point numeric type (aka Vector2f)
- Float3 - 3-d 32 bit floating point numeric type
- Float4 - 4-d 32 bit floating point numeric type
- String - short null-terminated string (max. 16 characters including the null-terminator)

Configuration file location

The location where the config file is found varies across different systems but tries to be as consistent as possible. Path resolution is the following:

Mobile platforms

- Look for “`data/faceengine.conf`” in current working directory.

Settings

System settings

| Parameter | Description | Type | Default value |
|----------------|--|---------------|---------------|
| verboseLogging | Level of log verbosity. 1 - Errors, 2 - Warnings, 3 - Info, 4 - Debug. | "Value::Int1" | 2 |

Verbosity level sets the upper limit of what type of messages may be printed out by the Luna SDK. For example, if user set verboseLogging to 3, it means that Errors, Warnings and Info messages will be printed out to the console. Verbose level of 0 indicates that there are no logging messages printed out at all.

Example:

```
<section name="system">  
  <param name="verboseLogging" type="Value::Int1" x="0" />  
</section>
```

Descriptor factory settings

Descriptor factory is a facility that creates descriptor extractors and matchers. Both of them utilize algorithms that require a number of coefficients (“weights”) to operate properly.

| Parameter | Description | Type | Default value |
|-----------------------------|--|---------------|---------------|
| model | CNN face descriptor version. Possible values: 59 | Value::Int1 | 59 |
| useMobileNet | MobileNet is faster but less accurate. Possible values: 0 - don't use mobile net version, 1 - use mobile net version. | Value::Int1 | 1 |
| distance | Distance between descriptors on matching. L1 faster, L2 make better precision. Possible values: L1, L2. Model 59 supports just L2 distance. | Value::String | L2 |
| descriptorCountWarningLevel | Threshold, that limits the ratio of created descriptors to the amount, defined by your license. When the threshold is exceeded, FSDK prints the warning. | Value::Float1 | 0.9 |

Example:

```
<section name="DescriptorFactory::Settings">
  <param name="model" type="Value::Int1" x="59" />
  <param name="useMobileNet" type="Value::Int1" x="1" />
  <param name="distance" type="Value::String" text="L2" />
  <param name="descriptorCountWarningLevel" type="Value::Float1" x="0.9" />
</section>
```

FaceDetV2 detector settings

| Parameter | Description | Type | Default value |
|-------------------|--|-----------------|---------------|
| FirstThreshold | 1-st threshold in [0..1] range. | "Value::Float1" | 0.6 |
| SecondThreshold | 2-nd threshold in [0..1] range. | "Value::Float1" | 0.7 |
| ThirdThreshold | 3-d threshold in [0..1] range. | "Value::Float1" | 0.6 |
| minFaceSize | Minimum face size in pixels. | "Value::Int1" | 50 |
| strictlyMinSize | Enforce Minimum face size. | "Value::Int1" | 0 |
| scaleFactor | Image scale factor. | "Value::Float1" | 0.7 |
| padding | Extension of rectangle. Do not change. | "Value::Float4" | see below |
| redetectTolerance | Redetection threshold. | "Value::Int1" | 0 |
| useLNet | Whether to use LNet or not. | "Value::Int" | 1 |

minFaceSize and scaleFactor accelerate face detection at the cost of lower recall for smaller faces.

If the strictlyMinSize parameter is enabled (the value is equal to 1), all detections with a size (max of width/height) smaller than minFaceSize will be excluded from the final result.

Example:

```
<section name="FaceDetV2::Settings">
  <param name="FirstThreshold" type="Value::Float1" x="0.51385"/>
  <param name="SecondThreshold" type="Value::Float1" x="0.248"/>
  <param name="ThirdThreshold" type="Value::Float1" x="0.76"/>
  <param name="minFaceSize" type="Value::Int1" x="50" />
  <param name="strictlyMinSize" type="Value::Int1" x="0" />
  <param name="scaleFactor" type="Value::Float1" x="0.7" />
  <param name="padding" type="Value::Float4" x="-0.20099958" y="
    0.10210337" z="0.20363552" w="0.08490226" />
  <param name="redetectTolerance" type="Value::Int1" x="0" />
  <param name="useLNet" type="Value::Int1" x="0" />
</section>
```

LNet

This group of parameters is non-public. Do not change any of the parameters.

