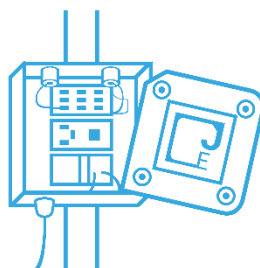


SED HEOP

Manual

v3.11



Content

Introduction	2
Compatibility.....	3
Installation	4
Package Installation	5
License	6
Audio	8
Audio Settings.....	8
Application.....	9
Noise Measurement.....	10
Communication	11
TCP Communication.....	11
Application Settings.....	13
Manual	13
Settings.....	13
Alerts.....	14
Audio Input.....	15
Audio Filter	15
Detector	16
Events	17
Events Archive	19
Noise Measurement.....	19
Simulation	20
TCP	20
OPSDK Alerts	22
Annexes and Other Documents	23

Introduction

SED (Sound Event Detector) is a solution that uses a proprietary algorithm driven by machine learning technology to detect, classify and subsequently alert on unwanted acoustic events. These events can be a gunshot, a scream or a glass break. The SED Application can be driven by a dedicated SED Device or by a Hikvision camera, as a HEOP application. This manual contains information about its HEOP version.



Compatibility

The compatibility of the SED Application requires:

- Chip architecture: G5 or G7
- HEOP 2.0 support
- Audio Support



Installation

The SED HEOP application can be downloaded on Hikvision gallery websites: **TBD** or on the following link: [SED HEOP Download](#).

The link navigates into a folder with on our storage. The user can choose from multiple versions of SED application. The name of the package contains this information:

- SED - name of the application.
- Application version – the current application version is 3.11
- Architecture - Hikvision chip architecture (G5, G7, H13).
- Detection Model – internal name of the detection model

packages 

Title ^	Modified time
☐ SED_1_0_0_G7_balanced_basic_M240321_3.app	03/25/2024 13:37:31

Figure 1: SED Package Folder



Package Installation

To install the application, navigate to the application settings on the target device. In the application settings, first import the license, and then it will be possible to import the application.

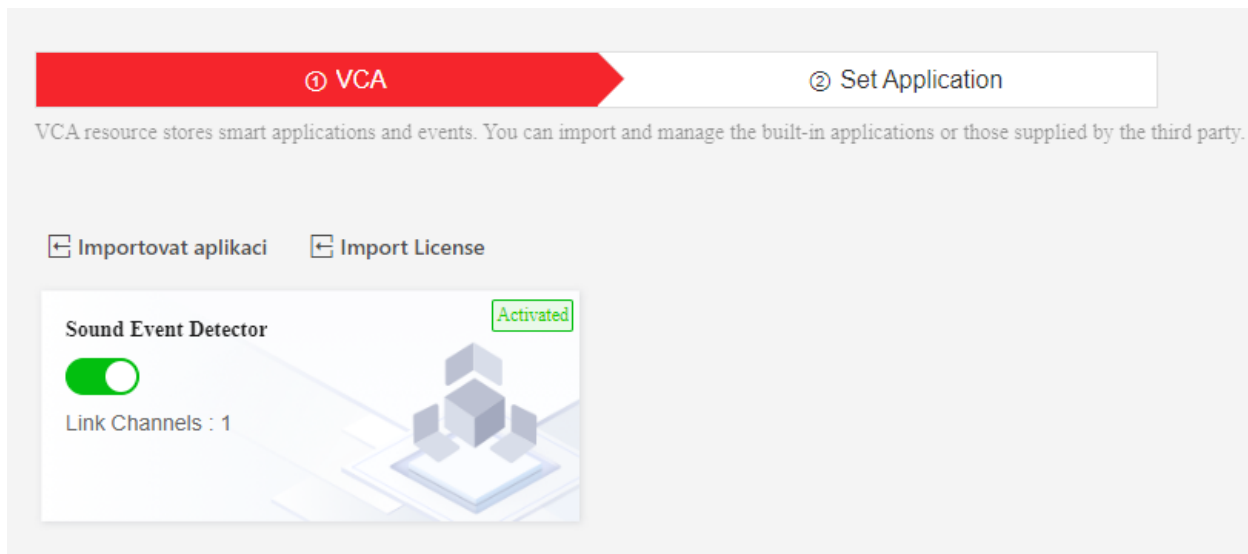


Figure 2: Application installation

Once the application is installed, it will be displayed among the installed applications. The Set Application tab contains application settings.

