SmartNavLib

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Chapter 1

Namespace Index

1.1 Namespace List

Here is a list of all namespaces with brief descriptions:

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

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

Chapter 3

Class Index

3.1 Class List

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

Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

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
```

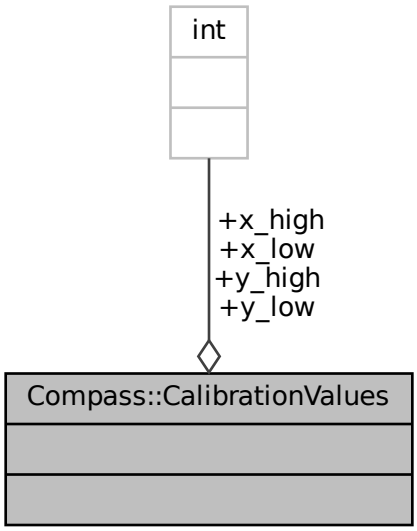
Chapter 6

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
```

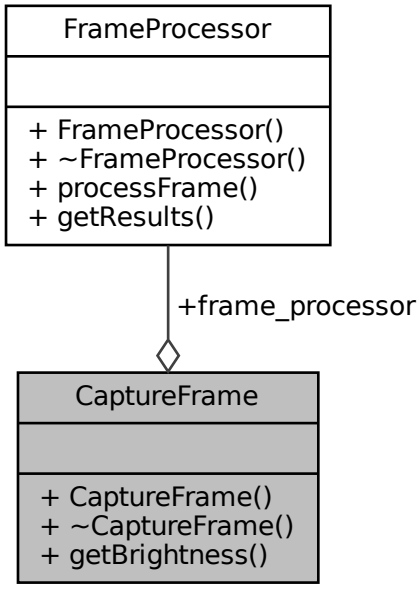
The documentation for this struct was generated from the following file:

- 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 responsable of open, init, and use a v4l2 device driver author: Fuschetto Martin email: 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

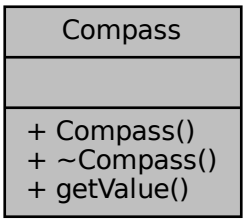
The documentation for this class was generated from the following files:

- 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

X_AXIS	
Y_AXIS	
Z_AXIS	

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

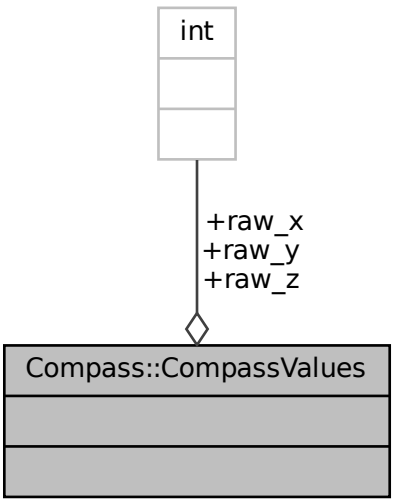
The documentation for this class was generated from the following files:

- 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
```

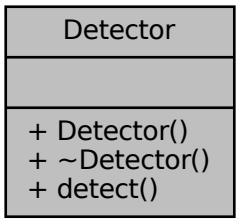
The documentation for this struct was generated from the following file:

- 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

image	

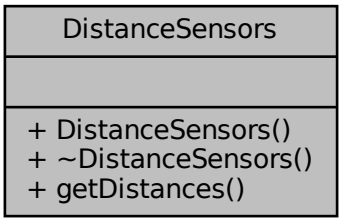
The documentation for this class was generated from the following files:

- 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>

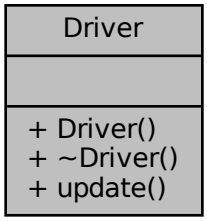
The documentation for this class was generated from the following files:

- 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

operation_mode	
speed_variation	
yaw_variation	

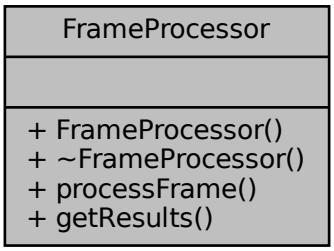
The documentation for this class was generated from the following file:

- 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.

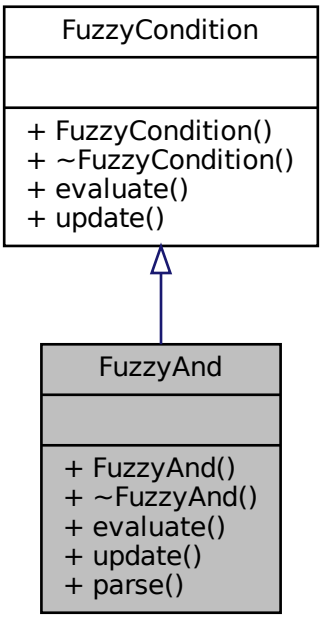
The documentation for this class was generated from the following files:

- modules/capture-frame/FrameProcessor.hpp
- modules/capture-frame/FrameProcessor.cpp

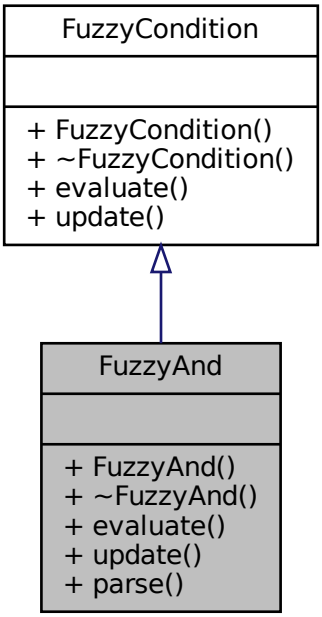
6.9 FuzzyAnd Class Reference

```
#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

system_io	

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

and_json	

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

value	
system_io	

Implements FuzzyCondition.

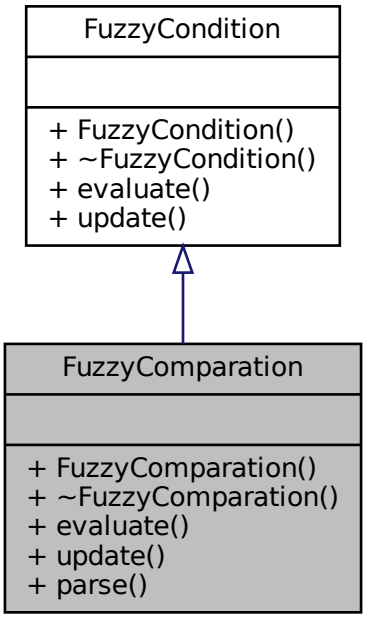
The documentation for this class was generated from the following files:

- modules/fuzzy-control-system/FuzzyAnd.hpp
- modules/fuzzy-control-system/FuzzyAnd.cpp

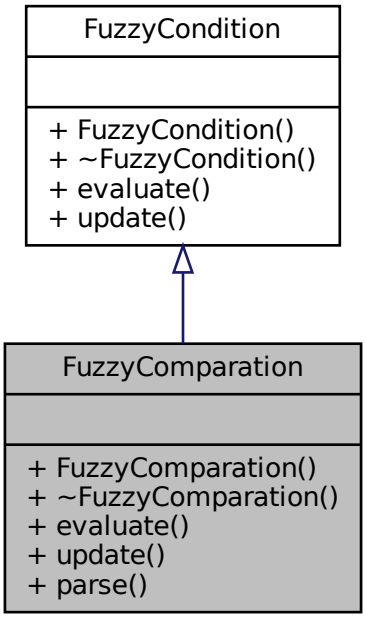
6.10 FuzzyComparation Class Reference

`#include <FuzzyComparation.hpp>`

Inheritance diagram for FuzzyComparation:



Collaboration diagram for FuzzyComparation:



Public Member Functions

- FuzzyComparation (std::pair< std::string, std::string > comparation)
- virtual ~FuzzyComparation ()=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 &comparation_json)

  Try to parse comparation.

Additional Inherited Members

6.10.1 Constructor & Destructor Documentation

6.10.1.1 FuzzyComparation()

```
FuzzyComparation::FuzzyComparation (
            std::pair< std::string, std::string > comparation ) [inline]
```

FuzzyComparation constructor

6.10.1.2 ~FuzzyComparation()

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

FuzzyComparation destructor

6.10.2 Member Function Documentation

6.10.2.1 evaluate()

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

Evaluate and condition.

Parameters

system_io	

Returns

float

Implements FuzzyCondition.

6.10.2.2 parse()

```
FuzzyCondition::FuzzyConditionPtr FuzzyComparation::parse (
            const nlohmann::json & comparation_json ) [static]
```

Try to parse comparation.

Parameters

comparation_json	

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

value	

Implements FuzzyCondition.

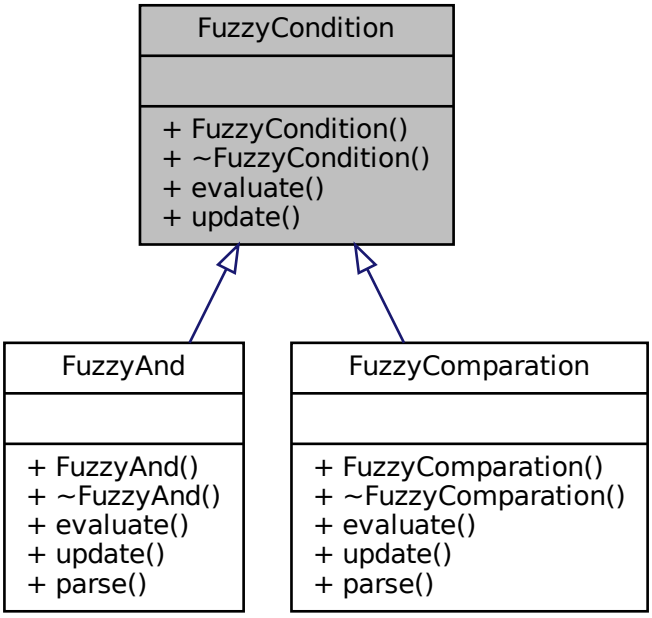
The documentation for this class was generated from the following files:

- modules/fuzzy-control-system/FuzzyComparation.hpp
- modules/fuzzy-control-system/FuzzyComparation.cpp

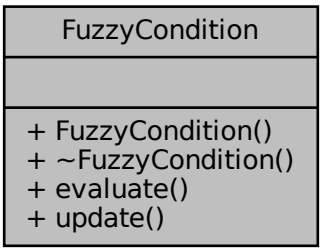
6.11 FuzzyCondition Class Reference

```
#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

system_io	

Returns

float

Implemented in FuzzyComparation, and FuzzyAnd.

6.11.3.2 update()

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

Update any condition.

Parameters

value	
system_io	

Implemented in FuzzyComparation, and FuzzyAnd.

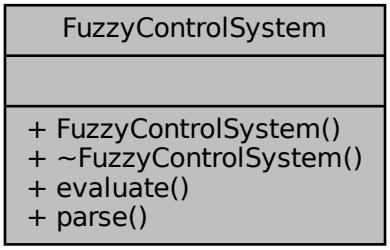
The documentation for this class was generated from the following file:

- 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

inputs_to_update	

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

fuzzy_control_system_json	

Returns

FuzzyControlSystem

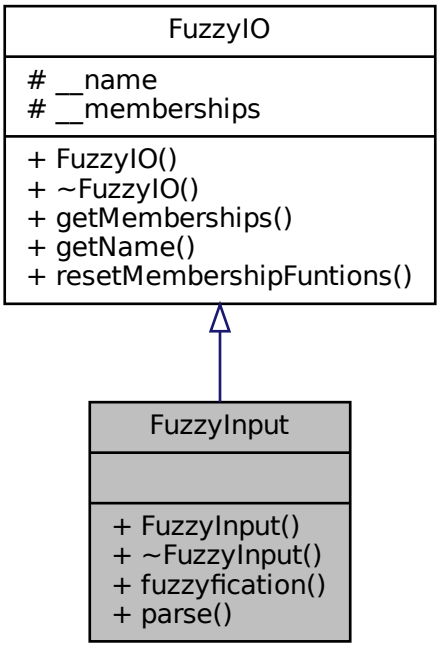
The documentation for this class was generated from the following files:

- modules/fuzzy-control-system/FuzzyControlSystem.hpp
- modules/fuzzy-control-system/FuzzyControlSystem.cpp

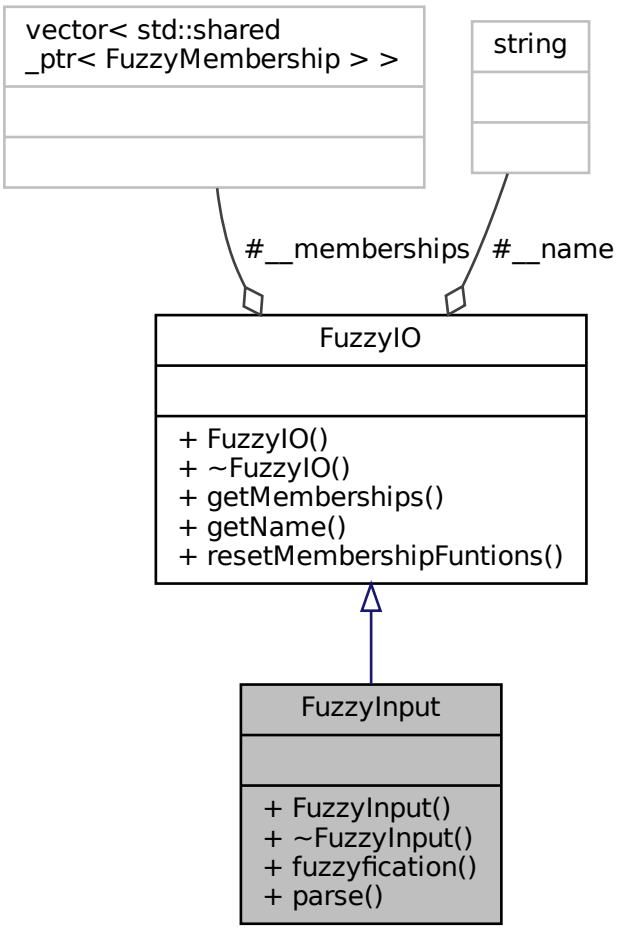
6.13 FuzzyInput Class Reference

