

## SmartNavLib

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# Chapter 1

## Namespace Index

### 1.1 Namespace List

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## Chapter 2

# Hierarchical Index

### 2.1 Class Hierarchy

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## Chapter 5

# Namespace Documentation

### 5.1 Registers Namespace Reference

#### Variables

- uint32\_t [QMC5883L\\_X\\_LSB](#) = 0x00
- uint32\_t [QMC5883L\\_X\\_MSB](#) = 0x01
- uint32\_t [QMC5883L\\_Y\\_LSB](#) = 0x02
- uint32\_t [QMC5883L\\_Y\\_MSB](#) = 0x03
- uint32\_t [QMC5883L\\_Z\\_LSB](#) = 0x04
- uint32\_t [QMC5883L\\_Z\\_MSB](#) = 0x05
- uint32\_t [QMC5883L\\_STATUS](#) = 0x06
- uint32\_t [QMC5883L\\_TEMP\\_LSB](#) = 0x07
- uint32\_t [QMC5883L\\_TEMP\\_MSB](#) = 0x08
- uint32\_t [QMC5883L\\_CONFIG](#) = 0x09
- uint32\_t [QMC5883L\\_CONFIG2](#) = 0x0A
- uint32\_t [QMC5883L\\_RESET](#) = 0x0B
- uint32\_t [QMC5883L\\_RESERVED](#) = 0x0C
- uint32\_t [QMC5883L\\_CHIP\\_ID](#) = 0x0D

#### 5.1.1 Variable Documentation

##### 5.1.1.1 QMC5883L\_CHIP\_ID

```
uint32_t Registers::QMC5883L_CHIP_ID = 0x0D
```

##### 5.1.1.2 QMC5883L\_CONFIG

```
uint32_t Registers::QMC5883L_CONFIG = 0x09
```

#### 5.1.1.3 QMC5883L\_CONFIG2

```
uint32_t Registers::QMC5883L_CONFIG2 = 0x0A
```

#### 5.1.1.4 QMC5883L\_RESERVED

```
uint32_t Registers::QMC5883L_RESERVED = 0x0C
```

#### 5.1.1.5 QMC5883L\_RESET

```
uint32_t Registers::QMC5883L_RESET = 0x0B
```

#### 5.1.1.6 QMC5883L\_STATUS

```
uint32_t Registers::QMC5883L_STATUS = 0x06
```

#### 5.1.1.7 QMC5883L\_TEMP\_LSB

```
uint32_t Registers::QMC5883L_TEMP_LSB = 0x07
```

#### 5.1.1.8 QMC5883L\_TEMP\_MSB

```
uint32_t Registers::QMC5883L_TEMP_MSB = 0x08
```

#### 5.1.1.9 QMC5883L\_X\_LSB

```
uint32_t Registers::QMC5883L_X_LSB = 0x00
```

#### 5.1.1.10 QMC5883L\_X\_MSB

```
uint32_t Registers::QMC5883L_X_MSB = 0x01
```

#### 5.1.1.11 QMC5883L\_Y\_LSB

```
uint32_t Registers::QMC5883L_Y_LSB = 0x02
```

#### 5.1.1.12 QMC5883L\_Y\_MSB

```
uint32_t Registers::QMC5883L_Y_MSB = 0x03
```

#### 5.1.1.13 QMC5883L\_Z\_LSB

```
uint32_t Registers::QMC5883L_Z_LSB = 0x04
```

#### 5.1.1.14 QMC5883L\_Z\_MSB

```
uint32_t Registers::QMC5883L_Z_MSB = 0x05
```





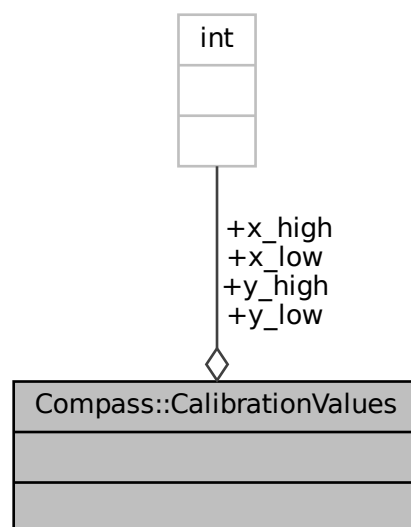
## Chapter 6

# Class Documentation

### 6.1 Compass::CalibrationValues Struct Reference

```
#include <Compass.hpp>
```

Collaboration diagram for Compass::CalibrationValues:



#### Public Attributes

- `int x_low`
- `int y_low`
- `int x_high`
- `int y_high`

### 6.1.1 Detailed Description

Calibrartion values

### 6.1.2 Member Data Documentation

#### 6.1.2.1 x\_high

```
int Compass::CalibrationValues::x_high
```

#### 6.1.2.2 x\_low

```
int Compass::CalibrationValues::x_low
```

#### 6.1.2.3 y\_high

```
int Compass::CalibrationValues::y_high
```

#### 6.1.2.4 y\_low

```
int Compass::CalibrationValues::y_low
```

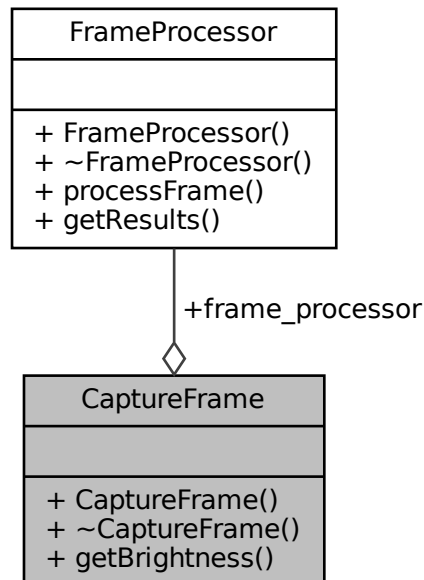
The documentation for this struct was generated from the following file:

- modules/compass/[Compass.hpp](#)

## 6.2 CaptureFrame Class Reference

```
#include <CaptureFrame.hpp>
```

Collaboration diagram for CaptureFrame:



### Classes

- struct [ImageBuffer](#)

### Public Types

- enum [pixelFormat](#) { [PIX\\_FMT\\_RGB24](#) = 0 }
- using [EventCallback](#) = std::function< void(std::shared\_ptr< [VirtualImage](#) > img, void \*ctx)>

### Public Member Functions

- [CaptureFrame](#) ([EventCallback](#) cb, uint32\_t width, uint32\_t height, [pixelFormat](#) pixel\_format, uint32\_t frame\_count=1)
- [~CaptureFrame](#) ()
- uint32\_t [getBrightness](#) () const  
*Return brightness.*

### Public Attributes

- [FrameProcessor](#) [frame\\_processor](#)

## 6.2.1 Detailed Description

This module is responsible of open, init, and use a v4l2 device driver author: Fuschetto Martin email: [marfus@hotmail.es](mailto:marfus@hotmail.es) date: 15/11/22 version: 0.0

## 6.2.2 Member Typedef Documentation

### 6.2.2.1 EventCallback

```
using CaptureFrame::EventCallback = std::function<void (std::shared_ptr<VirtualImage> img,
void* ctx)>
```

Callback of captured frame

## 6.2.3 Member Enumeration Documentation

### 6.2.3.1 pixelFormat

```
enum CaptureFrame::pixelFormat
```

Enumerator

|               |  |
|---------------|--|
| PIX_FMT_RGB24 |  |
|---------------|--|

## 6.2.4 Constructor & Destructor Documentation

### 6.2.4.1 CaptureFrame()

```
CaptureFrame::CaptureFrame (
    EventCallback cb,
    uint32_t width,
    uint32_t height,
    pixelFormat pixel_format,
    uint32_t frame_count = 1 )
```

[CaptureFrame](#) constructor

#### 6.2.4.2 ~CaptureFrame()

```
CaptureFrame::~CaptureFrame ( )
```

[CaptureFrame](#) destructor

### 6.2.5 Member Function Documentation

#### 6.2.5.1 getBrightness()

```
uint32_t CaptureFrame::getBrightness ( ) const [inline]
```

Return brightness.

Returns

uint32\_t

### 6.2.6 Member Data Documentation

#### 6.2.6.1 frame\_processor

```
FrameProcessor CaptureFrame::frame_processor
```

[FrameProcessor](#)

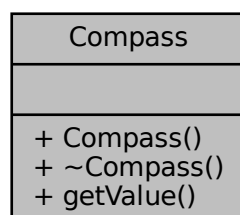
The documentation for this class was generated from the following files:

- modules/capture-frame/[CaptureFrame.hpp](#)
- modules/capture-frame/[CaptureFrame.cpp](#)

## 6.3 Compass Class Reference

```
#include <Compass.hpp>
```

Collaboration diagram for Compass:



## Classes

- struct [CalibrationValues](#)
- struct [CompassValues](#)

## Public Types

- enum [Axes](#) { [X\\_AXIS](#) = 0 , [Y\\_AXIS](#) , [Z\\_AXIS](#) }

## Public Member Functions

- [Compass](#) ()
- [~Compass](#) ()
- float [getValue](#) ()  
*Get compass value (thread safe)*

## 6.3.1 Member Enumeration Documentation

### 6.3.1.1 Axes

enum [Compass::Axes](#)

Axes

Enumerator

|                        |  |
|------------------------|--|
| <a href="#">X_AXIS</a> |  |
| <a href="#">Y_AXIS</a> |  |
| <a href="#">Z_AXIS</a> |  |

## 6.3.2 Constructor & Destructor Documentation

### 6.3.2.1 Compass()

[Compass::Compass](#) ( )

[Compass](#) constructor

### 6.3.2.2 ~Compass()

[Compass::~~Compass](#) ( )

[Compass](#) destructor

### 6.3.3 Member Function Documentation

#### 6.3.3.1 getValue()

```
float Compass::getValue ( ) [inline]
```

Get compass value (thread safe)

#### Returns

float

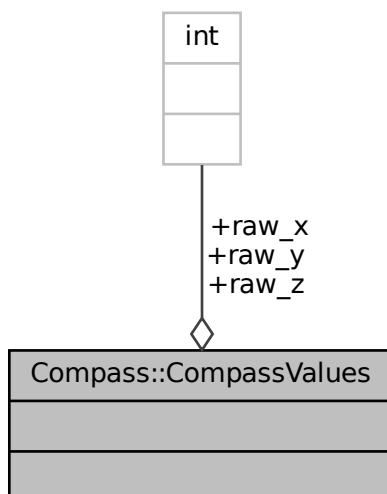
The documentation for this class was generated from the following files:

- modules/compass/[Compass.hpp](#)
- modules/compass/[Compass.cpp](#)

## 6.4 Compass::CompassValues Struct Reference

```
#include <Compass.hpp>
```

Collaboration diagram for Compass::CompassValues:



## Public Attributes

- int [raw\\_x](#)
- int [raw\\_y](#)
- int [raw\\_z](#)

### 6.4.1 Detailed Description

Raw values of the compass

### 6.4.2 Member Data Documentation

#### 6.4.2.1 raw\_x

```
int Compass::CompassValues::raw_x
```

#### 6.4.2.2 raw\_y

```
int Compass::CompassValues::raw_y
```

#### 6.4.2.3 raw\_z

```
int Compass::CompassValues::raw_z
```

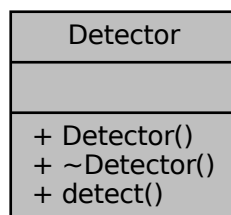
The documentation for this struct was generated from the following file:

- [modules/compass/Compass.hpp](#)

## 6.5 Detector Class Reference

```
#include <Detector.hpp>
```

Collaboration diagram for Detector:





## Public Member Functions

- [Detector](#) ()
- [~Detector](#) ()=default
- `std::vector< RecognitionResult > detect` (`std::shared_ptr< VirtualImage > image`)  
*Process a new frame.*

## 6.5.1 Constructor & Destructor Documentation

### 6.5.1.1 Detector()

```
Detector::Detector ( )
```

[Detector](#) constructor

### 6.5.1.2 ~Detector()

```
Detector::~~Detector ( ) [default]
```

[Detector](#) destructor

## 6.5.2 Member Function Documentation

### 6.5.2.1 detect()

```
std::vector< RecognitionResult > Detector::detect (
    std::shared_ptr< VirtualImage > image )
```

Process a new frame.

Parameters

|              |  |
|--------------|--|
| <i>image</i> |  |
|--------------|--|

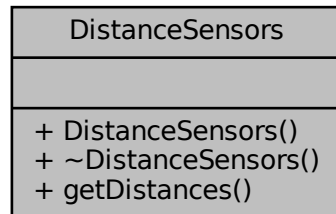
The documentation for this class was generated from the following files:

- `modules/capture-frame/Detector.hpp`
- `modules/capture-frame/Detector.cpp`

## 6.6 DistanceSensors Class Reference

```
#include <DistanceSensors.hpp>
```

Collaboration diagram for DistanceSensors:



## Public Member Functions

- [DistanceSensors](#) ()
- [~DistanceSensors](#) ()
- `std::vector< int >` [getDistances](#) ()

*Get the Distances to objects.*

## 6.6.1 Constructor & Destructor Documentation

### 6.6.1.1 DistanceSensors()

```
DistanceSensors::DistanceSensors ( )
```

DistanceSensor constructor

### 6.6.1.2 ~DistanceSensors()

```
DistanceSensors::~~DistanceSensors ( )
```

DistanceSensor destructor

## 6.6.2 Member Function Documentation

### 6.6.2.1 getDistances()

```
std::vector< int > DistanceSensors::getDistances ( )
```

Get the Distances to objects.

#### Returns

```
std::vector<int>
```

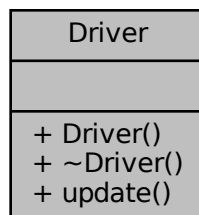
The documentation for this class was generated from the following files:

- modules/hc-sr04/[DistanceSensors.hpp](#)
- modules/hc-sr04/[DistanceSensors.cpp](#)

## 6.7 Driver Class Reference

```
#include <Driver.hpp>
```

Collaboration diagram for Driver:



### Public Types

- enum [operationMode](#) { [OP\\_STOP](#) = 0 , [OP\\_DRIVE](#) }

### Public Member Functions

- [Driver](#) ()
- [~Driver](#) ()
- void [update](#) ([operationMode](#) operation\_mode, int speed\_variation, int yaw\_variation)  
*Update the speed and yaw for driving the car.*

### 6.7.1 Member Enumeration Documentation

#### 6.7.1.1 operationMode

```
enum Driver::operationMode
```

## Enumerator

|          |       |
|----------|-------|
| OP_STOP  | Stop  |
| OP_DRIVE | Drive |

## 6.7.2 Constructor & Destructor Documentation

### 6.7.2.1 Driver()

```
Driver::Driver ( ) [inline]
```

[Driver](#) constructor

### 6.7.2.2 ~Driver()

```
Driver::~~Driver ( ) [inline]
```

[Driver](#) destructor

## 6.7.3 Member Function Documentation

### 6.7.3.1 update()

```
void Driver::update (
    operationMode operation_mode,
    int speed_variation,
    int yaw_variation ) [inline]
```

Update the speed and yaw for driving the car.

## Parameters

|                        |  |
|------------------------|--|
| <i>operation_mode</i>  |  |
| <i>speed_variation</i> |  |
| <i>yaw_variation</i>   |  |

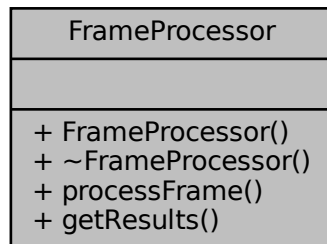
The documentation for this class was generated from the following file:

- modules/driver/[Driver.hpp](#)

## 6.8 FrameProcessor Class Reference

```
#include <FrameProcessor.hpp>
```

Collaboration diagram for FrameProcessor:



### Public Member Functions

- [FrameProcessor](#) ()=default
- [~FrameProcessor](#) ()=default
- void [processFrame](#) (std::shared\_ptr< [VirtualImage](#) > frame)  
*Consume the frame.*
- std::vector< [RecognitionResult](#) > [getResults](#) ()  
*Get the Results object.*

### 6.8.1 Constructor & Destructor Documentation

#### 6.8.1.1 FrameProcessor()

```
FrameProcessor::FrameProcessor ( ) [default]
```

[FrameProcessor](#) constructor

#### 6.8.1.2 ~FrameProcessor()

```
FrameProcessor::~~FrameProcessor ( ) [default]
```

[FrameProcessor](#) destructor

## 6.8.2 Member Function Documentation

### 6.8.2.1 `getResults()`

```
std::vector< RecognitionResult > FrameProcessor::getResults ( )
```

Get the Results object.

#### Returns

`std::vector<RecognitionResult>`

### 6.8.2.2 `processFrame()`

```
void FrameProcessor::processFrame (
    std::shared_ptr< VirtualImage > frame )
```

Consume the frame.

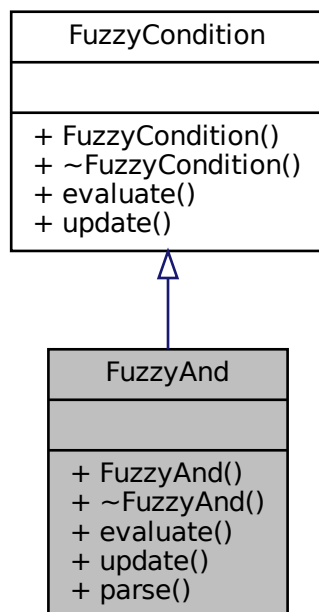
The documentation for this class was generated from the following files:

- [modules/capture-frame/FrameProcessor.hpp](#)
- [modules/capture-frame/FrameProcessor.cpp](#)

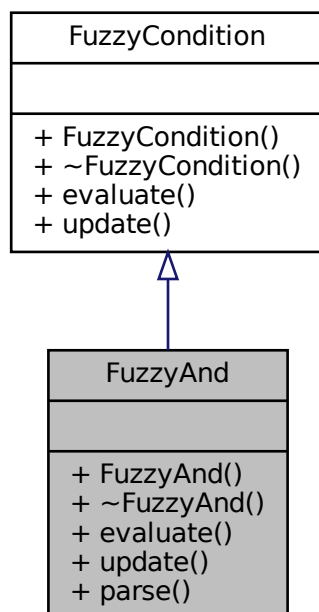
## 6.9 FuzzyAnd Class Reference

```
#include <FuzzyAnd.hpp>
```

Inheritance diagram for FuzzyAnd:



Collaboration diagram for FuzzyAnd:



## Public Member Functions

- [FuzzyAnd](#) (std::vector< [FuzzyConditionPtr](#) > condition)
- virtual [~FuzzyAnd](#) ()=default
- virtual float [evaluate](#) (std::vector< [FuzzyInput](#) > &system\_input) const override  
*Evaluate and condition.*
- virtual void [update](#) (float value, std::vector< [FuzzyOutput](#) > &system\_output) override  
*Update and with a new value.*

## Static Public Member Functions

- static [FuzzyConditionPtr](#) [parse](#) (const nlohmann::json &and\_json)  
*Try to parse and condition.*

## Additional Inherited Members

### 6.9.1 Constructor & Destructor Documentation

#### 6.9.1.1 FuzzyAnd()

```
FuzzyAnd::FuzzyAnd (
    std::vector< FuzzyConditionPtr > condition ) [inline]
```

[FuzzyAnd](#) constructor

#### 6.9.1.2 ~FuzzyAnd()

```
virtual FuzzyAnd::~~FuzzyAnd ( ) [virtual], [default]
```

[FuzzyAnd](#) destructor

### 6.9.2 Member Function Documentation

#### 6.9.2.1 evaluate()

```
float FuzzyAnd::evaluate (
    std::vector< FuzzyInput > & system_input ) const [override], [virtual]
```

Evaluate and condition.



## Parameters

|                 |  |
|-----------------|--|
| <i>system</i> ↔ |  |
| <i>_io</i>      |  |

## Returns

float

Implements [FuzzyCondition](#).

## 6.9.2.2 parse()

```
FuzzyCondition::FuzzyConditionPtr FuzzyAnd::parse (
    const nlohmann::json & and_json ) [static]
```

Try to parse and condition.