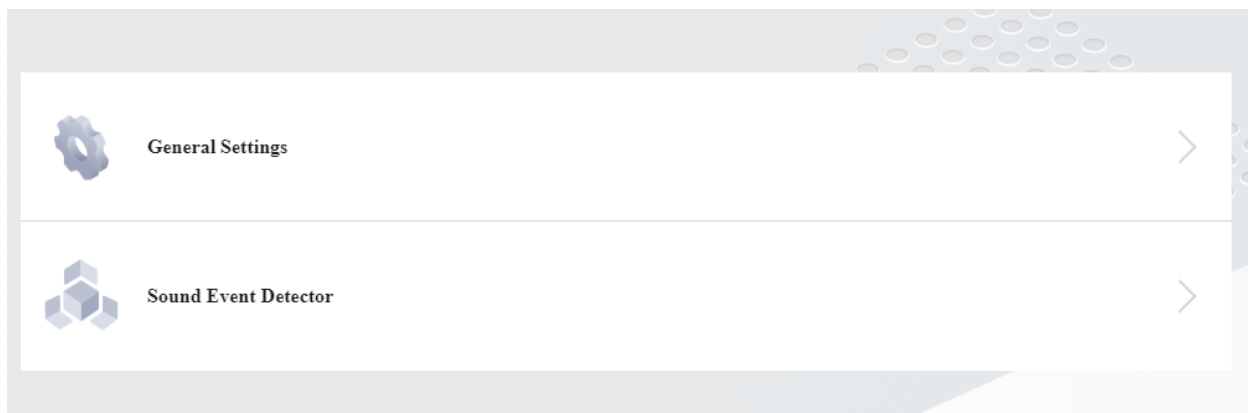
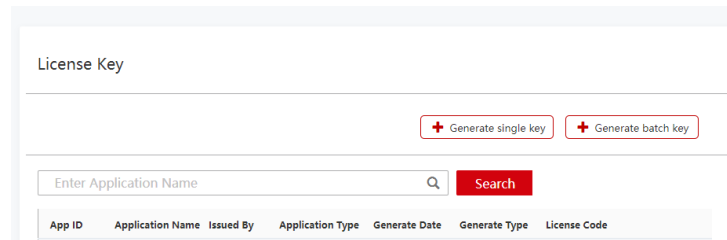


Figure 3: Application settings

License

To activate the license key, navigate to the Hikvision [License Key](#) page. Generate a key based on the code you have obtained after the SED SW license purchase.

