Acoustic Event Detection MI User Manual

V1.1

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REVISION HISTORY

Revision No.	Description	Date
1.0	• Created	03/06/2017
1.1	• Modify the error code	04/25/2017

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1. INTRODUCTION

1.1. Purpose

Acoustic event detection (AED) is a function used for detecting specific acoustic event from audio streams. Currently AED contains baby cry detection and loud sound detection (LSD).

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2. SPECIFICATION

1. The distance between baby and mic should be less than 1 meter
2. For best performance, background environment should be quiet
3. If you are using audio files as the sound source (instead of real baby), you should make sure
   甲、 There is no aliasing in audio files, see Figure 1
   乙、 There is no signal clipping in audio files, see Figure 2
   丙、 Effective sample rate is larger than 8 kHz, see Figure 3
   丁、 Speaker volume and mic gain is high enough

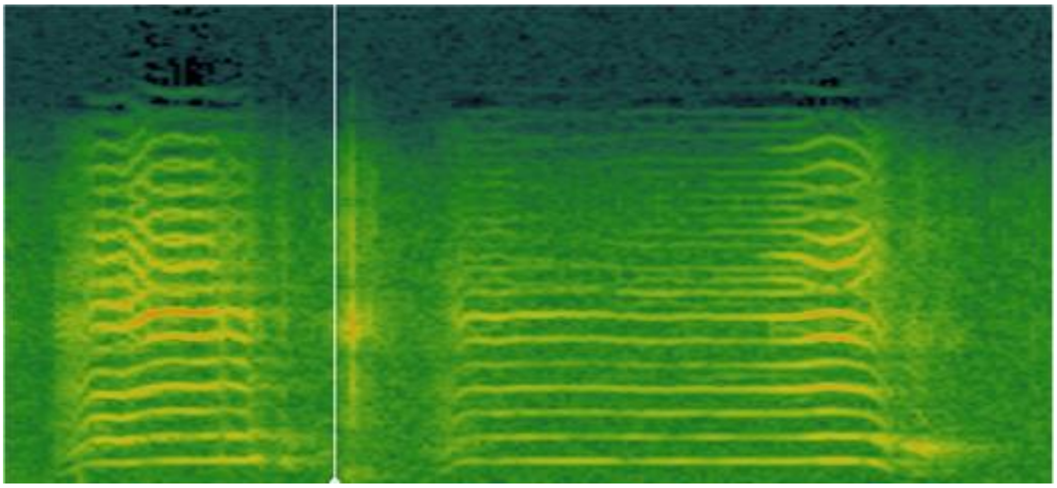

Figure 1: Audio example of aliasing.

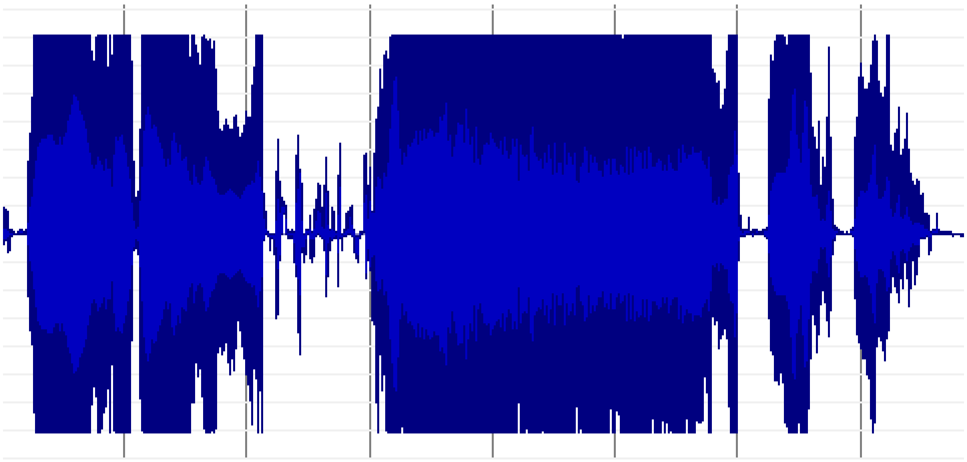

Figure 2: Audio example of clipping.