```
#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 fuzzyfication (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 fuzzyfication()

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

Input fuzzification.

6.13.2.2 parse()

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

Try to parse input.

Parameters

io	input to parse

Returns

FuzzyInput

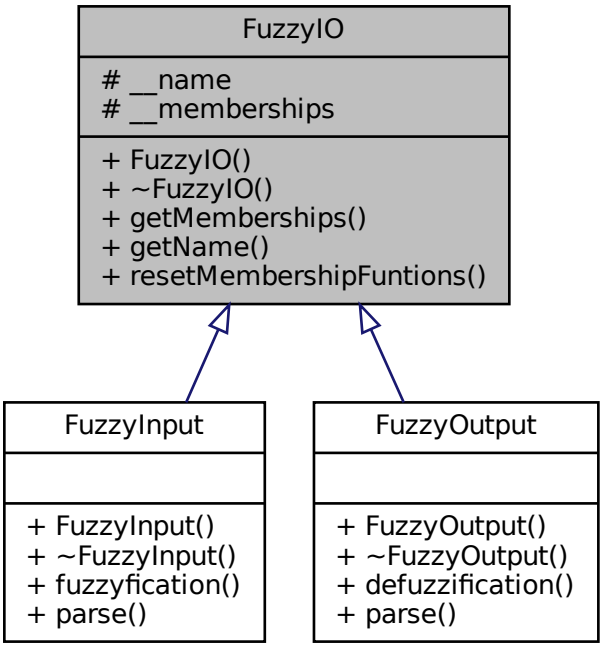
The documentation for this class was generated from the following files:

- modules/fuzzy-control-system/FuzzyInput.hpp
- modules/fuzzy-control-system/FuzzyInput.cpp

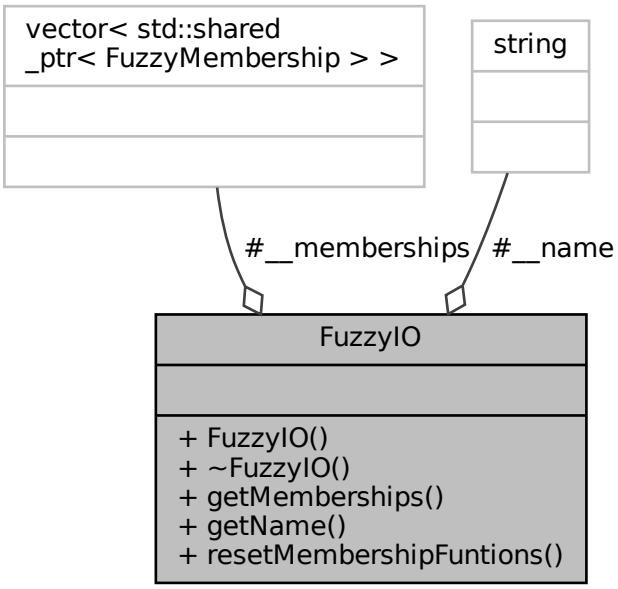
6.14 FuzzyIO Class Reference

`#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

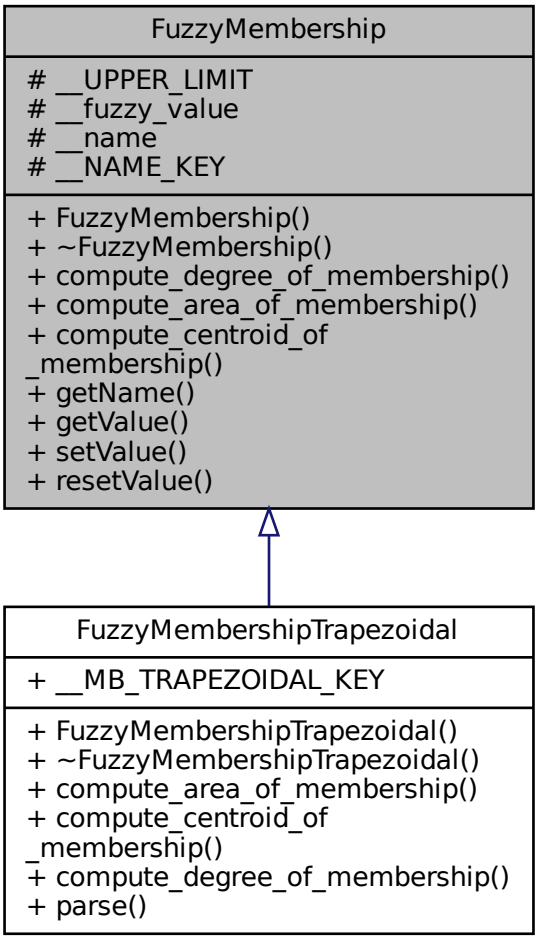
The documentation for this class was generated from the following file:

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

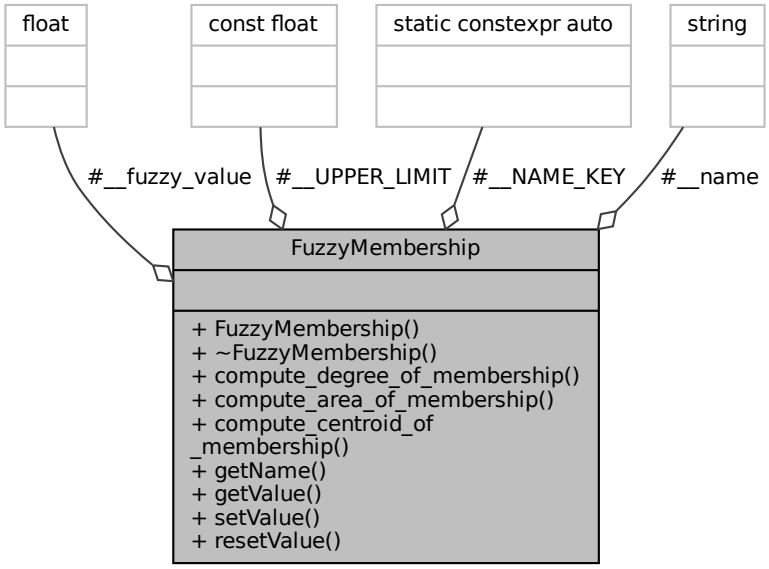
6.15 FuzzyMembership Class Reference

```
#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

value	

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

value	

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

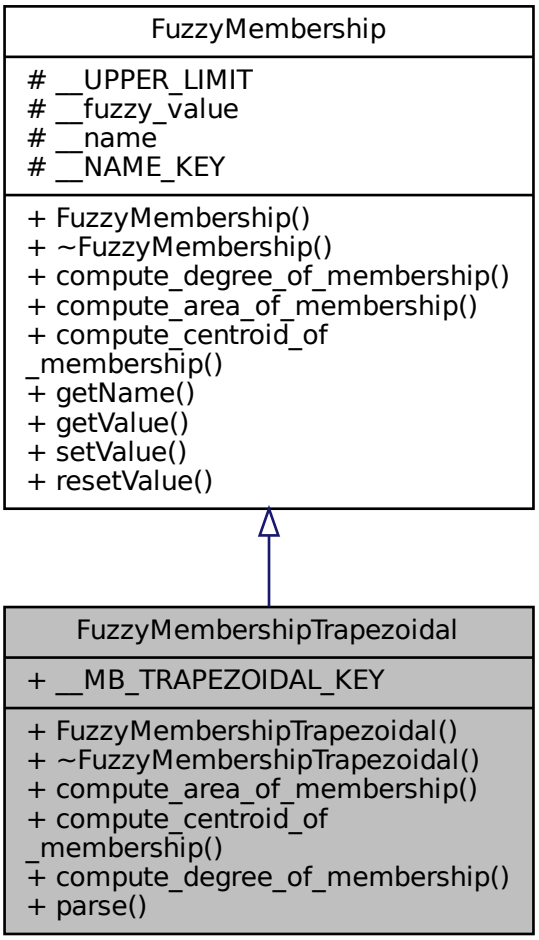
The documentation for this class was generated from the following file:

- modules/fuzzy-control-system/FuzzyMembership.hpp

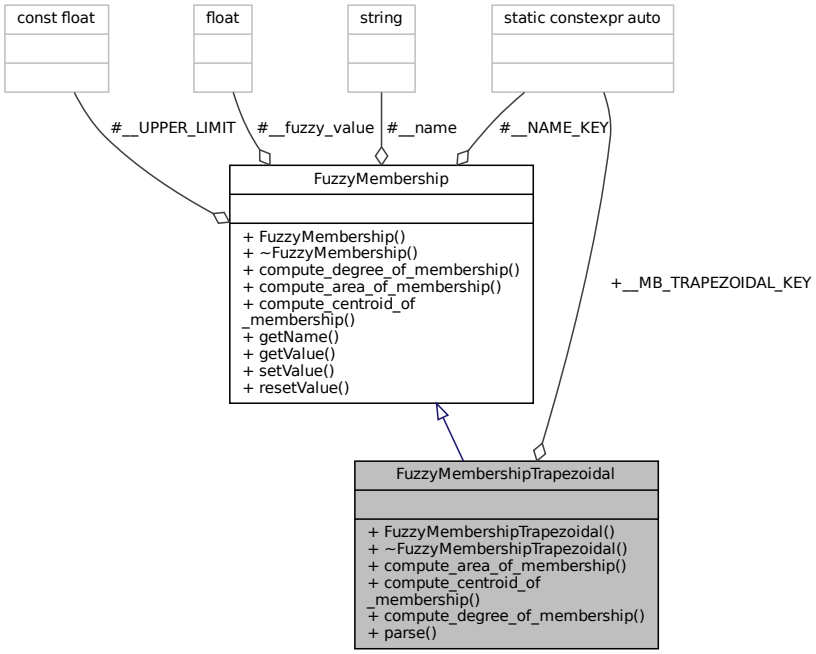
6.16 FuzzyMembershipTrapezoidal Class Reference

`#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

value	

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

value	

Implements FuzzyMembership.

6.16.2.4 parse()

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

Try to parse membership function.

Parameters

input_json	

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 memebership function key

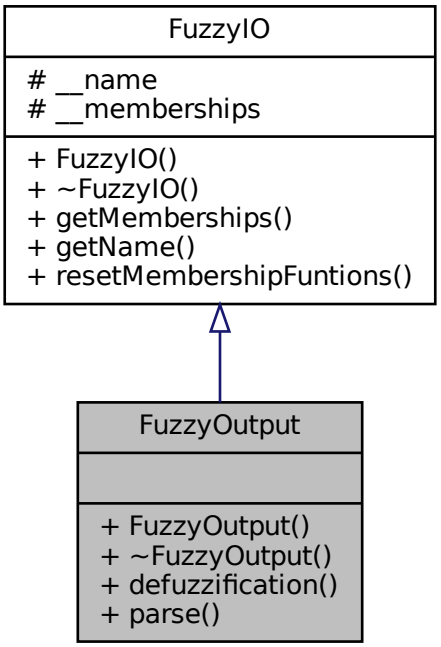
The documentation for this class was generated from the following files:

- modules/fuzzy-control-system/FuzzyMembershipTrapezoidal.hpp
- modules/fuzzy-control-system/FuzzyMembershipTrapezoidal.cpp

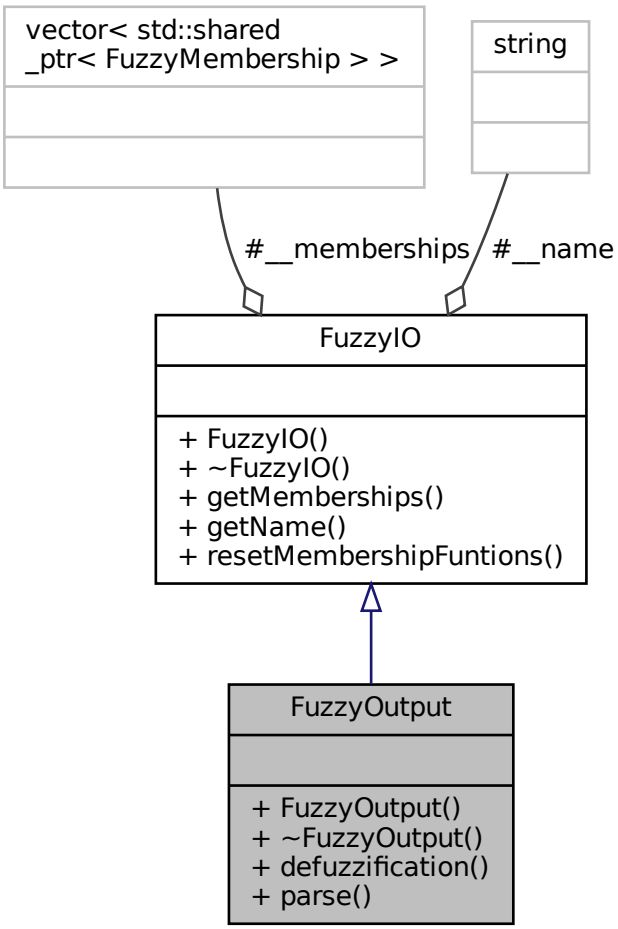
6.17 FuzzyOutput Class Reference

`#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

io	input to parse

Returns

FuzzyInput

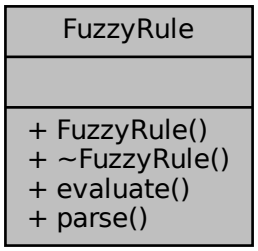
The documentation for this class was generated from the following files:

- 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

system_input	
system_output	

6.18.2.2 parse()

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

Try to parse rule.

Parameters

rule_json	Rule to parse

Returns

FuzzyRule

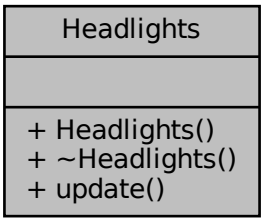
The documentation for this class was generated from the following files:

- 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

value	

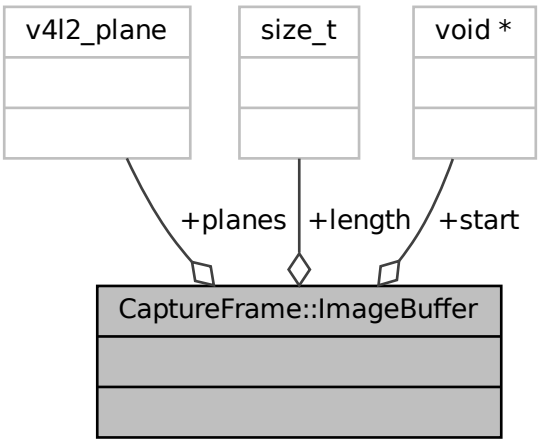
The documentation for this class was generated from the following file:

- 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]
```