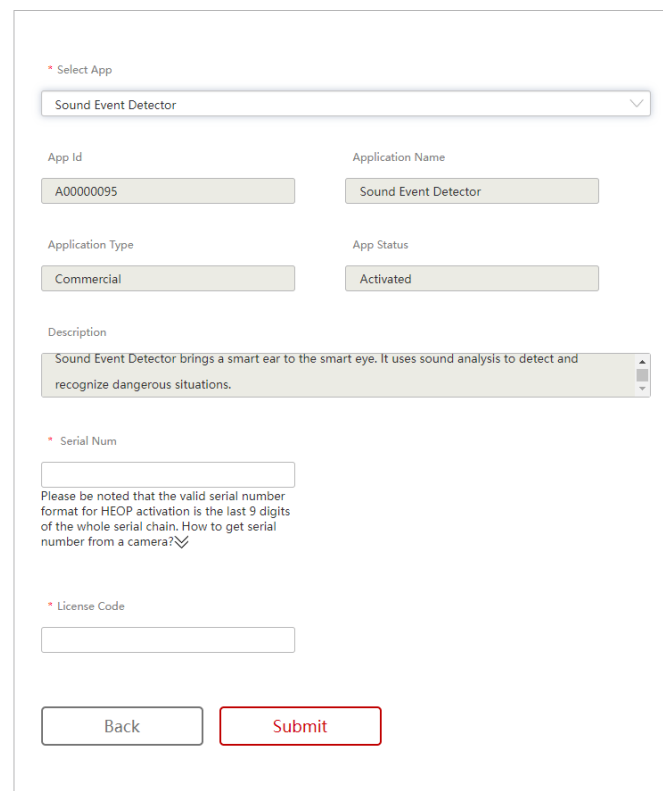


The screenshot shows the 'License Key' page. At the top, there are two buttons: 'Generate single key' and 'Generate batch key'. Below these is a search bar with the placeholder text 'Enter Application Name' and a 'Search' button. At the bottom, there is a table with the following headers: 'App ID', 'Application Name', 'Issued By', 'Application Type', 'Generate Date', 'Generate Type', and 'License Code'.

Figure 4: License Key page

Click on **Generate single key** or **Generate batch key** button.

Generate License Key



The screenshot shows the 'Generate License Key' form. It includes a dropdown menu for 'Select App' with 'Sound Event Detector' selected. Below this are input fields for 'App Id' (A00000095) and 'Application Name' (Sound Event Detector). There are also input fields for 'Application Type' (Commercial) and 'App Status' (Activated). A description field contains the text: 'Sound Event Detector brings a smart ear to the smart eye. It uses sound analysis to detect and recognize dangerous situations.' Below the description is a 'Serial Num' input field with a note: 'Please be noted that the valid serial number format for HEOP activation is the last 9 digits of the whole serial chain. How to get serial number from a camera?'. At the bottom, there is a 'License Code' input field and two buttons: 'Back' and 'Submit'.

Figure 5: Generate key page

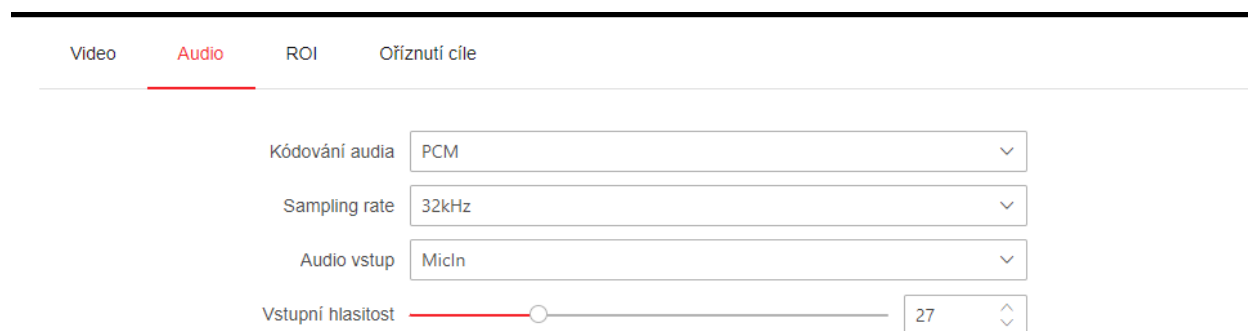
Select the Sound Event detector application, fill in the Serial Number of the target device and fill in the license code. When it is done, click on the **Submit** button- the License key is downloaded and it can then be imported on the target device. When the license is successfully imported, the application can be installed.

Audio

To ensure that the application works as expected, the target device needs to be equipped with a recommended microphone, and audio needs to be properly set.

Audio Settings

The proper audio settings are crucial for the proper functionality of the application. The reason is that the application does not have direct access to the microphone and cannot set it by itself. The data received by the application must be in the proper format. To ensure that, navigate to the **Settings -> Video and Audio** and select the **Audio** tab



Video	Audio	ROI	Ořiznutí cíle
Kódování audia			
PCM			
Sampling rate			
32kHz			
Audio vstup			
MicIn			
Vstupní hlasitost			
27			

Figure 6: Audio settings

Set the audio coding to **PCM**, Sampling rate **32kHz** and Audio input **MicIn**. The microphone volume is recommended to be set in between 25 - 35. The higher value increases the range of the detection, but if it is too high, the audio input signal becomes too noisy.