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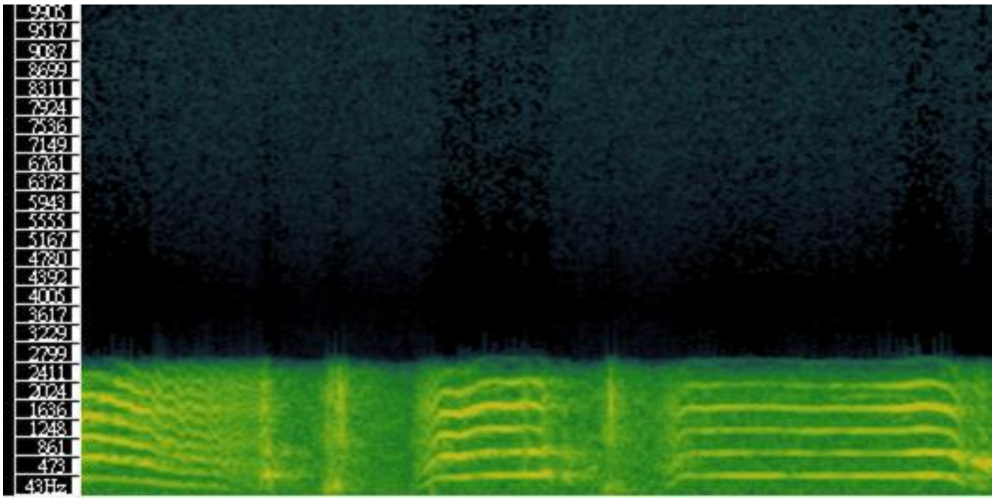

Figure 3. Audio example of effective sample rate is below 8kHz

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3. NOTE

This library uses open source codes; the corresponding license files are doc/LICENSE_1.txt and doc/LICENSE_2.txt. If you use this library in any form, you must place the license files along with your document or library/executable.

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4. API REFERENCE

4.1. API Overview

- MI_AED_Init: Initialize AED library
- MI_AED_Uninit: To exit the lib function and release memory
- MI_AED_Run: Perform AED
- MI_AED_GetResult: Get result of AED library
- MI_AED_SetSensitivity: Set AED sensitivity
- MI_AED_SetOperatingPoint: Set AED operating point
- MI_AED_SetVadThreshold: Set VAD threshold in dBFS
- MI_AED_SetLsdThreshold: Set LSD threshold in dBFS
- MI_AED_RunLsd: Perform LSD
- MI_AED_GetLsdResult: Get result of LSD process

4.2. API Lists

MI_AED_Init

Purpose

Initialize AED library

Function Prototype

AED_HANDLE MI_AED_Init(*AedParams* *aed_params, *S32* *point_length)*;*

Arguments

Name	Description
AedParams	Structure of AedParams
point_length	Input data length

Return value

Return value	Description
AED_HANDLE	AED handle pointer address
NULL	Initialization failure

Requirement

Header files: mi_aed.h

Library files: libAED_Linux.a or libAED_Linux.so

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MI_AED_Uninit

Purpose

To exit the lib function and release memory

Function Prototype

void MI_AED_Uninit(*AED_HANDLE* aedHandle);

Arguments

Name	Description
aedHandle	Pointer to the AED_HANDLE

Return value

Return value	Description
void	NA

Requirement

Header files: mi_aed.h

Library files: libAED_Linux.a or libAED_Linux.so

MI_AED_Run

Purpose

Perform AED

Function Prototype

MI_RET MI_AED_Run(*AED_HANDLE* aedHandle, *S16* *audio_input);

Arguments

Name	Description
aedHandle	Pointer to the AED_HANDLE
audio_input	Audio input address. The input array should have point_number*channel (fields of AedProcessStruct) elements. For example, for 8 kHz stereo, the input array should have 256*2 elements; for 32 kHz mono, the input array should have 1024*1 elements