HeadPoseEstimator settings

In mobile mode, HeadPose estimator is able to compute head pose angles using raw input image data.

EyeEstimator settings

This estimator aims to determine:

- Eye state: Open, Closed, Occluded;
- Precise eye iris location as an array of landmarks;
- Precise eyelid location as an array of landmarks.

To determine more exact eye state additional auxiliary model `eye_status_estimation_*.plan` is used. You can enable this auxiliary model through config (`faceengine.conf`).

| Parameter | Description | Type | Default value |
|----------------------------|-----------------|----------------------------|---------------|
| <code>useStatusPlan</code> | 0 - Off, 1 - On | <code>"Value::Int1"</code> | 1 |

Example:

```
<section name="EyeEstimator::Settings">  
  <param name="useStatusPlan" type="Value::Int1" x="1"/>  
</section>
```

Medical mask estimator settings

Medical mask estimator predicts predominant mask features.

Estimator accuracy depends on thresholds listed below.

If accuracy (low FPR) is more important, TPR could be sacrificed by heightening the threshold.

Corresponding FPR and TPR values are also listed below.

Thresholds for MedicalMaskEstimation

The below parameters specify parameter thresholds in the [0..1] range and are of the "Value : Float1" type.

maskThreshold

| Threshold range | Default threshold | FPR range | TPR range |
|-----------------|-------------------|--------------|---------------|
| 0.65 - 0.9 | 0.65 | 0.014 - 0.01 | 0.976 - 0.886 |

noMaskThreshold

| Threshold range | Default threshold | FPR range | TPR range |
|-----------------|-------------------|--------------|--------------|
| 0.65 - 0.79 | 0.65 | 0.01 - 0.005 | 0.94 - 0.903 |

occludedFaceThreshold

| Threshold range | Default threshold | FPR range | TPR range |
|-----------------|-------------------|--------------|---------------|
| 0.5 - 0.602 | 0.5 | 0.016 - 0.01 | 0.924 - 0.881 |

Thresholds for MedicalMaskEstimationExtended

The below parameters specify parameter thresholds in the [0..1] range and are of the "Value : Float1" type.

maskExtendedThreshold

| Threshold range | Default threshold | FPR range | TPR range |
|-----------------|-------------------|--------------|---------------|
| 0.65 - 0.784 | 0.65 | 0.013 - 0.01 | 0.923 - 0.894 |

noMaskExtendedThreshold

| Threshold range | Default threshold | FPR range | TPR range |
|-----------------|-------------------|--------------|--------------|
| 0.65 - 0.79 | 0.65 | 0.01 - 0.005 | 0.94 - 0.903 |

maskNotInPlaceExtendedThreshold

| Threshold range | Default threshold | FPR range | TPR range |
|-----------------|-------------------|---------------|---------------|
| 0.65 - 0.85 | 0.65 | 0.009 - 0.005 | 0.918 - 0.833 |

occludedFaceExtendedThreshold

| Threshold range | Default threshold | FPR range | TPR range |
|-----------------|-------------------|--------------|---------------|
| 0.5 - 0.602 | 0.5 | 0.016 - 0.01 | 0.924 - 0.881 |

Example:

```
<section name="MedicalMaskEstimatorV3::Settings">
  <param name="maskExtendedThreshold" type="Value::Float1" x="0.65"/>
  <param name="noMaskExtendedThreshold" type="Value::Float1" x="0.65"
    />
  <param name="maskNotInPlaceExtendedThreshold" type="Value::Float1" x=
    ="0.65"/>
  <param name="occludedFaceExtendedThreshold" type="Value::Float1" x="
    0.5"/>
  <param name="maskThreshold" type="Value::Float1" x="0.65"/>
  <param name="noMaskThreshold" type="Value::Float1" x="0.65"/>
  <param name="occludedFaceThreshold" type="Value::Float1" x="0.65"/>
</section>
```

Mouth Estimator settings

Mouth estimator predicts predominant mouth state.