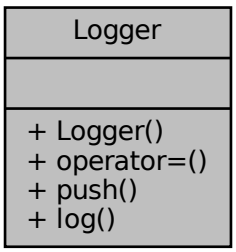
The documentation for this struct was generated from the following file:

- 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

level	

Returns

LogStream

6.21.2.2 operator=()

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

Delete assignnment operator

6.21.2.3 push()

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

Push a new msg into the queue.

Parameters

new_msg	

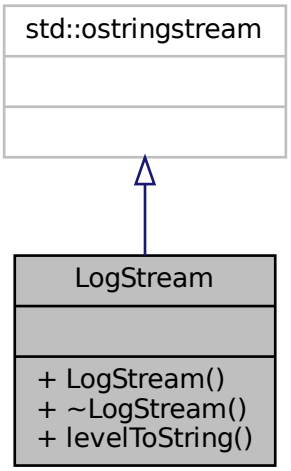
The documentation for this class was generated from the following files:

- modules/logger/Logger.hpp
- modules/logger/Logger.cpp

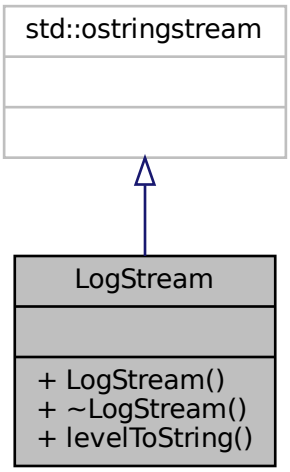
6.22 LogStream Class Reference

```
#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

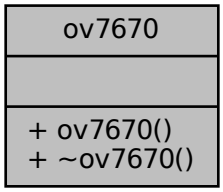
The documentation for this class was generated from the following files:

- 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

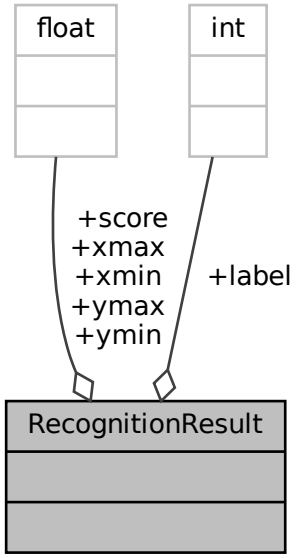
The documentation for this class was generated from the following files:

- 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

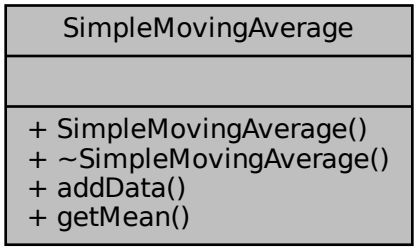
The documentation for this struct was generated from the following file:

- 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

data	

6.25.2.2 getMean()

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

Get the Mean of the queue.

Returns

float

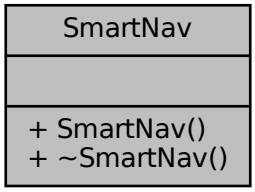
The documentation for this class was generated from the following file:

- 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

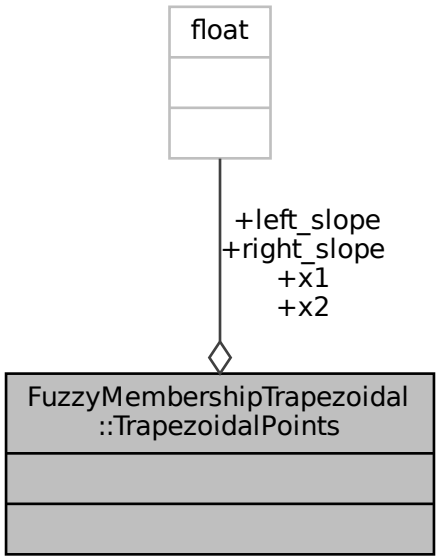
The documentation for this class was generated from the following file:

- 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

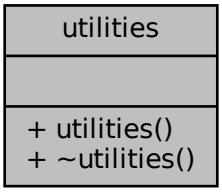
The documentation for this struct was generated from the following file:

- 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

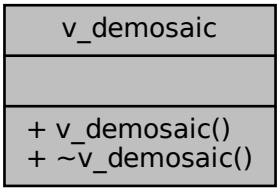
The documentation for this class was generated from the following file:

- 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

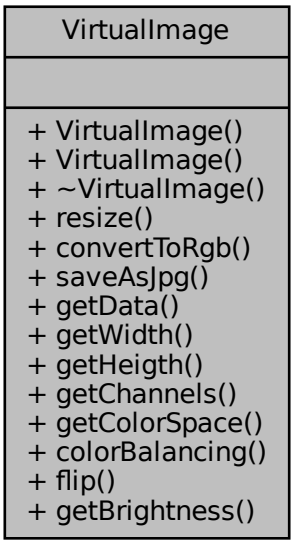
The documentation for this class was generated from the following files:

- modules/capture-frame/v_demosaic.hpp
- modules/capture-frame/v_demosaic.cpp

6.30 VirtualImage Class Reference

`#include <VirtualImage.hpp>`

Collaboration diagram for VirtualImage:



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

percent	

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

orientation	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

width	
height	

Returns

* Resize

6.30.2.11 saveAsJpg()

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

Save image as jpeg.

Parameters

directory	

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

- modules/capture-frame/VirtualImage.hpp
- modules/capture-frame/VirtualImage.cpp

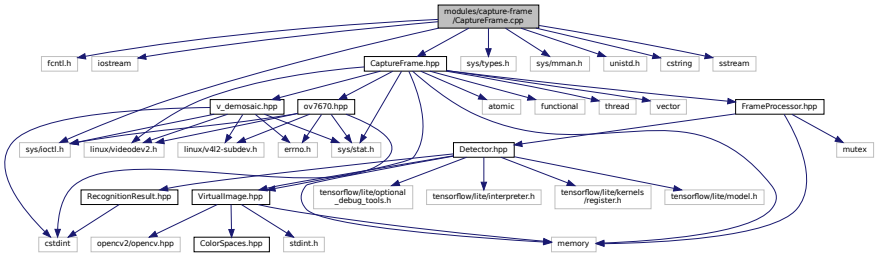
Chapter 7

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

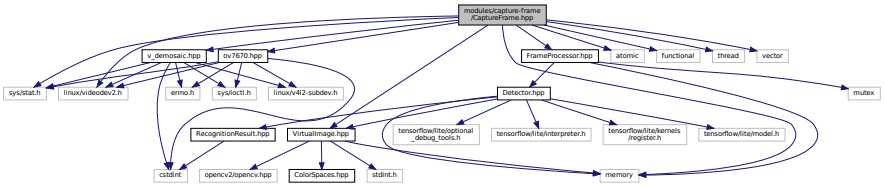
7.1.1.1 DEBUG_PRINT

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

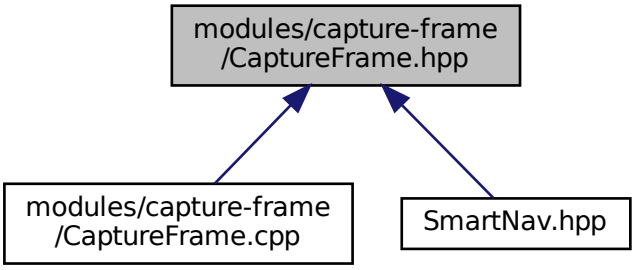
7.2 modules/capture-frame/CaptureFrame.hpp File Reference

