

Other Code

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## Chapter 1

## Other

This sub-project contains other sub-projects which support the Raspberry Pi project



## Chapter 2

# Namespace Index

### 2.1 Namespace List

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<a href="#">behaviour_tree::node::blackboard</a>	12
<a href="#">behaviour_tree::node::composite</a>	13
<a href="#">behaviour_tree::node::custom</a>	14
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<a href="#">behaviour_tree::node::custom::condition</a>	16
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## Chapter 3

# Hierarchical Index

### 3.1 Class Hierarchy

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

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behaviour_tree::BehaviourTreeParser . . . . .	25
behaviour_tree::node::custom::CustomNodeParser . . . . .	39
behaviour_tree::node::custom::CarCustomNodeParser . . . . .	30
rplidar::DeviceInfo . . . . .	41
std::enable_shared_from_this	
behaviour_tree::Context . . . . .	35
behaviour_tree::node::Node . . . . .	54
behaviour_tree::node::blackboard::BlackboardNode . . . . .	29
behaviour_tree::node::blackboard::ChangeInteger . . . . .	31
behaviour_tree::node::blackboard::IntegerCondition . . . . .	48
behaviour_tree::node::composite::Composite . . . . .	33
behaviour_tree::node::composite::Random . . . . .	61
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behaviour_tree::node::custom::action::Print . . . . .	59
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behaviour_tree::node::leaf::Leaf . . . . .	52
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behaviour_tree::node::leaf::Succeed . . . . .	89
behaviour_tree::node::leaf::UseRoot . . . . .	102
rplidar::ExpressPacket . . . . .	44

rplidar::HealthInfo . . . . .	<a href="#">47</a>
rplidar::Measure . . . . .	<a href="#">53</a>
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behaviour_tree::Root . . . . .	<a href="#">66</a>
rplidar::RPLidar . . . . .	<a href="#">68</a>
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## Chapter 4

# Class Index

### 4.1 Class List

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

<a href="#">behaviour_tree::BehaviourTree</a>	23
<a href="#">behaviour_tree::BehaviourTreeParser</a>	25
<a href="#">behaviour_tree::node::blackboard::BlackboardNode</a>	29
<a href="#">behaviour_tree::node::custom::CarCustomNodeParser</a>	30
<a href="#">behaviour_tree::node::blackboard::ChangeInteger</a>	31
<a href="#">behaviour_tree::node::composite::Composite</a>	33
<a href="#">behaviour_tree::Context</a>	35
<a href="#">behaviour_tree::node::custom::CustomNode</a>	38
<a href="#">behaviour_tree::node::custom::CustomNodeParser</a>	39
<a href="#">behaviour_tree::node::decorator::Decorator</a>	40
<a href="#">rplidar::DeviceInfo</a>	41
<a href="#">behaviour_tree::node::custom::action::Drive</a>	42
<a href="#">rplidar::ExpressPacket</a>	44
<a href="#">behaviour_tree::node::leaf::Fail</a>	46
<a href="#">rplidar::HealthInfo</a>	
Health Info for Lidar Scanner	47
<a href="#">behaviour_tree::node::blackboard::IntegerCondition</a>	48
<a href="#">behaviour_tree::node::decorator::Invert</a>	50
<a href="#">behaviour_tree::node::leaf::Leaf</a>	52
<a href="#">rplidar::Measure</a>	53
<a href="#">behaviour_tree::node::Node</a>	54
<a href="#">behaviour_tree::node::custom::action::PauseExecution</a>	57
<a href="#">behaviour_tree::node::custom::action::Print</a>	59
<a href="#">behaviour_tree::node::composite::Random</a>	61
<a href="#">utils::RawTypeNameFormat</a>	63
<a href="#">behaviour_tree::node::decorator::Repeat</a>	64
<a href="#">behaviour_tree::Root</a>	66
<a href="#">rplidar::RPLidar</a>	
Class for communicating with <a href="#">RPLidar</a> rangefinder scanners	68
<a href="#">rplidar::ScanInfo</a>	77
<a href="#">behaviour_tree::node::composite::Selector</a>	78
<a href="#">behaviour_tree::node::composite::Sequence</a>	80
<a href="#">behaviour_tree::node::custom::action::SetAngle</a>	82
<a href="#">behaviour_tree::node::custom::action::SetSpeed</a>	84
<a href="#">behaviour_tree::node::custom::action::SetWheelDirection</a>	87

