SnAirBeats

1.0

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Chapter 1

SnAirBeats

1.1 SnAIRbeats

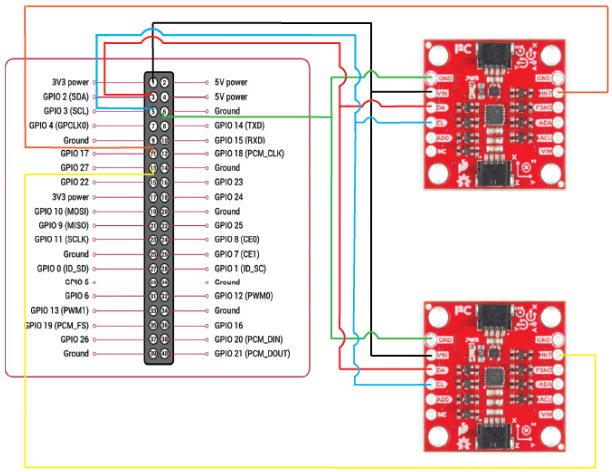
SnAirBeats is a next generation method to practice the drums, while reducing noise and space typically required to do so. The SnAirBeat set uses intertial measurement units (IMU) within the sticks to track their movement and play a corresponding drum, not requiring any physical hitting like modern electric drum sets need.

1.2 Building

SnAIRBeats requires the following components to work:

- 1x `Raspberry Pi 5`
- 2x `SEN15335 Breakout IMU`
- 1x `External USB Speaker`

The circuit's wires should be at least 1m long to ensure comfortable movement while playing to avoid risk of damaging the project. A wiring guide can be seen below:



The drumsticks for the project need to be 3D printed via the STLs provided within this repository.

1.3 Prerequisites

Firstly it should be noted that SnAIRBeats can only run on a Linux system. It is recommened to use a Raspberry Pi operating system such as Raspebian as the packages will not work on Windows systems.

Before installing any of the prerequisites, please update your package list with:

```
sudo apt update
```

There are 4 main libraries that need to be installed for this project:

- Libgpiod - for general purpose input/output
- mraa - IoT and hardware interface library (required for IMU driver)
- YAML - Support for YAML (required for IMU driver)
- ALSA - To process and play sound files

These packages can be installed by running the following commands through the terminal of the Raspberry Pi.

```
sudo apt install -y libgpiod-dev
sudo apt install -y libmraa-dev
sudo apt install -y libyaml-dev
sudo apt install -y libasound2-dev
```

1.4 Compliation from source

The project is built using a series of CMakeLists.txt which locate and link the required internal and external libraries for the project. By running the code below, the CMake will generate the respective make files within each of files. Running make will build the project and return an executable.

```
cmake .
make
```

It may take a few seconds for everything to build properly, but once everything has been successfully created you can use the code below to run SnAIRBeats.

```
./SnairBeats
```

1.5 Usage

SnAIRBeats works by reading the direction of acceleration within the IMUs. Holding the sticks with the X-direction representing the vertical axis:

- Hitting a stick down will play a snare drum
- Hitting a stick to either side will play a high tom
- Lunging the stick forward will play a crash cymbal

If desired, the sounds played by each direction can be changed by swapping files in the ALSAPlayer library found either here or through the command directory:

```
cd src/libs/ALSAPlayer/include
ls
```

1.5.1 Maximum Latency

The highest sampling rate the SEN 15335 IMUs can work at is 1.125kHz.
This value can be adjusted in the main.cpp file by altering the SampleRateDivider variable. This divides the sampling rate by 1+SampleRateDivider.

We have found that the maximum latency the sticks can be reliably played at is 25Hz (1125Hz/44+1). While decreasing the latency may improve the sensitivity of the sticks, the higher this value is the greater the power consumption will be.

1.6 Libraries

Here is a small description of each of the libraries used within the project and what they are used for.

1.6.1 ALSAPlayer

ALSAPlayer takes .wav files from inside its include folder and converts them into audio buffers using the ConvertFiles function. This library is heavily based off of driver written by Adam Stark found at https://github.com/adamstark/AudioFile.

Audio devices are opened using the Open function which once finished can be used to play the created audiobuffers using the playFile function. The playFile function is built to play small audios and will interrupt itself, cancelling whatever is playing to play the next audio. This is much easier for SnAIRBeats compared to mixing as the interrupt of the drum notes is not noticable to the human ear, especially with the sample delay between each hit.

1.6.2 GPIO

The GPIO library initialises the GPIO pins of the Raspberry Pi. Using libgpiod, an event driven interrupt function called "worker" is used to read one of the GPIO pins for a HIGH value. The function is blocked until a rising edge event is seen in the GPIO pin selected in the constructor.

The interrupt is data-ready based and therefore wakes whenever new data is available from the sensor. Within the constructor, 2 objects were passed in, the Maths object and the I2C-IMU driver. The new data is read from the IMU's registers using a read function and passed into a callback which inputs the data into the maths object to be thresholded.

1.6.3 I2C

The I2C library is a driver written specifically for the ICM-20948 chip seen within the SEN 15335 IMU and is very heavily based off of driver written by NTKot found at https://github.com/NTkot/icm20948_i2c with the Raw-Data-Ready interrupt turned on and the magnetometer turned off.

For each sensor used within the system, an object from this driver is built with a separate I2C address to differentiate between the two. These objects come with pre-built functions, must useful is the Read_Accel_Gyro which reads the registers of the IMU and stores the values in a variable within the object. These variables are what are passed into the IMUMaths callback through the GPIO worker whenever data is ready.

1.6.4 IMUMaths

This libary was written to threshold the data that came through from the GPIO worker and has two main goals. Firstly it reads the data passed through and checks whether any of the values correlate to a hit and then play the corresponding audio from the ALSAAudio object. It also contains a sample delay to stop multiple sounds being played from the same hit. This is achieved using a simple boolean that is turned true after a hit is detected and waits a set number of samples before the boolean flips back, allowing another hit to be detected.

1.7 Unit tests

This project uses unit testing to validate the functionality of the key classes, including classes responsible for IMU data processing and audio playback.

Tests are written using the GoogleTest framework and integrated with CTest for easy execution.

To run the tests from the root directory, use:

```
./run_tests
```

or to use CMake directly, run:

```
ctest
```

1.8 Documentation

Complete documentation for this project can be found in documentation.pdf.

1.9 Sponsorship and funding

We are very grateful for RS Components for providing us with components that allowed us to complete this project.

1.10 Media

- Instagram

1.11 Authors

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1.12 Licenses

The IMU driver has been adapted from the driver written by NTKot and can be found at https://github.com/NTkot/icm20948_i2c

The ALSAPlayer library has been adapted from the driver written by Adam Stark and can be found at https://github.com/adamstark/AudioFile

Chapter 2

Namespace Index

2.1 Namespace List

Here is a list of all namespaces with brief descriptions:

Chapter 3

Hierarchical Index

3.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 4

Class Index

4.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 5

File Index

5.1 File List

Here is a list of all files with brief descriptions:

Chapter 6

Namespace Documentation

6.1 AudioPlayerName Namespace Reference

Classes

- class AudioPlayer

6.2 GPIOName Namespace Reference

Classes

- class GPIOClass
- struct MathsCallbackStruct

Typedefs

- typedef void(* GPIOCallback) (void *context, float, float, float)

6.2.1 Typedef Documentation

6.2.1.1 GPIOCallback

```
typedef void(* GPIOName::GPIOCallback) (void *context, float, float, float)
```

6.3 icm20948 Namespace Reference

Classes

- class ICM20948_I2C

6.4 IMUMathsName Namespace Reference

Classes

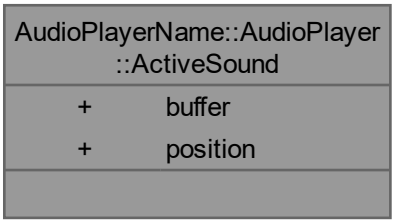
- struct AudioCallback
- class IMUMaths

Chapter 7

Class Documentation

7.1 AudioPlayerName::AudioPlayer::ActiveSound Struct Reference

Collaboration diagram for AudioPlayerName::AudioPlayer::ActiveSound:



Public Attributes

- std::vector< int32_t > * buffer
- size_t position

7.1.1 Member Data Documentation

7.1.1.1 buffer

```
std::vector<int32_t>* AudioPlayerName::AudioPlayer::ActiveSound::buffer
```

7.1.1.2 position

```
size_t AudioPlayerName::AudioPlayer::ActiveSound::position
```

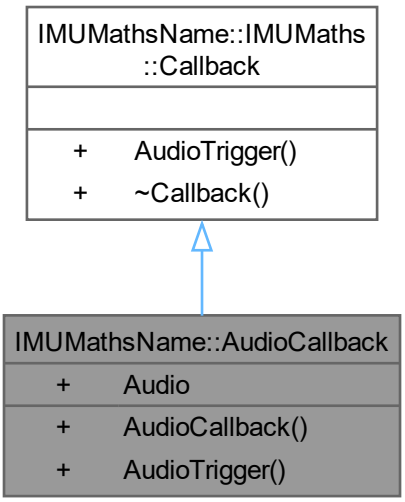
The documentation for this struct was generated from the following file:

- src/libs/ALSAPlayer/include/ALSAPlayer.hpp

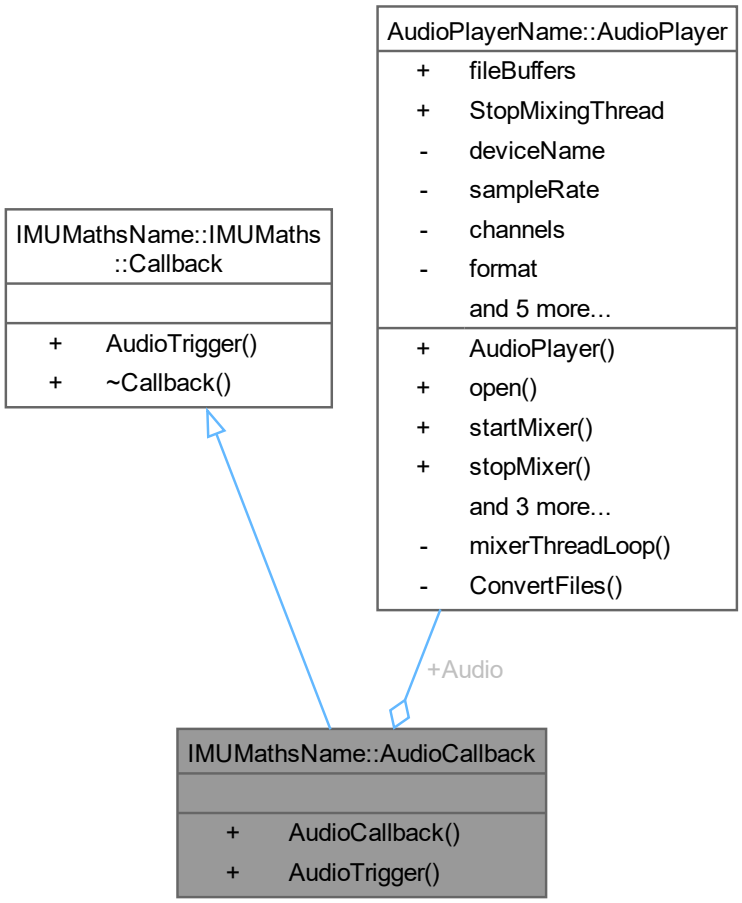
7.2 IMUMathsName::AudioCallback Struct Reference

`#include <IMUMaths.hpp>`

Inheritance diagram for IMUMathsName::AudioCallback:



Collaboration diagram for IMUMathsName::AudioCallback:



Public Member Functions

- AudioCallback (AudioPlayerName::AudioPlayer &audio)
- virtual void AudioTrigger (const std::string &FilePath)

Public Member Functions inherited from IMUMathsName::IMUMaths::Callback

- virtual ~Callback ()

Public Attributes

- AudioPlayerName::AudioPlayer & Audio

7.2.1 Constructor & Destructor Documentation

7.2.1.1 AudioCallback()

```
IMUMathsName::AudioCallback::AudioCallback (
            AudioPlayerName::AudioPlayer & audio)  [inline]
```

7.2.2 Member Function Documentation

7.2.2.1 AudioTrigger()

```
virtual void IMUMathsName::AudioCallback::AudioTrigger (
            const std::string & FilePath)  [inline], [virtual]
```

Implements IMUMathsName::IMUMaths::Callback.

7.2.3 Member Data Documentation

7.2.3.1 Audio

```
AudioPlayerName::AudioPlayer& IMUMathsName::AudioCallback::Audio
```

The documentation for this struct was generated from the following file:

- src/libs/IMUMaths/include/IMUMaths.hpp

7.3 AudioPlayerName::AudioPlayer Class Reference

```
#include <ALSAPlayer.hpp>
```

Collaboration diagram for AudioPlayerName::AudioPlayer:

Classes

- struct ActiveSound

Public Member Functions

- AudioPlayer (const std::string &device="default", unsigned int rate=44100, unsigned int ch=2, snd_pcm_↩ format_t fmt=SND_PCM_FORMAT_S16_LE, snd_pcm_uframes_t frames=256, const std::vector< std::string > &filesToConvert={"src/libs/ALSAPlayer/include/CrashCymbal.wav", "src/libs/ALSAPlayer/include/High↩ Tom.wav", "src/libs/ALSAPlayer/include/SnareDrum.wav"})

  Constructor for AudioPlayer class.
- bool open ()

  Open PCM device for playback.
- void startMixer ()

  Start mixer thread.
- void stopMixer ()

  Stop mixer thread.
- bool addSoundToMixer (const std::string &fileKey)

  Add input sound to mixer and play it.
- void close ()

  Close PCM handle and free all associated resources.
- ~AudioPlayer ()

  Destructor.

Public Attributes

- std::unordered_map< std::string, std::vector< int32_t > > fileBuffers
- bool StopMixingThread = false

Private Member Functions

- void mixerThreadLoop ()
- void ConvertFiles (const std::vector< std::string > &filePaths)

Private Attributes

- std::string deviceName
- unsigned int sampleRate
- unsigned int channels
- snd_pcm_format_t format
- snd_pcm_uframes_t framesPerPeriod
- snd_pcm_t * handle
- std::thread mixThread
- std::vector< ActiveSound > ActiveSounds
- std::mutex ActiveMutex

7.3.1 Constructor & Destructor Documentation

7.3.1.1 AudioPlayer()

```
AudioPlayerName::AudioPlayer::AudioPlayer (
            const std::string & device = "default",
            unsigned int rate = 44100,
            unsigned int ch = 2,
            snd_pcm_format_t fmt = SND_PCM_FORMAT_S16_LE,
            snd_pcm_uframes_t frames = 256,
            const std::vector< std::string > & filesToConvert = {"src/libs/ALSAPlayer/include/CrashCymbal.wa
[inline]
```

Constructor for AudioPlayer class.

Handles audio file loading, conversion and playback.

Parameters

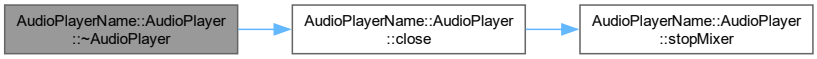
device	The name of the ALSA device to use.
rate	Sample rate in Hz.
ch	Number of channels.
fmt	Format of audio data.
frames	Number of frames per period.
filesToConvert	Sound files used.

7.3.1.2 ~AudioPlayer()

```
AudioPlayerName::AudioPlayer::~AudioPlayer ()  [inline]
```

Destructor.

Here is the call graph for this function:



7.3.2 Member Function Documentation

7.3.2.1 addSoundToMixer()

```
bool AudioPlayerName::AudioPlayer::addSoundToMixer (
            const std::string & fileKey)  [inline]
```

Add input sound to mixer and play it.

It includes the following steps:

- register detected sound in the mixer
- add sound to buffer and remove sounds that have finished playing
- play sound

Parameters

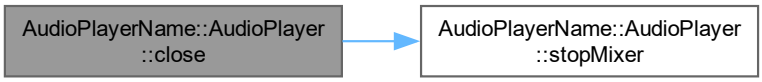
fileKey	Sound file key.

7.3.2.2 close()

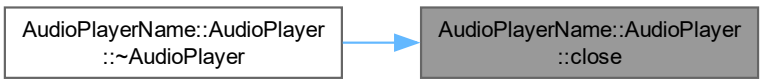
```
void AudioPlayerName::AudioPlayer::close ()  [inline]
```

Close PCM handle and free all associated resources.

Here is the call graph for this function:



Here is the caller graph for this function:



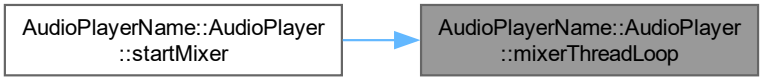
7.3.2.3 ConvertFiles()

```
void AudioPlayerName::AudioPlayer::ConvertFiles (
            const std::vector< std::string > & filePaths)  [inline], [private]
```

7.3.2.4 mixerThreadLoop()

```
void AudioPlayerName::AudioPlayer::mixerThreadLoop ()  [inline], [private]
```

Here is the caller graph for this function:



7.3.2.5 open()

```
bool AudioPlayerName::AudioPlayer::open ()  [inline]
```

Open PCM device for playback.

It includes the following steps:

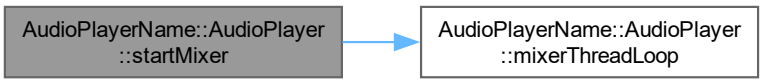
- open the PCM device
- allocate hardware parameters object and fill it in with default values
- set desired hardware parameters (set access type, format, number of channels, sample rate, period size)
- write parameters to the driver
- get period size

7.3.2.6 startMixer()

```
void AudioPlayerName::AudioPlayer::startMixer ()  [inline]
```

Start mixer thread.

Here is the call graph for this function:

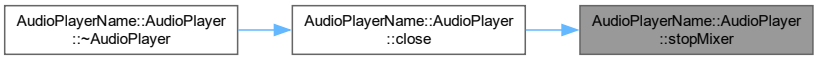


7.3.2.7 stopMixer()

```
void AudioPlayerName::AudioPlayer::stopMixer ()  [inline]
```

Stop mixer thread.