```
#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

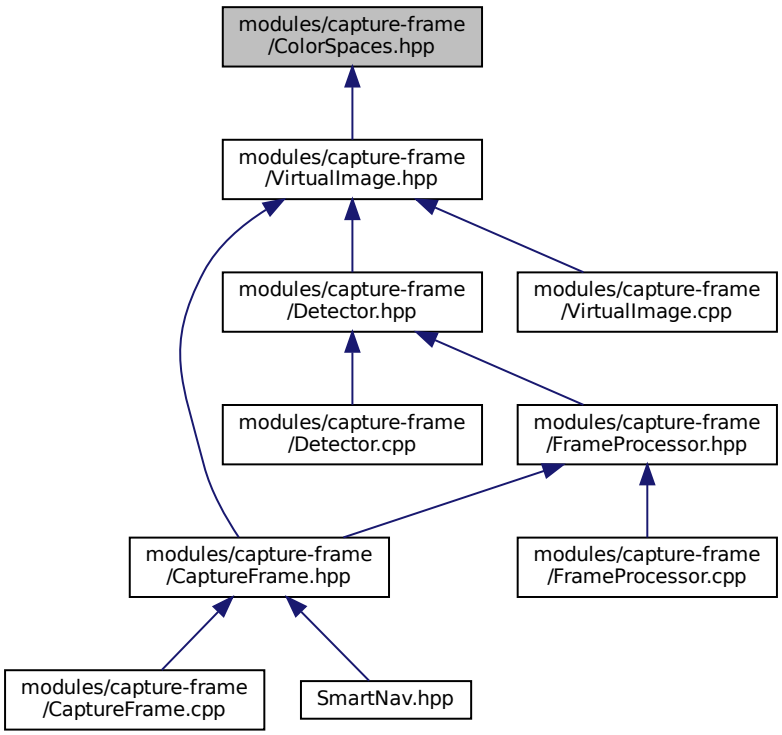
7.2.1.1 CLEAR

```
#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

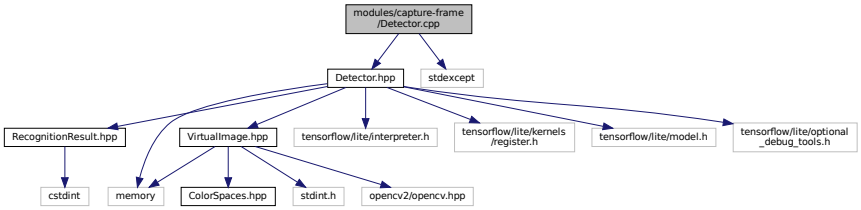
Enumerator

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

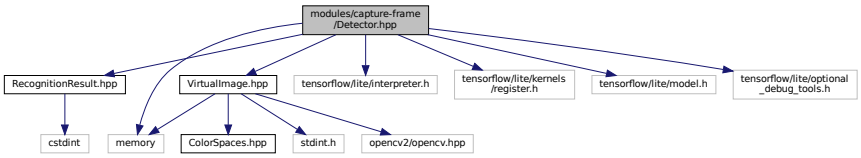
7.4.1.1 DEBUG_PRINT

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

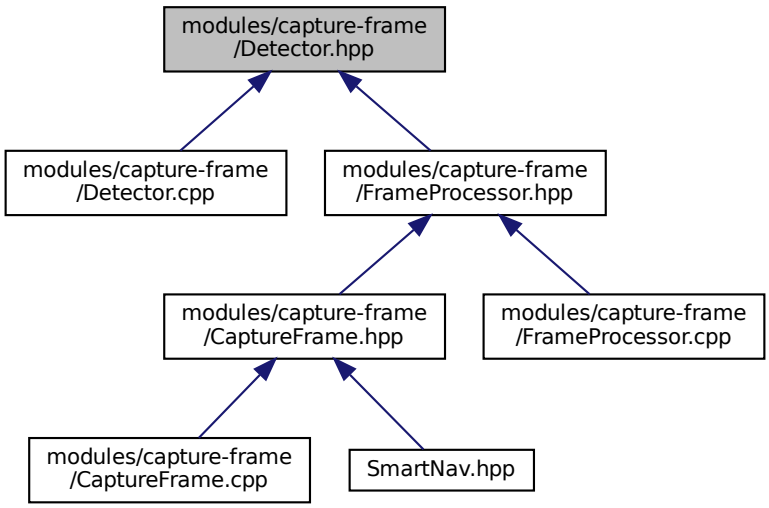
7.5 modules/capture-frame/Detector.hpp File Reference

```
#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

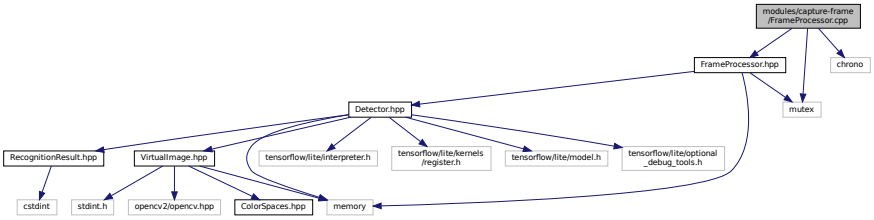
- class Detector

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

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

```
#include <mutex>
```

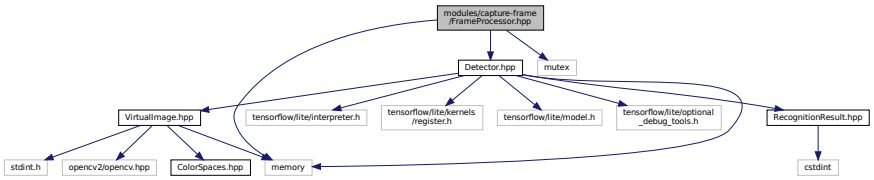
Include dependency graph for FrameProcessor.cpp:



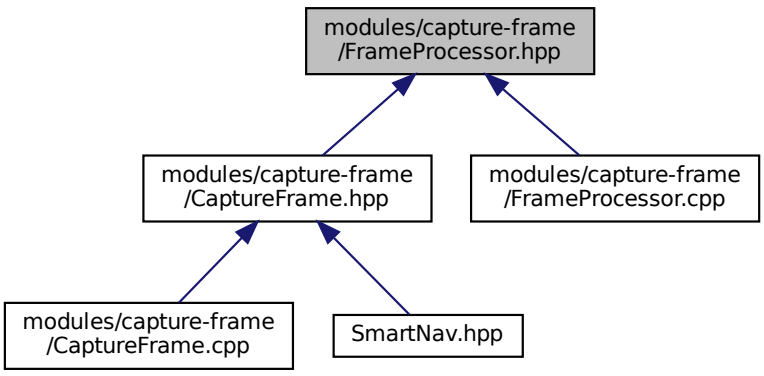
7.7 modules/capture-frame/FrameProcessor.hpp File Reference

```
#include <memory>
#include <mutex>
#include "Detector.hpp"
```

Include dependency graph for FrameProcessor.hpp:



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



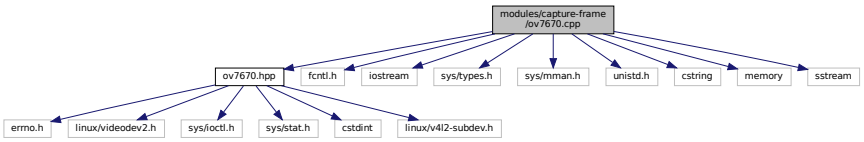
Classes

- 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
```

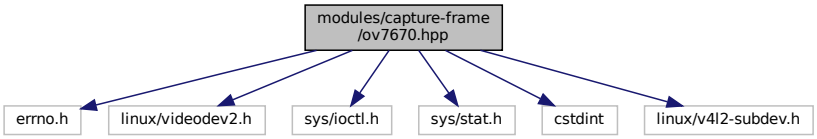
7.8.1.2 DEBUG_PRINT

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

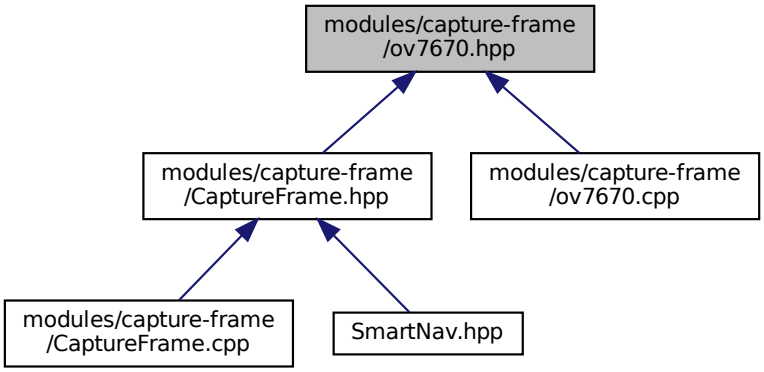
7.9 modules/capture-frame/ov7670.hpp File Reference

```
#include <errno.h>
#include <linux/videodev2.h>
#include <sys/ioctl.h>
#include <sys/stat.h>
#include <cstdint>
#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

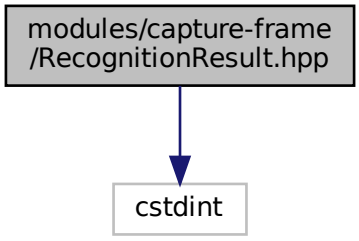
```
#define CLEAR(
              x ) memset(&(x), 0, sizeof(x))
```

Clear v4l2d struct

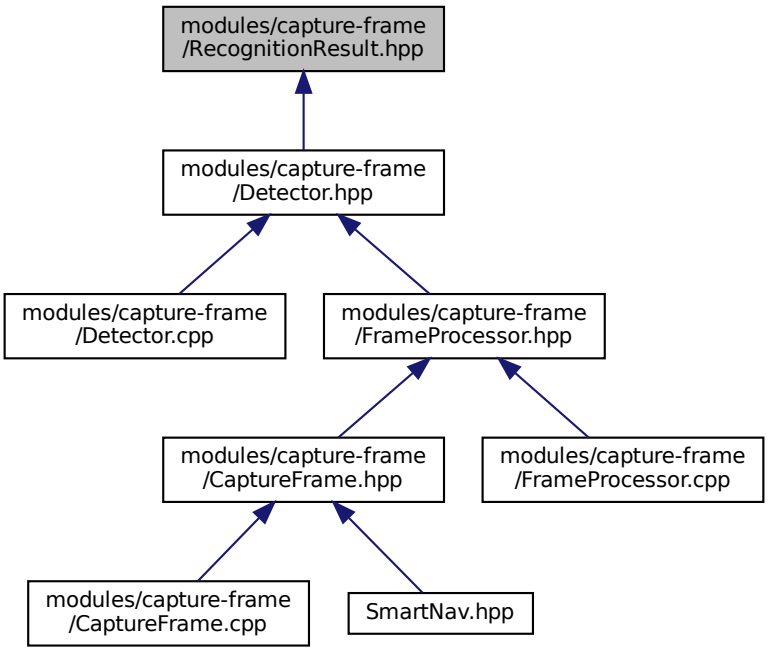
7.10 modules/capture-frame/RecognitionResult.hpp File Reference

```
#include <cstdint>
```

Include dependency graph for RecognitionResult.hpp:



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



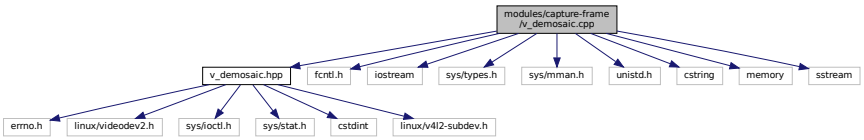
Classes

- 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...  )
```

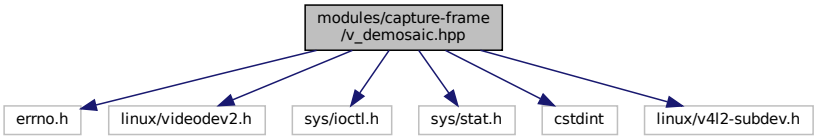
Value:

```
printf( "DEBUG: %s:%d:%s(): " fmt, \
__FILE__, __LINE__, __func__, ##args)
```

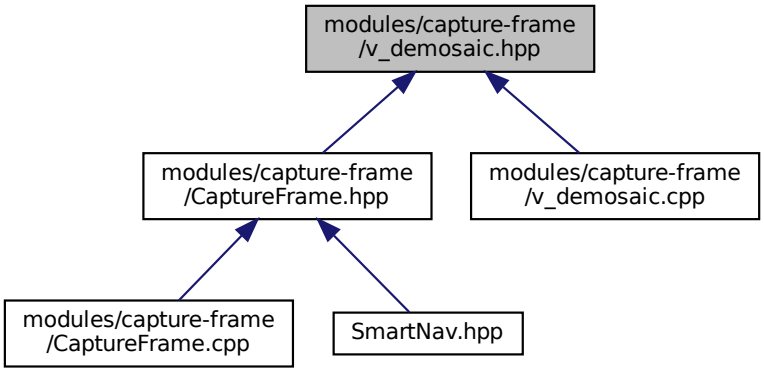
7.12 modules/capture-frame/v_demosaic.hpp File Reference