<a href="#">behaviour_tree::node::leaf::Succeed</a>	89
<a href="#">behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan</a>	90
<a href="#">behaviour_tree::node::custom::condition::SucceedOnAverageColour</a>	93
<a href="#">behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan</a>	96
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## Chapter 5

# File Index

### 5.1 File List

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behaviour_tree/include/behaviour_tree/node/composite/Random.hpp	121
behaviour_tree/include/behaviour_tree/node/composite/Selector.hpp	122
behaviour_tree/include/behaviour_tree/node/composite/Sequence.hpp	124
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behaviour_tree/include/behaviour_tree/node/custom/CustomNodeParser.hpp	126
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behaviour_tree_car/include/behaviour_tree/node/custom/action/PauseExecution.hpp	142
behaviour_tree_car/include/behaviour_tree/node/custom/action/Print.hpp	144
behaviour_tree_car/include/behaviour_tree/node/custom/action/SetAngle.hpp	145

behaviour_tree_car/include/behaviour_tree/node/custom/action/SetSpeed.hpp . . . . .	147
behaviour_tree_car/include/behaviour_tree/node/custom/action/SetWheelDirection.hpp . . . . .	149
behaviour_tree_car/include/behaviour_tree/node/custom/action/Turn.hpp . . . . .	152
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behaviour_tree_car/include/behaviour_tree/node/custom/condition/SucceedOnAverageColour.hpp . . . . .	157
behaviour_tree_car/include/behaviour_tree/node/custom/condition/SucceedOnAverageNearbyScan.hpp . . . . .	160
behaviour_tree_tester/src/main.cpp . . . . .	162
behaviour_tree_validator/src/main.cpp . . . . .	163
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utils/include/utils/Utility.hpp . . . . .	175

## Chapter 6

# Namespace Documentation

### 6.1 behaviour\_tree Namespace Reference

#### Namespaces

- namespace [global](#)
- namespace [node](#)

#### Classes

- class [BehaviourTree](#)
- class [BehaviourTreeParser](#)
- class [Context](#)
- class [Root](#)

#### Enumerations

- enum class [Status](#) { [Success](#) , [Failure](#) , [Running](#) }

#### 6.1.1 Enumeration Type Documentation

##### 6.1.1.1 Status

```
enum class behaviour_tree::Status [strong]
```

#### Enumerator

Success	
Failure	
Running	



## Enumerator

ChangeInteger	
IntegerCondition	

## 6.4.1.2 ConditionOperatorType

```
enum class behaviour_tree::node::blackboard::ConditionOperatorType [strong]
```

## Enumerator

Equal	
NotEqual	
GreaterThan	
GreaterThanOrEqual	
LessThan	
LessThanOrEqual	

## 6.4.1.3 IntegerChangeType

```
enum class behaviour_tree::node::blackboard::IntegerChangeType [strong]
```

## Enumerator

Set	
Add	
Subtract	

## 6.5 behaviour\_tree::node::composite Namespace Reference

## Classes

- class [Composite](#)
- class [Random](#)
- class [Selector](#)
- class [Sequence](#)

## Enumerations

- enum class [CompositeType](#) { [Sequence](#) , [Selector](#) , [Random](#) }

## 6.5.1 Enumeration Type Documentation

### 6.5.1.1 CompositeType

```
enum class behaviour_tree::node::composite::CompositeType [strong]
```

Enumerator

Sequence	
Selector	
Random	

## 6.6 behaviour\_tree::node::custom Namespace Reference

### Namespaces

- namespace [action](#)
- namespace [condition](#)

### Classes

- class [CarCustomNodeParser](#)
- class [CustomNode](#)
- class [CustomNodeParser](#)

## 6.7 behaviour\_tree::node::custom::action Namespace Reference

### Classes

- class [Drive](#)
- class [PauseExecution](#)
- class [Print](#)
- class [SetAngle](#)
- class [SetSpeed](#)
- class [SetWheelDirection](#)
- class [Turn](#)

### Enumerations

- enum class [ClockDirectionType](#) { [Clockwise](#) , [AntiClockwise](#) }
- enum class [DirectionType](#) { [Forward](#) , [Backward](#) }
- enum class [ServoType](#) { [FrontWheels](#) , [CameraServo1](#) , [CameraServo2](#) }
- enum class [WheelType](#) { [Left](#) , [Right](#) , [Both](#) }