## Parameters

|                 |  |
|-----------------|--|
| <i>and_json</i> |  |
|-----------------|--|

## Returns

FuzzyConditionPtr

## 6.9.2.3 update()

```
void FuzzyAnd::update (
    float value,
    std::vector< FuzzyOutput > & system_output ) [override], [virtual]
```

Update and with a new value.

## Parameters

|                 |  |
|-----------------|--|
| <i>value</i>    |  |
| <i>system</i> ↔ |  |
| <i>_io</i>      |  |

Implements [FuzzyCondition](#).

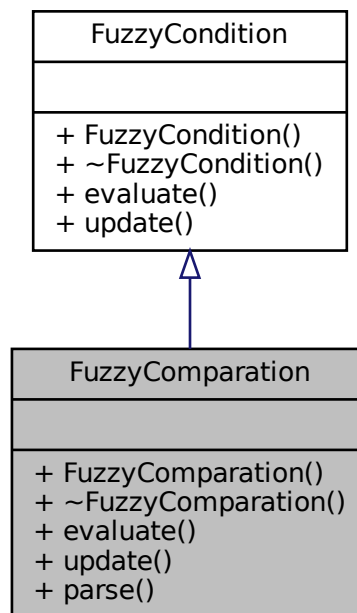
The documentation for this class was generated from the following files:

- modules/fuzzy-control-system/[FuzzyAnd.hpp](#)
- modules/fuzzy-control-system/[FuzzyAnd.cpp](#)

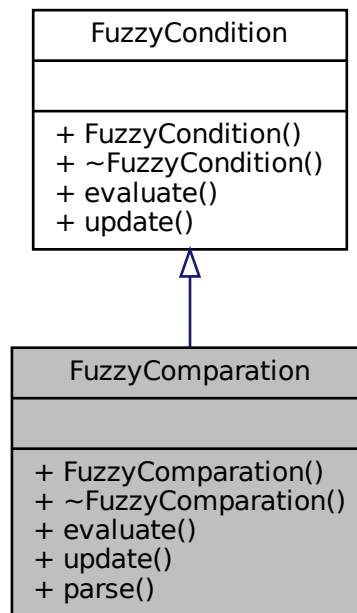
## 6.10 FuzzyComparison Class Reference

```
#include <FuzzyComparison.hpp>
```

Inheritance diagram for FuzzyComparison:



Collaboration diagram for FuzzyComparison:



## Public Member Functions

- `FuzzyComparison` (`std::pair< std::string, std::string > comparison`)
- virtual `~FuzzyComparison` ()=default
- virtual float `evaluate` (`std::vector< FuzzyInput > &system_input`) const override  
*Evaluate and condition.*
- virtual void `update` (float value, `std::vector< FuzzyOutput > &system_output`) override  
*Update system outputs with value.*

## Static Public Member Functions

- static `FuzzyConditionPtr parse` (const `nlohmann::json &comparison_json`)  
*Try to parse comparison.*

## Additional Inherited Members

### 6.10.1 Constructor & Destructor Documentation

### 6.10.1.1 FuzzyComparison()

```
FuzzyComparison::FuzzyComparison (
    std::pair< std::string, std::string > comparison ) [inline]
```

[FuzzyComparison](#) constructor

### 6.10.1.2 ~FuzzyComparison()

```
virtual FuzzyComparison::~~FuzzyComparison ( ) [virtual], [default]
```

[FuzzyComparison](#) destructor

## 6.10.2 Member Function Documentation

### 6.10.2.1 evaluate()

```
float FuzzyComparison::evaluate (
    std::vector< FuzzyInput > & system_input ) const [override], [virtual]
```

Evaluate and condition.

#### Parameters

|                 |  |
|-----------------|--|
| <i>system</i> ↔ |  |
| <i>_io</i>      |  |

#### Returns

float

Implements [FuzzyCondition](#).

### 6.10.2.2 parse()

```
FuzzyCondition::FuzzyConditionPtr FuzzyComparison::parse (
    const nlohmann::json & comparison_json ) [static]
```

Try to parse comparison.

#### Parameters

|                        |  |
|------------------------|--|
| <i>comparison_json</i> |  |
|------------------------|--|

**Returns**

FuzzyConditionPtr

**6.10.2.3 update()**

```
void FuzzyComparation::update (
    float value,
    std::vector< FuzzyOutput > & system_output ) [override], [virtual]
```

Update system outputs with value.

**Parameters**

|              |  |
|--------------|--|
| <i>value</i> |  |
|--------------|--|

Implements [FuzzyCondition](#).

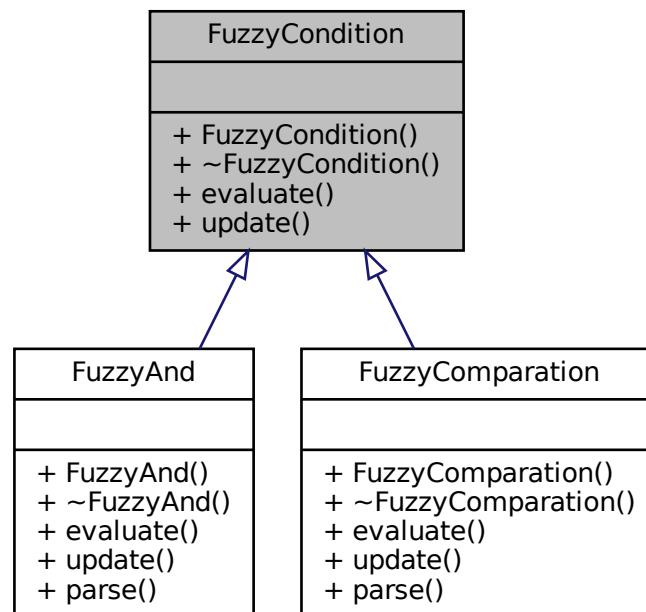
The documentation for this class was generated from the following files:

- [modules/fuzzy-control-system/FuzzyComparation.hpp](#)
- [modules/fuzzy-control-system/FuzzyComparation.cpp](#)

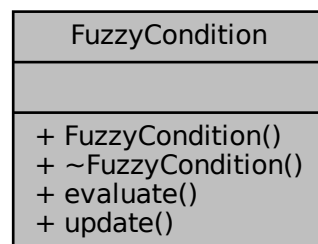
## 6.11 FuzzyCondition Class Reference

```
#include <FuzzyCondition.hpp>
```

Inheritance diagram for FuzzyCondition:



Collaboration diagram for FuzzyCondition:



## Public Types

- using [FuzzyConditionPtr](#) = `std::shared_ptr< FuzzyCondition >`

## Public Member Functions

- [FuzzyCondition](#) ()=default

- virtual `~FuzzyCondition()`=default
- virtual float `evaluate` (std::vector< `FuzzyInput` > &system\_input) const =0  
*Evaluate any condition.*
- virtual void `update` (float value, std::vector< `FuzzyOutput` > &system\_io)=0  
*Update any condition.*

## 6.11.1 Member Typedef Documentation

### 6.11.1.1 FuzzyConditionPtr

```
using FuzzyCondition::FuzzyConditionPtr = std::shared_ptr<FuzzyCondition>
```

`FuzzyCondition` smart pointer

## 6.11.2 Constructor & Destructor Documentation

### 6.11.2.1 FuzzyCondition()

```
FuzzyCondition::FuzzyCondition ( ) [default]
```

`FuzzyCondition` constructor

### 6.11.2.2 ~FuzzyCondition()

```
virtual FuzzyCondition::~~FuzzyCondition ( ) [virtual], [default]
```

`FuzzyCondition` destructor

## 6.11.3 Member Function Documentation

### 6.11.3.1 evaluate()

```
virtual float FuzzyCondition::evaluate (
    std::vector< FuzzyInput > & system_input ) const [pure virtual]
```

Evaluate any condition.

**Parameters**

|                 |  |
|-----------------|--|
| <i>system</i> ↔ |  |
| <i>_io</i>      |  |

**Returns**

float

Implemented in [FuzzyComparison](#), and [FuzzyAnd](#).

**6.11.3.2 update()**

```
virtual void FuzzyCondition::update (
    float value,
    std::vector< FuzzyOutput > & system_io ) [pure virtual]
```

Update any condition.

**Parameters**

|                 |  |
|-----------------|--|
| <i>value</i>    |  |
| <i>system</i> ↔ |  |
| <i>_io</i>      |  |

Implemented in [FuzzyComparison](#), and [FuzzyAnd](#).

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

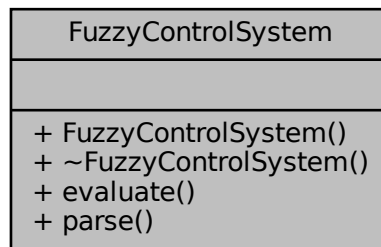
- modules/fuzzy-control-system/[FuzzyCondition.hpp](#)

**6.12 FuzzyControlSystem Class Reference**

```
#include <FuzzyControlSystem.hpp>
```



Collaboration diagram for FuzzyControlSystem:



## Public Member Functions

- [FuzzyControlSystem](#) (std::vector< [FuzzyInput](#) > system\_inputs, std::vector< [FuzzyOutput](#) > system\_outputs, std::vector< [FuzzyRule](#) > system\_rules)
- [~FuzzyControlSystem](#) ()=default
- std::vector< [FuzzyOutput](#) > [evaluate](#) (std::vector< std::pair< std::string, float >> inputs\_to\_update)  
*Update system input.*

## Static Public Member Functions

- static [FuzzyControlSystem](#) [parse](#) (const nlohmann::json &fuzzy\_control\_system\_json)  
*Try to parse system.json*

## 6.12.1 Constructor & Destructor Documentation

### 6.12.1.1 FuzzyControlSystem()

```
FuzzyControlSystem::FuzzyControlSystem (
    std::vector< FuzzyInput > system_inputs,
    std::vector< FuzzyOutput > system_outputs,
    std::vector< FuzzyRule > system_rules ) [inline]
```

[FuzzyControlSystem](#) constructor

### 6.12.1.2 ~FuzzyControlSystem()

```
FuzzyControlSystem::~~FuzzyControlSystem ( ) [default]
```

[FuzzyControlSystem](#) destructor

## 6.12.2 Member Function Documentation

### 6.12.2.1 evaluate()

```
std::vector< FuzzyOutput > FuzzyControlSystem::evaluate (
    std::vector< std::pair< std::string, float >> inputs_to_update )
```

Update system input.

#### Parameters

|                         |  |
|-------------------------|--|
| <i>inputs_to_update</i> |  |
|-------------------------|--|

#### Returns

std::vector<fuzzyOutput> Return fuzzy\_outputs

### 6.12.2.2 parse()

```
FuzzyControlSystem FuzzyControlSystem::parse (
    const nlohmann::json & fuzzy_control_system_json ) [static]
```

Try to parse system.json

#### Parameters

|                                  |  |
|----------------------------------|--|
| <i>fuzzy_control_system_json</i> |  |
|----------------------------------|--|

#### Returns

[FuzzyControlSystem](#)

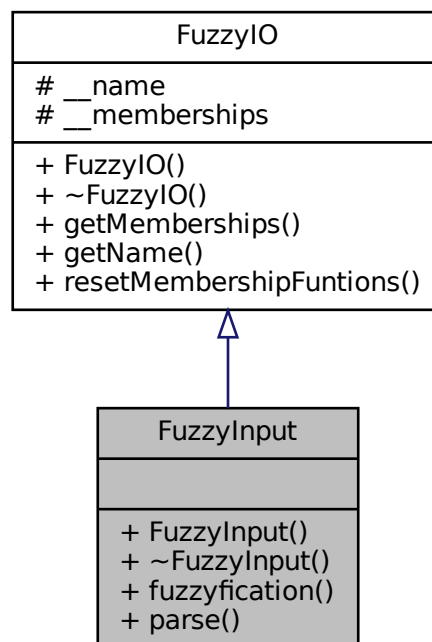
The documentation for this class was generated from the following files:

- [modules/fuzzy-control-system/FuzzyControlSystem.hpp](#)
- [modules/fuzzy-control-system/FuzzyControlSystem.cpp](#)

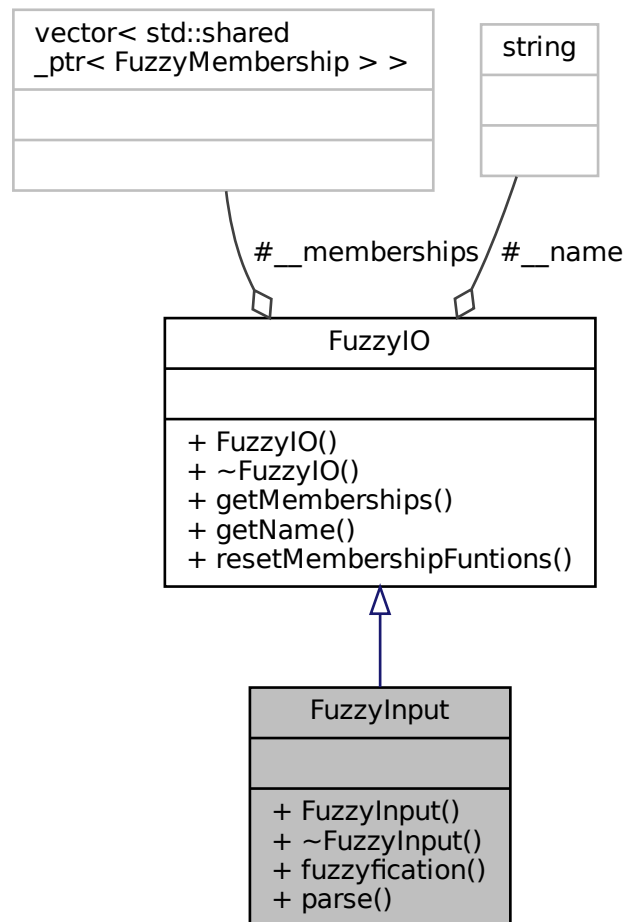
## 6.13 FuzzyInput Class Reference

```
#include <FuzzyInput.hpp>
```

Inheritance diagram for FuzzyInput:



Collaboration diagram for FuzzyInput:



## Public Member Functions

- [FuzzyInput](#) (const std::string &name, std::vector< std::shared\_ptr< [FuzzyMembership](#) > > memberships)
- virtual [~FuzzyInput](#) ()=default
- void [fuzzification](#) (float input\_value)  
*Input fuzzification.*

## Static Public Member Functions

- static [FuzzyInput parse](#) (const nlohmann::json &input\_json)  
*Try to parse input.*

## Additional Inherited Members

### 6.13.1 Constructor & Destructor Documentation

### 6.13.1.1 FuzzyInput()

```
FuzzyInput::FuzzyInput (
    const std::string & name,
    std::vector< std::shared_ptr< FuzzyMembership >> memberships ) [inline]
```

[FuzzyInput](#) constructor

### 6.13.1.2 ~FuzzyInput()

```
virtual FuzzyInput::~FuzzyInput ( ) [virtual], [default]
```

[FuzzyInput](#) destructor

## 6.13.2 Member Function Documentation

### 6.13.2.1 fuzzification()

```
void FuzzyInput::fuzzification (
    float input_value )
```

Input fuzzification.

### 6.13.2.2 parse()

```
FuzzyInput FuzzyInput::parse (
    const nlohmann::json & input_json ) [static]
```

Try to parse input.

#### Parameters

|           |                |
|-----------|----------------|
| <i>io</i> | input to parse |
|-----------|----------------|

#### Returns

[FuzzyInput](#)

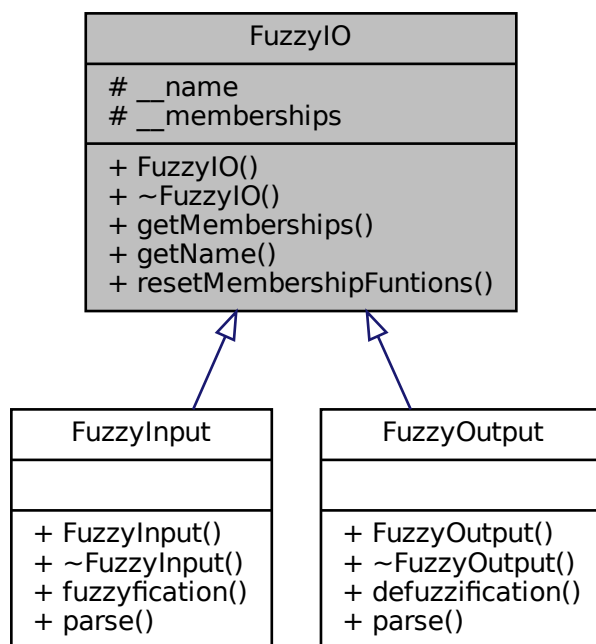
The documentation for this class was generated from the following files:

- [modules/fuzzy-control-system/FuzzyInput.hpp](#)
- [modules/fuzzy-control-system/FuzzyInput.cpp](#)

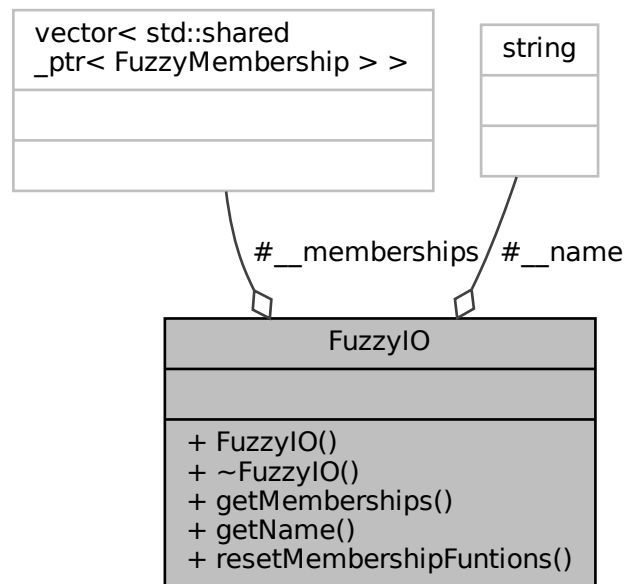
## 6.14 FuzzyIO Class Reference

```
#include <FuzzyIO.hpp>
```

Inheritance diagram for FuzzyIO:



Collaboration diagram for FuzzyIO:



## Public Member Functions

- [FuzzyIO](#) (const std::string &name, std::vector< std::shared\_ptr< [FuzzyMembership](#) > > memberships)
- virtual [~FuzzyIO](#) ()=default
- std::vector< std::shared\_ptr< [FuzzyMembership](#) > > [getMemberships](#) () const  
*Get the memberships object.*
- std::string [getName](#) () const  
*Get the Name object.*
- void [resetMembershipFuntions](#) ()  
*Reset all membership functions.*

## Protected Attributes

- std::string [\\_\\_name](#)
- std::vector< std::shared\_ptr< [FuzzyMembership](#) > > [\\_\\_memberships](#)

### 6.14.1 Constructor & Destructor Documentation

#### 6.14.1.1 FuzzyIO()

```
FuzzyIO::FuzzyIO (
    const std::string & name,
    std::vector< std::shared_ptr< FuzzyMembership >> memberships ) [inline]
```

FuzzyIO constructor

#### 6.14.1.2 ~FuzzyIO()

```
virtual FuzzyIO::~FuzzyIO ( ) [virtual], [default]
```

FuzzyIO destructor

### 6.14.2 Member Function Documentation

#### 6.14.2.1 getMemberships()

```
std::vector<std::shared_ptr<FuzzyMembership> > FuzzyIO::getMemberships ( ) const [inline]
```

Get the memberships object.

##### Returns

std::vector<std::shared\_ptr<FuzzyMembership>>

#### 6.14.2.2 getName()

```
std::string FuzzyIO::getName ( ) const [inline]
```

Get the Name object.

##### Returns

std::string

#### 6.14.2.3 resetMembershipFuntions()

```
void FuzzyIO::resetMembershipFuntions ( ) [inline]
```

Reset all membership functions.