Application

The SED Application detects the sound of an unwanted acoustic event. The audio classification process is done in 2 steps.

The first step in the classification process is detection, which is responsible for detecting that something unusual has happened in the target device's surroundings. The detected unusual event is further analysed to distinguish between the common events (ambulance, traffic, train, siren, children, construction works, etc.) and the dangerous ones (gunshot, glass break, scream, etc.). The detector is energy-based, and with standard settings in standard behaviour, it detects around 2500 unusual events each day. Therefore, the detector alone is not sufficient to reliably detect dangerous events.

The second step is classification. The SED application contains a classifier based on deep neural networks. The classifier has very high accuracy (99.7%) and therefore it detects dangerous situations with high sensitivity without wasting resources on false alarms.

Based on the result of the classification process, two groups of acoustic events are distinguished:

- **SED Alert:** The acoustic event was recognised as one of the dangerous situations. The SED Application recognises dangerous situations such as Gunshot, Glass Break, Scream, Male Scream, etc. SED Alerts trigger an alert on the user side by default.
- **SED Event:** The acoustic event was NOT recognised as dangerous. The user is not informed about those events by default. Still, the information about the detection might be useful in some specific cases:
 - Warehouse during a night when silence is expected.
 - Senior house during a night when an intense impulse sound might indicate a human fall.
 - etc.

Complete list of alerts and events [here](#).

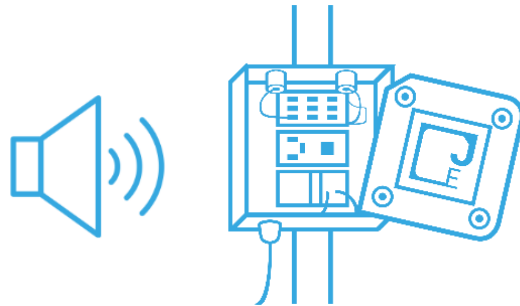
The input audio data are processed and analysed directly on the target device, and it is not necessary to send it outside the device. To minimise the amount of time that is needed to serve a triggered alert, SED enables the possibility to send a small audio fragment that has triggered the alert, together with the alert data. This small audio fragment is sufficient to distinguish between real and false alarms, but it is not sufficient to identify a person. All the details can be found in **[GDPR Study]**

Noise Measurement

Noise measurement is an additional feature of the SED application that computes an ambient noise level in the device's surroundings. The computed value is periodically sent to the user in a defined interval. Based on the measurement values, graphs or heat maps can be created.

A further analysis can be made based on the measurement values:

- A sudden increase in noise level might indicate a potentially dangerous situation (e.g. sport fans grouping or a demonstration).
- It can inform the user about the disturbance of the night piece.
- It can indicate a shouting before a street fight.
- etc.



Communication

The SED Alerts can communicate with the target VMS over **SED Server** via TCP protocol. It is planned to implement sending alerts over the OPSDK Alerts once it supports sending ONVIF messages.

TCP Communication

The SED Application uses a proprietary encrypted TCP protocol to communicate with the SED Server. SED Server, available in the cloud and can be used for communication, is provided by default, together with technical support.

The main advantages of communication over the SED Server are:

- **Adaptation of classification model:** When a device is located in a new place, it can happen that it starts to trigger multiple false alarms on a specific sound. If the device communicates over the SED Server, it is possible to catch the sound fragments that cause the false alarms and tune the default classification model for the specific environment. This is the reason why we highly recommend to enable communication over the SED Server at least for the first month after the installation of the SED application.
- **Localisation:** When at least 3 devices detect the same event, it is possible to triangulate the exact location of the sound source (shooter in case of a gunshot, hooligan in case of a glass break or victim in case of screaming). The SED Server serves as the central point where the data from devices is processed, and localisation is calculated.
- **Combine HEOP and SED Devices:** The SED Server is able to handle communication from both the HEOP SED Application and the SED Device. The common case is to use in a place where localisation is needed, one HEOP Application on a camera that observes the surroundings, together with two SED Devices.
- **Compatibility:** The SED Server implements multiple standard communication protocols to communicate with VMS - ONVIF, REST OpenAPI, Contact ID, etc. Besides, it is possible to create drivers for proprietary solutions.
- **One entry point:** Multiple VMS charge fees based on the number of entry points. SED Server is only one entry point from the VMS point of view, but it can redirect messages from all the devices

The SED Server is available in the cloud by default, but there are other possibilities:

- The server can be placed on the user's local machine to handle the communication within a private local network.

For manuals and further information about SED Server and its communication protocols specifications, contact us at support@jalud-embedded.com.

Application Settings

The open button on the application panel navigates to the settings page.



Figure 7: Settings Page

Manual

This option navigates to [SED HEOP Manuals](#) folder. The user can download the actual version of this manual in multiple language variants.

manuals 

Moje soubory

Název ^	Čas úpravy	
 br	02/21/2023 11:20:40	
 cs	02/21/2023 11:20:26	
 de	02/21/2023 11:20:22	
 en	02/21/2023 11:20:13	
 es	02/21/2023 11:20:33	

Settings

The SED application behaviour might be affected via settings. The settings are split into categories, and the user can use the navigation panel to switch in between the categories.

Setting

Alerts	AudioFilter	AudioInput	Detector	Events	EventsArchive	NoiseMeasurement	Simulation	TCP
--------	-------------	------------	----------	--------	---------------	------------------	------------	-----

Figure 8: Navigation Panel

Any change of settings takes effect after the application restarts. The user is informed about it on the settings page. Values that were recently updated and haven't taken effect yet are, in this case, displayed on the settings page.

Setting

Changes will take effect after a reboot.

Alerts	AudioFilter	AudioInput	Detector	Events	EventsArchive	NoiseMeasurement	Simulation	TCP
--------	-------------	------------	----------	--------	---------------	------------------	------------	-----

Enabled Updated!
☐

Figure 9: Settings Changed

Settings within categories are sorted in alphabetical order as the page is generated.

Alerts

Alert settings allow user to enable and disable sending alerts based on their type. The recordings of examples for each alert type can be downloaded [here](#). The set of alerts differs based on the SW version – **full** vs **basic**.

Complete list and description of alerts and events [here](#).

Alerts	AudioFilter	AudioInput	Detector	Events	EventsArchive	NoiseMeasurement	Simulation	TCP
--------	-------------	------------	----------	--------	---------------	------------------	------------	-----

Aggression
☐

GlassTester
☐

Glassbreak
☐

Gunshot
☐

MaleScream
☐

Scream
☐

Save

Figure 10: Alert Settings

Audio Input

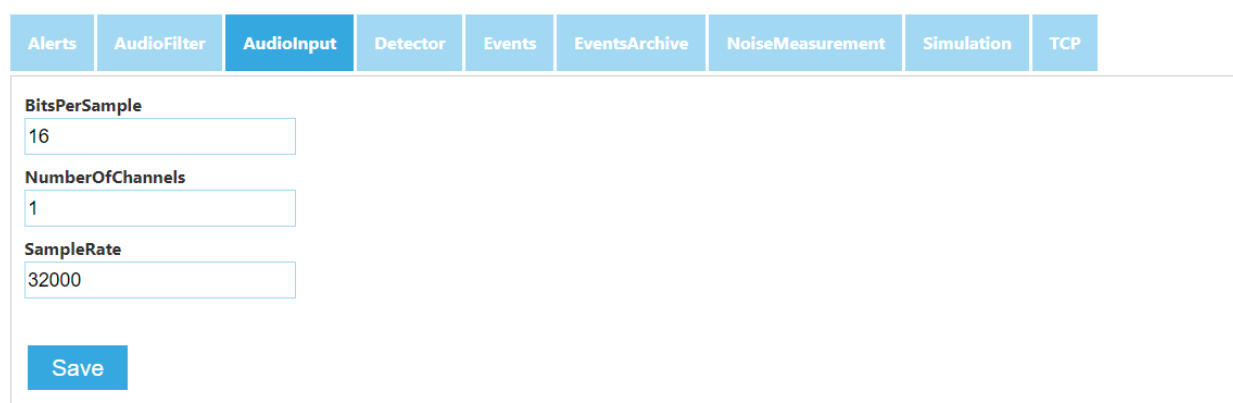
!DO NOT CHANGE WITHOUT PREVIOUS DISCUSSION!