```
#include <errno.h>
#include <linux/videodev2.h>
#include <sys/ioctl.h>
#include <sys/stat.h>
#include <cstdint>
#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

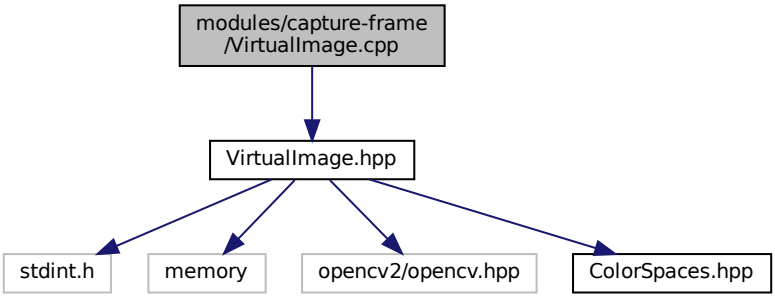
```
#define CLEAR(
              x ) memset(&(x), 0, sizeof(x))
```

Clear vl2d struct

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

```
#include "VirtualImage.hpp"
```

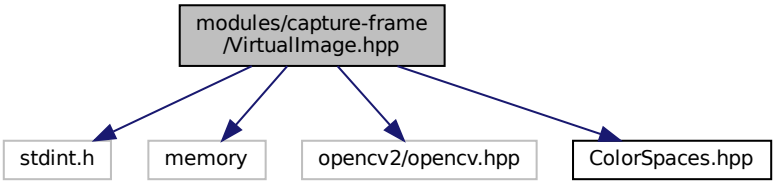
Include dependency graph for VirtualImage.cpp:



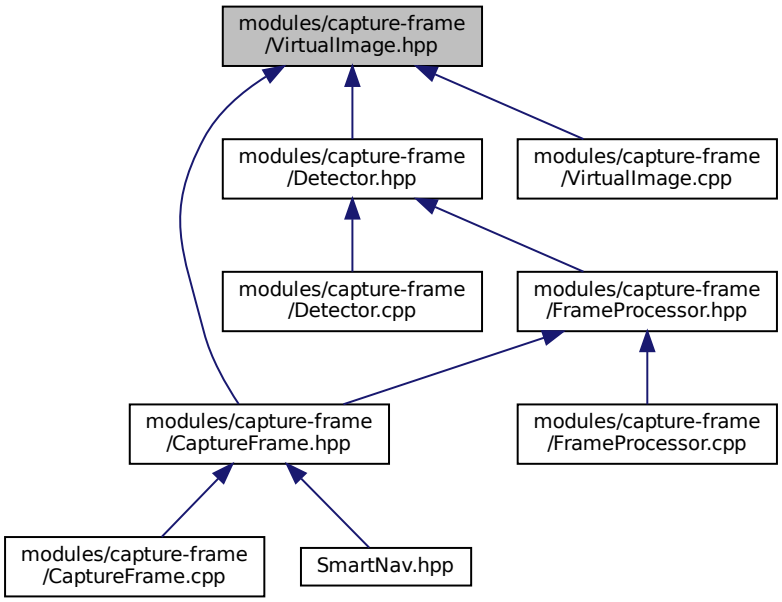
7.14 modules/capture-frame/VirtualImage.hpp File Reference

```
#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:



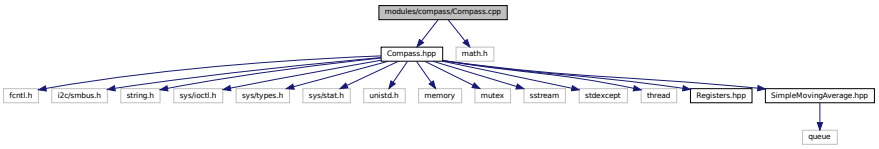
Classes

- 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

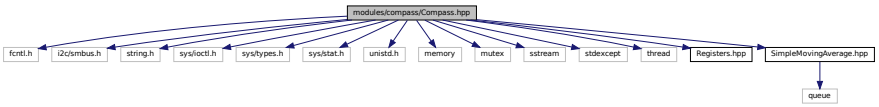
7.15.1.1 DEBUG_PRINT

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

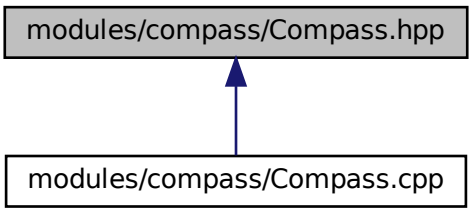
7.16 modules/compass/Compass.hpp File Reference

```
#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:

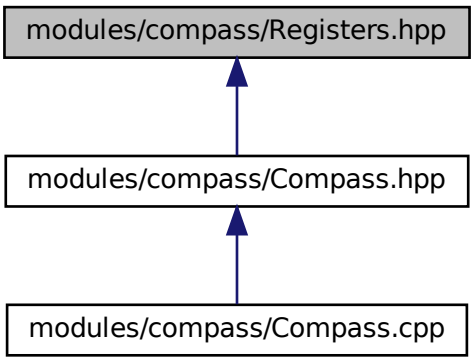


Classes

- 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

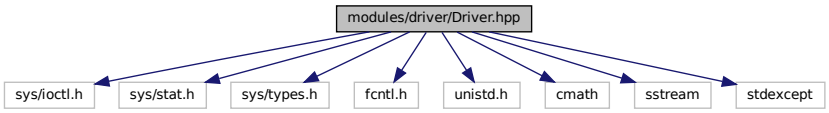
Variables

- 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

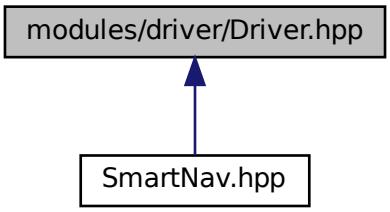
7.18 modules/driver/Driver.hpp File Reference

```
#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

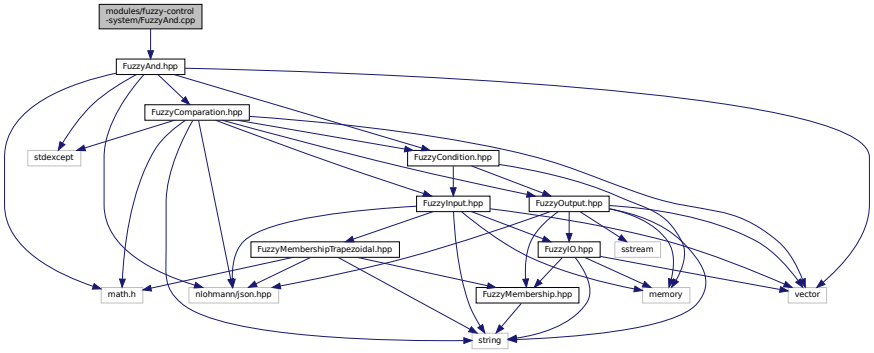
```
#define L298N_IOC_RIGHT _IO(L298N_IOC_NMAGICO, 3)
```

7.18.1.8 L298N_IOC_STOP

```
#define L298N_IOC_STOP _IO(L298N_IOC_NMAGICO, 0)
```

7.19 modules/fuzzy-control-system/FuzzyAnd.cpp File Reference

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



Macros

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

7.19.1 Macro Definition Documentation

7.19.1.1 DEBUG_PRINT

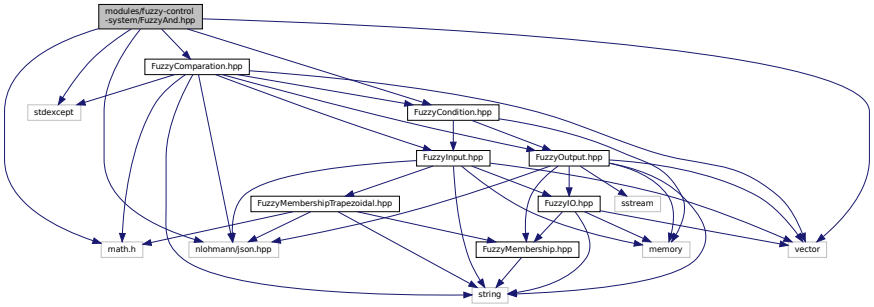
```
#define DEBUG_PRINT(
              fmt,
              ...  ) do {} while (0)
```

7.20 modules/fuzzy-control-system/FuzzyAnd.hpp File Reference

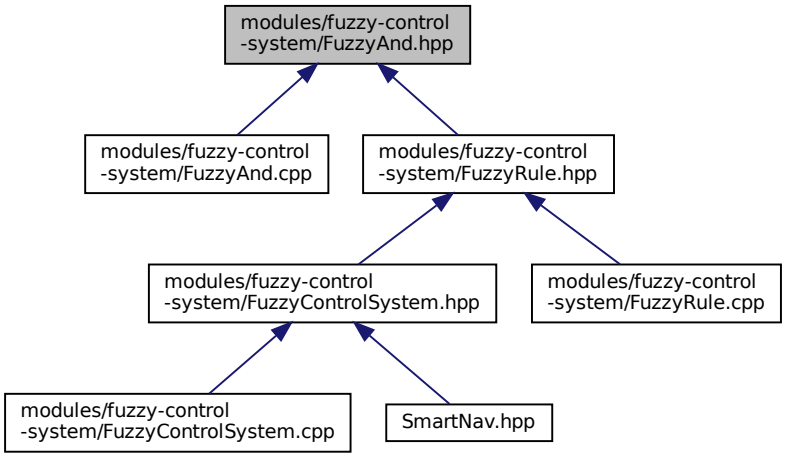
```
#include <math.h>
#include <stdexcept>
#include <vector>
#include <nlohmann/json.hpp>
#include <FuzzyCondition.hpp>
```

```
#include <FuzzyComparation.hpp>
```

Include dependency graph for FuzzyAnd.hpp:



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



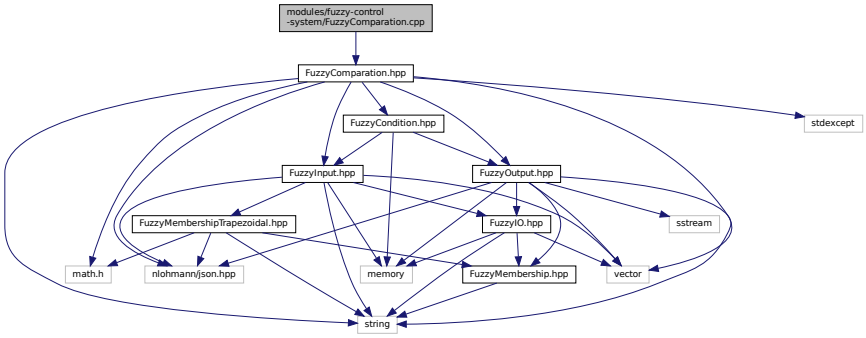
Classes

- class FuzzyAnd

7.21 modules/fuzzy-control-system/FuzzyComparation.cpp File Reference