### 6.14.3 Member Data Documentation

#### 6.14.3.1 `__memberships`

```
std::vector<std::shared_ptr<FuzzyMembership> > FuzzyIO::__memberships [protected]
```

Memberships function

#### 6.14.3.2 `__name`

```
std::string FuzzyIO::__name [protected]
```

Input/Output name

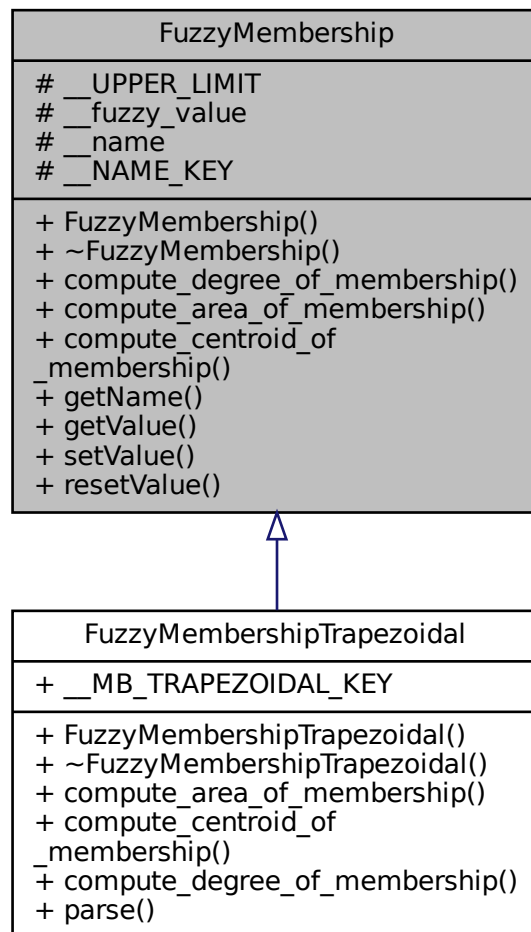
The documentation for this class was generated from the following file:

- `modules/fuzzy-control-system/FuzzyIO.hpp`

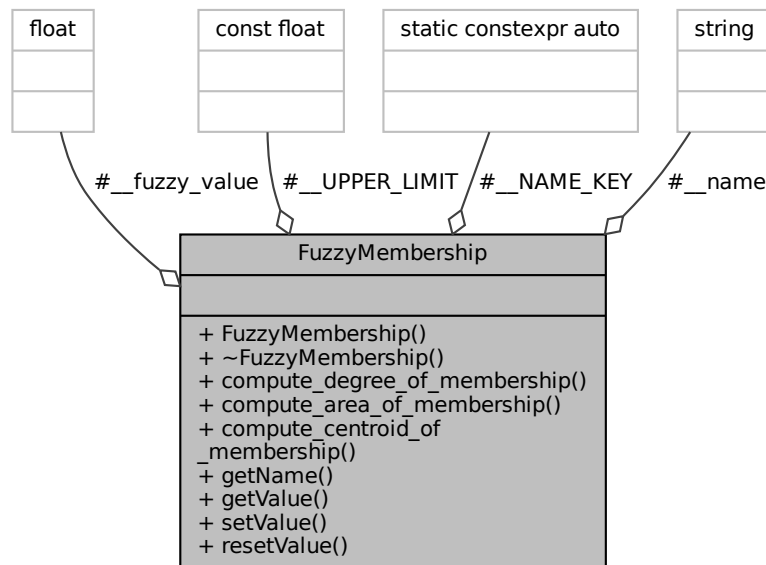
## 6.15 FuzzyMembership Class Reference

```
#include <FuzzyMembership.hpp>
```

Inheritance diagram for FuzzyMembership:



Collaboration diagram for FuzzyMembership:



## Public Types

- using [FuzzyMembershipPtr](#) = std::shared\_ptr< [FuzzyMembership](#) >

## Public Member Functions

- [FuzzyMembership](#) (const std::string &name)
- virtual [~FuzzyMembership](#) ()=default
- virtual void [compute\\_degree\\_of\\_membership](#) (float input\_value)=0  
*Compute degree of membership.*
- virtual float [compute\\_area\\_of\\_membership](#) ()=0  
*Compute area of membership.*
- virtual float [compute\\_centroid\\_of\\_membership](#) ()=0  
*Compute centroid of membership.*
- std::string [getName](#) () const  
*Get the Name object.*
- float [getValue](#) () const  
*Get the Value object.*
- void [setValue](#) (float value)  
*Set the Value object.*
- void [resetValue](#) ()  
*Reset fuzzy value.*

## Protected Attributes

- const float [\\_\\_UPPER\\_LIMIT](#) = 1.0
- float [\\_\\_fuzzy\\_value](#) = 0.0
- const std::string [\\_\\_name](#)

## Static Protected Attributes

- static constexpr auto `__NAME_KEY` {"name"}

## 6.15.1 Member Typedef Documentation

### 6.15.1.1 FuzzyMembershipPtr

```
using FuzzyMembership::FuzzyMembershipPtr = std::shared_ptr<FuzzyMembership>
```

[FuzzyMembership](#) smart pointer

## 6.15.2 Constructor & Destructor Documentation

### 6.15.2.1 FuzzyMembership()

```
FuzzyMembership::FuzzyMembership (  
    const std::string & name ) [inline]
```

[FuzzyMembership](#) constructor

### 6.15.2.2 ~FuzzyMembership()

```
virtual FuzzyMembership::~~FuzzyMembership ( ) [virtual], [default]
```

[FuzzyMembership](#) destructor

## 6.15.3 Member Function Documentation

### 6.15.3.1 compute\_area\_of\_membership()

```
virtual float FuzzyMembership::compute_area_of_membership ( ) [pure virtual]
```

Compute area of membership.

#### Returns

float

Implemented in [FuzzyMembershipTrapezoidal](#).

### 6.15.3.2 compute\_centroid\_of\_membership()

```
virtual float FuzzyMembership::compute_centroid_of_membership ( ) [pure virtual]
```

Compute centroid of membership.

#### Returns

float

Implemented in [FuzzyMembershipTrapezoidal](#).

### 6.15.3.3 compute\_degree\_of\_membership()

```
virtual void FuzzyMembership::compute_degree_of_membership (
    float input_value ) [pure virtual]
```

Compute degree of membership.

#### Parameters

|              |  |
|--------------|--|
| <i>value</i> |  |
|--------------|--|

Implemented in [FuzzyMembershipTrapezoidal](#).

### 6.15.3.4 getName()

```
std::string FuzzyMembership::getName ( ) const [inline]
```

Get the Name object.

#### Returns

std::string

### 6.15.3.5 getValue()

```
float FuzzyMembership::getValue ( ) const [inline]
```

Get the Value object.

#### Returns

float

### 6.15.3.6 resetValue()

```
void FuzzyMembership::resetValue ( ) [inline]
```

Reset fuzzy value.

### 6.15.3.7 setValue()

```
void FuzzyMembership::setValue (
    float value ) [inline]
```

Set the Value object.

Parameters

|              |  |
|--------------|--|
| <i>value</i> |  |
|--------------|--|

## 6.15.4 Member Data Documentation

### 6.15.4.1 \_\_fuzzy\_value

```
float FuzzyMembership::__fuzzy_value = 0.0 [protected]
```

Fuzzy value

### 6.15.4.2 \_\_name

```
const std::string FuzzyMembership::__name [protected]
```

[FuzzyMembership](#) name

### 6.15.4.3 \_\_NAME\_KEY

```
constexpr auto FuzzyMembership::__NAME_KEY {"name"} [static], [constexpr], [protected]
```

Name key

### 6.15.4.4 \_\_UPPER\_LIMIT

```
const float FuzzyMembership::__UPPER_LIMIT = 1.0 [protected]
```

Max membership value

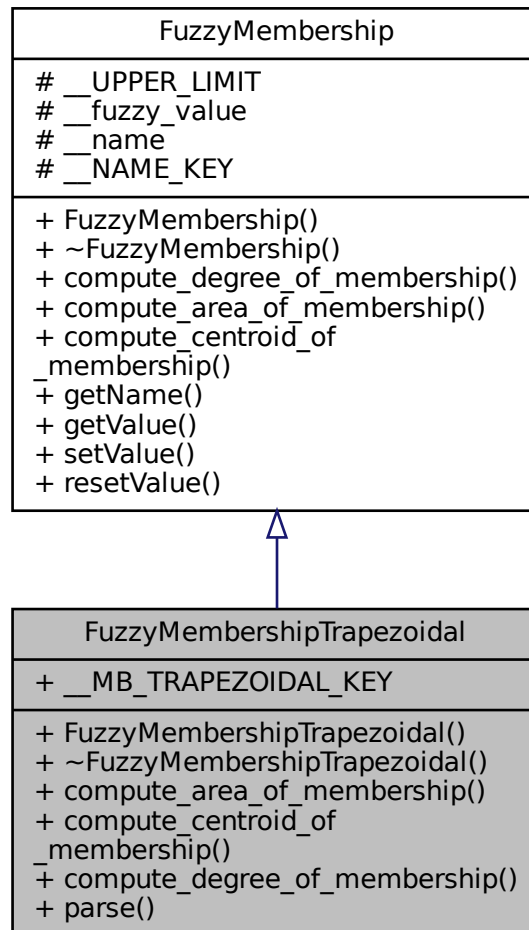
The documentation for this class was generated from the following file:

- [modules/fuzzy-control-system/FuzzyMembership.hpp](#)

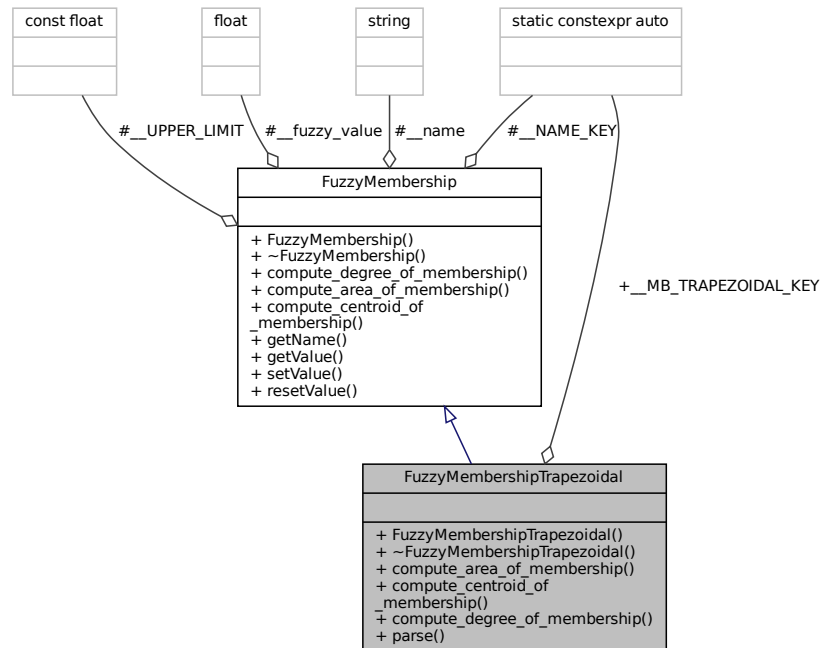
## 6.16 FuzzyMembershipTrapezoidal Class Reference

```
#include <FuzzyMembershipTrapezoidal.hpp>
```

Inheritance diagram for FuzzyMembershipTrapezoidal:



Collaboration diagram for FuzzyMembershipTrapezoidal:



## Classes

- struct [TrapezoidalPoints](#)

## Public Member Functions

- [FuzzyMembershipTrapezoidal](#) (const std::string &name, [TrapezoidalPoints](#) trapezoidal\_points)
- virtual [~FuzzyMembershipTrapezoidal](#) ()=default
- virtual float [compute\\_area\\_of\\_membership](#) ()  
*Compute area of the trapezoid.*
- virtual float [compute\\_centroid\\_of\\_membership](#) ()  
*Compute centroid of membership.*
- virtual void [compute\\_degree\\_of\\_membership](#) (float input\_value) override  
*Evaluate membership function (membership degree)*

## Static Public Member Functions

- static [FuzzyMembershipPtr](#) [parse](#) (const nlohmann::json &memb\_function\_json)  
*Try to parse membership function.*

## Static Public Attributes

- static constexpr auto [\\_MB\\_TRAPEZOIDAL\\_KEY](#) {"trapezoidal"}



## Additional Inherited Members

### 6.16.1 Constructor & Destructor Documentation

#### 6.16.1.1 FuzzyMembershipTrapezoidal()

```
FuzzyMembershipTrapezoidal::FuzzyMembershipTrapezoidal (
    const std::string & name,
    TrapezoidalPoints trapezoidal_points ) [inline]
```

[FuzzyMembershipTrapezoidal](#) constructor

#### 6.16.1.2 ~FuzzyMembershipTrapezoidal()

```
virtual FuzzyMembershipTrapezoidal::~~FuzzyMembershipTrapezoidal ( ) [virtual], [default]
```

[FuzzyMembershipTrapezoidal](#) destructor

### 6.16.2 Member Function Documentation

#### 6.16.2.1 compute\_area\_of\_membership()

```
float FuzzyMembershipTrapezoidal::compute_area_of_membership ( ) [virtual]
```

Compute area of the trapezoid.

##### Parameters

|              |  |
|--------------|--|
| <i>value</i> |  |
|--------------|--|

##### Returns

float

Implements [FuzzyMembership](#).

#### 6.16.2.2 compute\_centroid\_of\_membership()

```
float FuzzyMembershipTrapezoidal::compute_centroid_of_membership ( ) [virtual]
```

Compute centroid of membership.

**Returns**

float

Implements [FuzzyMembership](#).**6.16.2.3 compute\_degree\_of\_membership()**

```
void FuzzyMembershipTrapezoidal::compute_degree_of_membership (
    float input_value ) [override], [virtual]
```

Evaluate membership function (membership degree)

**Parameters**

|              |  |
|--------------|--|
| <i>value</i> |  |
|--------------|--|

Implements [FuzzyMembership](#).**6.16.2.4 parse()**

```
FuzzyMembership::FuzzyMembershipPtr FuzzyMembershipTrapezoidal::parse (
    const nlohmann::json & memb_function_json ) [static]
```

Try to parse membership function.

**Parameters**

|                   |  |
|-------------------|--|
| <i>input_json</i> |  |
|-------------------|--|

**Returns**[FuzzyMembershipTrapezoidal](#)**6.16.3 Member Data Documentation****6.16.3.1 \_\_MB\_TRAPEZOIDAL\_KEY**

```
constexpr const char * FuzzyMembershipTrapezoidal::__MB_TRAPEZOIDAL_KEY {"trapezoidal"} [static],
[constexpr]
```

Trapezoidal membership function key

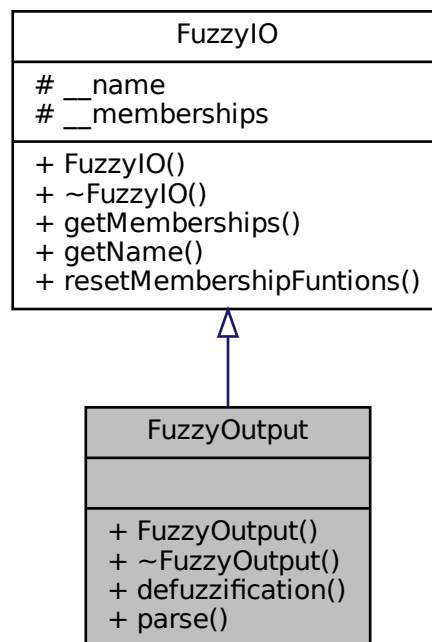
The documentation for this class was generated from the following files:

- modules/fuzzy-control-system/[FuzzyMembershipTrapezoidal.hpp](#)
- modules/fuzzy-control-system/[FuzzyMembershipTrapezoidal.cpp](#)

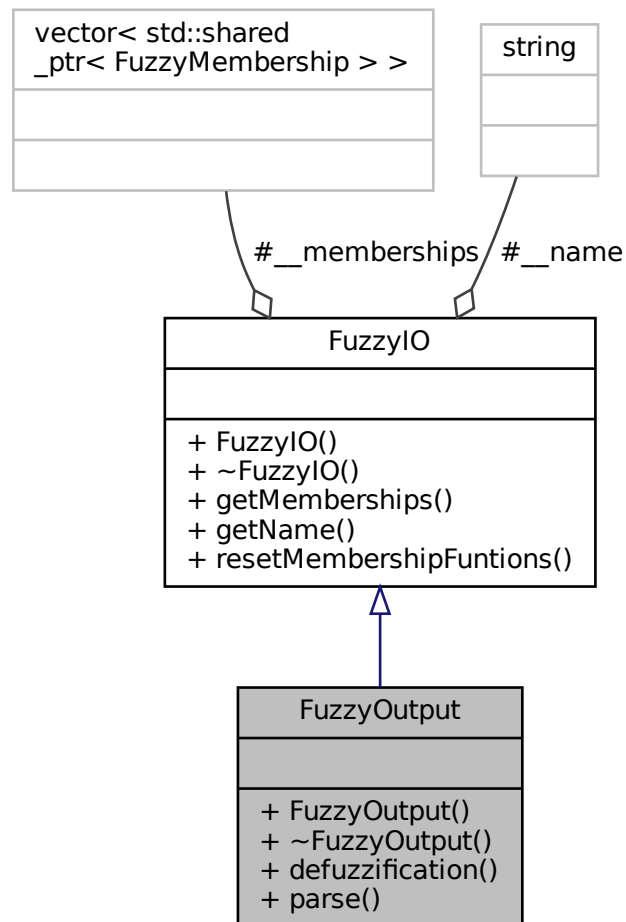
## 6.17 FuzzyOutput Class Reference

```
#include <FuzzyOutput.hpp>
```

Inheritance diagram for FuzzyOutput:



Collaboration diagram for FuzzyOutput:



## Public Member Functions

- `FuzzyOutput` (const std::string &name, std::vector< std::shared\_ptr< `FuzzyMembership` > > memberships)
- virtual `~FuzzyOutput` ()=default
- float `defuzzification` ()  
*Membership defuzzification.*

## Static Public Member Functions

- static `FuzzyOutput parse` (const nlohmann::json &output\_json)  
*Try to parse output.*

## Additional Inherited Members

### 6.17.1 Constructor & Destructor Documentation

### 6.17.1.1 FuzzyOutput()

```
FuzzyOutput::FuzzyOutput (
    const std::string & name,
    std::vector< std::shared_ptr< FuzzyMembership >> memberships ) [inline]
```

[FuzzyOutput](#) constructor

### 6.17.1.2 ~FuzzyOutput()

```
virtual FuzzyOutput::~FuzzyOutput ( ) [virtual], [default]
```

[FuzzyOutput](#) destructor

## 6.17.2 Member Function Documentation

### 6.17.2.1 defuzzification()

```
float FuzzyOutput::defuzzification ( )
```

Membership defuzzification.

Returns

float

### 6.17.2.2 parse()

```
FuzzyOutput FuzzyOutput::parse (
    const nlohmann::json & output_json ) [static]
```

Try to parse output.

Parameters

|           |                |
|-----------|----------------|
| <i>io</i> | input to parse |
|-----------|----------------|

Returns

[FuzzyInput](#)

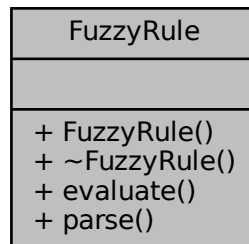
The documentation for this class was generated from the following files:

- modules/fuzzy-control-system/[FuzzyOutput.hpp](#)
- modules/fuzzy-control-system/[FuzzyOutput.cpp](#)

## 6.18 FuzzyRule Class Reference

```
#include <FuzzyRule.hpp>
```

Collaboration diagram for FuzzyRule:



### Public Member Functions

- [FuzzyRule](#) (std::string name, [FuzzyCondition::FuzzyConditionPtr](#) fuzzy\_input\_condition, [FuzzyCondition::FuzzyConditionPtr](#) fuzzy\_output\_condition)
- [~FuzzyRule](#) ()=default
- void [evaluate](#) (std::vector< [FuzzyInput](#) > &system\_input, std::vector< [FuzzyOutput](#) > &system\_output)  
*Evaluate the inputs and update the outputs.*

### Static Public Member Functions

- static [FuzzyRule parse](#) (const nlohmann::json &rule\_json)  
*Try to parse rule.*

## 6.18.1 Constructor & Destructor Documentation

### 6.18.1.1 FuzzyRule()

```
FuzzyRule::FuzzyRule (
    std::string name,
    FuzzyCondition::FuzzyConditionPtr fuzzy_input_condition,
    FuzzyCondition::FuzzyConditionPtr fuzzy_output_condition ) [inline]
```

[FuzzyRule](#) constructor

### 6.18.1.2 `~FuzzyRule()`

```
FuzzyRule::~~FuzzyRule ( ) [default]
```

[FuzzyRule](#) destructor

## 6.18.2 Member Function Documentation

### 6.18.2.1 `evaluate()`

```
void FuzzyRule::evaluate (
    std::vector< FuzzyInput > & system_input,
    std::vector< FuzzyOutput > & system_output )
```

Evaluate the inputs and update the outputs.