Here is the caller graph for this function:



7.3.3 Member Data Documentation

7.3.3.1 ActiveMutex

```
std::mutex AudioPlayerName::AudioPlayer::ActiveMutex  [private]
```

7.3.3.2 ActiveSounds

```
std::vector<ActiveSound> AudioPlayerName::AudioPlayer::ActiveSounds  [private]
```

7.3.3.3 channels

```
unsigned int AudioPlayerName::AudioPlayer::channels  [private]
```

7.3.3.4 deviceName

```
std::string AudioPlayerName::AudioPlayer::deviceName  [private]
```

7.3.3.5 fileBuffers

```
std::unordered_map<std::string, std::vector<int32_t> > AudioPlayerName::AudioPlayer::file↩
Buffers
```

7.3.3.6 format

```
snd_pcm_format_t AudioPlayerName::AudioPlayer::format  [private]
```

7.3.3.7 framesPerPeriod

```
snd_pcm_uframes_t AudioPlayerName::AudioPlayer::framesPerPeriod  [private]
```

7.3.3.8 handle

```
snd_pcm_t* AudioPlayerName::AudioPlayer::handle  [private]
```

7.3.3.9 mixThread

```
std::thread AudioPlayerName::AudioPlayer::mixThread  [private]
```

7.3.3.10 sampleRate

```
unsigned int AudioPlayerName::AudioPlayer::sampleRate  [private]
```

7.3.3.11 StopMixingThread

```
bool AudioPlayerName::AudioPlayer::StopMixingThread = false
```

The documentation for this class was generated from the following file:

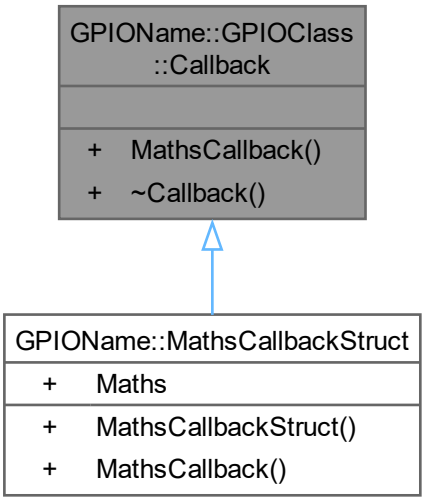
- src/libs/ALSAPlayer/include/ALSAPlayer.hpp

7.4 GPIOName::GPIOClass::Callback Struct Reference

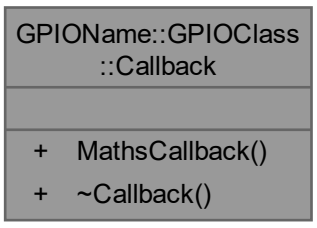
Callback using virtual void.

`#include <gpioevent.h>`

Inheritance diagram for GPIOName::GPIOClass::Callback:



Collaboration diagram for GPIOName::GPIOClass::Callback:



Public Member Functions

- virtual void MathsCallback (float X, float Y, float Z)=0
- virtual ~Callback ()

7.4.1 Detailed Description

Callback using virtual void.

7.4.2 Constructor & Destructor Documentation

7.4.2.1 ~Callback()

```
virtual GPIOName::GPIOClass::Callback::~Callback ()  [inline], [virtual]
```

7.4.3 Member Function Documentation

7.4.3.1 MathsCallback()

```
virtual void GPIOName::GPIOClass::Callback::MathsCallback (
            float X,
            float Y,
            float Z)  [pure virtual]
```

Implemented in GPIOName::MathsCallbackStruct.

The documentation for this struct was generated from the following file:

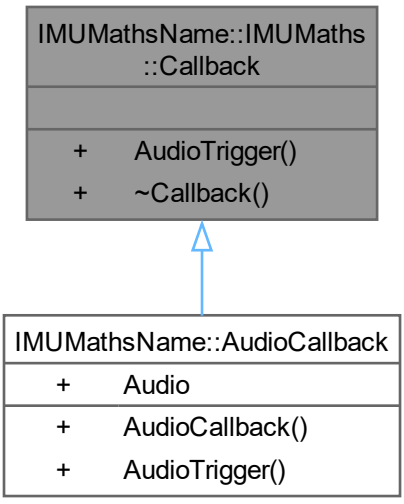
- src/libs/GPIO/include/gpioevent.h

7.5 IMUMathsName::IMUMaths::Callback Struct Reference

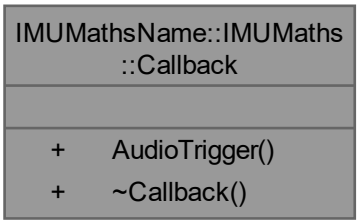
Callback using virtual void.

`#include <IMUMaths.hpp>`

Inheritance diagram for IMUMathsName::IMUMaths::Callback:



Collaboration diagram for IMUMathsName::IMUMaths::Callback:



Public Member Functions

- virtual void AudioTrigger (const std::string &FilePath)=0
- virtual ~Callback ()

7.5.1 Detailed Description

Callback using virtual void.

7.5.2 Constructor & Destructor Documentation

7.5.2.1 ~Callback()

```
virtual IMUMathsName::IMUMaths::Callback::~Callback ()  [inline], [virtual]
```

7.5.3 Member Function Documentation

7.5.3.1 AudioTrigger()

```
virtual void IMUMathsName::IMUMaths::Callback::AudioTrigger (
            const std::string & FilePath)  [pure virtual]
```

Implemented in IMUMathsName::AudioCallback.

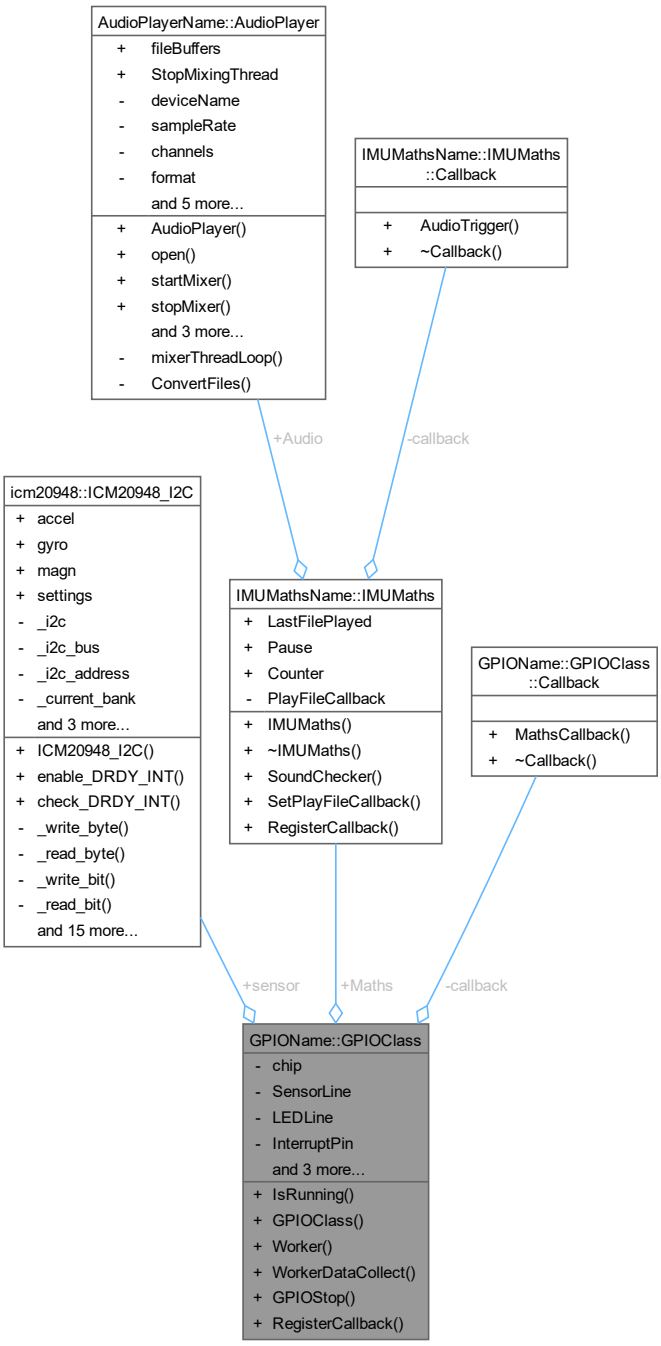
The documentation for this struct was generated from the following file:

- src/libs/IMUMaths/include/IMUMaths.hpp

7.6 GPIOName::GPIOClass Class Reference

`#include <gpioevent.h>`

Collaboration diagram for GPIOName::GPIOClass:



Classes

- struct Callback

  Callback using virtual void.

Public Member Functions

- bool IsRunning () const
- GPIOClass (const char *chipName, int InterruptPin, icm20948::ICM20948_I2C &sensor, IMUMathsName::IMUMaths &Maths)

  Constructor for GPIOClass.
- void Worker ()

  Event driven worker reading data when HIGH seen on GPIO.
- void WorkerDataCollect ()

  Event driven worker reading data when HIGH seen on GPIO and records data to a CSV.
- void GPIOStop ()

  Changes a boolean to end the worker.
- void RegisterCallback (Callback *cb)

  Registers a callback.