## 6.7.1 Enumeration Type Documentation

### 6.7.1.1 ClockDirectionType

```
enum class behaviour_tree::node::custom::action::ClockDirectionType [strong]
```

Enumerator

Clockwise	
AntiClockwise	

### 6.7.1.2 DirectionType

```
enum class behaviour_tree::node::custom::action::DirectionType [strong]
```

Enumerator

Forward	
Backward	

### 6.7.1.3 ServoType

```
enum class behaviour_tree::node::custom::action::ServoType [strong]
```

Enumerator

FrontWheels	
CameraServo1	
CameraServo2	

### 6.7.1.4 WheelType

```
enum class behaviour_tree::node::custom::action::WheelType [strong]
```

Enumerator

Left	
Right	
Both	

## 6.8 `behaviour_tree::node::custom::condition` Namespace Reference

### Classes

- class [SucceedOnAnyNearbyScan](#)
- class [SucceedOnAverageColour](#)
- class [SucceedOnAverageNearbyScan](#)

## 6.9 `behaviour_tree::node::decorator` Namespace Reference

### Classes

- class [Decorator](#)
- class [Invert](#)
- class [Repeat](#)

### Enumerations

- enum class [DecoratorType](#) { [Invert](#) , [Repeat](#) }

### 6.9.1 Enumeration Type Documentation

#### 6.9.1.1 `DecoratorType`

```
enum class behaviour\_tree::node::decorator::DecoratorType [strong]
```

Enumerator

<a href="#">Invert</a>	
<a href="#">Repeat</a>	

## 6.10 `behaviour_tree::node::leaf` Namespace Reference

### Classes

- class [Fail](#)
- class [Leaf](#)
- class [Succeed](#)
- class [UseRoot](#)

## Enumerations

- enum class [LeafType](#) { [Succeed](#) , [Fail](#) , [UseRoot](#) }

### 6.10.1 Enumeration Type Documentation

#### 6.10.1.1 LeafType

```
enum class behaviour_tree::node::leaf::LeafType [strong]
```

##### Enumerator

Succeed	
Fail	
UseRoot	

## 6.11 rplidar Namespace Reference

### Classes

- struct [DeviceInfo](#)
- class [ExpressPacket](#)
- struct [HealthInfo](#)
  - Health Info for Lidar Scanner.*
- struct [Measure](#)
- class [RPLidar](#)
  - Class for communicating with [RPLidar](#) rangefinder scanners.*
- struct [ScanInfo](#)

### Enumerations

- enum [ScanType](#) { [NORMAL](#) = 0 , [FORCE](#) , [EXPRESS](#) }

### Variables

- constexpr uint8\_t [SYNC\\_BYTE](#) = 0xA5
- constexpr uint8\_t [SYNC\\_BYTE2](#) = 0x5A
- constexpr uint8\_t [GET\\_INFO\\_BYTE](#) = 0x50
- constexpr uint8\_t [GET\\_HEALTH\\_BYTE](#) = 0x52
- constexpr uint8\_t [STOP\\_BYTE](#) = 0x25
- constexpr uint8\_t [RESET\\_BYTE](#) = 0x40
- constexpr int [DESCRIPTOR\\_LEN](#) = 7
- constexpr int [INFO\\_LEN](#) = 20
- constexpr int [HEALTH\\_LEN](#) = 3
- constexpr int [INFO\\_TYPE](#) = 4
- constexpr int [HEALTH\\_TYPE](#) = 6
- constexpr int [MAX\\_MOTOR\\_PWM](#) = 1023
- constexpr int [DEFAULT\\_MOTOR\\_PWM](#) = 660
- constexpr uint8\_t [SET\\_PWM\\_BYTE](#) = 0xF0