Return value

Return value	Description
MI_RET_SUCCESS	Success
MI_BCRY_RET_INIT_ERROR	BCRY init error

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Requirement

Header files: mi_aed.h
Library files: libAED_Linux.a or libAED_Linux.so

MI_AED_GetResult

Purpose

Get result of AED library

Function Prototype

MI_RET MI_AED_GetResult(*AED_HANDLE* aedHandle);

Arguments

Name	Description
aedHandle	Pointer to the AED_HANDLE

Return value

Return value	Description
1	Acoustic event detected
0	No detection

Requirement

Header files: mi_aed.h
Library files: libAED_Linux.a or libAED_Linux.so

MI_AED_SetSensitivity

Purpose

Set AED sensitivity

Function Prototype

MI_RET MI_AED_SetSensitivity(*AED_HANDLE* aedHandle, *AedSensitivity* sensitivity);

Arguments

Name	Description
aedHandle	Pointer to the AED_HANDLE
sensitivity	Enumeration of *AedSensitivity*

Return value

Return value	Description

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Return value	Description
MI_RET_SUCCESS	Success
MI_BCRY_RET_INVALID_HANDLE	Invalid handle

Requirement

Header files: mi_aed.h

Library files: libAED_Linux.a or libAED_Linux.so

MI_AED_SetOperatingPoint

Purpose

Set AED operating point

Function Prototype

MI_RET MI_AED_SetOperatingPoint(*AED_HANDLE* aedHandle, *S32* operating_point);

Arguments

Name	Description
aedHandle	Pointer to the AED_HANDLE
operating_point	Operating point can only be in [-10, 10]. Default is 0 ● Increasing operating point will lower false alarm rate ● Decreasing operating point will lower miss detection rate

Return value

Return value	Description
MI_RET_SUCCESS	Success
MI_BCRY_RET_INVALID_HANDLE	Invalid BCRY handle

Requirement

Header files: mi_aed.h

Library files: libAED_Linux.a or libAED_Linux.so

MI_AED_SetVadThreshold

Purpose

Set VAD threshold in dBFS

Function Prototype

MI_RET MI_AED_SetVadThreshold(*AED_HANDLE* aedHandle, *S32* threshold_db);

Arguments

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Name	Description
aedHandle	Pointer to the AED_HANDLE
threshold_db	Default threshold is -40 (dBFS)

Return value

Return value	Description
MI_RET_SUCCESS	Success
MI_BCRY_RET_INVALID_HANDLE	Invalid BCRY handle

Requirement

Header files: mi_aed.h

Library files: libAED_Linux.a or libAED_Linux.so

MI_AED_SetLsdThreshold

Purpose

Set LSD threshold in dBFS

Function Prototype

MI_RET MI_AED_SetLsdThreshold*(AED_HANDLE* aedHandle, *S32* threshold_db);

Arguments

Name	Description
aedHandle	Pointer to the AED_HANDLE
threshold_db	Default threshold is -40 (dBFS)

Return value

Return value	Description
MI_RET_SUCCESS	Success
MI_BCRY_RET_INVALID_HANDLE	Invalid BCRY handle

Requirement

Header files: mi_aed.h

Library files: libAED_Linux.a or libAED_Linux.so

MI_AED_RunLsd

Purpose

Perform LSD

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Function Prototype

MI_RET MI_AED_RunLsd(*AED_HANDLE* aedHandle, *S16* *audio_input, *S32* agc_gain);

Arguments

Name	Description
aedHandle	Pointer to the AED_HANDLE
audio_input	Audio input address. The input array should have point_number*channel (fields of AedProcessStruct) elements. For example, for 8 kHz stereo, the input array should have 256*2 elements; for 32 kHz mono, the input array should have 1024*1 elements
agc_gain	Gain modified by AGC in dBFS. However, take 16 kHz sample rate for example, the number of points to be processed by AED and AGC are 512 and 256. That is, when you call IaaAed_RunLsd once, you will have called IaaAgc_Run twice. Therefore, you might want to set agc_gain to the average of two gain value — previous and current — suggested by AGC. In short, for 16 kHz, agc_gain = (previous_gain_value + current_gain_value) / 2