Parameters

|                      |  |
|----------------------|--|
| <i>system_input</i>  |  |
| <i>system_output</i> |  |

### 6.18.2.2 `parse()`

```
FuzzyRule FuzzyRule::parse (
    const nlohmann::json & rule_json ) [static]
```

Try to parse rule.

Parameters

|                  |               |
|------------------|---------------|
| <i>rule_json</i> | Rule to parse |
|------------------|---------------|

Returns

[FuzzyRule](#)

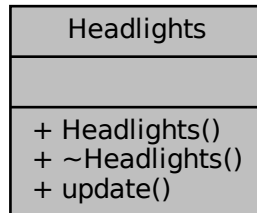
The documentation for this class was generated from the following files:

- modules/fuzzy-control-system/[FuzzyRule.hpp](#)
- modules/fuzzy-control-system/[FuzzyRule.cpp](#)

## 6.19 Headlights Class Reference

```
#include <Headlights.hpp>
```

Collaboration diagram for Headlights:



### Public Member Functions

- [Headlights](#) ()
- [~Headlights](#) ()=default
- void [update](#) (uint32\_t value)

*Update the headlight value.*

### 6.19.1 Constructor & Destructor Documentation

#### 6.19.1.1 Headlights()

```
Headlights::Headlights ( ) [inline]
```

[Headlights](#) constructor

#### 6.19.1.2 ~Headlights()

```
Headlights::~~Headlights ( ) [default]
```

[Headlights](#) destructor

### 6.19.2 Member Function Documentation

#### 6.19.2.1 update()

```
void Headlights::update (
    uint32_t value ) [inline]
```

Update the headlight value.



## Parameters

|              |  |
|--------------|--|
| <i>value</i> |  |
|--------------|--|

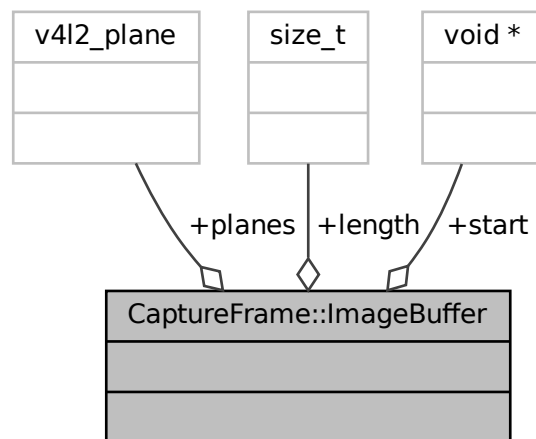
The documentation for this class was generated from the following file:

- modules/headlights/[Headlights.hpp](#)

## 6.20 CaptureFrame::ImageBuffer Struct Reference

```
#include <CaptureFrame.hpp>
```

Collaboration diagram for CaptureFrame::ImageBuffer:



### Public Attributes

- void \* [start](#) [VIDEO\_MAX\_PLANES]
- size\_t [length](#) [VIDEO\_MAX\_PLANES]
- v4l2\_plane [planes](#) [VIDEO\_MAX\_PLANES]

### 6.20.1 Detailed Description

Image buffer

### 6.20.2 Member Data Documentation

### 6.20.2.1 length

```
size_t CaptureFrame::ImageBuffer::length[VIDEO_MAX_PLANES]
```

### 6.20.2.2 planes

```
v4l2_plane CaptureFrame::ImageBuffer::planes[VIDEO_MAX_PLANES]
```

### 6.20.2.3 start

```
void* CaptureFrame::ImageBuffer::start[VIDEO_MAX_PLANES]
```

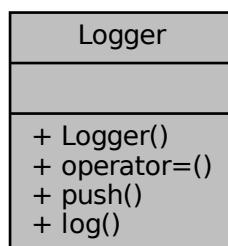
The documentation for this struct was generated from the following file:

- modules/capture-frame/[CaptureFrame.hpp](#)

## 6.21 Logger Class Reference

```
#include <Logger.hpp>
```

Collaboration diagram for Logger:



### Public Member Functions

- [Logger](#) ([Logger](#) const &)=delete
- void [operator=](#) ([Logger](#) const &)=delete
- void [push](#) (std::string new\_msg)

*Push a new msg into the queue.*

## Static Public Member Functions

- static [LogStream](#) [log](#) ([LogLevels](#) level=[LogLevels::Info](#))

*This create [Logger](#) object and return a [LogStream](#) object.*

### 6.21.1 Constructor & Destructor Documentation

#### 6.21.1.1 [Logger](#)()

```
Logger::Logger (  
    Logger const & ) [delete]
```

Delete copy constructor

### 6.21.2 Member Function Documentation

#### 6.21.2.1 [log](#)()

```
static LogStream Logger::log (  
    LogLevels level = LogLevels::Info ) [inline], [static]
```

This create [Logger](#) object and return a [LogStream](#) object.

##### Parameters

|              |  |
|--------------|--|
| <i>level</i> |  |
|--------------|--|

##### Returns

[LogStream](#)

#### 6.21.2.2 [operator=](#)()

```
void Logger::operator= (  
    Logger const & ) [delete]
```

Delete assignment operator

### 6.21.2.3 push()

```
void Logger::push (
    std::string new_msg )
```

Push a new msg into the queue.

## Parameters

|                |  |
|----------------|--|
| <i>new_msg</i> |  |
|----------------|--|

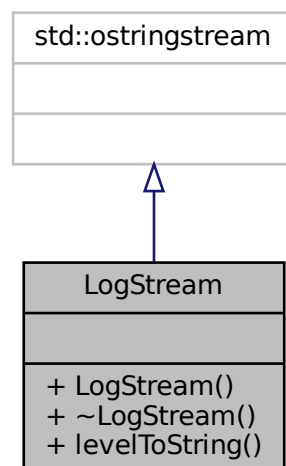
The documentation for this class was generated from the following files:

- modules/logger/[Logger.hpp](#)
- modules/logger/[Logger.cpp](#)

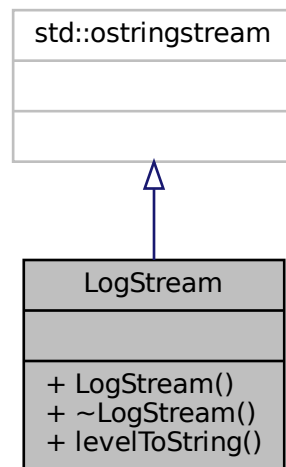
## 6.22 LogStream Class Reference

```
#include <LogStream.hpp>
```

Inheritance diagram for LogStream:



Collaboration diagram for LogStream:



## Public Member Functions

- [LogStream](#) ([Logger](#) &logger, [LogLevels](#) log\_level)
- [~LogStream](#) ()
- `std::string` [levelToString](#) ()  
*Get the string of the level.*

## 6.22.1 Constructor & Destructor Documentation

### 6.22.1.1 LogStream()

```
LogStream::LogStream (
    Logger & logger,
    LogLevels log_level )
```

[LogStream](#) constructor

### 6.22.1.2 ~LogStream()

```
LogStream::~~LogStream ( )
```

[LogStream](#) destructor

## 6.22.2 Member Function Documentation

### 6.22.2.1 levelToString()

```
std::string LogStream::levelToString ( )
```

Get the string of the level.

Returns

std::string

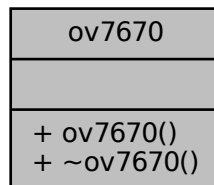
The documentation for this class was generated from the following files:

- modules/logger/[LogStream.hpp](#)
- modules/logger/[LogStream.cpp](#)

## 6.23 ov7670 Class Reference

```
#include <ov7670.hpp>
```

Collaboration diagram for ov7670:



### Public Types

- enum [pixelFormat](#) { `SBGGR8_1X8` = 0 }

### Public Member Functions

- [ov7670](#) (uint32\_t width, uint32\_t height, [pixelFormat](#) pixel\_format, uint32\_t frame\_rate)
- [~ov7670](#) ()

## 6.23.1 Member Enumeration Documentation

### 6.23.1.1 pixelFormat

```
enum ov7670::pixelFormat
```

Pixel formats supported

## Enumerator

|            |  |
|------------|--|
| SBGGR8_1X8 |  |
|------------|--|

## 6.23.2 Constructor & Destructor Documentation

### 6.23.2.1 `ov7670()`

```
ov7670::ov7670 (
    uint32_t width,
    uint32_t height,
    pixelFormat pixel_format,
    uint32_t frame_rate )
```

[ov7670](#) constructor

### 6.23.2.2 `~ov7670()`

```
ov7670::~~ov7670 ( )
```

[ov7670](#) destructor

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

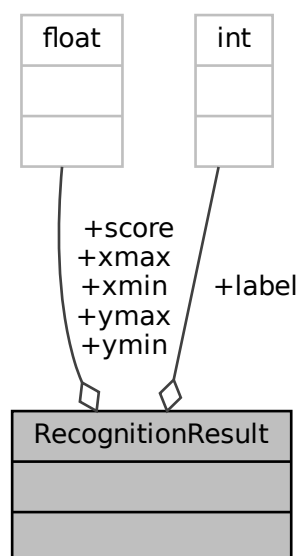
- [modules/capture-frame/ov7670.hpp](#)
- [modules/capture-frame/ov7670.cpp](#)

## 6.24 RecognitionResult Struct Reference

```
#include <RecognitionResult.hpp>
```



Collaboration diagram for RecognitionResult:



## Public Attributes

- int [label](#)
- float [score](#)
- float [ymin](#)
- float [xmin](#)
- float [ymax](#)
- float [xmax](#)

### 6.24.1 Member Data Documentation

#### 6.24.1.1 label

```
int RecognitionResult::label
```

Class label

#### 6.24.1.2 score

```
float RecognitionResult::score
```

Class score

### 6.24.1.3 xmax

```
float RecognitionResult::xmax
```

X-axis maximum value

### 6.24.1.4 xmin

```
float RecognitionResult::xmin
```

X-axis minimum value

### 6.24.1.5 ymax

```
float RecognitionResult::ymax
```

Y-axis maximum value

### 6.24.1.6 ymin

```
float RecognitionResult::ymin
```

Y-axis minimum value

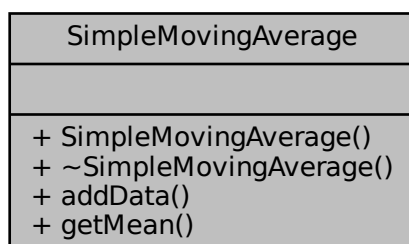
The documentation for this struct was generated from the following file:

- modules/capture-frame/[RecognitionResult.hpp](#)

## 6.25 SimpleMovingAverage Class Reference

```
#include <SimpleMovingAverage.hpp>
```

Collaboration diagram for SimpleMovingAverage:



## Public Member Functions

- [SimpleMovingAverage](#) (int queue\_len)
- [~SimpleMovingAverage](#) ()=default
- void [addData](#) (float data)  
*Add data to the queue.*
- float [getMean](#) ()  
*Get the Mean of the queue.*

## 6.25.1 Constructor & Destructor Documentation

### 6.25.1.1 SimpleMovingAverage()

```
SimpleMovingAverage::SimpleMovingAverage (  
    int queue_len ) [inline]
```

[SimpleMovingAverage](#) constructor

### 6.25.1.2 ~SimpleMovingAverage()

```
SimpleMovingAverage::~~SimpleMovingAverage ( ) [default]
```

[SimpleMovingAverage](#) destructor

## 6.25.2 Member Function Documentation

### 6.25.2.1 addData()

```
void SimpleMovingAverage::addData (  
    float data ) [inline]
```

Add data to the queue.

#### Parameters

|             |  |
|-------------|--|
| <i>data</i> |  |
|-------------|--|

### 6.25.2.2 getMean()

```
float SimpleMovingAverage::getMean ( ) [inline]
```

Get the Mean of the queue.

#### Returns

float

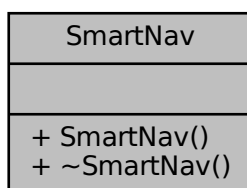
The documentation for this class was generated from the following file:

- modules/hc-sr04/[SimpleMovingAverage.hpp](#)

## 6.26 SmartNav Class Reference

```
#include <SmartNav.hpp>
```

Collaboration diagram for SmartNav:



### Public Member Functions

- [SmartNav](#) ()
- [~SmartNav](#) ()

#### 6.26.1 Constructor & Destructor Documentation

##### 6.26.1.1 SmartNav()

```
SmartNav::SmartNav ( ) [inline]
```

Smartnav constructor

## 6.26.1.2 ~SmartNav()

```
SmartNav::~~SmartNav ( ) [inline]
```

Smartnav destructor

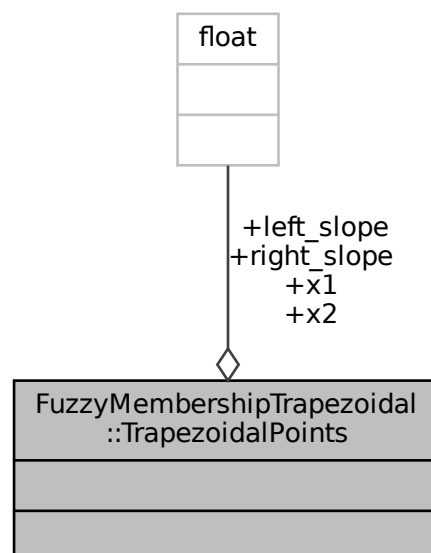
The documentation for this class was generated from the following file:

- [SmartNav.hpp](#)

## 6.27 FuzzyMembershipTrapezoidal::TrapezoidalPoints Struct Reference

```
#include <FuzzyMembershipTrapezoidal.hpp>
```

Collaboration diagram for FuzzyMembershipTrapezoidal::TrapezoidalPoints:



## Public Attributes

- float [x1](#)
- float [x2](#)
- float [right\\_slope](#)
- float [left\\_slope](#)

## 6.27.1 Member Data Documentation

**6.27.1.1 left\_slope**

```
float FuzzyMembershipTrapezoidal::TrapezoidalPoints::left_slope
```

Left slope

**6.27.1.2 right\_slope**

```
float FuzzyMembershipTrapezoidal::TrapezoidalPoints::right_slope
```

Right slope

**6.27.1.3 x1**

```
float FuzzyMembershipTrapezoidal::TrapezoidalPoints::x1
```

Smallest x point

**6.27.1.4 x2**

```
float FuzzyMembershipTrapezoidal::TrapezoidalPoints::x2
```

Higher x point

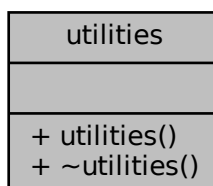
The documentation for this struct was generated from the following file:

- modules/fuzzy-control-system/[FuzzyMembershipTrapezoidal.hpp](#)

**6.28 utilities Class Reference**

```
#include <utilities.hpp>
```

Collaboration diagram for utilities:



## Public Member Functions

- [utilities](#) ()
- [~utilities](#) ()

### 6.28.1 Constructor & Destructor Documentation

#### 6.28.1.1 utilities()

```
utilities::utilities ( )
```

Utilities constructor

#### 6.28.1.2 ~utilities()

```
utilities::~utilities ( )
```

Utilities destructor

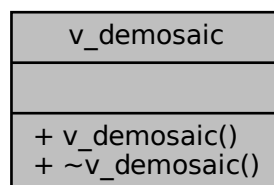
The documentation for this class was generated from the following file:

- modules/utilities/[utilities.hpp](#)

## 6.29 v\_demosaic Class Reference

```
#include <v_demosaic.hpp>
```

Collaboration diagram for v\_demosaic:



## Public Types

- enum [pixelFormat](#) { `RBG888_1X24` = 0 }

## Public Member Functions

- [v\\_demosaic](#) (uint32\_t width, uint32\_t height, [pixelFormat](#) pixel\_format)
- [~v\\_demosaic](#) ()

### 6.29.1 Member Enumeration Documentation

#### 6.29.1.1 pixelFormat

```
enum v_demosaic::pixelFormat
```

Pixel formats supported

Enumerator

|             |  |
|-------------|--|
| RBG888_1X24 |  |
|-------------|--|

### 6.29.2 Constructor & Destructor Documentation

#### 6.29.2.1 v\_demosaic()

```
v_demosaic::v_demosaic (
    uint32_t width,
    uint32_t height,
    pixelFormat pixel_format )
```

[ov7670](#) constructor

#### 6.29.2.2 ~v\_demosaic()

```
v_demosaic::~v_demosaic ( )
```

[ov7670](#) destructor

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

- modules/capture-frame/[v\\_demosaic.hpp](#)
- modules/capture-frame/[v\\_demosaic.cpp](#)



## 6.30 VirtualImage Class Reference

```
#include <VirtualImage.hpp>
```

Collaboration diagram for VirtualImage:

| VirtualImage  |
|---|
| <ul style="list-style-type: none"> <li>+ VirtualImage()</li> <li>+ VirtualImage()</li> <li>+ ~VirtualImage()</li> <li>+ resize()</li> <li>+ convertToRgb()</li> <li>+ saveAsJpg()</li> <li>+ getData()</li> <li>+ getWidth()</li> <li>+ getHeigth()</li> <li>+ getChannels()</li> <li>+ getColorSpace()</li> <li>+ colorBalancing()</li> <li>+ flip()</li> <li>+ getBrightness()</li> </ul> |

### Public Member Functions

- [VirtualImage](#) (uint32\_t width, uint32\_t height, uint32\_t channels)
- [VirtualImage](#) (uint32\_t width, uint32\_t height, uint32\_t channels, [ColorSpaces](#) color\_space, void \*data)
- [~VirtualImage](#) ()=default
- void [resize](#) (uint32\_t width, uint32\_t height)  
*Resize image.*
- void [convertToRgb](#) ()  
*convert the input format to rgb*
- void [saveAsJpg](#) (const std::string &directory)  
*Save image as jpeg.*
- cv::Mat [getData](#) () const  
*Get the Data.*
- int [getWidth](#) () const  
*Get the Width object.*
- int [getHeigth](#) () const  
*Get the Heigth object.*
- int [getChannels](#) () const  
*Get the Channels object.*
- [ColorSpaces](#) [getColorSpace](#) () const  
*Get the Color Space object.*
- void [colorBalancing](#) (float percent)

*Color balancing algorithm.*

- void [flip](#) (bool orientation)

*Flip image.*

- uint32\_t [getBrightness](#) () const

*Get the Brightness object.*

## 6.30.1 Constructor & Destructor Documentation

### 6.30.1.1 VirtualImage() [1/2]

```
VirtualImage::VirtualImage (
    uint32_t width,
    uint32_t height,
    uint32_t channels )
```

[VirtualImage](#) constructor

### 6.30.1.2 VirtualImage() [2/2]

```
VirtualImage::VirtualImage (
    uint32_t width,
    uint32_t height,
    uint32_t channels,
    ColorSpaces color_space,
    void * data )
```

[VirtualImage](#) constructor

### 6.30.1.3 ~VirtualImage()

```
VirtualImage::~VirtualImage ( ) [default]
```

[VirtualImage](#) destructor

## 6.30.2 Member Function Documentation

### 6.30.2.1 colorBalancing()

```
void VirtualImage::colorBalancing (
    float percent )
```

Color balancing algorithm.

## Parameters

|                |  |
|----------------|--|
| <i>percent</i> |  |
|----------------|--|

**6.30.2.2 convertToRgb()**

```
void VirtualImage::convertToRgb ( )
```

convert the input format to rgb

**6.30.2.3 flip()**

```
void VirtualImage::flip (
    bool orientation )
```

Flip image.

## Parameters

|                    |                              |
|--------------------|------------------------------|
| <i>orientation</i> | 0: vertically, 1: horizontal |
|--------------------|------------------------------|

**6.30.2.4 getBrightness()**

```
uint32_t VirtualImage::getBrightness ( ) const [inline]
```

Get the Brightness object.

## Returns

uint32\_t

**6.30.2.5 getChannels()**

```
int VirtualImage::getChannels ( ) const
```

Get the Channels object.