Estimator accuracy depends on thresholds listed below.

FPR and TPR values are specified for 0.5 threshold

Table 12: “Thresholds for MouthEstimation”

| Parameter | Description | Type | Default value | Threshold range | TPR | FPR |
|--------------------|--------------------------------|---------------|---------------|-----------------|-------|-------|
| occlusionThreshold | Threshold in the [0..1] range | Value::Float1 | 0.5 | 0.4 – 0.6 | 0.96 | 0.009 |
| smileThreshold | Threshold in the [0..1] range. | Value::Float1 | 0.5 | 0.4 – 0.6 | 0.97 | 0.04 |
| openThreshold | Threshold in the [0..1] range. | Value::Float1 | 0.5 | 0.4 – 0.6 | 0.986 | 0.01 |

Example:

```
<section name="MouthEstimator::Settings">
  <param name="occlusionThreshold" type="Value::Float1" x="0.5"/>
  <param name="smileThreshold" type="Value::Float1" x="0.5"/>
  <param name="openThreshold" type="Value::Float1" x="0.5"/>
</section>
```

Face Occlusion Estimator Settings

The Face Occlusion estimator predicts occlusion of various face areas such as the forehead, eyes, nose, mouth, and lower face.

Estimator accuracy depends on thresholds listed below.

| Parameter | Description | Type | Default | Threshold range |
|---------------------------|---------------------------|---------------|---------|-----------------|
| normalHairCoeff | Threshold for hair*. | Value::Float1 | 0.15 | 0.0 - 1.0 |
| overallOcclusionThreshold | Overall threshold. | Value::Float1 | 0.07 | 0.0 - 1.0 |
| foreheadThreshold | Threshold for forehead. | Value::Float1 | 0.1 | 0.0 - 1.0 |
| eyeThreshold | Threshold for eye. | Value::Float1 | 0.15 | 0.0 - 1.0 |
| noseThreshold | Threshold for nose. | Value::Float1 | 0.2 | 0.0 - 1.0 |
| mouthThreshold | Threshold for mouth. | Value::Float1 | 0.15 | 0.0 - 1.0 |
| lowerFaceThreshold | Threshold for lower face. | Value::Float1 | 0.2 | 0.0 - 1.0 |

Note:

The `normalHairCoeff` parameter determines whether the presence of hair is considered when analyzing face occlusion.

- If the percentage of hair occlusion is lower than `normalHairCoeff`, hair is not taken into account in the analysis.
- If the hair occlusion percentage exceeds `normalHairCoeff`, the excess hair occlusion is added to the overall face occlusion percentage.

Example calculation:

- Overall face occlusion score without hair: 0.05
- Overall face occlusion score with hair: 0.2
- `normalHairCoeff`: 0.15

In this case, the resulting overall face occlusion score would be calculated as follows:

- Resulting score = $0.05 + (0.2 - 0.15) = 0.1$.