Public Attributes

- icm20948::ICM20948_I2C & sensor
- IMUMathsName::IMUMaths & Maths

Private Attributes

- gpiod_chip * chip
- gpiod_line * SensorLine
- gpiod_line * LEDLine
- int InterruptPin
- int Counter
- bool Pause = true
- std::atomic< bool > running {true}
- Callback * callback = nullptr

7.6.1 Constructor & Destructor Documentation

7.6.1.1 GPIOClass()

```
GPIOName::GPIOClass::GPIOClass (
            const char * chipName,
            int InterruptPin,
            icm20948::ICM20948_I2C & sensor,
            IMUMathsName::IMUMaths & Maths)
```

Constructor for GPIOClass.

Parameters

chipName	The name of the GPIO chip (e.g., "gpiochip0")
InterruptPin	The GPIO pin number for interrupts
sensor	access to ICM20948_I2C objects (

See also

icm20948::ICM20948_I2C)

Parameters

Maths	access to IMUMaths objects (

See also

IMUMathsName::IMUMaths)

7.6.2 Member Function Documentation

7.6.2.1 GPIOStop()

```
void GPIOName::GPIOClass::GPIOStop ()
```

Changes a boolean to end the worker.

7.6.2.2 IsRunning()

```
bool GPIOName::GPIOClass::IsRunning () const  [inline]
```

7.6.2.3 RegisterCallback()

```
void GPIOName::GPIOClass::RegisterCallback (
            Callback * cb)  [inline]
```

Registers a callback.

Parameters

cb	callback to register

7.6.2.4 Worker()

```
void GPIOName::GPIOClass::Worker ()
```

Event driven worker reading data when HIGH seen on GPIO.

This function is an event driven interrupt controlled by a GPIO pin. Once this GPIO pin reads HIGH the function will read the data registers using the ReadAccel() callback from the IMU's driver which is then fed into the IMU Maths object to be analysed.

7.6.2.5 WorkerDataCollect()

```
void GPIOName::GPIOClass::WorkerDataCollect ()
```

Event driven worker reading data when HIGH seen on GPIO and records data to a CSV.

The function begins by initialising a csv file named by the user. This function then uses blocking interrupts controlled by a GPIO pin. Once this GPIO pin reads HIGH the function reads the data registers using the ReadAccel() callback from the IMU's driver and appends this data into the opened CSV file.

7.6.3 Member Data Documentation

7.6.3.1 callback

```
Callback* GPIOName::GPIOClass::callback = nullptr  [private]
```

7.6.3.2 chip

```
gpiod_chip* GPIOName::GPIOClass::chip  [private]
```

7.6.3.3 Counter

```
int GPIOName::GPIOClass::Counter  [private]
```

7.6.3.4 InterruptPin

```
int GPIOName::GPIOClass::InterruptPin  [private]
```

7.6.3.5 LEDLine

```
gpiod_line* GPIOName::GPIOClass::LEDLine  [private]
```

7.6.3.6 Maths

```
IMUMathsName::IMUMaths& GPIOName::GPIOClass::Maths
```

7.6.3.7 Pause

```
bool GPIOName::GPIOClass::Pause = true  [private]
```

7.6.3.8 running

```
std::atomic<bool> GPIOName::GPIOClass::running {true}  [private]
```

7.6.3.9 sensor

```
icm20948::ICM20948_I2C& GPIOName::GPIOClass::sensor
```

7.6.3.10 SensorLine

```
gpiod_line* GPIOName::GPIOClass::SensorLine  [private]
```

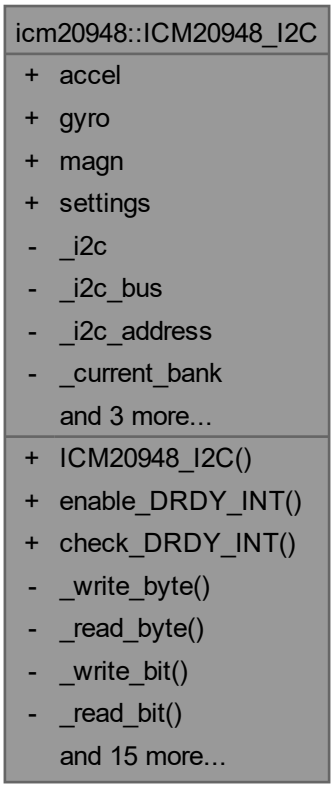
The documentation for this class was generated from the following file:

- src/libs/GPIO/include/gpioevent.h

7.7 icm20948::ICM20948_I2C Class Reference

```
#include <icm20948_i2c.hpp>
```

Collaboration diagram for icm20948::ICM20948_I2C:



Public Member Functions

- ICM20948_I2C (unsigned i2c_bus, unsigned i2c_address=ICM20948_I2C_ADDR, icm20948::settings=icm20948↩ ::settings())

  Constructor for ICM20948_I2C class.
- bool enable_DRDY_INT ()

  Enables the Data Ready Interrupt.
- bool check_DRDY_INT ()

  Checks if the Data Ready Interrupt is active.

Public Attributes

- float accel [3]
- float gyro [3]
- float magn [3]
- icm20948::settings settings

Private Member Functions

- bool _write_byte (const uint8_t bank, const uint8_t reg, const uint8_t byte)
- bool _read_byte (const uint8_t bank, const uint8_t reg, uint8_t &byte)
- bool _write_bit (const uint8_t bank, const uint8_t reg, const uint8_t bit_pos, const bool bit)
- bool _read_bit (const uint8_t bank, const uint8_t reg, const uint8_t bit_pos, bool &bit)
- bool _read_block_bytes (const uint8_t bank, const uint8_t start_reg, uint8_t *bytes, const int length)
- bool _write_mag_byte (const uint8_t mag_reg, const uint8_t byte)
- bool _read_mag_byte (const uint8_t mag_reg, uint8_t &byte)
- bool _read_int_byte (const uint8_t bank, const uint8_t reg, uint8_t &byte)
- bool _set_bank (uint8_t bank)
- bool _set_accel_sample_rate_div ()
- bool _set_accel_range_dlpf ()
- bool _set_gyro_sample_rate_div ()
- bool _set_gyro_range_dlpf ()
- bool _magnetometer_init ()
- bool _magnetometer_enable ()
- bool _magnetometer_set_mode ()
- bool _magnetometer_configured ()
- bool _magnetometer_set_readout ()
- bool _chip_i2c_master_reset ()

Private Attributes

- mraa::I2c _i2c
- unsigned _i2c_bus
- unsigned _i2c_address
- uint8_t _current_bank
- float _accel_scale_factor
- float _gyro_scale_factor
- float _magn_scale_factor

7.7.1 Constructor & Destructor Documentation

7.7.1.1 ICM20948_I2C()

```
icm20948::ICM20948_I2C::ICM20948_I2C (
            unsigned i2c_bus,
            unsigned i2c_address = ICM20948_I2C_ADDR,
            icm20948::settings  = icm20948::settings())
```

Constructor for ICM20948_I2C class.

Parameters

i2c_bus	The I2C bus number to which the sensor is connected.
i2c_address	The I2C address of the sensor (default is ICM20948_I2C_ADDR).
settings	The settings structure containing configuration parameters for the sensor. If not provided, default settings will be used -

See also

icm20948::settings (external).

7.7.2 Member Function Documentation

7.7.2.1 _chip_i2c_master_reset()

```
bool icm20948::ICM20948_I2C::_chip_i2c_master_reset ()  [private]
```

7.7.2.2 _magnetometer_configured()

```
bool icm20948::ICM20948_I2C::_magnetometer_configured ()  [private]
```

7.7.2.3 _magnetometer_enable()

```
bool icm20948::ICM20948_I2C::_magnetometer_enable ()  [private]
```

7.7.2.4 _magnetometer_init()

```
bool icm20948::ICM20948_I2C::_magnetometer_init ()  [private]
```

7.7.2.5 _magnetometer_set_mode()

```
bool icm20948::ICM20948_I2C::_magnetometer_set_mode ()  [private]
```

7.7.2.6 _magnetometer_set_readout()

```
bool icm20948::ICM20948_I2C::_magnetometer_set_readout ()  [private]
```

7.7.2.7 _read_bit()

```
bool icm20948::ICM20948_I2C::_read_bit (
            const uint8_t bank,
            const uint8_t reg,
            const uint8_t bit_pos,
            bool & bit)  [private]
```

7.7.2.8 _read_block_bytes()

```
bool icm20948::ICM20948_I2C::_read_block_bytes (
            const uint8_t bank,
            const uint8_t start_reg,
            uint8_t * bytes,
            const int length)  [private]
```

7.7.2.9 _read_byte()

```
bool icm20948::ICM20948_I2C::_read_byte (
            const uint8_t bank,
            const uint8_t reg,
            uint8_t & byte)  [private]
```

7.7.2.10 _read_int_byte()

```
bool icm20948::ICM20948_I2C::_read_int_byte (
            const uint8_t bank,
            const uint8_t reg,
            uint8_t & byte)  [private]
```

7.7.2.11 _read_mag_byte()

```
bool icm20948::ICM20948_I2C::_read_mag_byte (
            const uint8_t mag_reg,
            uint8_t & byte)  [private]
```

7.7.2.12 _set_accel_range_dlpf()

```
bool icm20948::ICM20948_I2C::_set_accel_range_dlpf ()  [private]
```

7.7.2.13 _set_accel_sample_rate_div()

```
bool icm20948::ICM20948_I2C::_set_accel_sample_rate_div ()  [private]
```

7.7.2.14 _set_bank()

```
bool icm20948::ICM20948_I2C::_set_bank (
            uint8_t bank)  [private]
```

7.7.2.15 _set_gyro_range_dlpf()

```
bool icm20948::ICM20948_I2C::_set_gyro_range_dlpf ()  [private]
```

7.7.2.16 _set_gyro_sample_rate_div()

```
bool icm20948::ICM20948_I2C::_set_gyro_sample_rate_div ()  [private]
```

7.7.2.17 _write_bit()

```
bool icm20948::ICM20948_I2C::_write_bit (
            const uint8_t bank,
            const uint8_t reg,
            const uint8_t bit_pos,
            const bool bit)  [private]
```

7.7.2.18 _write_byte()

```
bool icm20948::ICM20948_I2C::_write_byte (
            const uint8_t bank,
            const uint8_t reg,
            const uint8_t byte)  [private]
```

7.7.2.19 _write_mag_byte()

```
bool icm20948::ICM20948_I2C::_write_mag_byte (
            const uint8_t mag_reg,
            const uint8_t byte)  [private]
```

7.7.2.20 check_DRDY_INT()

```
bool icm20948::ICM20948_I2C::check_DRDY_INT ()
```

Checks if the Data Ready Interrupt is active.