## 6.11.1 Enumeration Type Documentation

### 6.11.1.1 ScanType

```
enum rplidar::ScanType
```

Enumerator

NORMAL	
FORCE	
EXPRESS	

## 6.11.2 Variable Documentation

### 6.11.2.1 DEFAULT\_MOTOR\_PWM

```
constexpr int rplidar::DEFAULT_MOTOR_PWM = 660 [constexpr]
```

### 6.11.2.2 DESCRIPTOR\_LEN

```
constexpr int rplidar::DESCRIPTOR_LEN = 7 [constexpr]
```

### 6.11.2.3 GET\_HEALTH\_BYTE

```
constexpr uint8_t rplidar::GET_HEALTH_BYTE = 0x52 [constexpr]
```

### 6.11.2.4 GET\_INFO\_BYTE

```
constexpr uint8_t rplidar::GET_INFO_BYTE = 0x50 [constexpr]
```

#### 6.11.2.5 HEALTH\_LEN

```
constexpr int rplidar::HEALTH_LEN = 3 [constexpr]
```

#### 6.11.2.6 HEALTH\_TYPE

```
constexpr int rplidar::HEALTH_TYPE = 6 [constexpr]
```

#### 6.11.2.7 INFO\_LEN

```
constexpr int rplidar::INFO_LEN = 20 [constexpr]
```

#### 6.11.2.8 INFO\_TYPE

```
constexpr int rplidar::INFO_TYPE = 4 [constexpr]
```

#### 6.11.2.9 MAX\_MOTOR\_PWM

```
constexpr int rplidar::MAX_MOTOR_PWM = 1023 [constexpr]
```

#### 6.11.2.10 RESET\_BYTE

```
constexpr uint8_t rplidar::RESET_BYTE = 0x40 [constexpr]
```

#### 6.11.2.11 SET\_PWM\_BYTE

```
constexpr uint8_t rplidar::SET_PWM_BYTE = 0xF0 [constexpr]
```

#### 6.11.2.12 STOP\_BYTE

```
constexpr uint8_t rplidar::STOP_BYTE = 0x25 [constexpr]
```

### 6.11.2.13 SYNC\_BYTE

```
constexpr uint8_t rplidar::SYNC_BYTE = 0xA5 [constexpr]
```

### 6.11.2.14 SYNC\_BYTE2

```
constexpr uint8_t rplidar::SYNC_BYTE2 = 0x5A [constexpr]
```

## 6.12 utils Namespace Reference

### Classes

- struct [RawTypeNameFormat](#)

### Functions

- template<typename T >  
constexpr const auto & [RawTypeName](#) ()
- constexpr bool [GetRawTypeNameFormat](#) ([RawTypeNameFormat](#) \*format)
- template<typename T >  
constexpr auto [CexprTypeName](#) ()
- template<typename T >  
const char \* [TypeName](#) ()
- template<typename T >  
const char \* [TypeName](#) (const T &)

### 6.12.1 Function Documentation

#### 6.12.1.1 CexprTypeName()

```
template<typename T >  
constexpr auto utils::CexprTypeName ( ) [constexpr]
```

#### 6.12.1.2 GetRawTypeNameFormat()

```
constexpr bool utils::GetRawTypeNameFormat (  
    RawTypeNameFormat * format ) [inline], [constexpr]
```

### 6.12.1.3 RawTypeName()

```
template<typename T >  
constexpr const auto & utils::RawTypeName ( ) [constexpr]
```

### 6.12.1.4 TypeName() [1/2]

```
template<typename T >  
const char * utils::TypeName ( )
```

### 6.12.1.5 TypeName() [2/2]

```
template<typename T >  
const char * utils::TypeName (   
    const T & )
```





## Chapter 7

# Class Documentation

### 7.1 `behaviour_tree::BehaviourTree` Class Reference

```
#include <BehaviourTree.hpp>
```

#### Public Member Functions

- `BehaviourTree` (unsigned int `cycle_limit`, std::vector< std::shared\_ptr< `Root` > > `roots`)
- void `start` ()
- `Status tick` (const int tick\_count, std::shared\_ptr< `Context` > context)
- `Status UseRoot` (const int tick\_count, std::shared\_ptr< `Context` > context, const std::string &id)
- bool `canRun` () const
- void `incrementCycle` ()
- void `resetCycles` ()
- const std::string `toString` () const

#### Private Attributes

- int `cycles` = 0
- std::shared\_ptr< `Root` > `root_to_use`
- const std::vector< std::shared\_ptr< `Root` > > `roots`
- const unsigned int `cycle_limit`

#### 7.1.1 Constructor & Destructor Documentation

##### 7.1.1.1 `BehaviourTree()`

```
behaviour_tree::BehaviourTree::BehaviourTree (
    unsigned int cycle_limit,
    std::vector< std::shared_ptr< Root > > roots ) [inline]
```