```
#include <FuzzyComparation.hpp>
```

Include dependency graph for FuzzyComparation.cpp:



Macros

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

7.21.1 Macro Definition Documentation

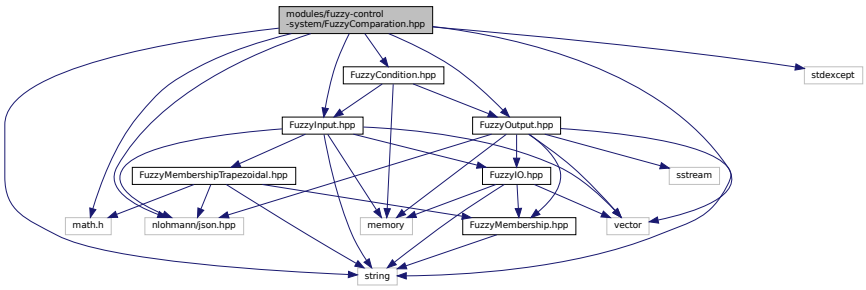
7.21.1.1 DEBUG_PRINT

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

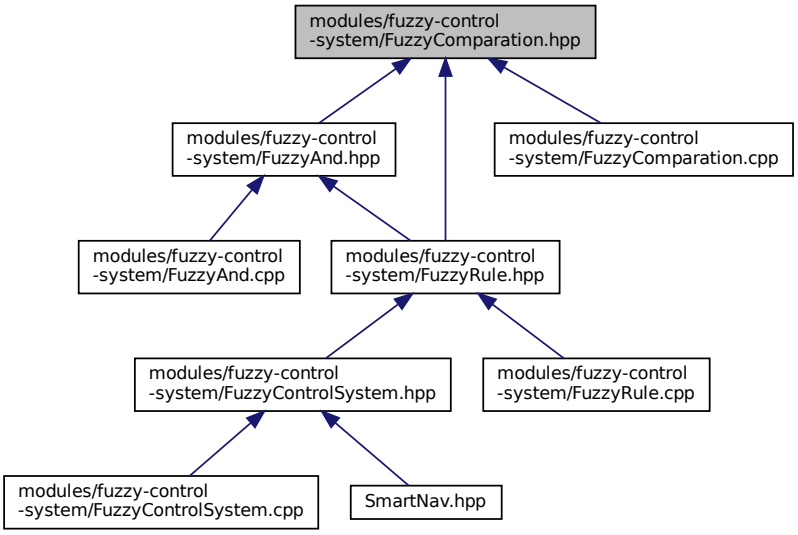
7.22 modules/fuzzy-control-system/FuzzyComparation.hpp File Reference

```
#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 FuzzyComparation.hpp:



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



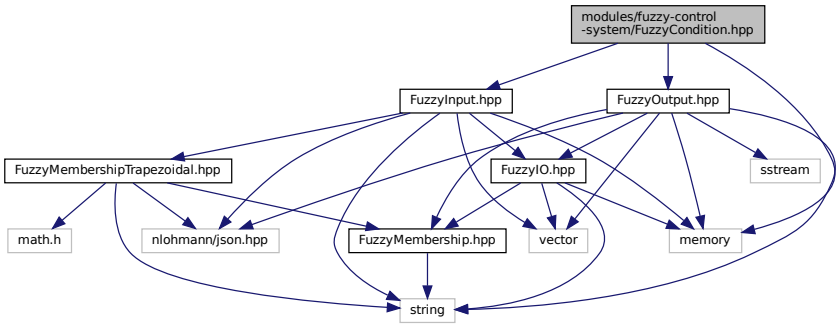
Classes

- class FuzzyComparation

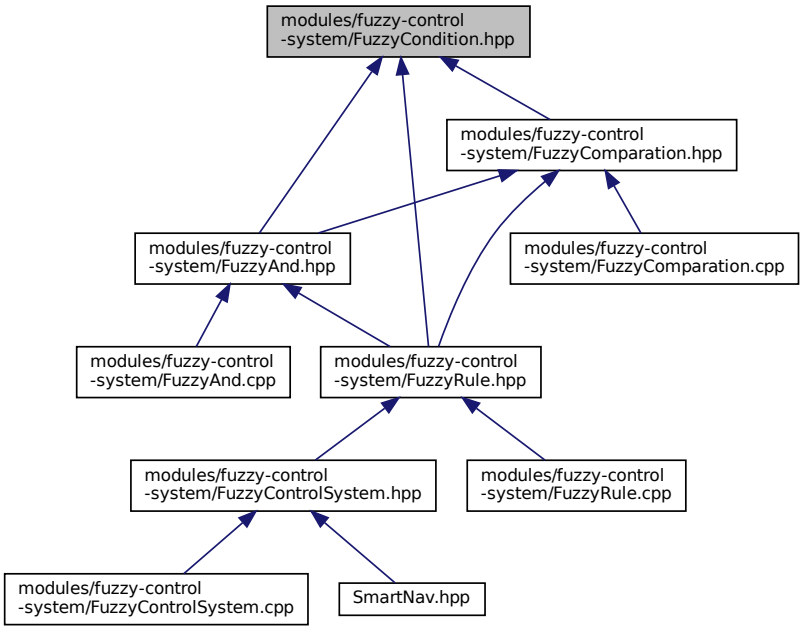
7.23 modules/fuzzy-control-system/FuzzyCondition.hpp File Reference

```
#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:

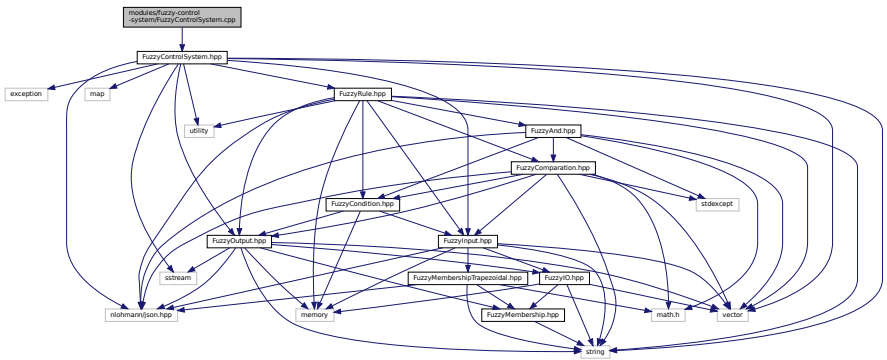


Classes

- 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
```

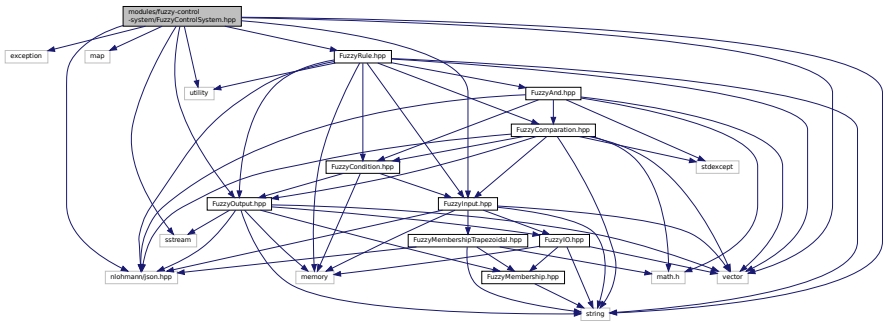
7.24.1.2 DEBUG_PRINT

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

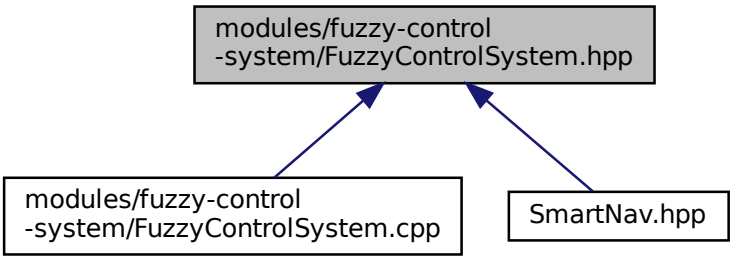
7.25 modules/fuzzy-control-system/FuzzyControlSystem.hpp File Reference

```
#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:



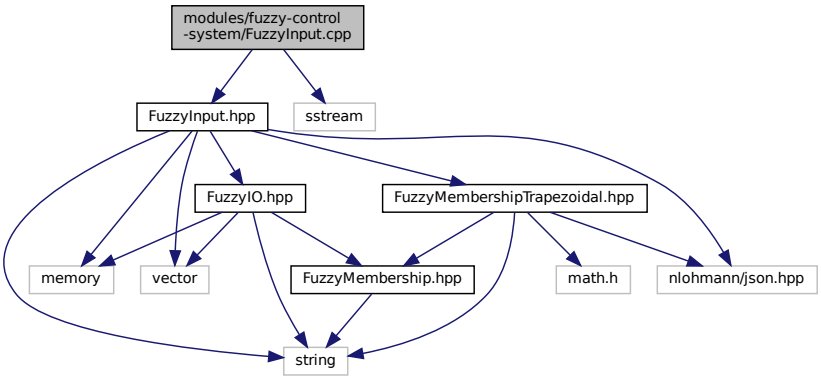
Classes

- class FuzzyControlSystem

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

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

Include dependency graph for FuzzyInput.cpp:

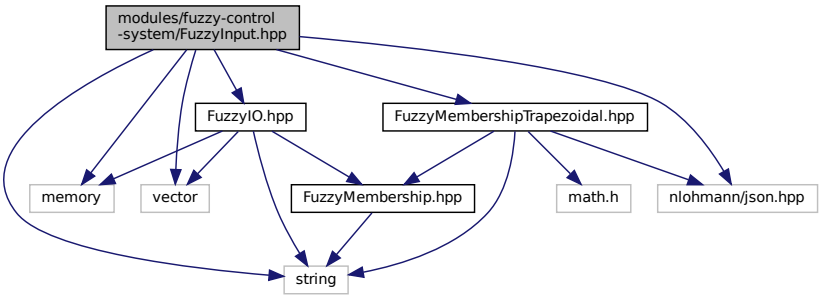


7.27 modules/fuzzy-control-system/FuzzyInput.hpp File Reference

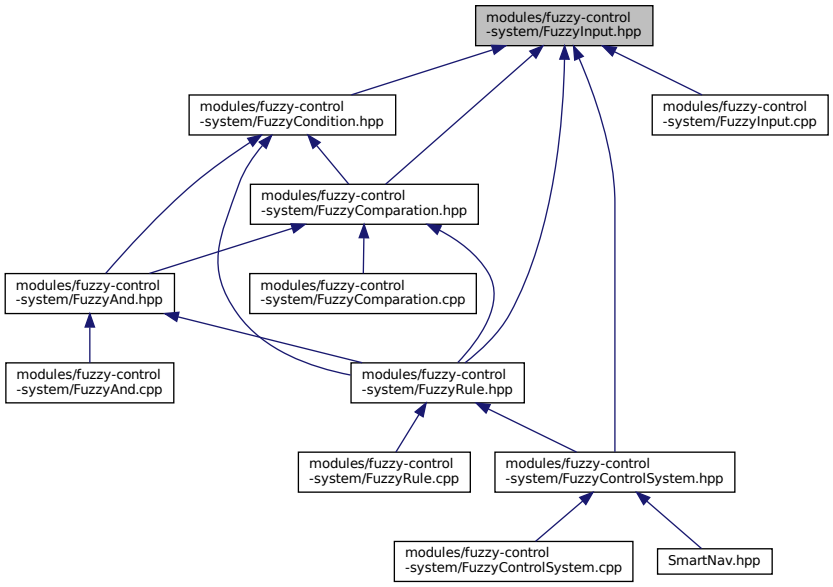
```
#include <memory>
#include <string>
#include <vector>
#include <FuzzyIO.hpp>
```

```
#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

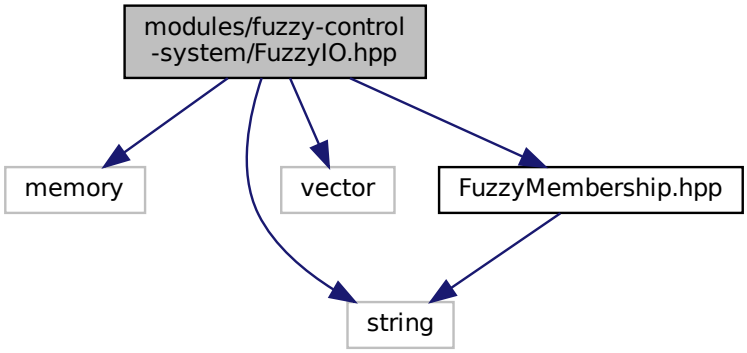
- class FuzzyInput

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

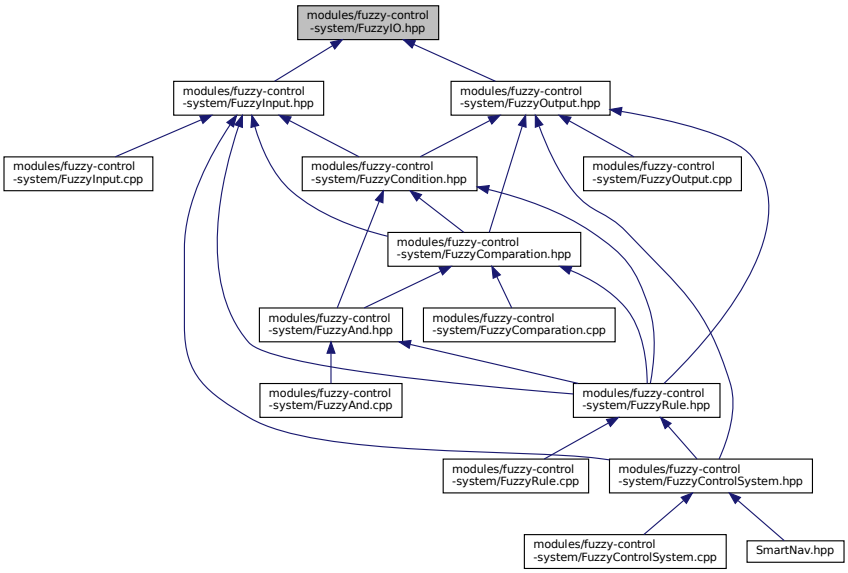
```
#include <memory>
#include <string>
#include <vector>
```