The function is run when the GPIO pin connected to the INT wire recieves a HIGH signal This reads the int_status register, reads the data from the data registers and thus unlatches the interrupt, ready for the next set of data

Returns

true if the registers were successfully read, false if an error occured

7.7.2.21 enable_DRDY_INT()

```
bool icm20948::ICM20948_I2C::enable_DRDY_INT ()
```

Enables the Data Ready Interrupt.

This function enables the Raw Data Ready Interrupt within the IMU by setting the specific registers so that it is notified when new data is available. When new data is available the INT pin on the IMU sends a HIGH value which can be read via a GPIO pin on the Pi.

Returns

true if the setup was successful, false if registers could not be written successefully

7.7.3 Member Data Documentation

7.7.3.1 _accel_scale_factor

```
float icm20948::ICM20948_I2C::_accel_scale_factor  [private]
```

7.7.3.2 _current_bank

```
uint8_t icm20948::ICM20948_I2C::_current_bank  [private]
```

7.7.3.3 _gyro_scale_factor

```
float icm20948::ICM20948_I2C::_gyro_scale_factor  [private]
```

7.7.3.4 _i2c

```
mraa::I2c icm20948::ICM20948_I2C::_i2c  [private]
```

7.7.3.5 _i2c_address

```
unsigned icm20948::ICM20948_I2C::_i2c_address  [private]
```

7.7.3.6 _i2c_bus

```
unsigned icm20948::ICM20948_I2C::_i2c_bus  [private]
```

7.7.3.7 _magn_scale_factor

```
float icm20948::ICM20948_I2C::_magn_scale_factor  [private]
```

7.7.3.8 accel

```
float icm20948::ICM20948_I2C::accel[3]
```

7.7.3.9 gyro

```
float icm20948::ICM20948_I2C::gyro[3]
```

7.7.3.10 magn

```
float icm20948::ICM20948_I2C::magn[3]
```

7.7.3.11 settings

`icm20948::settings icm20948::ICM20948_I2C::settings`

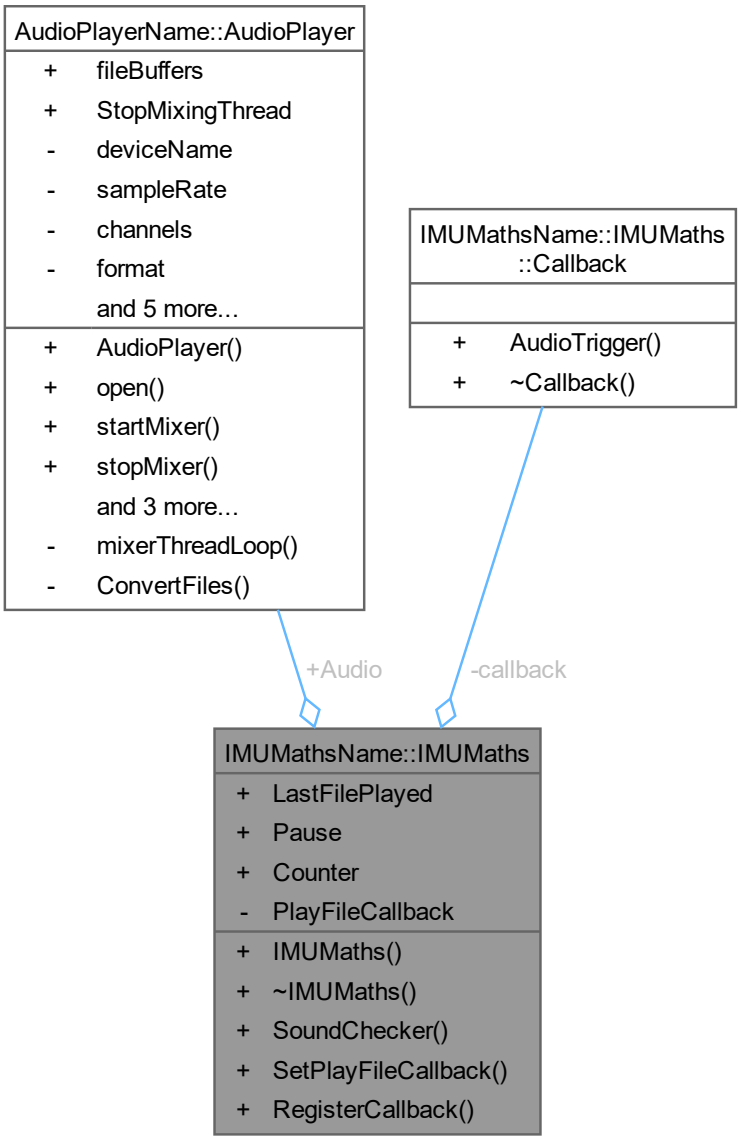
The documentation for this class was generated from the following file:

- src/libs/I2C/include/icm20948_i2c.hpp

7.8 IMUMathsName::IMUMaths Class Reference

`#include <IMUMaths.hpp>`

Collaboration diagram for IMUMathsName::IMUMaths:



Classes

- struct Callback

  Callback using virtual void.

Public Member Functions

- IMUMaths (AudioPlayerName::AudioPlayer &Audio)

  Constructs an object with access to the audio player.
- ~IMUMaths ()

  Destructor.
- void SoundChecker (float X, float Y, float Z)

  It measures each axis and sees if it falls within desired thresholds.
- void SetPlayFileCallback (const std::function< void(const std::string &)> &cb)

  Sets the callback.
- void RegisterCallback (Callback *cb)

  Registers a callback.

Public Attributes

- AudioPlayerName::AudioPlayer & Audio
- int LastFilePlayed
- bool Pause = false
- int Counter = 0

Private Attributes

- Callback * callback = nullptr
- std::function< void(const std::string &)> PlayFileCallback

7.8.1 Constructor & Destructor Documentation

7.8.1.1 IMUMaths()

```
IMUMathsName::IMUMaths::IMUMaths (
            AudioPlayerName::AudioPlayer & Audio)
```

Constructs an object with access to the audio player.

Parameters

Audio	used for playback (

See also

AudioPlayerName::AudioPlayer)

7.8.1.2 ~IMUMaths()

```
IMUMathsName::IMUMaths::~IMUMaths ()
```

Destructor.

7.8.2 Member Function Documentation

7.8.2.1 RegisterCallback()

```
void IMUMathsName::IMUMaths::RegisterCallback (
            Callback * cb)  [inline]
```

Registers a callback.

Parameters

cb	callback to register

7.8.2.2 SetPlayFileCallback()

```
void IMUMathsName::IMUMaths::SetPlayFileCallback (
            const std::function< void(const std::string &)> & cb)
```

Sets the callback.

It registers a callback via the function input

Parameters

cb	

7.8.2.3 SoundChecker()

```
void IMUMathsName::IMUMaths::SoundChecker (
            float X,
            float Y,
            float Z)
```

It measures each axis and sees if it falls within desired thresholds.