Audio input contains parameters of the audio input signal to match the classification settings. There is no need to change those settings under standard circumstances, and if the recommended microphone is used.

BitsPerSamples: Number of bits per each sample of the input audio device.

NumberOfChannels: Number of channels the input audio signal contains

SampleRate: Sample rate of the input audio signal.



Alerts	AudioFilter	AudioInput	Detector	Events	EventsArchive	NoiseMeasurement	Simulation	TCP
BitsPerSample 16 NumberOfChannels 1 SampleRate 32000 Save								

Figure 11: Audio Input

Audio Filter

!DO NOT CHANGE WITHOUT PREVIOUS DISCUSSION!

Audio Filters filter out noise from the input audio signal. The basic high-pass filter is sufficient for the target device to work in most environments. The audio filters are meant to be adapted if the target device is located in a specific environment with a high noise on specific frequencies. If it is the case contact us on support@jalud-embedded.com.

Type [index]: Type of the filter. The current version supports HighPass filter and Adaptive LMS filter.

HPFrequency: The high-pass cutoff frequency

Alerts AudioFilter AudioInput Detector Events EventsArchive NoiseMeasurement Simulation TCP

HPFrequency
100

TypeIndex
HighPass + -

Save

Figure 12: Audio Filter

Detector

!DO NOT CHANGE WITHOUT PREVIOUS DISCUSSION!

Detector settings affect the behaviour of the detector in the classification process, and therefore, it has a significant impact on the number of detected events. The default settings are suitable for most environments.

AdaptingPeriod[s]: When the application is started, the detector adapts the energy threshold on the ambient noise level. The SED application triggers no alerts during the time defined by Adaptation period after it is started.

Alpha: Defines how quickly detector adapts on the ambient noise level change. If the value is too low, the detector is not able to adapt quickly enough to a changing background. If the value is too high, the detector can adapt to the uncommon event too quickly and prevents its detection. The default value is tested in many environments to work in an optimal way.

FrameSize [ms]: The length of the audio signal frame from which the noise level is computed. Increasing the value reduces the accuracy of the timestamp of the beginning of a detected event. Lowering the value increases the vulnerability to a random noise.

Margin[dB]: The margin value defines a threshold how much the noise level of the event must exceed the average ambient noise level to be detected and classified. Change the settings only if needed and carefully. The default detector settings are optimal for most environments.

Event:

- **Fixed Length:** If the option is enabled, each detected event has a fixed duration defined by the *Max Duration* value. If disabled, the duration of the value can be shorter in case the energy level drops below the threshold.

- **Min Duration [ms]:** The minimum amount of time the energy of the event must remain above the threshold to be detected and classified.
- **Max Duration [ms]:** The maximum (or the fixed) event duration. If the event has longer duration only its beginning of the *Max Duration* length is classified.
- **Send Multiple Events:** This option defines what happens if event duration exceeds the *Max Duration*. If disabled (default) then the rest of the event is dropped - for most cases this behavior is sufficient. If enabled the end of one event is a beginning of another until the noise level drops below the threshold or until detector adapts on the new ambient noise. This option is useful in environment where a dangerous situation is probable to happen after a sudden increase of ambient noise:
 - production hall after switch on a loud machine
 - etc.