## Returns

int

#### 6.30.2.6 getColorSpace()

```
ColorSpaces VirtualImage::getColorSpace ( ) const
```

Get the Color Space object.

##### Returns

colorSpace

#### 6.30.2.7 getData()

```
cv::Mat VirtualImage::getData ( ) const
```

Get the Data.

##### Returns

cv::Mat

#### 6.30.2.8 getHeigth()

```
int VirtualImage::getHeigth ( ) const
```

Get the Heigth object.

##### Returns

int

#### 6.30.2.9 getWidth()

```
int VirtualImage::getWidth ( ) const
```

Get the Width object.

##### Returns

int

#### 6.30.2.10 resize()

```
void VirtualImage::resize (
    uint32_t width,
    uint32_t height )
```

Resize image.

## Parameters

|               |  |
|---------------|--|
| <i>width</i>  |  |
| <i>height</i> |  |

## Returns

\* Resize

**6.30.2.11 saveAsJpg()**

```
void VirtualImage::saveAsJpg (
    const std::string & directory )
```

Save image as jpeg.

## Parameters

|                  |  |
|------------------|--|
| <i>directory</i> |  |
|------------------|--|

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

- modules/capture-frame/[VirtualImage.hpp](#)
- modules/capture-frame/[VirtualImage.cpp](#)

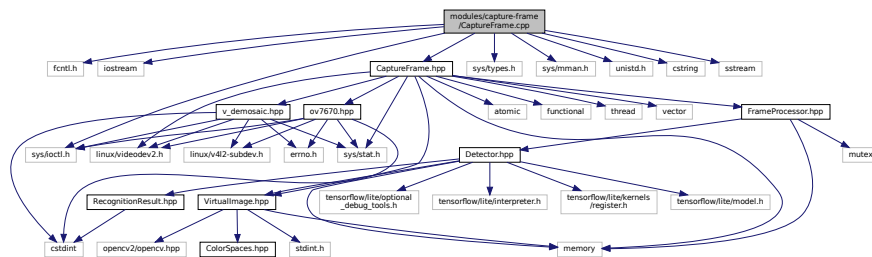


# File Documentation

## 7.1 modules/capture-frame/CaptureFrame.cpp File Reference

```
#include <fcntl.h>
#include <iostream>
#include <sys/ioctl.h>
#include <sys/types.h>
#include <sys/mman.h>
#include <unistd.h>
#include <cstring>
#include <sstream>
#include <CaptureFrame.hpp>
```

Include dependency graph for CaptureFrame.cpp:



## Macros

- #define **DEBUG\_PRINT**(fmt, ...) do { while (0)

### 7.1.1 Macro Definition Documentation

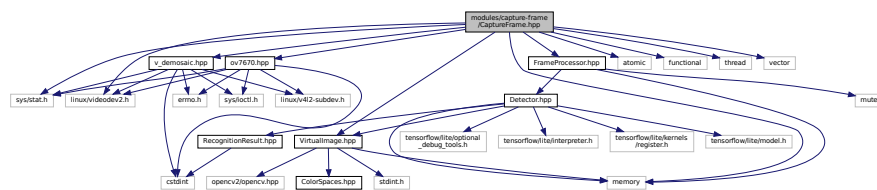
### 7.1.1.1 DEBUG\_PRINT

```
#define DEBUG_PRINT(  
    fmt,  
    ... ) do {} while (0)
```

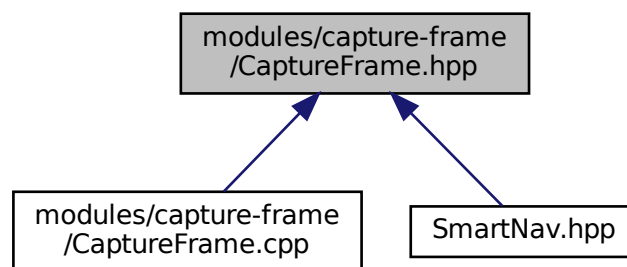
## 7.2 modules/capture-frame/CaptureFrame.hpp File Reference

```
#include <sys/stat.h>  
#include <linux/videodev2.h>  
#include <atomic>  
#include <functional>  
#include <memory>  
#include <thread>  
#include <vector>  
#include <VirtualImage.hpp>  
#include <ov7670.hpp>  
#include <v_demosaic.hpp>  
#include <FrameProcessor.hpp>
```

Include dependency graph for CaptureFrame.hpp:



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



## Classes

- class [CaptureFrame](#)
- struct [CaptureFrame::ImageBuffer](#)



## Macros

- #define `CLEAR(x)` `memset(&(x), 0, sizeof(x))`

### 7.2.1 Macro Definition Documentation

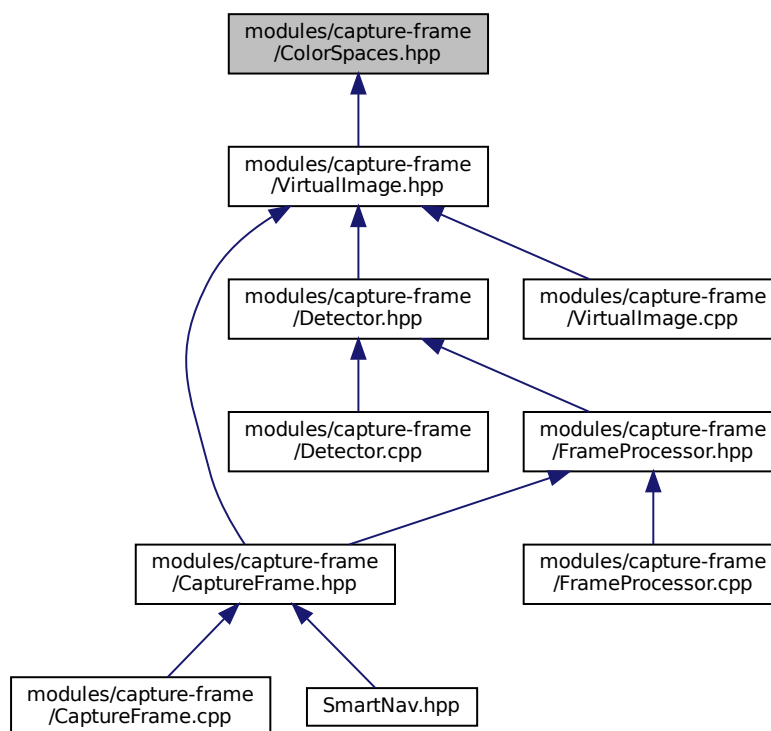
#### 7.2.1.1 CLEAR

```
#define CLEAR(  
    x ) memset (&(x), 0, sizeof(x))
```

Clear vl2d struct

## 7.3 modules/capture-frame/ColorSpaces.hpp File Reference

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



## Enumerations

- enum `ColorSpaces` {  
`NONE` = 0 , `RGB` , `RGBA` , `BGR` ,  
`BGRA` }

## 7.3.1 Enumeration Type Documentation

### 7.3.1.1 ColorSpaces

enum `ColorSpaces`

Color spaces supported

Enumerator

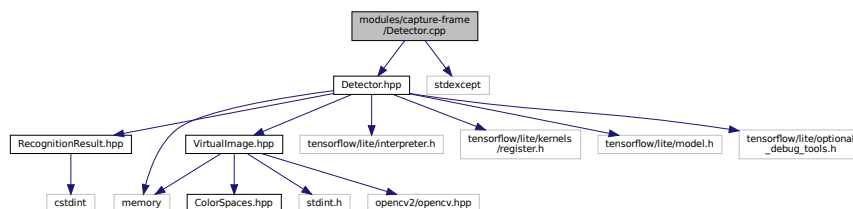
|      |  |
|------|--|
| NONE |  |
| RGB  |  |
| RGBA |  |
| BGR  |  |
| BGRA |  |

## 7.4 modules/capture-frame/Detector.cpp File Reference

```
#include "Detector.hpp"
```

```
#include <stdexcept>
```

Include dependency graph for Detector.cpp:



## Macros

- #define `DEBUG_PRINT`(fmt, ...) do {} while (0)

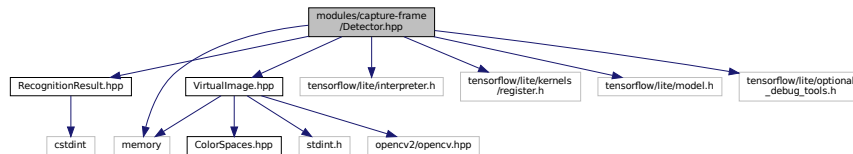
### 7.4.1 Macro Definition Documentation

#### 7.4.1.1 DEBUG\_PRINT

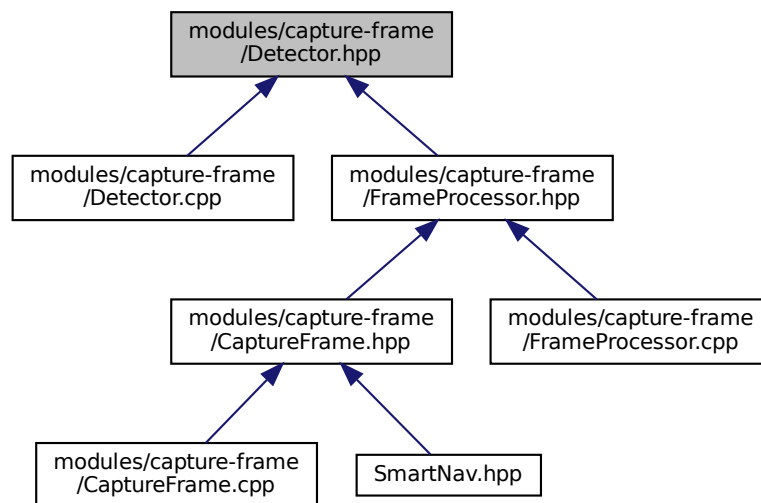
```
#define DEBUG_PRINT(
    fmt,
    ... ) do {} while (0)
```

## 7.5 modules/capture-frame/Detector.hpp File Reference

```
#include <memory>
#include "RecognitionResult.hpp"
#include "VirtualImage.hpp"
#include "tensorflow/lite/interpreter.h"
#include "tensorflow/lite/kernels/register.h"
#include "tensorflow/lite/model.h"
#include "tensorflow/lite/optional_debug_tools.h"
Include dependency graph for Detector.hpp:
```



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



### Classes

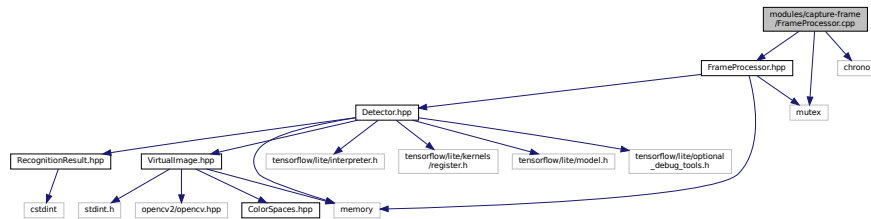
- class [Detector](#)

## 7.6 modules/capture-frame/FrameProcessor.cpp File Reference

```
#include "FrameProcessor.hpp"
#include <chrono>
```

```
#include <mutex>
```

Include dependency graph for FrameProcessor.cpp:



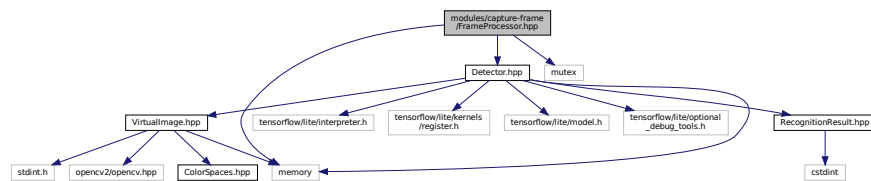
## 7.7 modules/capture-frame/FrameProcessor.hpp File Reference

```
#include <memory>
```

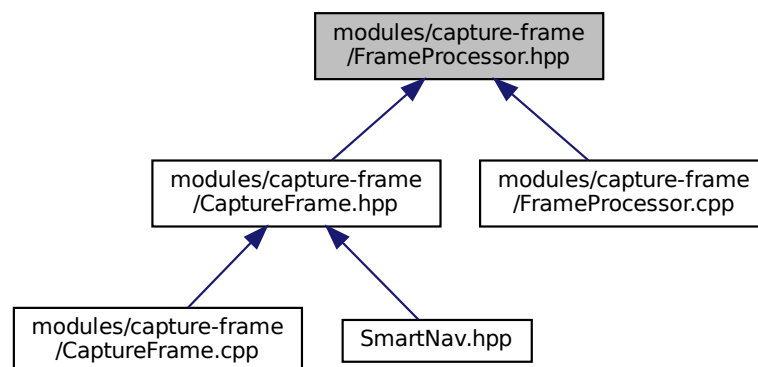
```
#include <mutex>
```

```
#include "Detector.hpp"
```

Include dependency graph for FrameProcessor.hpp:



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



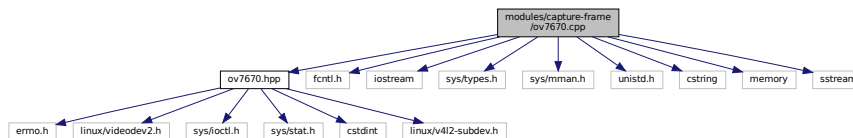
## Classes

- class [FrameProcessor](#)

## 7.8 modules/capture-frame/ov7670.cpp File Reference

```
#include <ov7670.hpp>
#include <fcntl.h>
#include <iostream>
#include <sys/types.h>
#include <sys/mman.h>
#include <unistd.h>
#include <cstring>
#include <memory>
#include <sstream>
```

Include dependency graph for ov7670.cpp:



### Macros

- #define [DEBUG\\_OV7670](#)
- #define [DEBUG\\_PRINT](#)(fmt, ...) fprintf(stderr, fmt, \_\_VA\_ARGS\_\_)

### 7.8.1 Macro Definition Documentation

#### 7.8.1.1 DEBUG\_OV7670

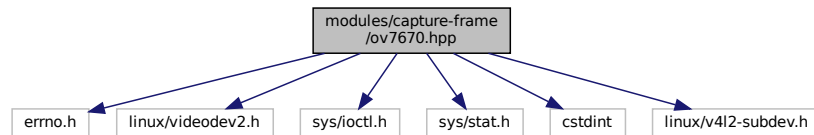
```
#define DEBUG_OV7670
```

#### 7.8.1.2 DEBUG\_PRINT

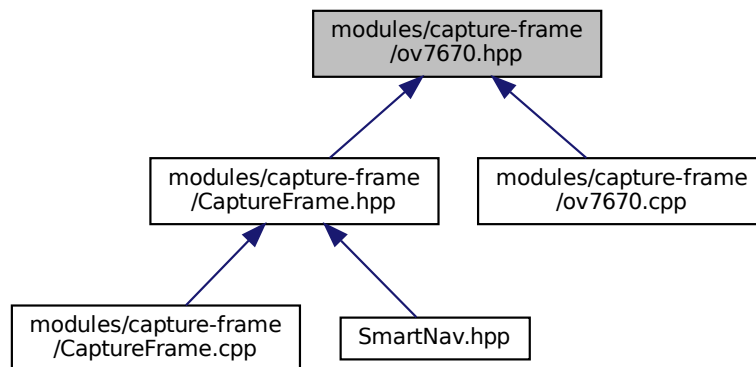
```
#define DEBUG_PRINT(
    fmt,
    ... ) fprintf(stderr, fmt, __VA_ARGS__)
```

## 7.9 modules/capture-frame/ov7670.hpp File Reference

```
#include <errno.h>
#include <linux/videodev2.h>
#include <sys/ioctl.h>
#include <sys/stat.h>
#include <stdint>
#include <linux/v4l2-subdev.h>
Include dependency graph for ov7670.hpp:
```



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



### Classes

- class [ov7670](#)

### Macros

- #define [CLEAR](#)(x) `memset(&(x), 0, sizeof(x))`

#### 7.9.1 Macro Definition Documentation

### 7.9.1.1 CLEAR

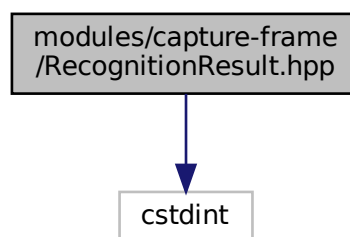
```
#define CLEAR(  
    x ) memset (&(x), 0, sizeof(x))
```

Clear vl2d struct

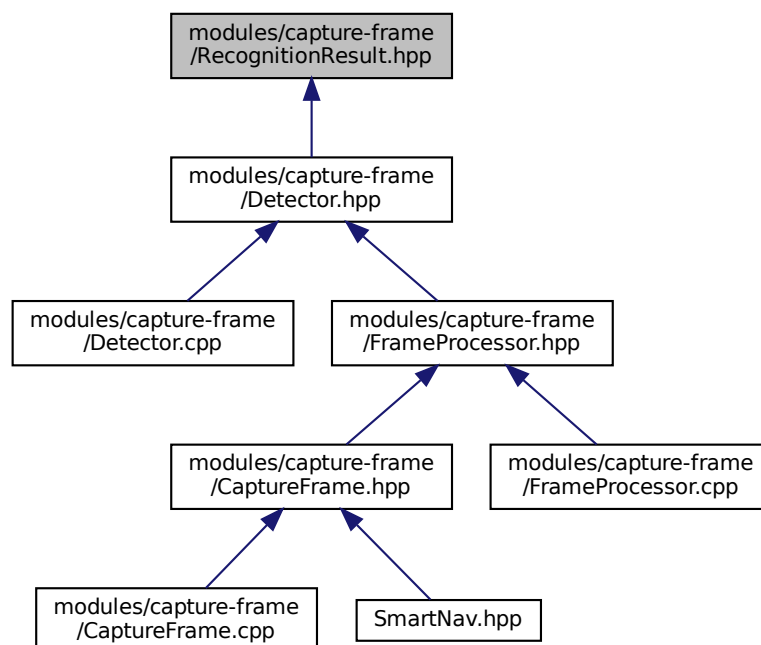
## 7.10 modules/capture-frame/RecognitionResult.hpp File Reference

```
#include <cstdint>
```

Include dependency graph for RecognitionResult.hpp:



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



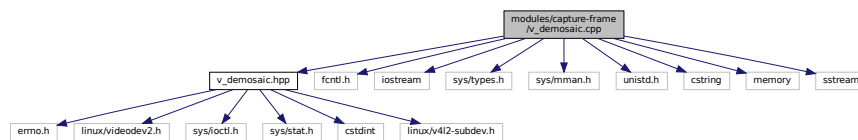
## Classes

- struct [RecognitionResult](#)

## 7.11 modules/capture-frame/v\_demosaic.cpp File Reference

```
#include <v_demosaic.hpp>
#include <fcntl.h>
#include <iostream>
#include <sys/types.h>
#include <sys/mman.h>
#include <unistd.h>
#include <cstring>
#include <memory>
#include <sstream>
```

Include dependency graph for v\_demosaic.cpp:



## Macros

- #define [DEBUG\\_DEMOSAIC](#) 1
- #define [DEBUG\\_PRINT](#)(fmt, args...)