If the acceleration along the specified axis falls within specified thersholds, it will play audio

Parameters

X	acceleration along the x-axis
Y	acceleration along the Y-axis
Z	acceleration along the Z-axis

7.8.3 Member Data Documentation

7.8.3.1 Audio

```
AudioPlayerName::AudioPlayer& IMUMathsName::IMUMaths::Audio
```

7.8.3.2 callback

```
Callback* IMUMathsName::IMUMaths::callback = nullptr  [private]
```

7.8.3.3 Counter

```
int IMUMathsName::IMUMaths::Counter = 0
```

7.8.3.4 LastFilePlayed

```
int IMUMathsName::IMUMaths::LastFilePlayed
```

7.8.3.5 Pause

```
bool IMUMathsName::IMUMaths::Pause = false
```

7.8.3.6 PlayFileCallback

```
std::function<void(const std::string&)> IMUMathsName::IMUMaths::PlayFileCallback  [private]
```

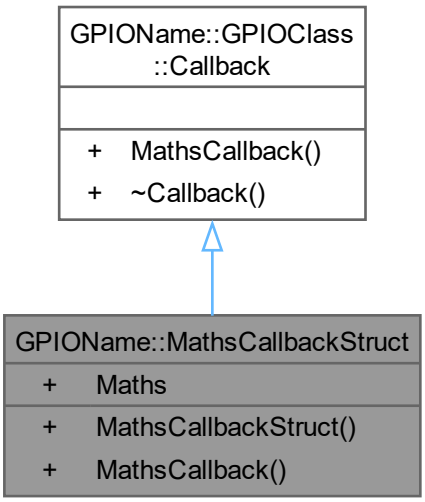
The documentation for this class was generated from the following file:

- src/libs/IMUMaths/include/IMUMaths.hpp

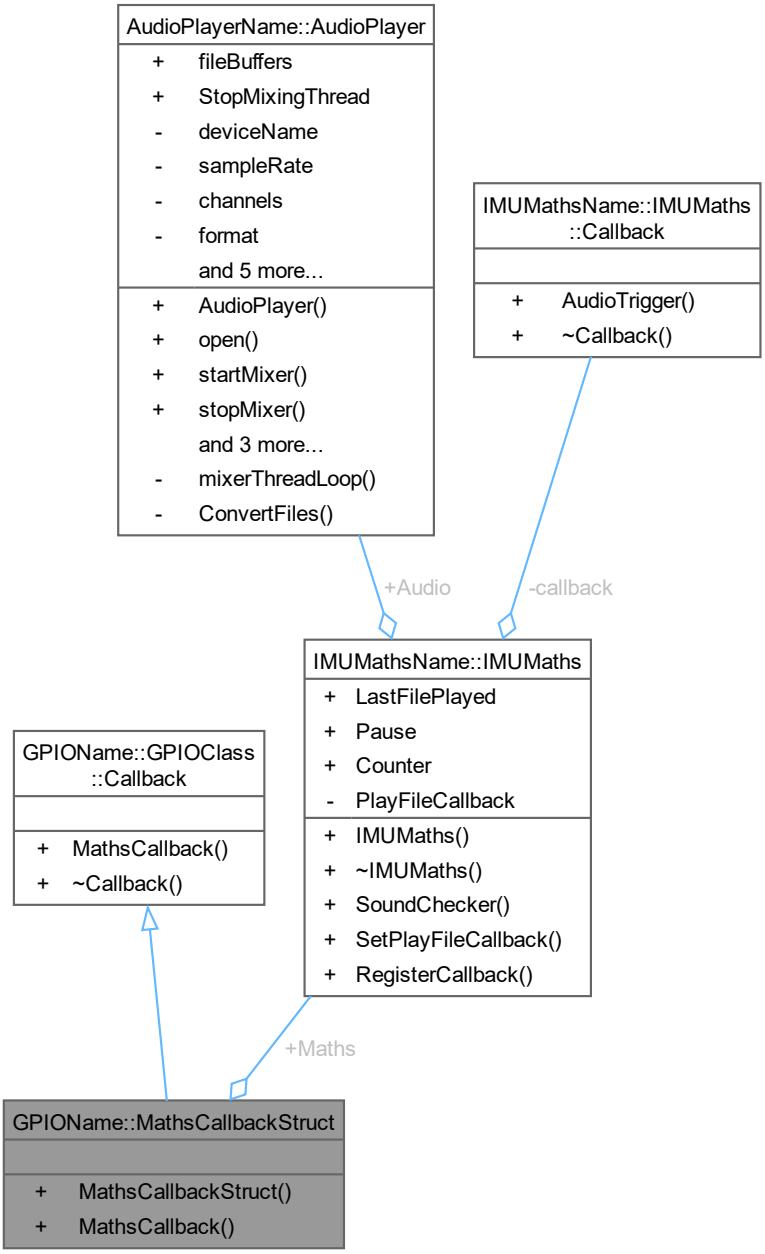
7.9 GPIOName::MathsCallbackStruct Struct Reference

`#include <gpioevent.h>`

Inheritance diagram for GPIOName::MathsCallbackStruct:



Collaboration diagram for GPIOName::MathsCallbackStruct:



Public Member Functions

- MathsCallbackStruct (IMUMathsName::IMUMaths &maths)
- virtual void MathsCallback (float X, float Y, float Z) override

Public Member Functions inherited from GPIOName::GPIOClass::Callback

- virtual ~Callback ()

Public Attributes

- IMUMathsName::IMUMaths & Maths

7.9.1 Constructor & Destructor Documentation

7.9.1.1 MathsCallbackStruct()

```
GPIOName::MathsCallbackStruct::MathsCallbackStruct (
            IMUMathsName::IMUMaths & maths)  [inline]
```

7.9.2 Member Function Documentation

7.9.2.1 MathsCallback()

```
virtual void GPIOName::MathsCallbackStruct::MathsCallback (
            float X,
            float Y,
            float Z)  [inline], [override], [virtual]
```

Implements GPIOName::GPIOClass::Callback.

7.9.3 Member Data Documentation

7.9.3.1 Maths

```
IMUMathsName::IMUMaths& GPIOName::MathsCallbackStruct::Maths
```

The documentation for this struct was generated from the following file:

- src/libs/GPIO/include/gpioevent.h

Chapter 8

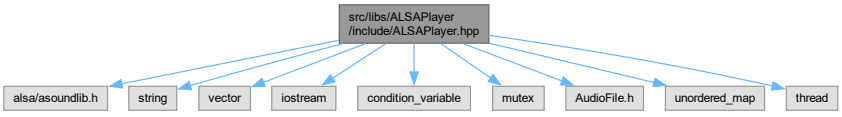
File Documentation

8.1 README.md File Reference

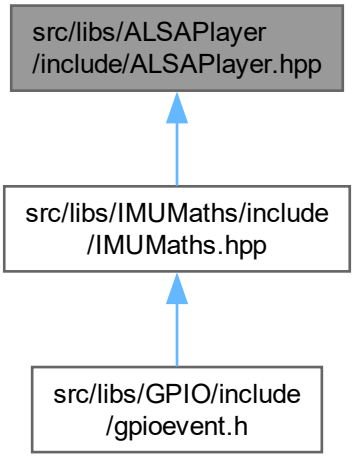
8.2 src/libs/ALSAPlayer/include/ALSAPlayer.hpp File Reference

```
#include <alsa/asoundlib.h>
#include <string>
#include <vector>
#include <iostream>
#include <condition_variable>
#include <mutex>
#include "AudioFile.h"
#include <unordered_map>
#include <thread>
```

Include dependency graph for ALSAPlayer.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class AudioPlayerName::AudioPlayer
- struct AudioPlayerName::AudioPlayer::ActiveSound

Namespaces

- namespace AudioPlayerName

8.3 ALSAPlayer.hpp

Go to the documentation of this file.

```
00001
00002 #ifndef ALSAPLAYER_H
00003 #define ALSAPLAYER_H
00004
00005 #include <alsa/asoundlib.h>
00006 #include <string>
00007 #include <vector>
00008 #include <iostream>
00009 #include <condition_variable>
00010 #include <mutex>
00011 #include "AudioFile.h"
00012 #include <unordered_map>
00013 #include <thread>
00014
00015
00016 namespace AudioPlayerName{
00017     class AudioPlayer{
00018         public:
00019         std::unordered_map<std::string, std::vector<int32_t» fileBuffers;
00020
00021         bool StopMixingThread = false;
00022
00035         AudioPlayer(const std::string& device="default",
00036             unsigned int rate = 44100,
```

```
00037             unsigned int ch = 2,
00038             snd_pcm_format_t fmt = SND_PCM_FORMAT_S16_LE,
00039             snd_pcm_uframes_t frames = 256,
00040             const std::vector<std::string>& filesToConvert =
    {"src/libs/ALSAPlayer/include/CrashCymbal.wav",
00041
    "src/libs/ALSAPlayer/include/HighTom.wav",
00042
    "src/libs/ALSAPlayer/include/SnareDrum.wav"})
00043         : deviceName(device), sampleRate(rate), channels(ch),
00044         format(fmt), framesPerPeriod(frames), handle(nullptr)
00045         {
00046             if (!filesToConvert.empty()){
00047                 ConvertFiles(filesToConvert);
00048             }
00049         }
00050
00061         bool open(){
00062             int rc = snd_pcm_open(&handle, deviceName.c_str(), SND_PCM_STREAM_PLAYBACK,0);
00063             if (rc < 0){
00064                 std::cerr « "Unable to open PCM devices: " « snd_strerror(rc) « std::endl;
00065                 return false;
00066             }
00067
00068             snd_pcm_hw_params_t* params;
00069             snd_pcm_hw_params_alloca(&params);
00070             snd_pcm_hw_params_any(handle, params);
00071             snd_pcm_hw_params_set_access(handle, params, SND_PCM_ACCESS_RW_INTERLEAVED);
00072             snd_pcm_hw_params_set_format(handle, params, format);
00073             snd_pcm_hw_params_set_channels(handle, params, channels);
00074
00075             unsigned int rate_near = sampleRate;
00076             snd_pcm_hw_params_set_rate_near(handle, params, &rate_near,0);
00077
00078             rc = snd_pcm_hw_params_set_period_size_near(handle, params, &framesPerPeriod, 0);
00079             if (rc <0) {
00080                 std::cerr « "Unable to set HW parameters: " « snd_strerror(rc) « std::endl;
00081                 return false;
00082             }
00083             snd_pcm_uframes_t bufferSize = framesPerPeriod * 4;
00084             rc = snd_pcm_hw_params_set_buffer_size_near(handle, params, &bufferSize);
00085             if (rc < 0) {
00086                 std::cerr « "Unable to set buffer size: " « snd_strerror(rc) « std::endl;
00087                 return false;
00088             }
00089
00090             rc = snd_pcm_hw_params(handle, params);
00091             if (rc < 0) {
00092              std::cerr « "Unable to set HW parameters: " « snd_strerror(rc) « std::endl;
00093              return false;
00094             }
00095
00096
00097             // Verify the final chosen period size and buffer size
00098             snd_pcm_hw_params_get_period_size(params, &framesPerPeriod, 0);
00099             snd_pcm_hw_params_get_buffer_size(params, &bufferSize);
00100             std::cout « "[DEBUG] Final period size: " « framesPerPeriod « std::endl;
00101             std::cout « "[DEBUG] Final buffer size: " « bufferSize « std::endl;
00102
00103             return true;
00104         }
00105
00106
00110         void startMixer() {
00111             if (!handle) {
00112                 std::cerr « "ALSA device is not open. Call open() first." « std::endl;
00113                 return;
00114             }
00115             StopMixingThread = false;
00116             mixThread = std::thread(&AudioPlayer::mixerThreadLoop, this);
00117         }
00118
00119
00123         void stopMixer() {
00124             StopMixingThread = true;
00125             if (mixThread.joinable()) {
00126                 mixThread.join();
00127             }
00128         }
00129
00130
00141         bool addSoundToMixer(const std::string& fileKey) {
00142             std::lock_guard<std::mutex> lock(ActiveMutex);
00143
00144             // Check if file buffer exists
00145             auto it = fileBuffers.find(fileKey);
00146             if (it == fileBuffers.end()) {
```