Example:

```
<section name="FaceOcclusionEstimator::Settings">
  <param name="normalHairCoeff" type="Value::Float1" x="0.15"/>
  <param name="overallOcclusionThreshold" type="Value::Float1" x="0.07"/>
  <param name="foreheadThreshold" type="Value::Float1" x="0.1"/>
  <param name="eyeThreshold" type="Value::Float1" x="0.15"/>
  <param name="noseThreshold" type="Value::Float1" x="0.2"/>
  <param name="mouthThreshold" type="Value::Float1" x="0.15"/>
  <param name="lowerFaceThreshold" type="Value::Float1" x="0.2"/>
</section>
```

Quality estimator settings

Quality estimator looks at several image parameters, like lightness (think overexposure), darkness (think underexposure), blurriness, illumination uniformity value, specularity value. Every float value is comparing with according threshold.

| Parameter | Type | Default value |
|-----------------------|-----------------|---------------|
| blurThreshold | "Value::Float1" | x="0.61" |
| lightThreshold | "Value::Float1" | x="0.57" |
| darknessThreshold | "Value::Float1" | x="0.50" |
| illuminationThreshold | "Value::Float1" | x="0.1" |
| specularityThreshold | "Value::Float1" | x="0.1" |
| usePlanV1 | "Value::Int1" | x="1" |
| usePlanV2 | "Value::Int1" | x="1" |

Example:

```
<section name="QualityEstimator::Settings">
  <param name="blurThreshold" type="Value::Float1" x="0.61"/>
  <param name="lightThreshold" type="Value::Float1" x="0.57"/>
  <param name="darknessThreshold" type="Value::Float1" x="0.50"/>
  <param name="illuminationThreshold" type="Value::Float1" x="0.1"/>
  <param name="specularityThreshold" type="Value::Float1" x="0.1"/>
  <param name="usePlanV1" type="Value::Int1" x="1" />
  <param name="usePlanV2" type="Value::Int1" x="1" />
</section>
```

Note: usePlanV1 toggles the Quality estimation, usePlanV2 toggles the SubjectiveQuality estimation. Note that you cannot disable both the parameters at the same time. In case you do this, you will receive the `fsdk::FSDKError::InvalidConfig` error code and the following logs:

```
[27.06.2024 12:38:59] [Error] QualityEstimator::Settings Failed to create
QualityEstimator! The both parameters: "usePlanV1" and "usePlanV2" in
section "QualityEstimator::Settings" are disabled at the same time.
```

GlassesEstimator settings

The glasses estimator estimates what types of glasses, if any, a person is currently wearing. Estimation quality depends on threshold values listed below. These threshold values are set to optimal by default.

| Parameter | Description | Type | Default value |
|---------------------|---------------------------------------|-----------------|---------------|
| noGlassesThreshold | noGlasses threshold in [0..1] range. | "Value::Float1" | 1 |
| eyeGlassesThreshold | eyeGlasses threshold in [0..1] range. | "Value::Float1" | 1 |
| sunGlassesThreshold | sunGlasses threshold in [0..1] range. | "Value::Float1" | 1 |

Example:

```
<section name="GlassesEstimator::Settings">
  <param name="noGlassesThreshold" type="Value::Float1" x="1"/>
  <param name="eyeGlassesThreshold" type="Value::Float1" x="1"/>
  <param name="sunGlassesThreshold" type="Value::Float1" x="1"/>
</section>
```


LivenessOneShotRGBEstimator settings

This estimator tells whether the person's face is real or fake (photo, printed image). Thresholds are listed below.

Liveness protects from presentation attacks - when user tries to cheat biometric system by demonstrating fake face to the face capturing camera, but not from image substitution attacks - when fake image is sent directly to the system, bypassing the camera.

LivenessOneShotRGBEstimator supports images, which are captured on Mobile devices or Webcam (PC or laptop). Correct working of the estimator with other source images is not guaranteed.

Supported shooting mode: cooperative, which means that user must interact with the camera and look at it.

User scenarios examples: authentication in mobile application, confirmation of transactions with biometric facial verification.