### 7.11.1 Macro Definition Documentation

#### 7.11.1.1 DEBUG\_DEMOSAIC

```
#define DEBUG_DEMOSAIC 1
```

#### 7.11.1.2 DEBUG\_PRINT

```
#define DEBUG_PRINT(  
    fmt,  
    args... )
```

#### Value:

```
%s:%d:%s(): " fmt, \  
__func__, ##args)
```

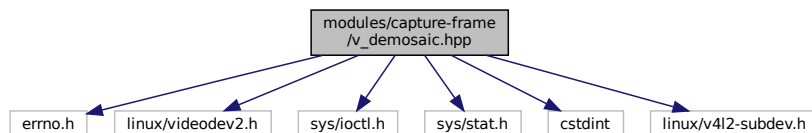
```
printf( "DEBUG:  
__FILE__, __LINE__,
```



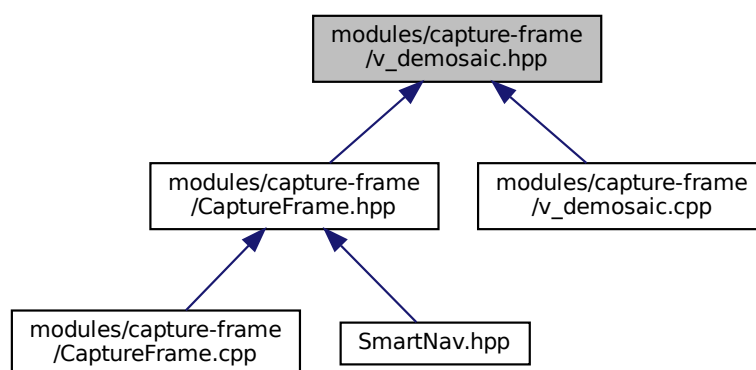
## 7.12 modules/capture-frame/v\_demosaic.hpp File Reference

```
#include <errno.h>
#include <linux/videodev2.h>
#include <sys/ioctl.h>
#include <sys/stat.h>
#include <stdint>
#include <linux/v4l2-subdev.h>
```

Include dependency graph for v\_demosaic.hpp:



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



### Classes

- class [v\\_demosaic](#)

### Macros

- #define [CLEAR](#)(x) `memset(&(x), 0, sizeof(x))`

#### 7.12.1 Macro Definition Documentation

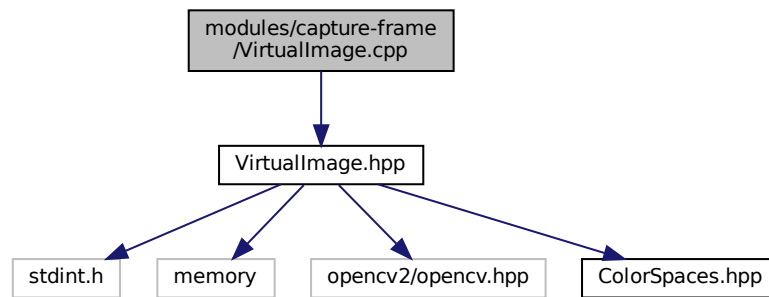
### 7.12.1.1 CLEAR

```
#define CLEAR(  
    x ) memset (&(x), 0, sizeof(x))
```

Clear vl2d struct

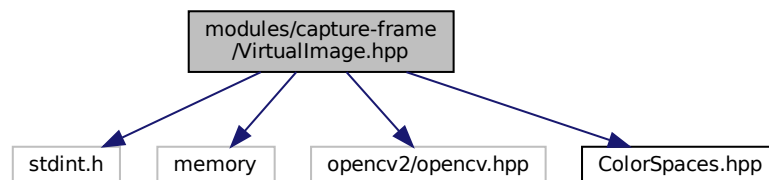
## 7.13 modules/capture-frame/VirtualImage.cpp File Reference

```
#include "VirtualImage.hpp"  
Include dependency graph for VirtualImage.cpp:
```

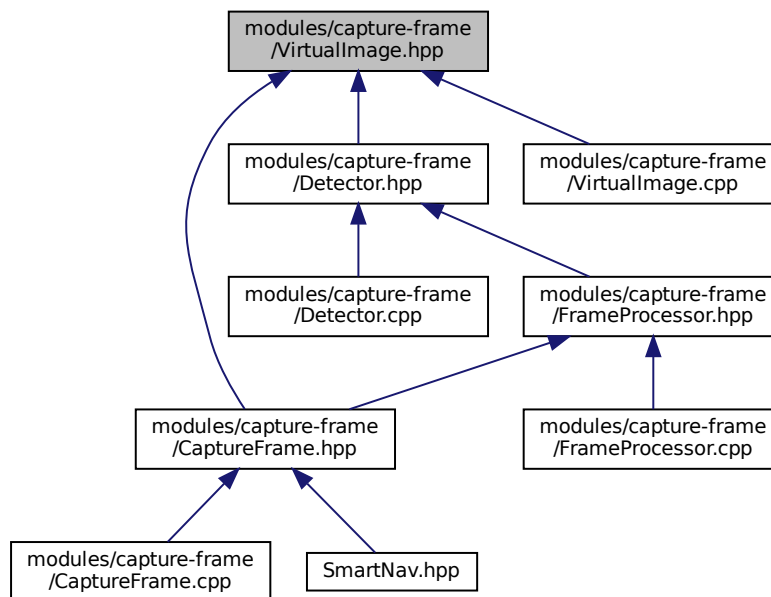


## 7.14 modules/capture-frame/VirtualImage.hpp File Reference

```
#include <stdint.h>  
#include <memory>  
#include <opencv2/opencv.hpp>  
#include "ColorSpaces.hpp"  
Include dependency graph for VirtualImage.hpp:
```



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



## Classes

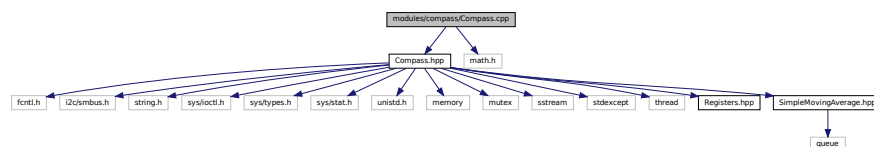
- class [VirtualImage](#)

## 7.15 modules/compass/Compass.cpp File Reference

```
#include <Compass.hpp>
```

```
#include <math.h>
```

Include dependency graph for `Compass.cpp`:



## Macros

- `#define` [DEBUG\\_PRINT](#)(fmt, ...) do {} while (0)

### 7.15.1 Macro Definition Documentation

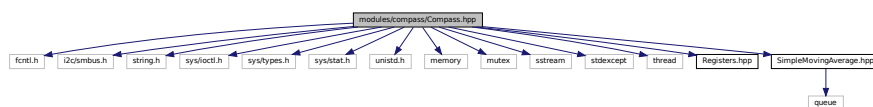
### 7.15.1.1 DEBUG\_PRINT

```
#define DEBUG_PRINT(  
    fmt,  
    ... ) do {} while (0)
```

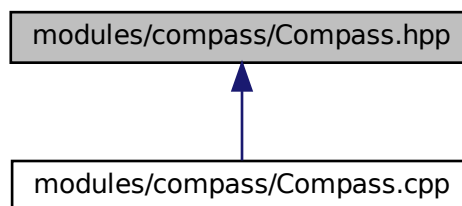
## 7.16 modules/compass/Compass.hpp File Reference

```
#include <fcntl.h>  
#include <i2c/smbus.h>  
#include <string.h>  
#include <sys/ioctl.h>  
#include <sys/types.h>  
#include <sys/stat.h>  
#include <unistd.h>  
#include <memory>  
#include <mutex>  
#include <sstream>  
#include <stdexcept>  
#include <thread>  
#include <Registers.hpp>  
#include <SimpleMovingAverage.hpp>
```

Include dependency graph for Compass.hpp:



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

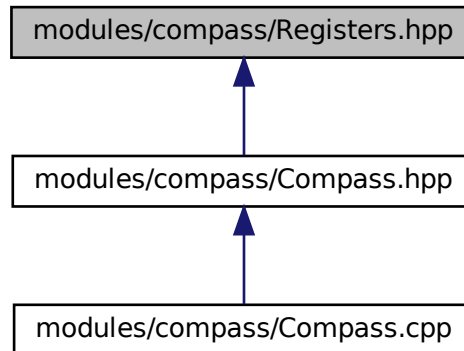


## Classes

- class [Compass](#)
- struct [Compass::CalibrationValues](#)
- struct [Compass::CompassValues](#)

## 7.17 modules/compass/Registers.hpp File Reference

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



### Namespaces

- [Registers](#)

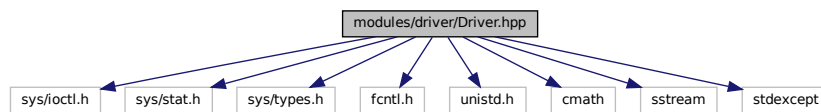
### Variables

- uint32\_t [Registers::QMC5883L\\_X\\_LSB](#) = 0x00
- uint32\_t [Registers::QMC5883L\\_X\\_MSB](#) = 0x01
- uint32\_t [Registers::QMC5883L\\_Y\\_LSB](#) = 0x02
- uint32\_t [Registers::QMC5883L\\_Y\\_MSB](#) = 0x03
- uint32\_t [Registers::QMC5883L\\_Z\\_LSB](#) = 0x04
- uint32\_t [Registers::QMC5883L\\_Z\\_MSB](#) = 0x05
- uint32\_t [Registers::QMC5883L\\_STATUS](#) = 0x06
- uint32\_t [Registers::QMC5883L\\_TEMP\\_LSB](#) = 0x07
- uint32\_t [Registers::QMC5883L\\_TEMP\\_MSB](#) = 0x08
- uint32\_t [Registers::QMC5883L\\_CONFIG](#) = 0x09
- uint32\_t [Registers::QMC5883L\\_CONFIG2](#) = 0x0A
- uint32\_t [Registers::QMC5883L\\_RESET](#) = 0x0B
- uint32\_t [Registers::QMC5883L\\_RESERVED](#) = 0x0C
- uint32\_t [Registers::QMC5883L\\_CHIP\\_ID](#) = 0x0D

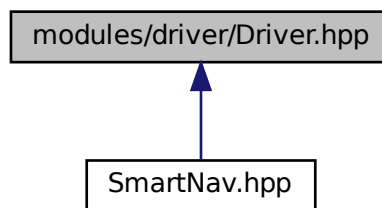
## 7.18 modules/driver/Driver.hpp File Reference

```
#include <sys/ioctl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <fcntl.h>
#include <unistd.h>
#include <cmath>
#include <sstream>
#include <stdexcept>
```

Include dependency graph for Driver.hpp:



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



### Classes

- class [Driver](#)

### Macros

- #define [L298N\\_IOC\\_NMAGICO](#) 'c'
- #define [L298N\\_IOC\\_STOP](#) \_IO(L298N\_IOC\_NMAGICO, 0)
- #define [L298N\\_IOC\\_FORWARD](#) \_IO(L298N\_IOC\_NMAGICO, 1)
- #define [L298N\\_IOC\\_BACK](#) \_IO(L298N\_IOC\_NMAGICO, 2)
- #define [L298N\\_IOC\\_RIGHT](#) \_IO(L298N\_IOC\_NMAGICO, 3)
- #define [L298N\\_IOC\\_LEFT](#) \_IO(L298N\_IOC\_NMAGICO, 4)
- #define [AXI\\_TIMER\\_IOC\\_NMAGICO](#) 'v'
- #define [AXI\\_TIMER\\_IOC\\_T\\_ON](#) \_IO(AXI\_TIMER\_IOC\_NMAGICO, 1)

## 7.18.1 Macro Definition Documentation

### 7.18.1.1 AXI\_TIMER\_IOC\_NMAGICO

```
#define AXI_TIMER_IOC_NMAGICO 'v'
```

### 7.18.1.2 AXI\_TIMER\_IOC\_T\_ON

```
#define AXI_TIMER_IOC_T_ON _IO(AXI_TIMER_IOC_NMAGICO, 1)
```

### 7.18.1.3 L298N\_IOC\_BACK

```
#define L298N_IOC_BACK _IO(L298N_IOC_NMAGICO, 2)
```

### 7.18.1.4 L298N\_IOC\_FORWARD

```
#define L298N_IOC_FORWARD _IO(L298N_IOC_NMAGICO, 1)
```

### 7.18.1.5 L298N\_IOC\_LEFT

```
#define L298N_IOC_LEFT _IO(L298N_IOC_NMAGICO, 4)
```

### 7.18.1.6 L298N\_IOC\_NMAGICO

```
#define L298N_IOC_NMAGICO 'c'
```

### 7.18.1.7 L298N\_IOC\_RIGHT

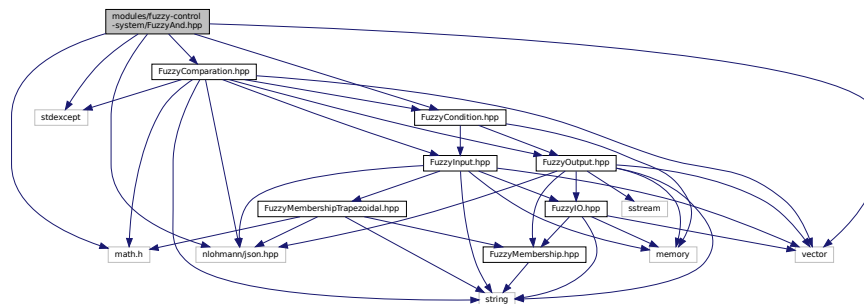
```
#define L298N_IOC_RIGHT _IO(L298N_IOC_NMAGICO, 3)
```



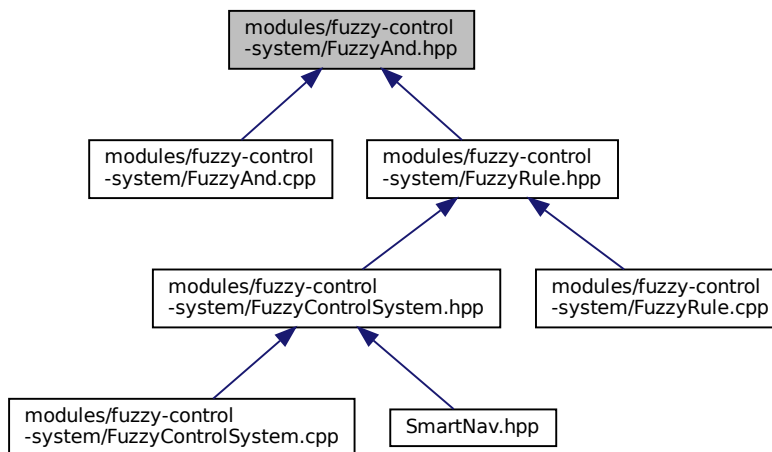


```
#include <FuzzyComparison.hpp>
```

Include dependency graph for FuzzyAnd.hpp:



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



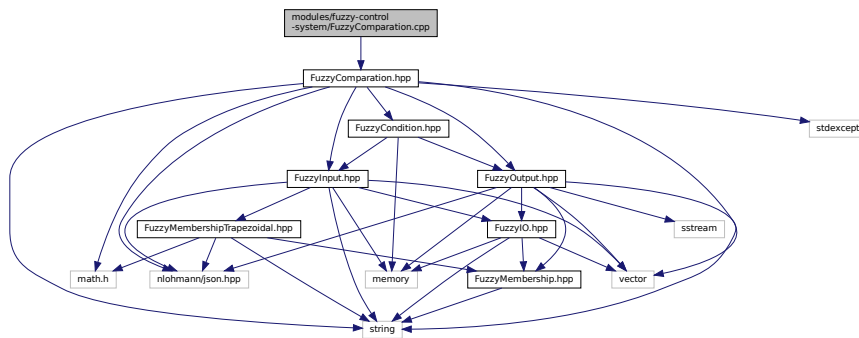
## Classes

- class [FuzzyAnd](#)

## 7.21 modules/fuzzy-control-system/FuzzyComparison.cpp File Reference

```
#include <FuzzyComparison.hpp>
```

Include dependency graph for FuzzyComparison.cpp:



## Macros

- #define `DEBUG_PRINT`(fmt, ...) do {} while (0)

### 7.21.1 Macro Definition Documentation

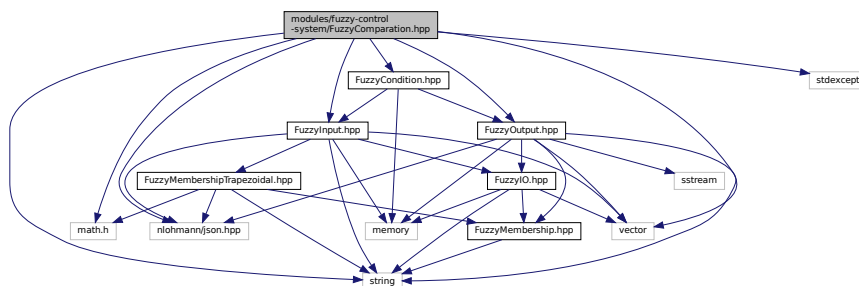
#### 7.21.1.1 DEBUG\_PRINT

```
#define DEBUG_PRINT(  
    fmt,  
    ... ) do {} while (0)
```

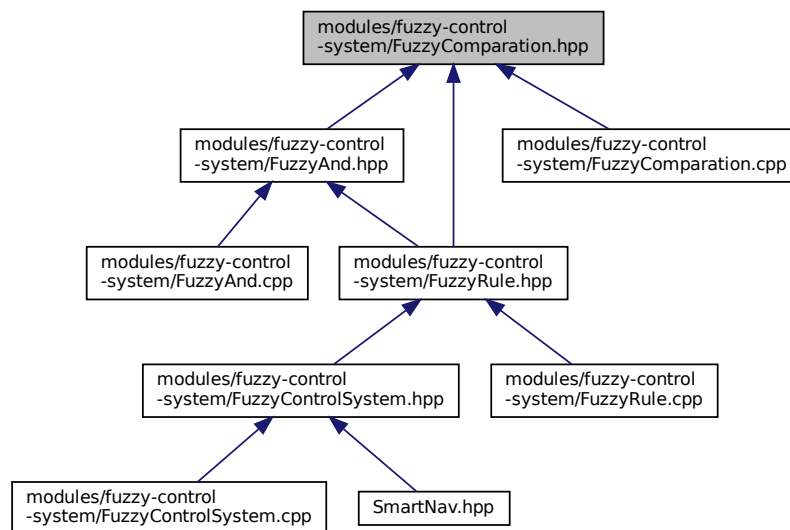
## 7.22 modules/fuzzy-control-system/FuzzyComparison.hpp File Reference

```
#include <math.h>  
#include <stdexcept>  
#include <string>  
#include <vector>  
#include "FuzzyCondition.hpp"  
#include "FuzzyInput.hpp"  
#include "FuzzyOutput.hpp"  
#include <nlohmann/json.hpp>
```

Include dependency graph for FuzzyComparison.hpp:



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



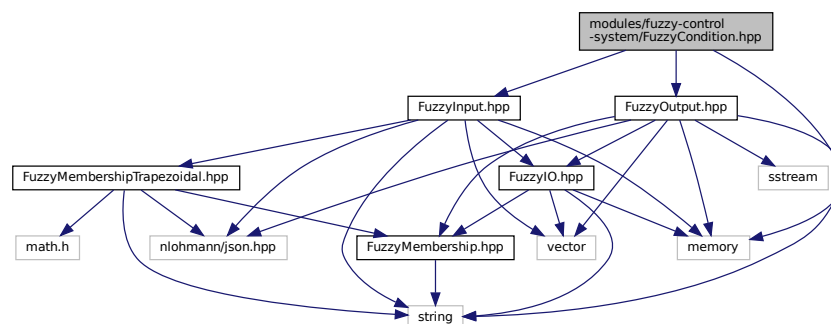
## Classes

- class [FuzzyComparison](#)

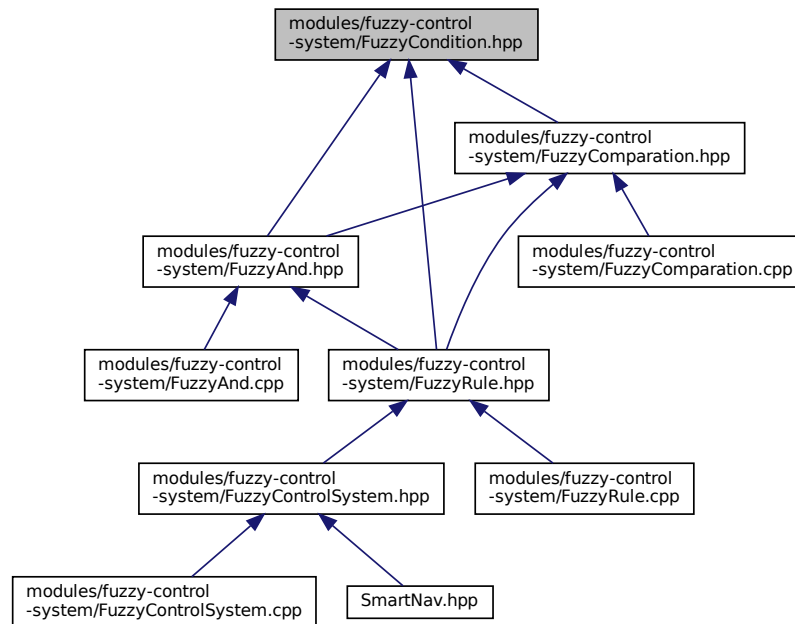
## 7.23 modules/fuzzy-control-system/FuzzyCondition.hpp File Reference

```
#include <memory>
#include <FuzzyInput.hpp>
#include <FuzzyOutput.hpp>
```