## 7.1.2 Member Function Documentation

### 7.1.2.1 canRun()

```
bool behaviour_tree::BehaviourTree::canRun ( ) const [inline]
```

### 7.1.2.2 incrementCycle()

```
void behaviour_tree::BehaviourTree::incrementCycle ( ) [inline]
```

### 7.1.2.3 resetCycles()

```
void behaviour_tree::BehaviourTree::resetCycles ( ) [inline]
```

### 7.1.2.4 start()

```
void behaviour_tree::BehaviourTree::start ( ) [inline]
```

### 7.1.2.5 tick()

```
Status behaviour_tree::BehaviourTree::tick (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline]
```

### 7.1.2.6 toString()

```
const std::string behaviour_tree::BehaviourTree::toString ( ) const [inline]
```

### 7.1.2.7 UseRoot()

```
Status behaviour_tree::BehaviourTree::UseRoot (
    const int tick_count,
    std::shared_ptr< Context > context,
    const std::string & id ) [inline]
```

### 7.1.3 Member Data Documentation

#### 7.1.3.1 cycle\_limit

```
const unsigned int behaviour_tree::BehaviourTree::cycle_limit [private]
```

#### 7.1.3.2 cycles

```
int behaviour_tree::BehaviourTree::cycles = 0 [private]
```

#### 7.1.3.3 root\_to\_use

```
std::shared_ptr<Root> behaviour_tree::BehaviourTree::root_to_use [private]
```

#### 7.1.3.4 roots

```
const std::vector<std::shared_ptr<Root> > behaviour_tree::BehaviourTree::roots [private]
```

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

- behaviour\_tree/include/behaviour\_tree/[BehaviourTree.hpp](#)

## 7.2 behaviour\_tree::BehaviourTreeParser Class Reference

```
#include <BehaviourTreeParser.hpp>
```

### Public Member Functions

- [BehaviourTreeParser](#) ([BehaviourTreeParser](#) const &)=delete
- void [operator=](#) ([BehaviourTreeParser](#) const &)=delete
- void [setCustomNodeParser](#) (std::shared\_ptr< [CustomNodeParser](#) > [custom\\_node\\_parser](#))
- tl::expected< std::shared\_ptr< [BehaviourTree](#) >, std::string > [parseXML](#) (const std::string &xml)
- tl::expected< std::shared\_ptr< [BehaviourTree](#) >, std::string > [parseFileXML](#) (const std::string &file\_path)

### Static Public Member Functions

- static [BehaviourTreeParser](#) & [instance](#) ()

## Private Member Functions

- [BehaviourTreeParser](#) ()
- tl::expected< std::shared\_ptr< [BehaviourTree](#) >, std::string > [parse](#) (pugi::xml\_document &doc)
- tl::expected< std::shared\_ptr< [Root](#) >, std::string > [parseRoot](#) (const pugi::xml\_node &node, const int index)
- tl::expected< std::shared\_ptr< [node::Node](#) >, std::string > [parseChild](#) (const pugi::xml\_node &node, const int index)
- tl::expected< std::shared\_ptr< [node::decorator::Decorator](#) >, std::string > [parseDecorator](#) (const pugi::xml\_node &node, const int index, const [DecoratorType](#) decorator\_type)
- tl::expected< std::shared\_ptr< [node::blackboard::BlackboardNode](#) >, std::string > [parseBlackboardNode](#) (const pugi::xml\_node &node, const int index, const [BlackboardType](#) blackboard\_node\_type)
- tl::expected< std::shared\_ptr< [Composite](#) >, std::string > [parseComposite](#) (const pugi::xml\_node &node, const int index, const [CompositeType](#) composite\_type)
- tl::expected< std::shared\_ptr< [node::custom::CustomNode](#) >, std::string > [parseCustomNode](#) (const pugi::xml\_node &node, const int index)

## Private Attributes

- std::shared\_ptr< [CustomNodeParser](#) > [custom\\_node\\_parser](#)

## 7.2.1 Constructor & Destructor Documentation

### 7.2.1.1 BehaviourTreeParser() [1/2]

```
behaviour_tree::BehaviourTreeParser::BehaviourTreeParser (
    BehaviourTreeParser const & ) [delete]
```