Image resolution minimum requirements:

- Mobile devices - 720 × 960 px
- Webcam (PC or laptop) - 1280 x 720 px

| Parameter | Description | Type | Default value |
|------------------------|------------------------------|-----------------|---------------|
| netType | NET version. | "Value::Int1" | 0 |
| realThreshold | Threshold in [0..1] range. | "Value::Float1" | 0.5 |
| qualityThreshold | Threshold in [0..1] range. | "Value::Float1" | 0.5 |
| calibrationCoeff | Coefficient in [0..1] range. | "Value::Float1" | 0.89 |
| mobileRealThreshold | Threshold in [0..1] range. | "Value::Float1" | 0.5 |
| mobileQualityThreshold | Threshold in [0..1] range. | "Value::Float1" | 0.5 |
| mobileCalibrationCoeff | Coefficient in [0..1] range. | "Value::Float1" | 0.968 |
| liteRealThreshold | Threshold in [0..1] range. | "Value::Float1" | 0.5 |
| liteQualityThreshold | Threshold in [0..1] range. | "Value::Float1" | 0.5 |

| Parameter | Description | Type | Default value |
|----------------------|------------------------------|----------------------|---------------|
| liteCalibrationCoeff | Coefficient in [0..1] range. | "Value::Float1" " | 0.991 |

```

<section name="LivenessOneShotRGBEstimator::Settings">
  <param name="netType" type="Value::Int1" x="0" />
  <!--Parameters for backend version (netType == 0) -->
  <param name="realThreshold" type="Value::Float1" x="0.5"/>
  <param name="qualityThreshold" type="Value::Float1" x="0.5" />
  <param name="calibrationCoeff" type="Value::Float1" x="0.89"/>
  <!--Parameters for mobile version (netType == 1) -->
  <param name="mobileRealThreshold" type="Value::Float1" x="0.5"/>
  <param name="mobileQualityThreshold" type="Value::Float1" x="0.5" />
  <param name="mobileCalibrationCoeff" type="Value::Float1" x="0.968"/>
  <!--Parameters for lite version (netType == 2) -->
  <param name="liteRealThreshold" type="Value::Float1" x="0.5"/>
  <param name="liteQualityThreshold" type="Value::Float1" x="0.5" />
  <param name="liteCalibrationCoeff" type="Value::Float1" x="0.991"/>
</section>

```

Runtime settings

Runtime configuration file provides parameters that user can tweak to achieve optimal performance of their app.

Note: The setting `<param name="numThreads" type="Value::Int1" x="-1"/>` means that will be taken the maximum number of available threads. This number of threads is equal to according number of available processor cores.

The name of runtime configuration file is `runtime.conf` and its placed in data directory. Its settings are described below:

| Parameter | Description | Type | Default value |
|-------------------------------|--|-----------------|---------------|
| <code>cpuClass</code> | Class of cpu by supported instructions - cpu, arm, auto. | "Value::String" | "auto" |
| <code>deviceClass</code> | Execution device type - cpu, gpu. | "Value::String" | "cpu" |
| <code>numThreads</code> | Number of worker threads. Default: number of CPU logical cores. | "Value::Int1" | -1 |
| <code>verboseLogging</code> | Level of log verbosity. 1 - Errors, 2 - Warnings, 3 - Info, 4 - Debug. | "Value::Int1" | 0 |
| <code>programCacheSize</code> | Maximum number of Program objects in cache. Should be less than 10000. | "Value::Int1" | 128 |

Verbosity level sets the upper limit of what type of messages may be printed out. For example, if user set `verboseLogging` to 3, it means that Errors, Warnings and Info messages will be printed out to the console. Verbose level of 0 indicates that there are no logging messages printed out at all.

Increasing the `programCacheSize` increases memory usage and potentially improves performance. Be careful, too large a value of this parameter can lead to a crash due to insufficient memory.

Example:

```
<section name="Runtime">
  <param name="cpuClass" type="Value::String" text="auto" />
  <param name="deviceClass" type="Value::String" text="cpu" />
  <param name="numThreads" type="Value::Int1" x="-1" />
  <param name="verboseLogging" type="Value::Int1" x="0" />
  <param name="programCacheSize" type="Value::Int1" x="128" />
</section>
```