Include dependency graph for FuzzyCondition.hpp:



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



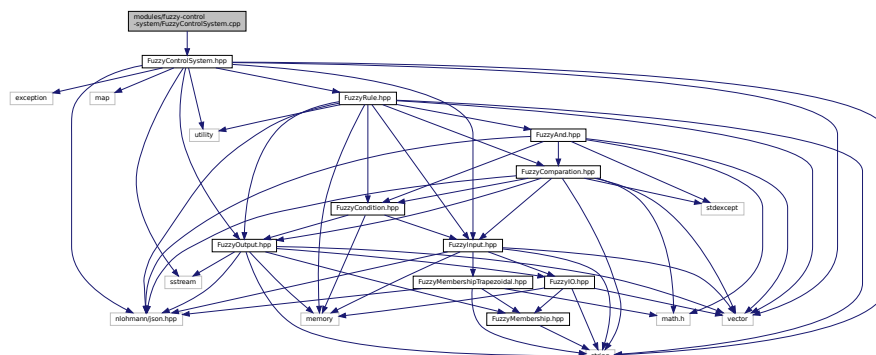
## Classes

- class [FuzzyCondition](#)

## 7.24 modules/fuzzy-control-system/FuzzyControlSystem.cpp File Reference

```
#include "FuzzyControlSystem.hpp"
```

Include dependency graph for FuzzyControlSystem.cpp:



## Macros

- `#define DEBUG\_FUZZYCONTROLSYSTEM 1`
- `#define DEBUG\_PRINT(fmt, ...) fprintf(stderr, fmt, __VA_ARGS__)`

### 7.24.1 Macro Definition Documentation

#### 7.24.1.1 `DEBUG_FUZZYCONTROLSYSTEM`

```
#define DEBUG_FUZZYCONTROLSYSTEM 1
```

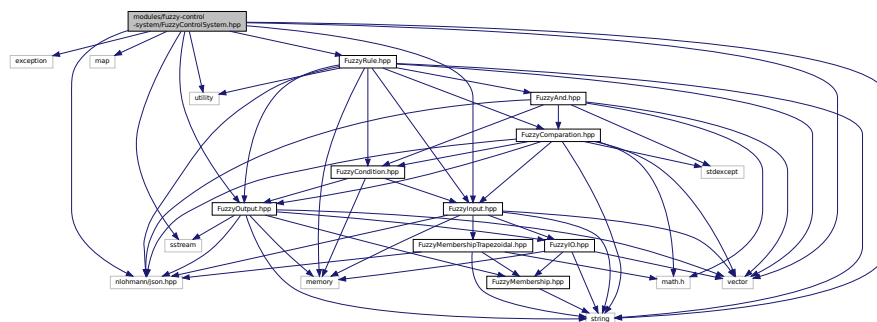
#### 7.24.1.2 `DEBUG_PRINT`

```
#define DEBUG_PRINT(  
    fmt,  
    ... ) fprintf(stderr, fmt, __VA_ARGS__)
```

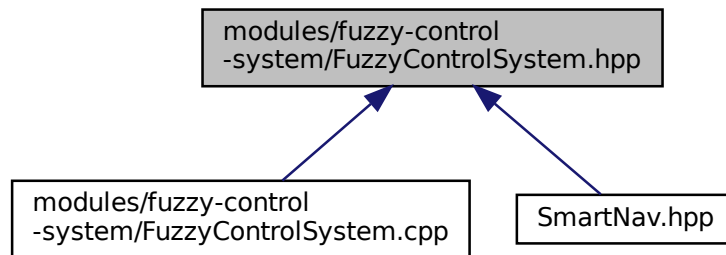
## 7.25 modules/fuzzy-control-system/FuzzyControlSystem.hpp File Reference

```
#include <exception>  
#include <nlohmann/json.hpp>  
#include <map>  
#include <sstream>  
#include <string>  
#include <vector>  
#include <utility>  
#include "FuzzyRule.hpp"  
#include "FuzzyInput.hpp"  
#include "FuzzyOutput.hpp"
```

Include dependency graph for FuzzyControlSystem.hpp:



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

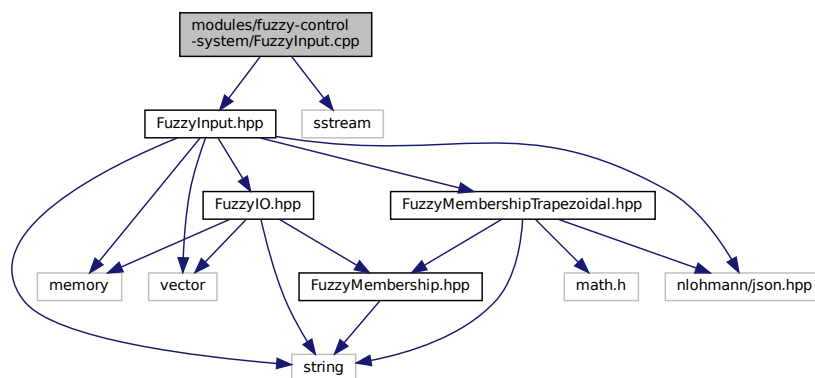


## Classes

- class [FuzzyControlSystem](#)

## 7.26 modules/fuzzy-control-system/FuzzyInput.cpp File Reference

```
#include <FuzzyInput.hpp>
#include <sstream>
Include dependency graph for FuzzyInput.cpp:
```



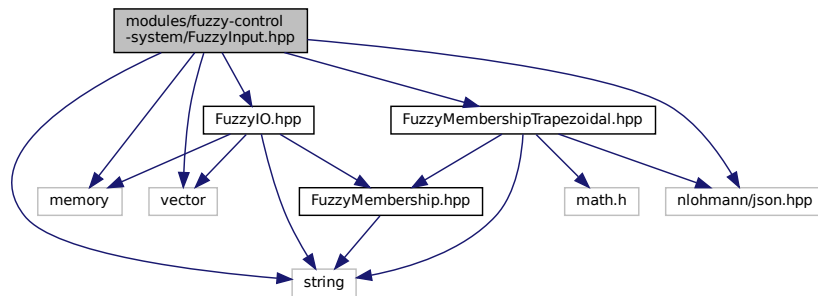
## 7.27 modules/fuzzy-control-system/FuzzyInput.hpp File Reference

```
#include <memory>
#include <string>
#include <vector>
#include <FuzzyIO.hpp>
```

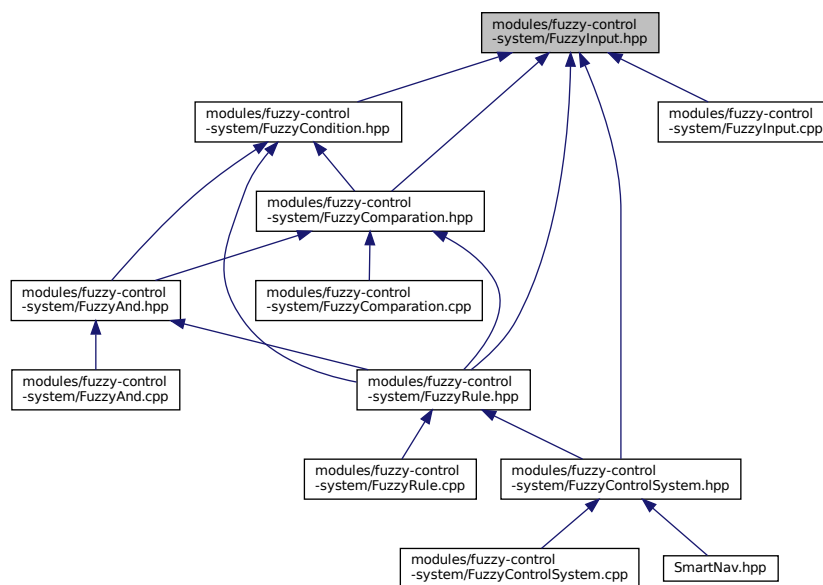
```
#include <FuzzyMembershipTrapezoidal.hpp>
```

```
#include <nlohmann/json.hpp>
```

Include dependency graph for FuzzyInput.hpp:



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



## Classes

- class [FuzzyInput](#)

## 7.28 modules/fuzzy-control-system/FuzzyIO.hpp File Reference

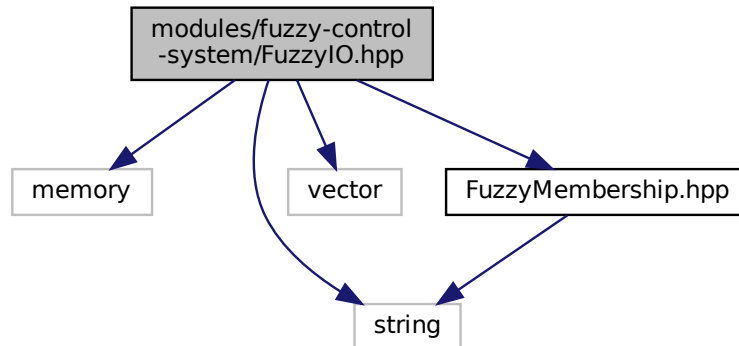
```
#include <memory>
```

```
#include <string>
```

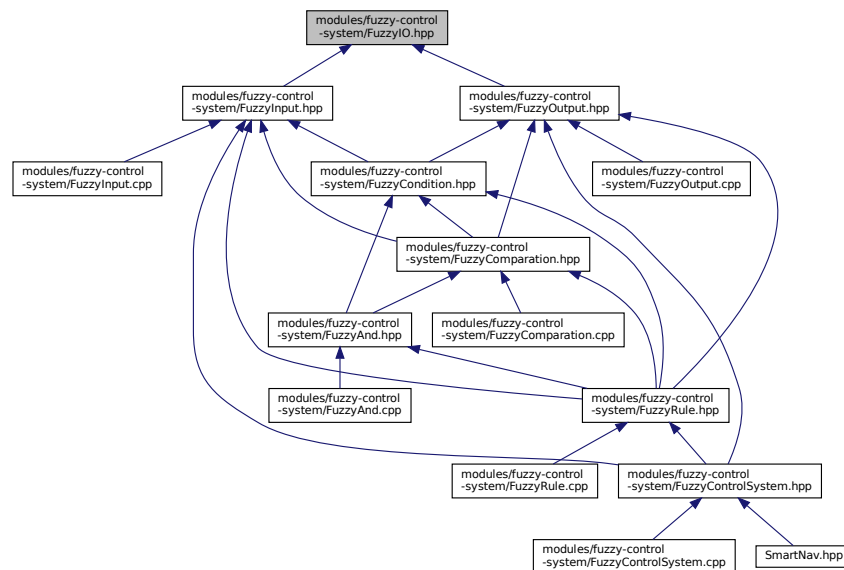
```
#include <vector>
```

```
#include <FuzzyMembership.hpp>
```

Include dependency graph for FuzzyIO.hpp:



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



## Classes

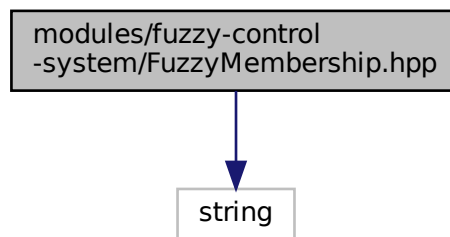
- class [FuzzyIO](#)

## 7.29 modules/fuzzy-control-system/FuzzyMembership.hpp File Reference

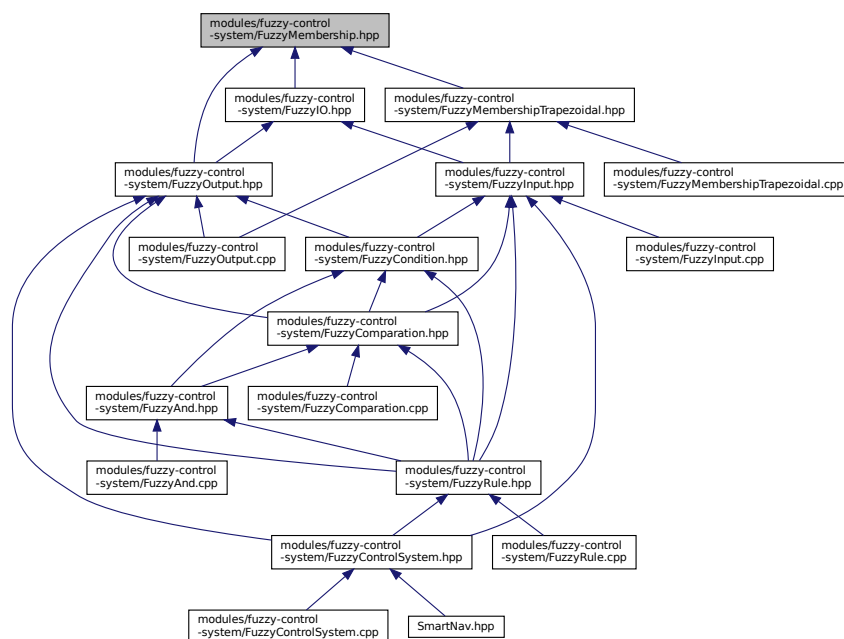
```
#include <string>
```



Include dependency graph for FuzzyMembership.hpp:



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



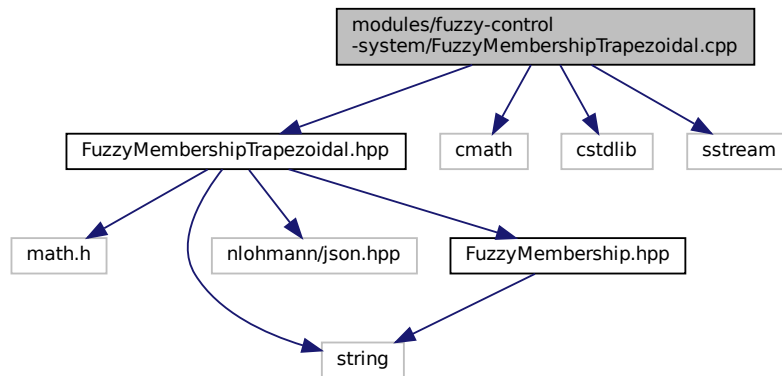
## Classes

- class [FuzzyMembership](#)

## 7.30 modules/fuzzy-control-system/FuzzyMembershipTrapezoidal.cpp File Reference

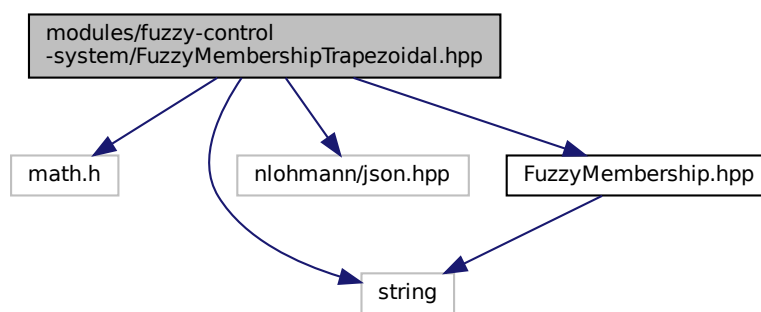
```
#include <FuzzyMembershipTrapezoidal.hpp>
#include <cmath>
```

```
#include <cstdlib>
#include <sstream>
Include dependency graph for FuzzyMembershipTrapezoidal.cpp:
```

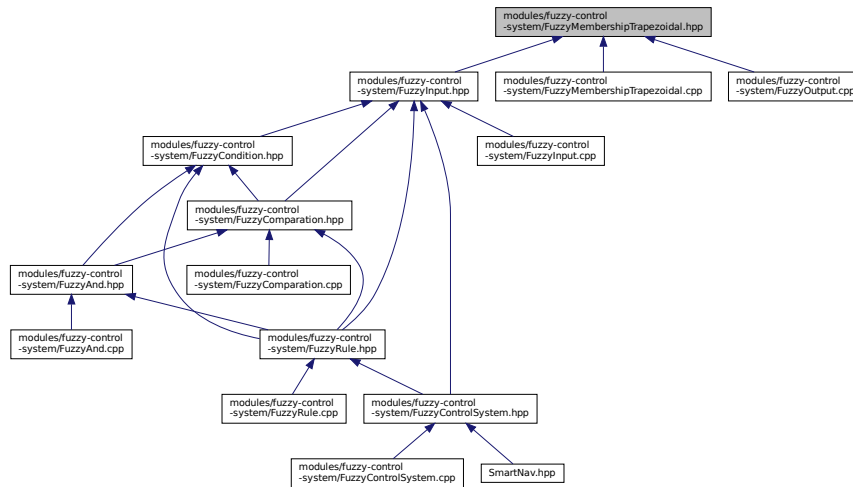


### 7.31 modules/fuzzy-control-system/FuzzyMembershipTrapezoidal.hpp File Reference

```
#include <math.h>
#include <string>
#include <nlohmann/json.hpp>
#include <FuzzyMembership.hpp>
Include dependency graph for FuzzyMembershipTrapezoidal.hpp:
```



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



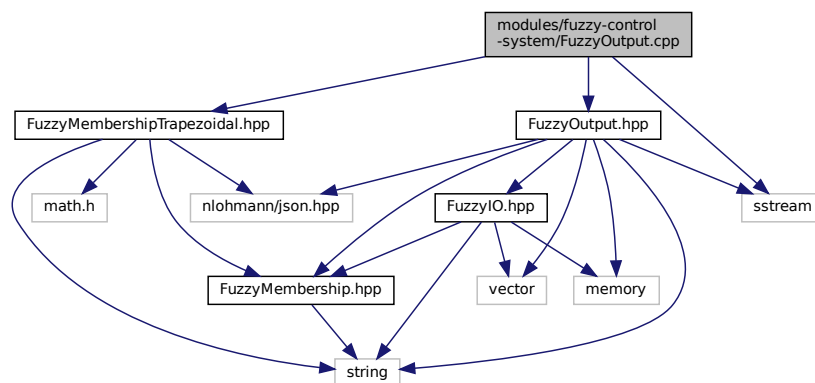
## Classes

- class [FuzzyMembershipTrapezoidal](#)
- struct [FuzzyMembershipTrapezoidal::TrapezoidalPoints](#)

## 7.32 modules/fuzzy-control-system/FuzzyOutput.cpp File Reference

```
#include <FuzzyOutput.hpp>
#include <FuzzyMembershipTrapezoidal.hpp>
#include <sstream>
```

Include dependency graph for FuzzyOutput.cpp:



## Macros

- `#define` [DEBUG\\_OUTPUT](#) 1
- `#define` [DEBUG\\_PRINT](#)(fmt, ...) `fprintf(stderr, fmt, __VA_ARGS__)`

### 7.32.1 Macro Definition Documentation

#### 7.32.1.1 DEBUG\_OUTPUT

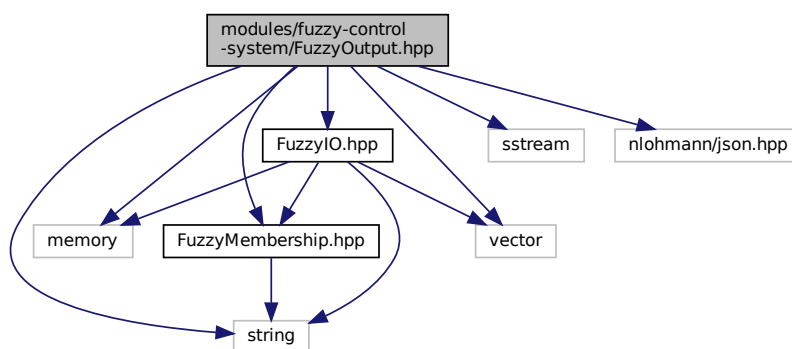
```
#define DEBUG_OUTPUT 1
```

#### 7.32.1.2 DEBUG\_PRINT

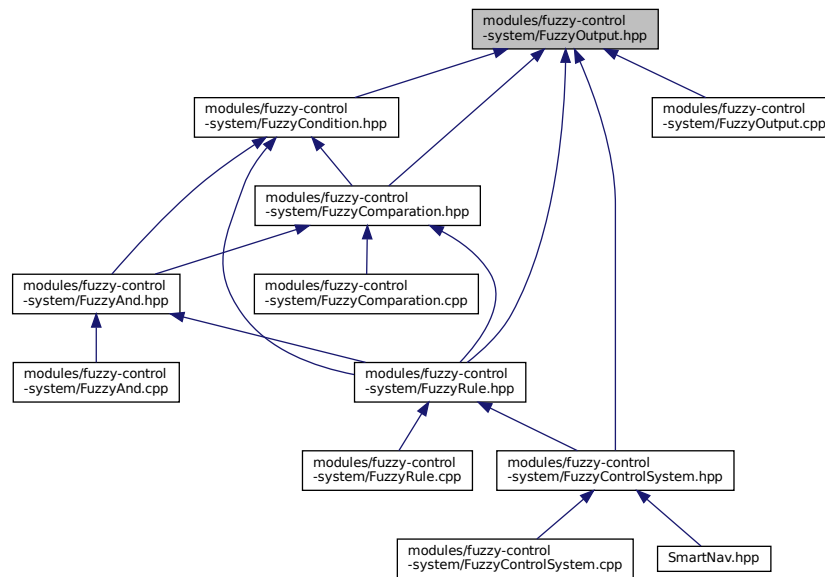
```
#define DEBUG_PRINT(  
    fmt,  
    ... ) fprintf(stderr, fmt, __VA_ARGS__)
```