Alerts	AudioFilter	AudioInput	Detector	Events	EventsArchive	NoiseMeasurement	Simulation	TCP
AdaptingPeriodS 5 Alpha 0.0004 Event\FixedLength ☐ Event\MaxDurationMs 1536 Event\MinDurationMs 128 Event\SendMultipleEvents ☐ FrameSizeMs 16 MarginDb 5 Save								

Figure 13: Detector Settings

Events

Events settings allows user to enable or disable sending events based on their type. The difference between alerts and events is that the alerts indicates sounds of dangerous or

unwanted events. The events on the other hand indicates a sound of events that are common in most of the environments and in most cases do not indicate anything special. Nevertheless, they might be interesting in some scenarios – for example detection of people in are when nobody should occur.

This feature is available only in the **full** SW variant. The recordings of examples for each alert type can be downloaded [here](#).

Animal: Sounds of animals like dogs, cats, goats and others

Bird: Sound of all kinds of birds

Children: Sounds of children playing, crying etc.

People: People speech, laugh, sneeze, cough, whistle etc.

Music: Sound of musical instruments or singing

Attention: bell of transport means, beep, city bells and all the similar sounds that should raise an attention

Horn: car or train horns.

Transport: Sound specific for tram, train, bus, etc.

Construction: Sound of construction works, including tools like drilling, wending, saw, etc.

Creak: squeaking, creaking and whistling of tires.

Noise: white noise, etc.

Others: all the sounds that are not included in any of the categories above.

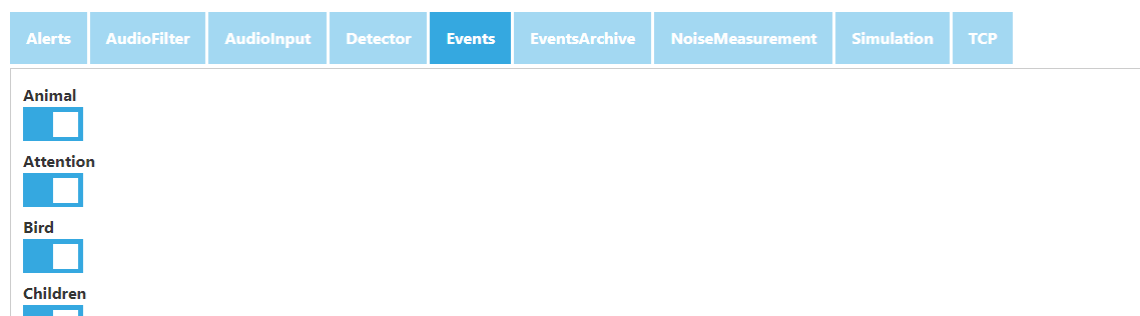


Figure 14: Events Settings

Events Archive

If archiving is enabled device stores all events that were classified regardless of their class. This functionality gives a possibility to investigate **false negatives** if such a case is identified.

Enabled: Enable/Disable archiving

MaxSpaceUsed[MB]: Defines a maximum size in MB of archived events on hard drive. In case of storing a new event that exceeds the value the oldest event in archive is removed first and the new event is stored afterwards.

MinSpaceLeft[MB]: Defines a minimum space in MB that must left on hard drive. The behavior of storing a new event that should breach the minimum amount of space on hard drive is identical as described above.

Alerts	AudioFilter	AudioInput	Detector	Events	EventsArchive	NoiseMeasurement	Simulation	TCP
Enabled ☐ MaxSpaceUsedMB 512 MinSpaceLeftMB 50 Save								

Figure 15: Events Archive Settings

Noise Measurement

Enabled: Enable/Disable noise measurement.

Interval[s]: Time between two noise measurements

Alerts	AudioFilter	AudioInput	Detector	Events	EventsArchive	NoiseMeasurement	Simulation	TCP
Enabled ☐ IntervalS 180 Save								

Figure 16: Noise Measurement Settings

Simulation

Simulation settings enable sending simulated alerts instead of processing audio signal. This option is useful especially for system tests

AlertsSimulationEnabled: If Alerts simulation is enabled the application does not process microphone input and triggers alerts periodically instead. Triggered alert contains valid timestamp but it contains no sound data nor any information about sound data energy level. The simulation switches one by one all the alerts enabled in **Alerts** settings.