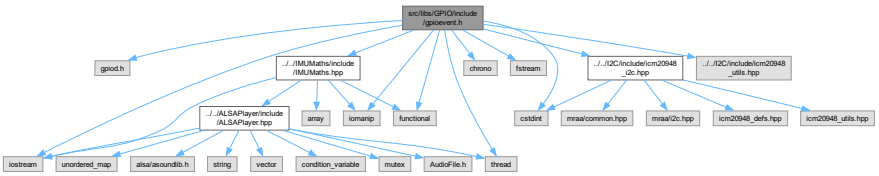
```
00147                 std::cerr « "Audio buffer not found for file: " « fileKey « std::endl;
00148                 return false;
00149             }
00150 
00151             // Create a new ActiveSound
00152             ActiveSound newSound;
00153 
00154             // pointer to the file's buffer
00155             newSound.buffer = &it->second;
00156             newSound.position = 0;
00157 
00158             // Add it to active sounds
00159             ActiveSounds.push_back(newSound);
00160             return true;
00161         }
00162 
00166         void close() {
00167             stopMixer();
00168             if (handle) {
00169                 snd_pcm_drop(handle);
00170                 snd_pcm_close(handle);
00171                 handle = nullptr;
00172             }
00173         }
00174 
00178         ~AudioPlayer() {
00179             close();
00180         }
00181 
00182 
00183         private:
00184         std::string deviceName;
00185         unsigned int sampleRate;
00186         unsigned int channels;
00187         snd_pcm_format_t format;
00188         snd_pcm_uframes_t framesPerPeriod;
00189         snd_pcm_t* handle;
00190 
00191         std::thread mixThread;
00192 
00193         struct ActiveSound {
00194             std::vector<int32_t>* buffer;
00195             size_t position;
00196         };
00197 
00198         std::vector<ActiveSound> ActiveSounds;
00199         std::mutex ActiveMutex;
00200 
00201         void mixerThreadLoop() {
00202             // Allocate a buffer for one period of audio
00203             const size_t periodSizeSamples = framesPerPeriod * channels;
00204             std::vector<int32_t> mixBuffer(periodSizeSamples, 0);
00205 
00206             while (!StopMixingThread) {
00207                 // Clear the mix buffer each iteration
00208                 std::fill(mixBuffer.begin(), mixBuffer.end(), 0);
00209 
00210                 {
00211                     // Locks the active list ofsounds
00212                     std::lock_guard<std::mutex> lock(ActiveMutex);
00213 
00214                     // Mixes all of the activesounds and removes those that have finished
00215                     for (auto it = ActiveSounds.begin(); it != ActiveSounds.end(); ) {
00216                         ActiveSound& sound = *it;
00217                         const size_t totalFrames = sound.buffer->size() / channels;
00218                         size_t framesLeft = totalFrames - sound.position;
00219 
00220                         // Callculate how may frakes are left to be mixed
00221                         size_t framesToMix = std::min<size_t>(framesPerPeriod, framesLeft);
00222 
00223                         //Mix the audio data from this sound into the buffer
00224                         for (size_t f = 0; f < framesToMix; ++f) {
00225                             for (unsigned int c = 0; c < channels; ++c) {
00226                                 // Source index in the file buffer
00227                                 size_t srcIndex = (sound.position + f) * channels + c;
00228                                 // Destination index in the mix buffer
00229                                 size_t dstIndex = f * channels + c;
00230 
00231                                 //Add up the sample
00232                                 mixBuffer[dstIndex] += (*sound.buffer)[srcIndex];
00233                             }
00234                         }
00235 
00236                         // Advance playback position
00237                         sound.position += framesToMix;
00238 
00239                         // If a sound has finished, remove it
```

```
00240                         if (sound.position >= totalFrames) {
00241                             it = ActiveSounds.erase(it);
00242                         } else {
00243                             ++it;
00244                         }
00245                     }
00246                 }
00247 
00248                 // Write the mixed buffer to ALSA
00249                 int rc = snd_pcm_writei(handle, mixBuffer.data(), framesPerPeriod);
00250                 if (rc == -EPIPE) {
00251                     std::cerr « "Underrun occurred\n";
00252                     snd_pcm_prepare(handle);
00253                 } else if (rc < 0) {
00254                     std::cerr « "Error from writei: " « snd_strerror(rc) « std::endl;
00255                 }
00256             }
00257         }
00258 
00259 
00260         void ConvertFiles(const std::vector<std::string>& filePaths) {
00261             std::vector<int32_t> result;
00262 
00263             for (const auto& path : filePaths) {
00264                 AudioFile<int32_t> file;
00265                 if (!file.load(path)) {
00266                     std::cerr « "Error loading file: " « path « std::endl;
00267                     continue;
00268                 }
00269 
00270                 int fileChannels = file.getNumChannels();
00271                 int ChannelSamples = file.getNumSamplesPerChannel();
00272 
00273                 std::vector<int32_t> interleaved;
00274                 interleaved.reserve(ChannelSamples * fileChannels);
00275                 for (int i=0; i < ChannelSamples; ++i){
00276                     for (int ch = 0; ch < fileChannels; ++ch){
00277                         interleaved.push_back(file.samples[ch][i]);
00278 
00279                     }
00280 
00281 
00282                 }
00283                 fileBuffers[path] = std::move(interleaved);
00284 
00285             }
00286         }
00287 
00288 
00289     };
00290 }
00291 
00292 
00293 
00294 #endif
```

8.4 src/libs/GPIO/include/gpioevent.h File Reference

```
#include <gpiod.h>
#include <iostream>
#include <thread>
#include <chrono>
#include <iomanip>
#include <fstream>
#include <cstdint>
#include <functional>
#include "../../I2C/include/icm20948_i2c.hpp"
#include "../../I2C/include/icm20948_utils.hpp"
#include "../../IMUMaths/include/IMUMaths.hpp"
```

Include dependency graph for gpioevent.h:



Classes

- class GPIOName::GPIOClass
- struct GPIOName::GPIOClass::Callback

  Callback using virtual void.
- struct GPIOName::MathsCallbackStruct

Namespaces

- namespace GPIOName

Typedefs

- typedef void(∗ GPIOName::GPIOCallback) (void ∗context, float, float, float)

8.5 gpioevent.h

Go to the documentation of this file.