Return value

Return value	Description
MI_RET_SUCCESS	Success
MI_BCRY_RET_INIT_ERROR	BCRY Init error

Requirement

Header files: mi_aed.h

Library files: libAED_Linux.a or libAED_Linux.so

Note

- MI_AED_RunLsd should be called before MI_AED_Run for each frame

MI_AED_GetLsdResult

Purpose

Get result of LSD

Function Prototype

MI_RET MI_AED_GetLsdResult(*AED_HANDLE* aedHandle);

Arguments

Name	Description

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Name	Description
aedHandle	Pointer to the AED_HANDLE

Return value

Return value	Description
1	Loud sound detected
0	No detection

Requirement

Header files: mi_aed.h

Library files: libAED_Linux.a or libAED_Linux.so

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5. DATA TYPE

5.1. Overview

AedParams	Define the audio sample rate and channel number of AED
AedSensitivity	Define sensitivity of AED
MI RET	Define error code of AED

5.2. Structure Lists

AedParams

Description

Define the audio sample rate and channel number of AED

Syntax

```
typedef struct {
        unsigned int sample_rate;
        unsigned int channel;
        int enable_nr;
} AedParams;
```

Member

Member	Description
sample_rate	The sample rate of audio input
channel	Channel number
enable_nr	Enable NR or not

5.3. Enumeration Lists

AedSensitivity

Description

Define sensitivity of AED

Syntax

```
typedef enum {
        AED_SEN_LOW,
        AED_SEN_MID,
```

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```
    AED_SEN_HIGH
} AedSensitivity;
```

Member

Member	Description
AED_SEN_LOW	Low sensitivity
AED_SEN_MID	Middle sensitivity (Default)
AED_SEN_HIGH	High sensitivity

MI_RET

Description

Define error code of AED

Syntax