AlertsSimulationInterval[s]: The interval in seconds in between two following alerts

AudioSimulationEnabled: If Audio simulation is enabled the application does not process microphone input and process data from an audio record stored on hard drive instead. Usage of this simulation is tricky in current version as the records needs to be placed on the device manually (via ssh for example). This is going to be fixed in future version.

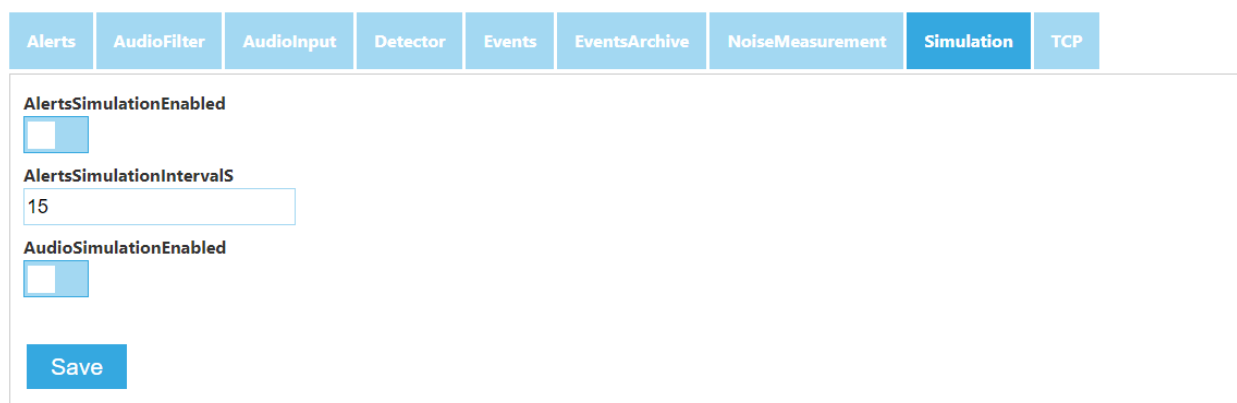


Figure 17: Audio Simulation Settings

TCP

Enabled: Enable/Disable TCP communication

Server Address: IP address of the server - the IP address of the cloud server is set by default.

Server Port: Port on which the server is listening for the incoming connections

Server Secured: Defines whether the communication with server is encrypted or not. The server in cloud requires secured connection.

Send Alerts: Enable / Disable sending of detected alerts (Gunshot, Glassbreak, Scream)

Send Alerts Data: Enable / Disable sending audio fragments together with alerts. The audio fragment is 1s long by default.

Send Events [index]: Enable / Disable sending of SED Events. Be aware that if all events are sent on a standard place a user might be flooded by up to several thousand events per day. To avoid these multiple settings are available:

- None (default): No events are sent.
- All: All detected events are sent.
- Above 60 dB: Only events that are louder than 60dB are sent.
- Above 75 dB: Only events that are louder than 75dB are sent.

Send Events Data: Enable / Disable sending audio fragments together with events. See more details in *Send Alerts Data*. If all events are sent and cloud SED Server is used discuss enable of sending events audio data with us on heop@jalud-embedded.com first.

Alerts	AudioFilter	AudioInput	Detector	Events	EventsArchive	NoiseMeasurement	Simulation	TCP
DeviceCrt device_81_001_005_001 Enabled ☒ SendAlerts ☒ SendAlertsData ☒ SendAlertsPictures ☒ SendEventsData ☐ SendEventsIndex None SendEventsPictures ☐ ServerAddress 80.211.41.205 ServerPort 44444 ServerSecured ☒ Save								

Figure 18: TCP Communication Settings

OPSDK Alerts

TBD

Annexes and Other Documents

[Annex A1]: List of recommended microphones - possible to download in [SED HEOP Manuals](#)

[GDPR Study]: TBD