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

Include dependency graph for FuzzyIO.hpp:



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



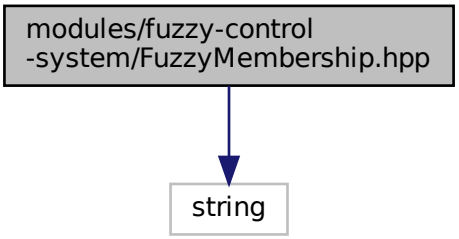
Classes

- class FuzzyIO

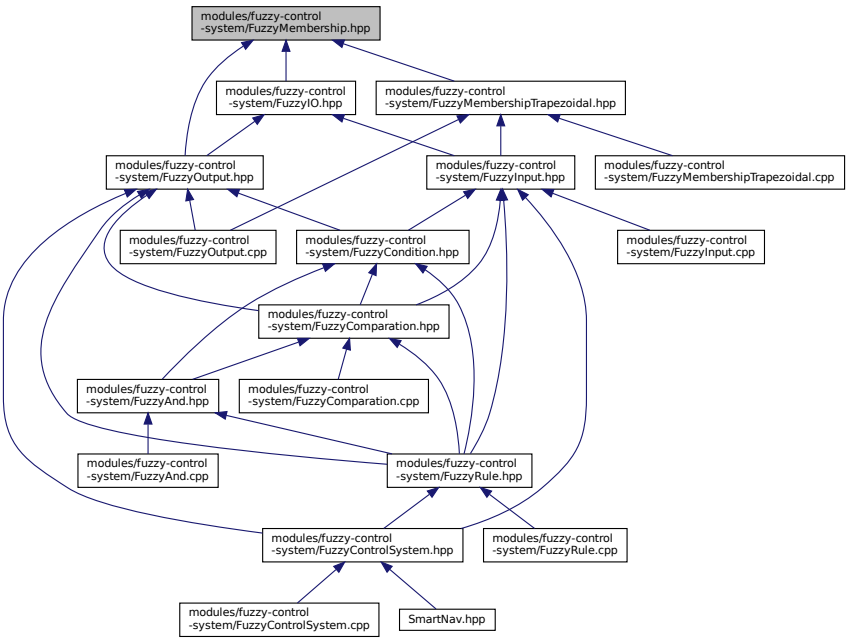
7.29 modules/fuzzy-control-system/FuzzyMembership.hpp File Reference

```
#include <string>
```

Include dependency graph for FuzzyMembership.hpp:



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



Classes

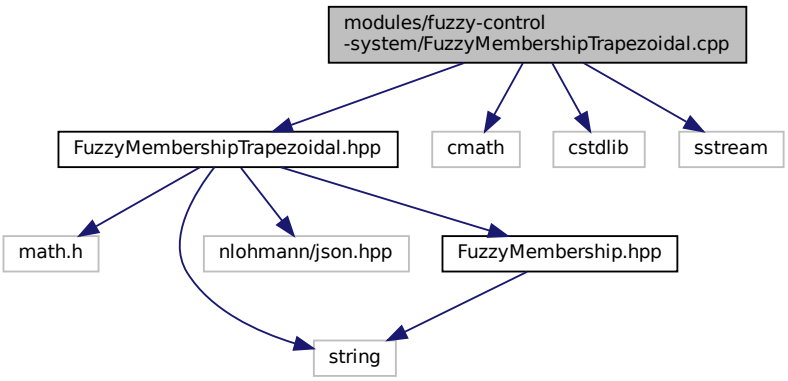
- class FuzzyMembership

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

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

```
#include <cstdlib>
#include <sstream>
```

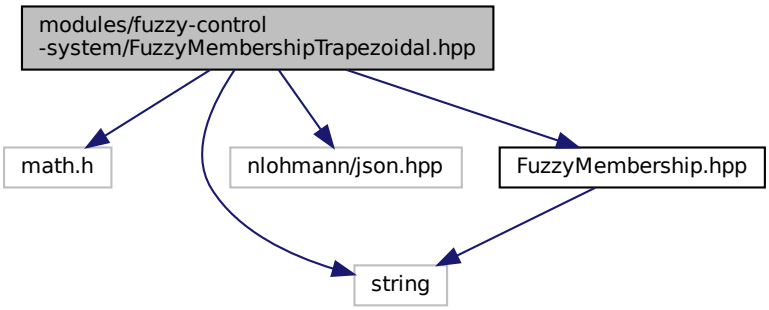
Include dependency graph for FuzzyMembershipTrapezoidal.cpp:



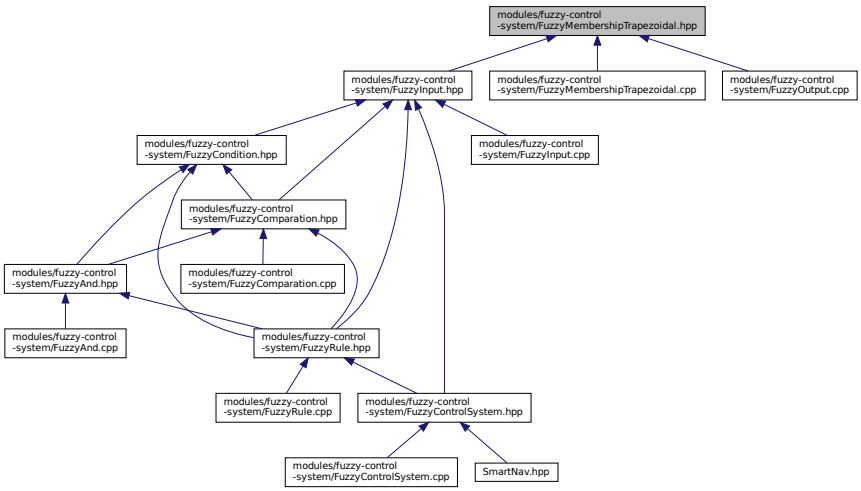
7.31 modules/fuzzy-control-system/FuzzyMembershipTrapezoidal.hpp File Reference

```
#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:



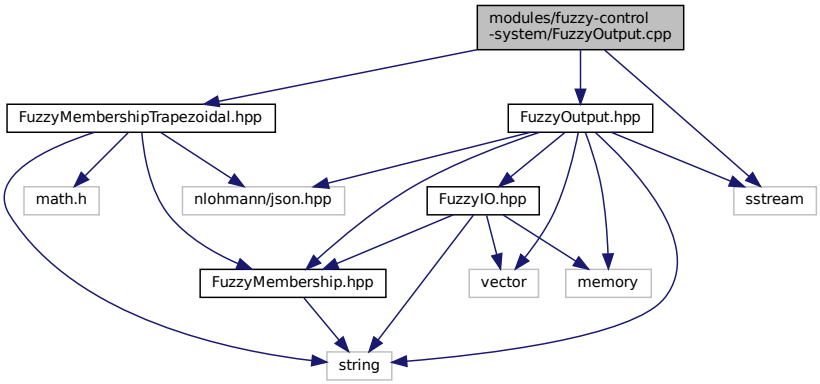
Classes

- 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
```

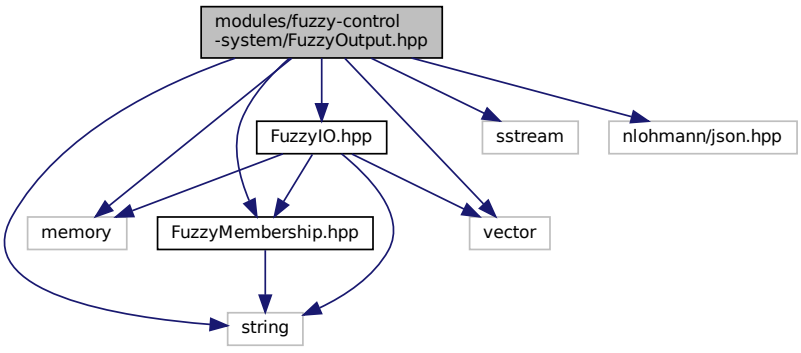
7.32.1.2 DEBUG_PRINT

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

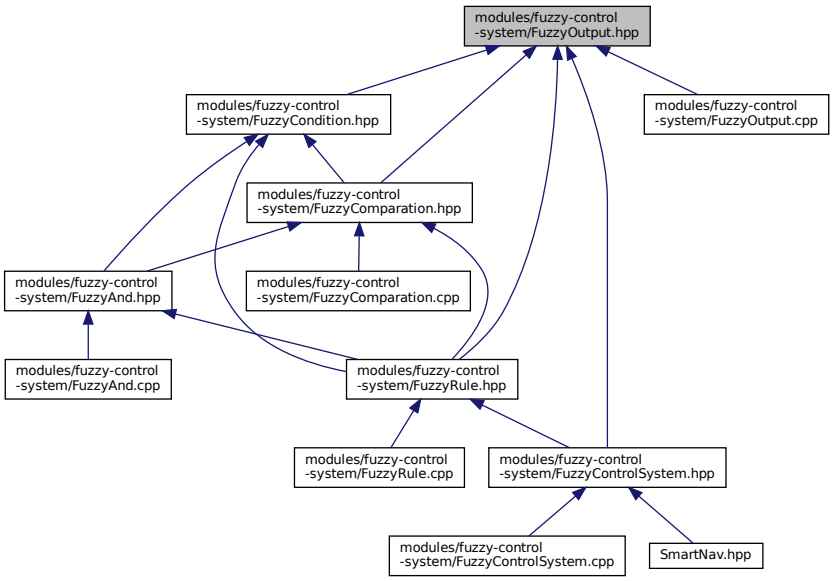
7.33 modules/fuzzy-control-system/FuzzyOutput.hpp File Reference

```
#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:



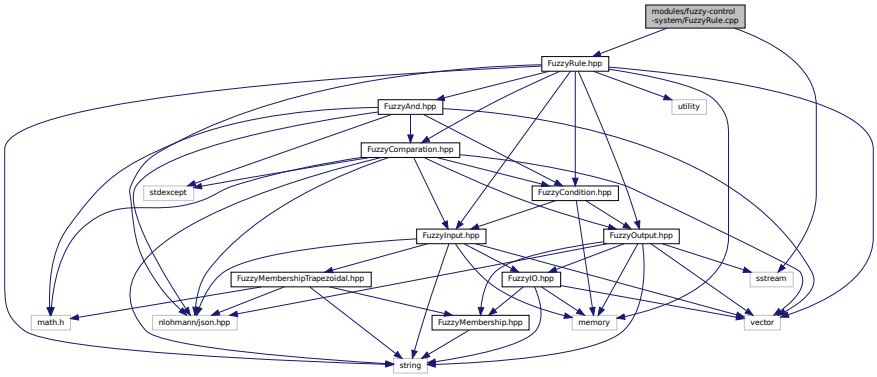
Classes

- 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__)
```