```
typedef enum {
    MI_RET_SUCCESS                          = 0x00000000,
    MI_BCRY_RET_INIT_ERROR                  = 0x10000201,
    MI_BCRY_RET_IC_CHECK_ERROR              = 0x10000202,
    MI_BCRY_RET_INVALID_HANDLE              = 0x10000203,
    MI_BCRY_RET_INVALID_SAMPLERATE          = 0x10000204
} MI_RET;
```

Member

Member	Description
MI_RET_SUCCESS	Success
MI_BCRY_RET_INIT_ERROR	BCRY init error
MI_BCRY_RET_IC_CHECK_ERROR	Incorrect platform check for BCRY
MI_BCRY_RET_INVALID_HANDLE	Invalid BCRY handle
MI_BCRY_RET_INVALID_SAMPLERATE	Invalid Sample rate of BCRY

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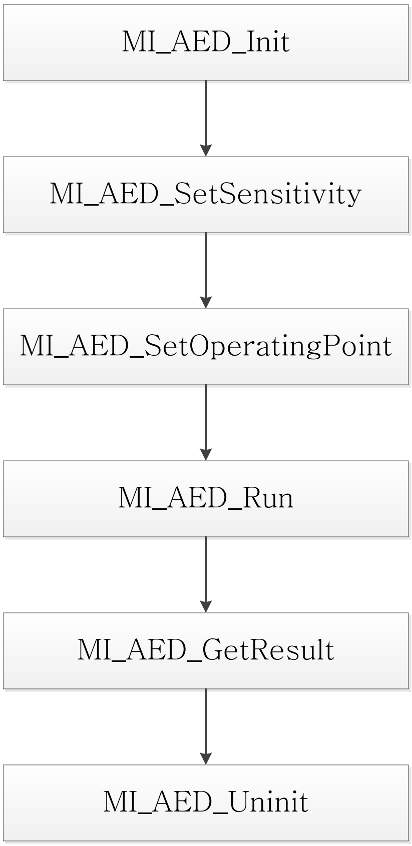
6. FLOW

6.1. Acoustic Event Detection



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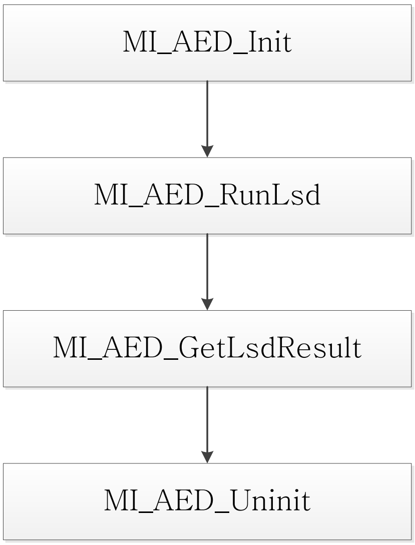
6.2. Loud Sound Detection



MI_AED_RunLsd should be called before MI_AED_Run for each frame

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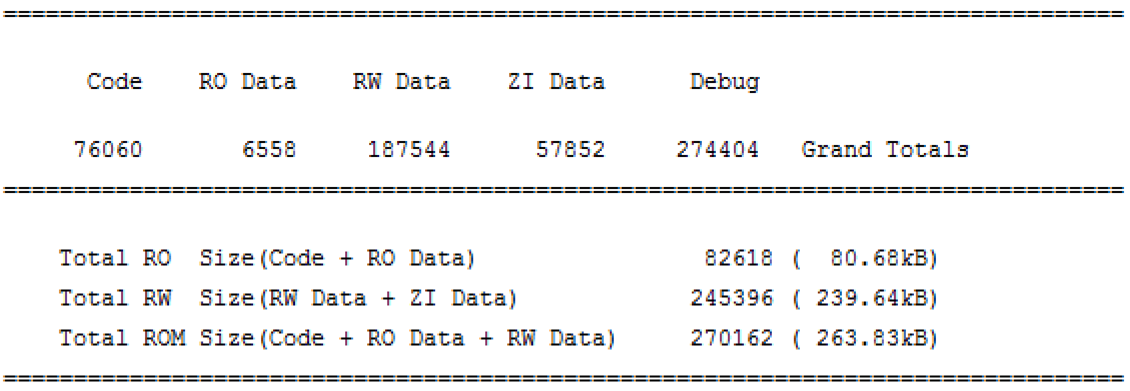
7. CODE/DATA SIZE INFORMATION



```
================================================================================

      Code     RO Data    RW Data     ZI Data      Debug

     76060        6558     187544       57852     274404   Grand Totals
================================================================================

    Total RO  Size(Code + RO Data)                 82618 (  80.68kB)
    Total RW  Size(RW Data + ZI Data)             245396 ( 239.64kB)
    Total ROM Size(Code + RO Data + RW Data)      270162 ( 263.83kB)
================================================================================
```

Figure 4: Code/data size information

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8. DRAME USAGE INFORMATION (WORKING BUFFER)

Sample Rate of Audio Input	Buffer Size (bytes)
8kHz	62512
16kHz	75372
32kHz	75372

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9. CPU MIPS/CLOCK CYCLES ESTIMATION

- Baby cry detection
  - 8 kHz: Core cycles/sec: 120 M
  - 16 kHz: Core cycles/sec: 130 M

Note: It is estimated on VSN_V3 (528 MHz)

- Loud sound detection

  For executing an MI_AED_RunLsd every 32 msec
  - 8 kHz/stereo
    - Instructions: 20 K
    - Core cycles: 30 K
  - 16 kHz/stereo
    - Instructions: 40 K
    - Core cycles: 60 K
  - 32 kHz/stereo
    - Instructions: 80 K
    - Core cycles: 120 K

Note: It is estimated on ADS Emulator

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