## 7.33 modules/fuzzy-control-system/FuzzyOutput.hpp File Reference

```
#include <memory>  
#include <sstream>  
#include <string>  
#include <vector>  
#include <FuzzyMembership.hpp>  
#include <FuzzyIO.hpp>  
#include <nlohmann/json.hpp>  
Include dependency graph for FuzzyOutput.hpp:
```



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



## Classes

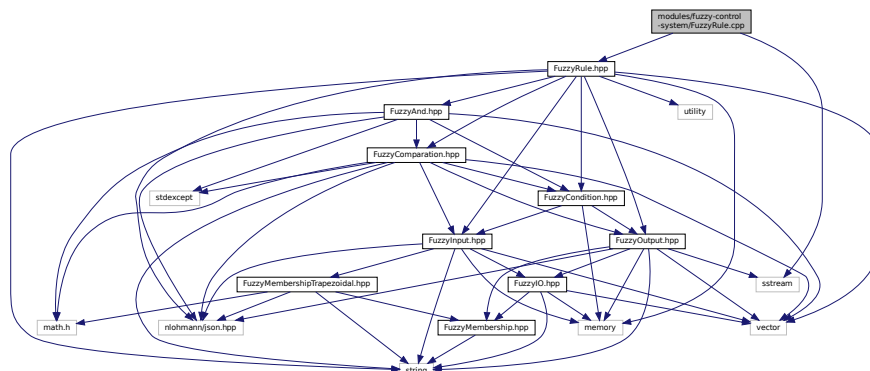
- class [FuzzyOutput](#)

## 7.34 modules/fuzzy-control-system/FuzzyRule.cpp File Reference

```
#include <FuzzyRule.hpp>
```

```
#include <sstream>
```

Include dependency graph for FuzzyRule.cpp:



## Macros

- `#define DEBUG\_RULE 1`
- `#define DEBUG\_PRINT(fmt, ...) fprintf(stderr, fmt, __VA_ARGS__)`

### 7.34.1 Macro Definition Documentation

#### 7.34.1.1 DEBUG\_PRINT

```
#define DEBUG_PRINT(  
    fmt,  
    ... ) fprintf(stderr, fmt, __VA_ARGS__)
```

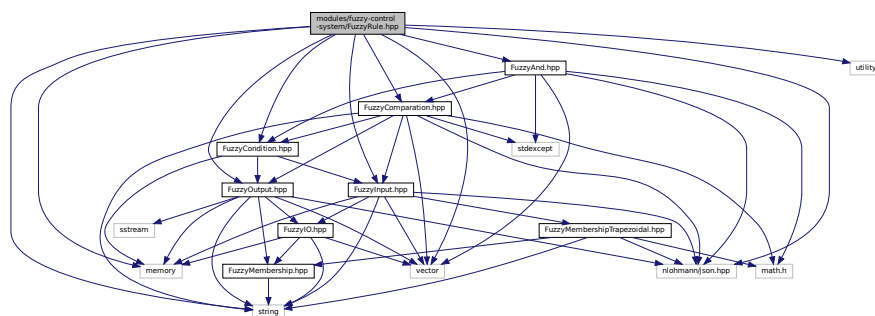
#### 7.34.1.2 DEBUG\_RULE

```
#define DEBUG_RULE 1
```

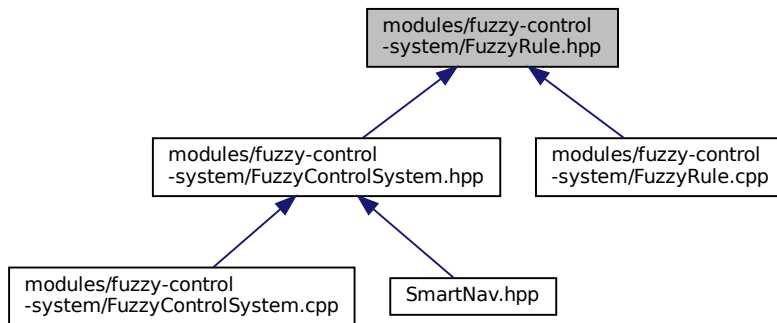
## 7.35 modules/fuzzy-control-system/FuzzyRule.hpp File Reference

```
#include <memory>  
#include <string>  
#include <utility>  
#include <vector>  
#include <FuzzyAnd.hpp>  
#include <FuzzyComparison.hpp>  
#include <FuzzyCondition.hpp>  
#include "FuzzyInput.hpp"  
#include "FuzzyOutput.hpp"  
#include <nlohmann/json.hpp>
```

Include dependency graph for FuzzyRule.hpp:



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



## Classes

- class [FuzzyRule](#)

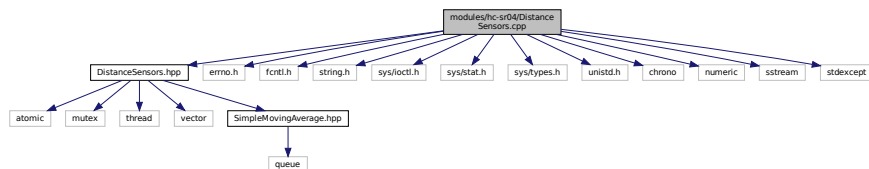
## 7.36 modules/hc-sr04/DistanceSensors.cpp File Reference

```

#include "DistanceSensors.hpp"
#include <errno.h>
#include <fcntl.h>
#include <string.h>
#include <sys/ioctl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#include <chrono>
#include <numeric>
#include <sstream>
#include <stdexcept>

```

Include dependency graph for DistanceSensors.cpp:



## Macros

- `#define HCSR04_IOC_NMAGICO 'c'`
- `#define HCSR04_IOC_TRIGGER_IO(HCSR04_IOC_NMAGICO, 1)`
- `#define DEBUG_PRINT(fmt, ...) do {} while (0)`

## 7.36.1 Macro Definition Documentation

### 7.36.1.1 DEBUG\_PRINT

```
#define DEBUG_PRINT(  
    fmt,  
    ... ) do {} while (0)
```

### 7.36.1.2 HCSR04\_IOC\_NMAGICO

```
#define HCSR04_IOC_NMAGICO 'c'
```

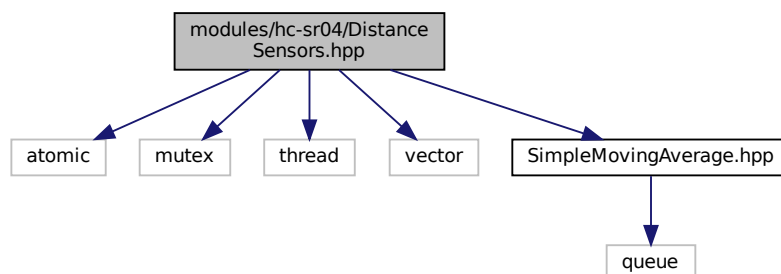
### 7.36.1.3 HCSR04\_IOC\_TRIGGER

```
#define HCSR04_IOC_TRIGGER _IO(HCSR04\_IOC\_NMAGICO, 1)
```

## 7.37 modules/hc-sr04/DistanceSensors.hpp File Reference

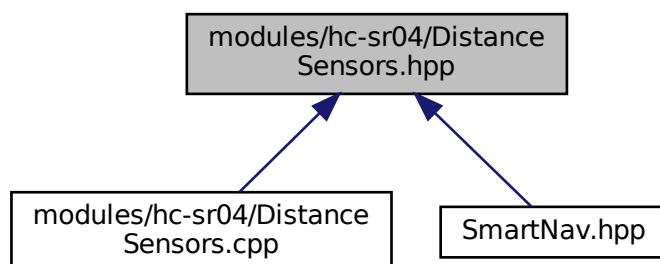
```
#include <atomic>  
#include <mutex>  
#include <thread>  
#include <vector>  
#include <SimpleMovingAverage.hpp>
```

Include dependency graph for DistanceSensors.hpp:





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



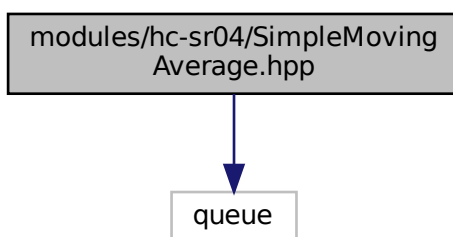
## Classes

- class [DistanceSensors](#)

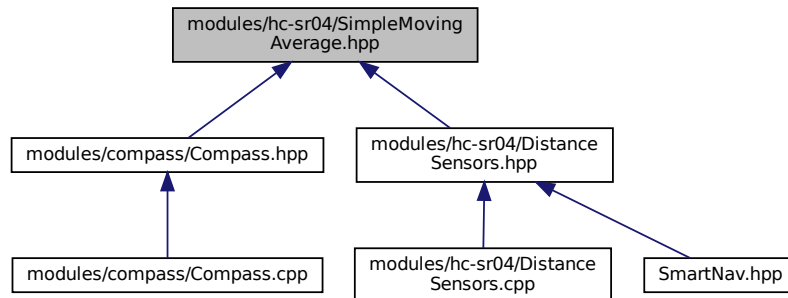
## 7.38 modules/hc-sr04/SimpleMovingAverage.hpp File Reference

```
#include <queue>
```

Include dependency graph for SimpleMovingAverage.hpp:



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



## Classes

- class [SimpleMovingAverage](#)

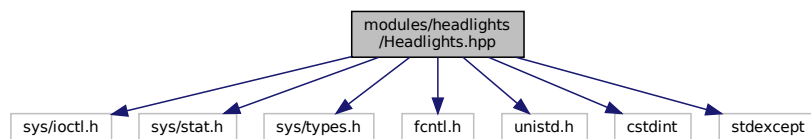
## 7.39 modules/headlights/Headlights.hpp File Reference

```

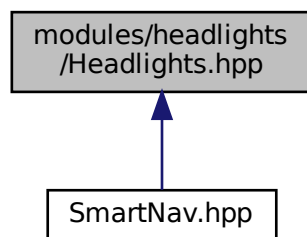
#include <sys/ioctl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <fcntl.h>
#include <unistd.h>
#include <stdint>
#include <stdexcept>

```

Include dependency graph for Headlights.hpp:



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



## Classes

- class [Headlights](#)

## Macros

- `#define` [AXI\\_TIMER\\_IOC\\_NMAGICO](#) 'v'
- `#define` [AXI\\_TIMER\\_IOC\\_T\\_ON](#) \_IO([AXI\\_TIMER\\_IOC\\_NMAGICO](#), 1)

### 7.39.1 Macro Definition Documentation

#### 7.39.1.1 AXI\_TIMER\_IOC\_NMAGICO

```
#define AXI_TIMER_IOC_NMAGICO 'v'
```

#### 7.39.1.2 AXI\_TIMER\_IOC\_T\_ON

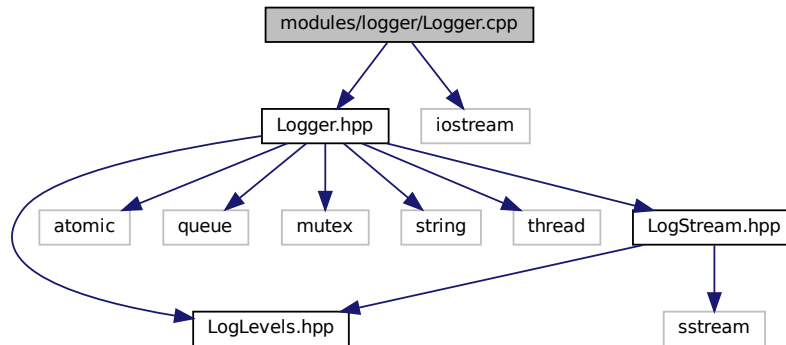
```
#define AXI_TIMER_IOC_T_ON _IO(AXI_TIMER_IOC_NMAGICO, 1)
```

## 7.40 modules/logger/Logger.cpp File Reference

```
#include "Logger.hpp"
```

```
#include <iostream>
```

Include dependency graph for Logger.cpp:



## 7.41 modules/logger/Logger.hpp File Reference

```
#include "LogLevels.hpp"
```

```
#include <atomic>
```

```
#include <queue>
```

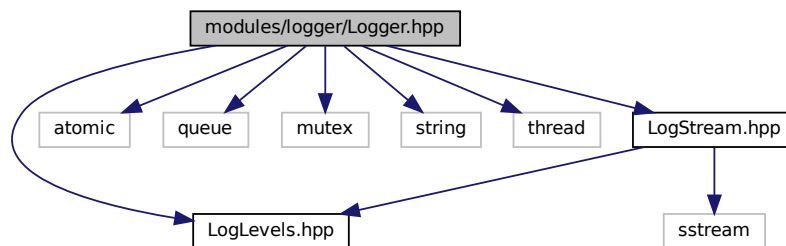
```
#include <mutex>
```

```
#include <string>
```

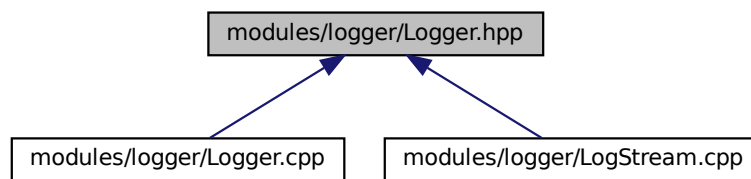
```
#include <thread>
```

```
#include "LogStream.hpp"
```

Include dependency graph for Logger.hpp:



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

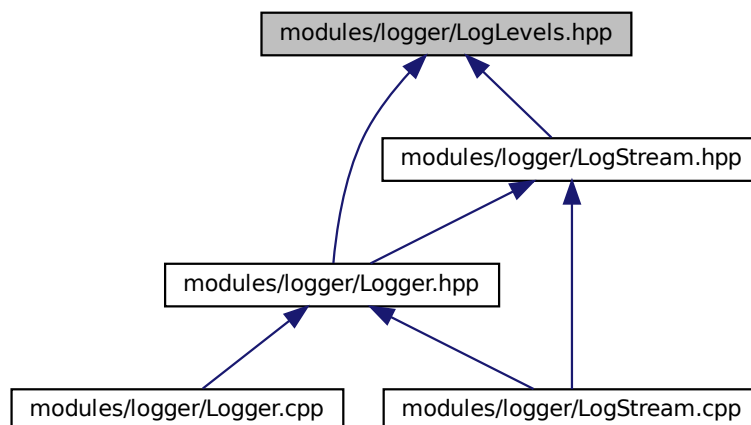


## Classes

- class [Logger](#)

## 7.42 modules/logger/LogLevels.hpp File Reference

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



## Enumerations

- enum class [LogLevels](#) { [Info](#) = 0 , [Warning](#) , [Fatal](#) }

### 7.42.1 Enumeration Type Documentation

#### 7.42.1.1 LogLevels

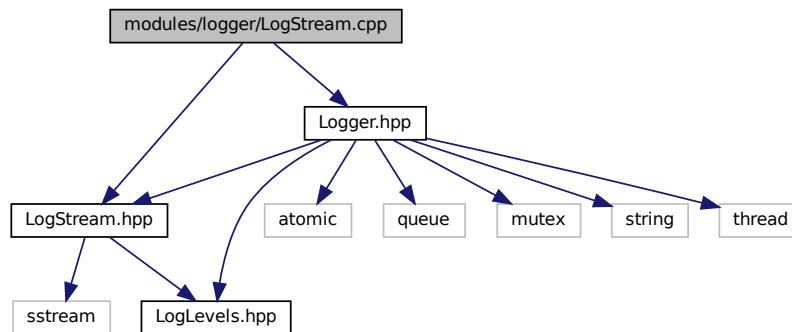
```
enum LogLevels [strong]
```

## Enumerator

|         |                     |
|---------|---------------------|
| Info    | Informative message |
| Warning | Warning message     |
| Fatal   | Fatal message       |

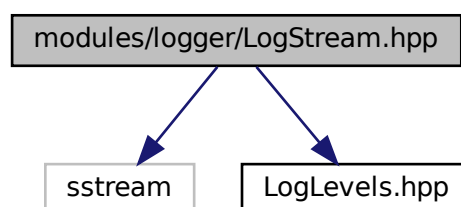
## 7.43 modules/logger/LogStream.cpp File Reference

```
#include "LogStream.hpp"
#include "Logger.hpp"
Include dependency graph for LogStream.cpp:
```

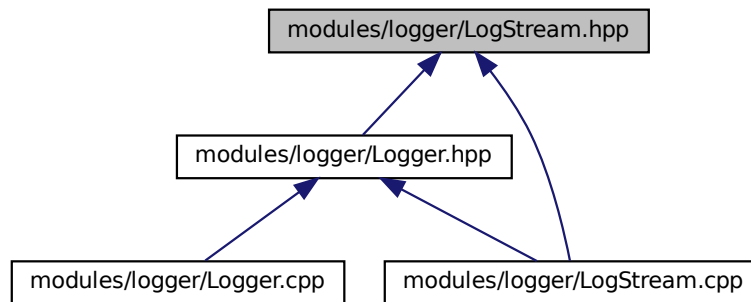


## 7.44 modules/logger/LogStream.hpp File Reference

```
#include <sstream>
#include "LogLevels.hpp"
Include dependency graph for LogStream.hpp:
```



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



## Classes

- class [LogStream](#)

## 7.45 modules/utilities/utilities.hpp File Reference

## Classes

- class [utilities](#)

## Functions

- [printf](#) ("Time measured: %.3f seconds.\n", elapsed.count() \*1e-9)

## Variables

- auto [begin](#) = std::chrono::system\_clock::now()
- auto [end](#) = std::chrono::system\_clock::now()
- auto [elapsed](#) = std::chrono::duration\_cast<std::chrono::nanoseconds>(end - begin)

### 7.45.1 Function Documentation

#### 7.45.1.1 printf()

```

printf (
    "Time measured:  %.3f seconds.\n" ,
    elapsed.count() *1e- 9 )

```

## 7.45.2 Variable Documentation

### 7.45.2.1 begin

```
auto begin = std::chrono::system_clock::now()
```

### 7.45.2.2 elapsed

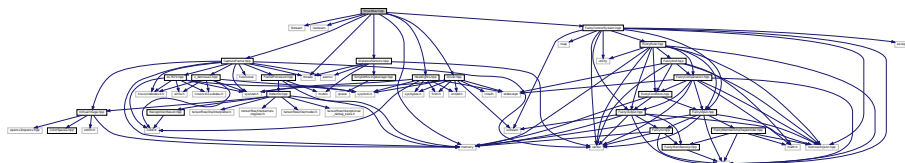
```
auto elapsed = std::chrono::duration_cast<std::chrono::nanoseconds>(end - begin)
```

### 7.45.2.3 end

```
auto end = std::chrono::system_clock::now()
```

## 7.46 SmartNav.hpp File Reference

```
#include <fstream>
#include <iostream>
#include <memory>
#include <thread>
#include "CaptureFrame.hpp"
#include "Driver.hpp"
#include "DistanceSensors.hpp"
#include "FuzzyControlSystem.hpp"
#include "Headlights.hpp"
Include dependency graph for SmartNav.hpp:
```



## Classes

- class [SmartNav](#)



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