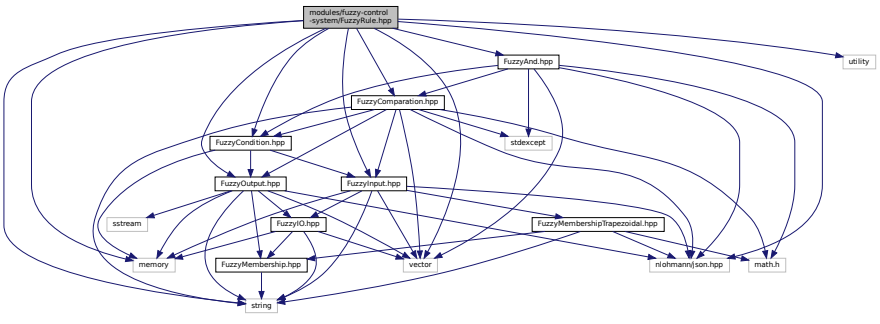
7.34.1.2 DEBUG_RULE

```
#define DEBUG_RULE 1
```

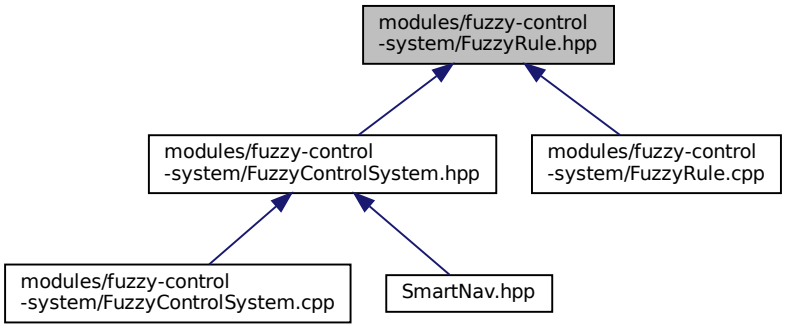
7.35 modules/fuzzy-control-system/FuzzyRule.hpp File Reference

```
#include <memory>
#include <string>
#include <utility>
#include <vector>
#include <FuzzyAnd.hpp>
#include <FuzzyComparation.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:



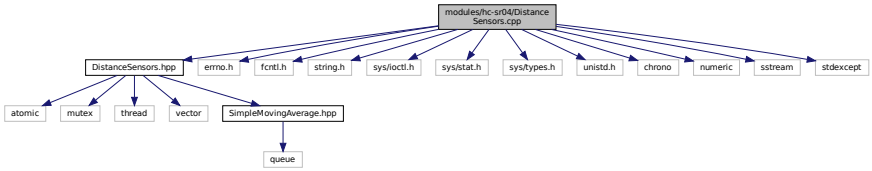
Classes

- 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'
```

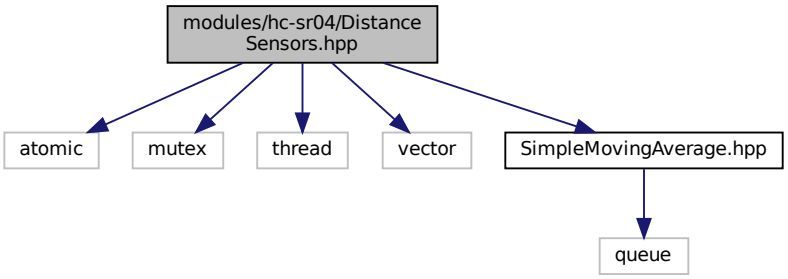
7.36.1.3 HCSR04_IOC_TRIGGER

```
#define HCSR04_IOC_TRIGGER _IO(HCSR04_IOC_NMAGICO, 1)
```

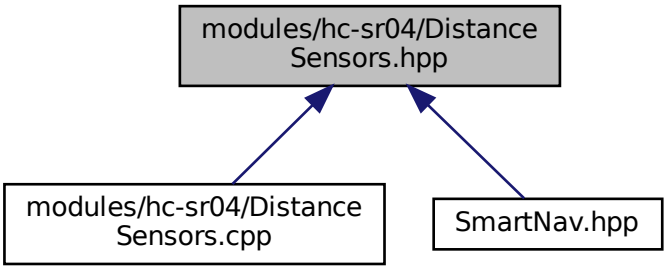
7.37 modules/hc-sr04/DistanceSensors.hpp File Reference

```
#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:



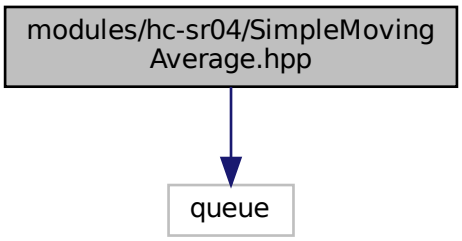
Classes

- class DistanceSensors

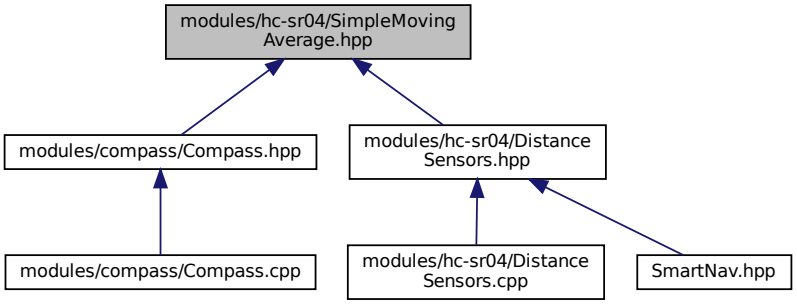
7.38 modules/hc-sr04/SimpleMovingAverage.hpp File Reference

```
#include <queue>
```

Include dependency graph for SimpleMovingAverage.hpp:



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



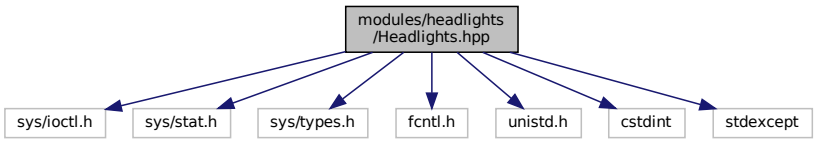
Classes

- class SimpleMovingAverage

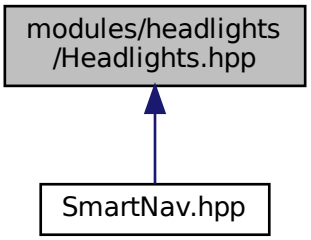
7.39 modules/headlights/Headlights.hpp File Reference

```
#include <sys/ioctl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <fcntl.h>
#include <unistd.h>
#include <cstdint>
#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'
```

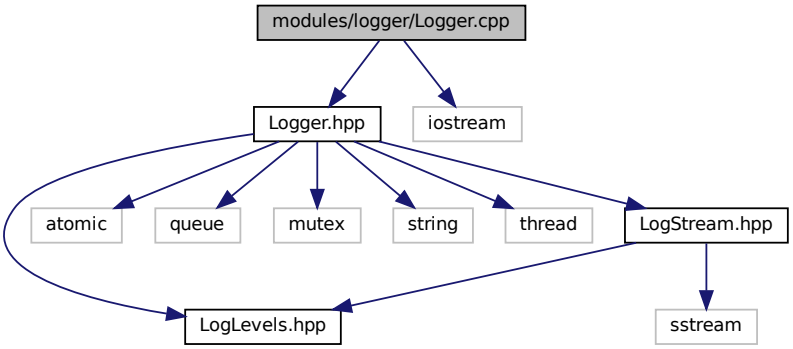
7.39.1.2 AXI_TIMER_IOC_T_ON

```
#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>
```

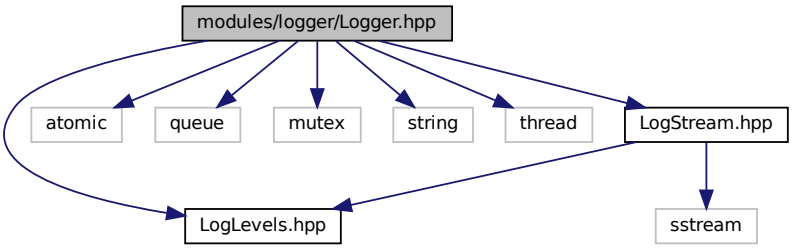
Include dependency graph for Logger.cpp:



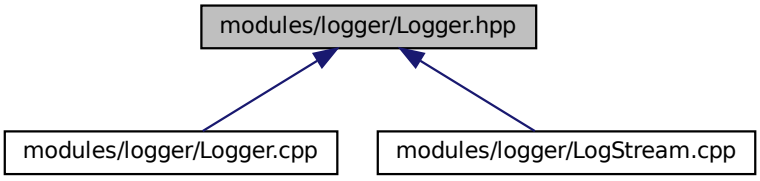
7.41 modules/logger/Logger.hpp File Reference

```
#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:

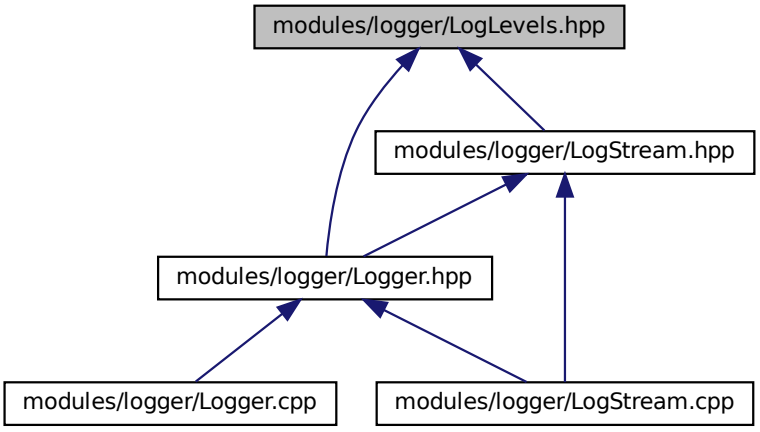


Classes

- 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]
```

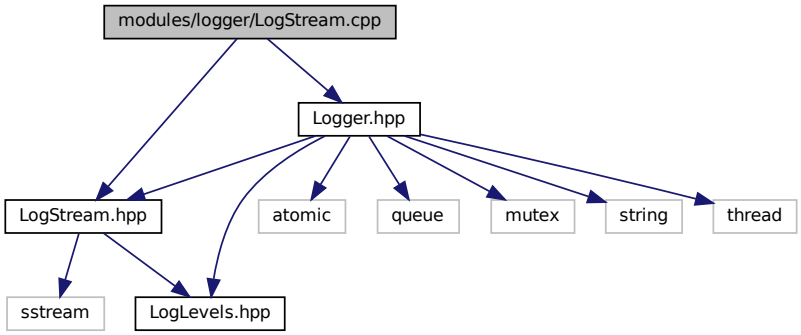
Enumerator

Info	Informative message
Warning	Warning message
Fatal	Fatal message

7.43 modules/logger/LogStream.cpp File Reference

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

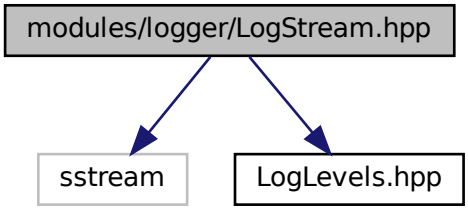
Include dependency graph for LogStream.cpp:



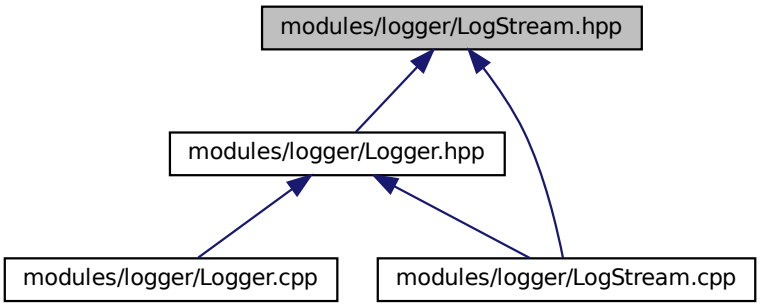
7.44 modules/logger/LogStream.hpp File Reference

```
#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)
```

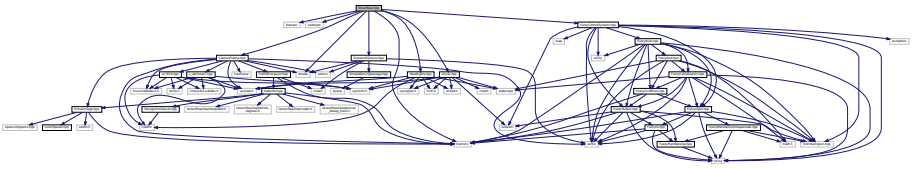
7.45.2.3 end

```
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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