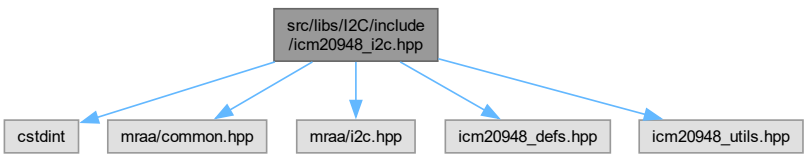
```
00001 #ifndef GPIOEVENT_H
00002 #define GPIOEVENT_H
00003
00004
00005 #include <gpiod.h>
00006 #include <iostream>
00007 #include <thread>
00008 #include <chrono>
00009 #include <iomanip>
00010 #include <fstream>
00011 #include <cstdint>
00012 #include <functional>
00013
00014 #include "../../I2C/include/icm20948_i2c.hpp"
00015 #include "../../I2C/include/icm20948_utils.hpp"
00016
00017 #include "../../IMUMaths/include/IMUMaths.hpp"
00018
00019
00020 namespace GPIOName {
00021
00022     typedef void (*GPIOCallback)(void* context, float, float, float);
00023     class GPIOClass {
00024     public:
00025         icm20948::ICM20948_I2C& sensor;
00026         IMUMathsName::IMUMaths& Maths;
00027
00028         // GPIOCallback callback;
00029         // void* CallbackFunction;
00030
00031         // function added for testing
00032         bool IsRunning() const {
00033             return running.load();
00034         }
```

```
00035
00044         GPIOClass(const char* chipName, int InterruptPin,
00045              icm20948::ICM20948_I2C& sensor, IMUMathsName::IMUMaths& Maths);
00046
00055         void Worker();
00056
00067         void WorkerDataCollect();
00068
00072         void GPIOStop();
00073
00077         struct Callback{
00078             virtual void MathsCallback(float X, float Y, float Z) = 0;
00079             virtual ~Callback(){};
00080         };
00081
00087         void RegisterCallback(Callback* cb){
00088             callback = cb;
00089         }
00090
00091         // void SetCallback(GPIOCallback cb, void* context);
00092         // static void IMUMathsCallback(void* context, float X, float Y, float Z){
00093         //     IMUMathsName::IMUMaths* maths = static_cast<IMUMathsName::IMUMaths*>(context);
00094         //     maths->SoundChecker(X,Y,Z);
00095         // }
00096
00097
00098
00099         private:
00100         gpiod_chip* chip;
00101         gpiod_line* SensorLine;
00102         gpiod_line* LEDLine;
00103         int InterruptPin;
00104         int Counter;
00105         bool Pause = true;
00106
00107         std::atomic<bool> running{true};
00108         Callback* callback = nullptr;
00109
00110     };
00111
00112     struct MathsCallbackStruct : GPIOName::GPIOClass::Callback{
00113         IMUMathsName::IMUMaths& Maths;
00114
00115         MathsCallbackStruct(IMUMathsName::IMUMaths& maths) : Maths(maths) {}
00116
00117         virtual void MathsCallback(float X, float Y, float Z) override {
00118             Maths.SoundChecker(X, Y, Z);
00119         }
00120     };
00121 }
00122
00123
00124
00125 #endif
```

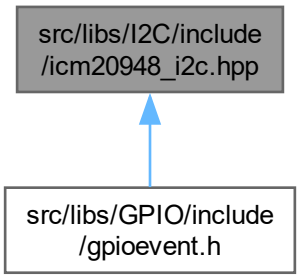
8.6 src/libs/I2C/include/icm20948_i2c.hpp File Reference

```
#include <cstdint>
#include "mraa/common.hpp"
#include "mraa/i2c.hpp"
#include "icm20948_defs.hpp"
#include "icm20948_utils.hpp"
```

Include dependency graph for icm20948_i2c.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class icm20948::ICM20948_I2C

Namespaces

- namespace icm20948

8.7 icm20948_i2c.hpp

Go to the documentation of this file.

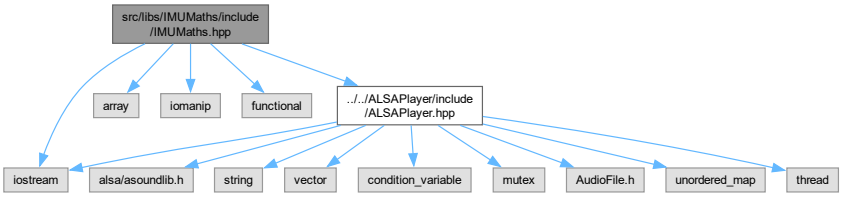
```
00001 #ifndef ICM20948_I2C_HPP
00002 #define ICM20948_I2C_HPP
00003
00004 #include <cstdint>
00005
00006 #include "mraa/common.hpp"
00007 #include "mraa/i2c.hpp"
00008
00009 #include "icm20948_defs.hpp"
00010 #include "icm20948_utils.hpp"
00011
00012 namespace icm20948
00013 {
00014     class ICM20948_I2C
00015     {
00016         private:
00017             mraa::I2c _i2c;
00018             unsigned _i2c_bus, _i2c_address;
00019             uint8_t _current_bank;
00020             float _accel_scale_factor, _gyro_scale_factor, _magn_scale_factor;
00021
00022             bool _write_byte(const uint8_t bank, const uint8_t reg, const uint8_t byte);
00023             bool _read_byte(const uint8_t bank, const uint8_t reg, uint8_t &byte);
00024             bool _write_bit(const uint8_t bank, const uint8_t reg, const uint8_t bit_pos, const bool
      bit);
00025             bool _read_bit(const uint8_t bank, const uint8_t reg, const uint8_t bit_pos, bool &bit);
00026             bool _read_block_bytes(const uint8_t bank, const uint8_t start_reg, uint8_t *bytes, const
     int length);
00027             bool _write_mag_byte(const uint8_t mag_reg, const uint8_t byte);
00028             bool _read_mag_byte(const uint8_t mag_reg, uint8_t &byte);
00029             bool _read_int_byte(const uint8_t bank, const uint8_t reg, uint8_t &byte);
00030
00031             bool _set_bank(uint8_t bank);
00032             bool _set_accel_sample_rate_div();
00033             bool _set_accel_range_dlpf();
```

```
00034             bool _set_gyro_sample_rate_div();
00035             bool _set_gyro_range_dlpf();
00036 
00037             bool _magnetometer_init();
00038             bool _magnetometer_enable();
00039             bool _magnetometer_set_mode();
00040             bool _magnetometer_configured();
00041             bool _magnetometer_set_readout();
00042 
00043             bool _chip_i2c_master_reset();
00044 
00045         public:
00046             // Contains linear acceleration in m/s^2
00047             float accel[3];
00048             // Contains angular velocities in rad/s
00049             float gyro[3];
00050             // Contains magnetic field strength in uTesla
00051             float magn[3];
00052 
00053             // Sensor settings
00054             icm20948::settings settings;
00055 
00064             ICM20948_I2C(unsigned i2c_bus, unsigned i2c_address = ICM20948_I2C_ADDR,
    icm20948::settings
00065                 = icm20948::settings());
00066 
00068 
00084             bool init();
00085 
00099             bool reset();
00100 
00111             bool wake();
00112 
00128             bool set_settings();
00129 
00143             bool read_accel_gyro();
00144 
00156             bool read_magn();
00157 
00159 
00170             bool enable_DRDY_INT();
00171 
00181             bool check_DRDY_INT();
00182     };
00183 }
00184 
00185 #endif
```

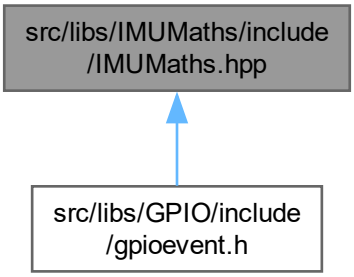
8.8 src/libs/IMUMaths/include/IMUMaths.hpp File Reference

```
#include <iostream>
#include <array>
#include <iomanip>
#include <functional>
#include "../../ALSAPlayer/include/ALSAPlayer.hpp"
```

Include dependency graph for IMUMaths.hpp:



This graph shows which files directly or indirectly include this file:



Classes

- class IMUMathsName::IMUMaths
- struct IMUMathsName::IMUMaths::Callback

  Callback using virtual void.
- struct IMUMathsName::AudioCallback

Namespaces

- namespace IMUMathsName

8.9 IMUMaths.hpp

Go to the documentation of this file.

```
00001 #ifndef IMUMATHS_H
00002 #define IMUMATHS_H
00003
00004
00005 #include <iostream>
00006 #include <array>
00007 #include <iomanip>
00008 #include <functional>
00009
00010 #include "../../ALSAPlayer/include/ALSAPlayer.hpp"
00011
00012
00013 namespace IMUMathsName {
00014     class IMUMaths{
00015
00016         public:
00017         AudioPlayerName::AudioPlayer &Audio;
00018
00024         IMUMaths(AudioPlayerName::AudioPlayer &Audio);
00025
00029         ~IMUMaths();
00030
00031
00032         // For debugging: Identifier of the last audio file played
00033
00034         int LastFilePlayed;
00035
00046         void SoundChecker(float X, float Y, float Z);
00047
```

```
00055         void SetPlayFileCallback(const std::function<void(const std::string&)>& cb);
00056
00057         // Pauses
00058         bool Pause = false;
00059
00060         // Counter variable
00061         int Counter = 0;
00062
00066         struct Callback{
00067             virtual void AudioTrigger(const std::string& FilePath) = 0;
00068             virtual ~Callback(){};
00069         };
00070
00076         void RegisterCallback(Callback* cb){
00077             callback = cb;
00078             //std::cout « "[IMUMaths] Registered callback at address: " « callback « std::endl;
00079         }
00080
00081
00082
00083         private:
00084
00085         Callback* callback = nullptr;
00086         std::function<void(const std::string&)> PlayFileCallback;
00087
00088
00089     };
00090
00091     struct AudioCallback : IMUMathsName::IMUMaths::Callback{
00092         AudioPlayerName::AudioPlayer& Audio;
00093
00094         AudioCallback(AudioPlayerName::AudioPlayer& audio) : Audio(audio) {}
00095
00096         virtual void AudioTrigger(const std::string& FilePath){
00097             std::thread([this,FilePath]{
00098                 Audio.addSoundToMixer(FilePath);
00099
00100             }).detach();
00101         }
00102     };
00103 }
00104
00105
00106 #endif
```