### 7.2.1.2 BehaviourTreeParser() [2/2]

```
behaviour_tree::BehaviourTreeParser::BehaviourTreeParser ( ) [inline], [private]
```

## 7.2.2 Member Function Documentation

### 7.2.2.1 instance()

```
static BehaviourTreeParser & behaviour_tree::BehaviourTreeParser::instance ( ) [inline],
[static]
```

### 7.2.2.2 operator=()

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

### 7.2.2.3 parse()

```
tl::expected< std::shared_ptr< BehaviourTree >, std::string > behaviour_tree::BehaviourTree↵
Parser::parse (
    pugi::xml_document & doc ) [inline], [private]
```

### 7.2.2.4 parseBlackboardNode()

```
tl::expected< std::shared_ptr< node::blackboard::BlackboardNode >, std::string > behaviour_↵
tree::BehaviourTreeParser::parseBlackboardNode (
    const pugi::xml_node & node,
    const int index,
    const BlackboardType blackboard_node_type ) [inline], [private]
```

### 7.2.2.5 parseChild()

```
tl::expected< std::shared_ptr< node::Node >, std::string > behaviour_tree::BehaviourTree↵
Parser::parseChild (
    const pugi::xml_node & node,
    const int index ) [inline], [private]
```

### 7.2.2.6 parseComposite()

```
tl::expected< std::shared_ptr< Composite >, std::string > behaviour_tree::BehaviourTree↵
Parser::parseComposite (
    const pugi::xml_node & node,
    const int index,
    const CompositeType composite_type ) [inline], [private]
```

### 7.2.2.7 parseCustomNode()

```
tl::expected< std::shared_ptr< node::custom::CustomNode >, std::string > behaviour_tree::↵
BehaviourTreeParser::parseCustomNode (
    const pugi::xml_node & node,
    const int index ) [inline], [private]
```

#### 7.2.2.8 parseDecorator()

```
tl::expected< std::shared_ptr< node::decorator::Decorator >, std::string > behaviour_tree::Behavi↵
ourTreeParser::parseDecorator (
    const pugi::xml_node & node,
    const int index,
    const DecoratorType decorator_type ) [inline], [private]
```

#### 7.2.2.9 parseFileXML()

```
tl::expected< std::shared_ptr< BehaviourTree >, std::string > behaviour_tree::BehaviourTree↵
Parser::parseFileXML (
    const std::string & file_path ) [inline]
```

#### 7.2.2.10 parseRoot()

```
tl::expected< std::shared_ptr< Root >, std::string > behaviour_tree::BehaviourTreeParser↵
::parseRoot (
    const pugi::xml_node & node,
    const int index ) [inline], [private]
```

#### 7.2.2.11 parseXML()

```
tl::expected< std::shared_ptr< BehaviourTree >, std::string > behaviour_tree::BehaviourTree↵
Parser::parseXML (
    const std::string & xml ) [inline]
```

#### 7.2.2.12 setCustomNodeParser()

```
void behaviour_tree::BehaviourTreeParser::setCustomNodeParser (
    std::shared_ptr< CustomNodeParser > custom_node_parser ) [inline]
```

### 7.2.3 Member Data Documentation

### 7.2.3.1 custom\_node\_parser

```
std::shared_ptr<CustomNodeParser> behaviour_tree::BehaviourTreeParser::custom_node_parser
[private]
```

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

- behaviour\_tree/include/behaviour\_tree/[BehaviourTreeParser.hpp](#)

## 7.3 behaviour\_tree::node::blackboard::BlackboardNode Class Reference

```
#include <BlackboardNode.hpp>
```

Inheritance diagram for behaviour\_tree::node::blackboard::BlackboardNode:



### Public Member Functions

- [BlackboardNode](#) (const std::string &name)
- virtual const [BlackboardType](#) type () const =0

### Additional Inherited Members

### 7.3.1 Constructor & Destructor Documentation

#### 7.3.1.1 BlackboardNode()

```
behaviour_tree::node::blackboard::BlackboardNode::BlackboardNode (
    const std::string & name ) [inline]
```

### 7.3.2 Member Function Documentation

### 7.3.2.1 type()

```
virtual const BlackboardType behaviour_tree::node::blackboard::BlackboardNode::type ( ) const
[pure virtual]
```

Implemented in [behaviour\\_tree::node::blackboard::ChangeInteger](#), and [behaviour\\_tree::node::blackboard::IntegerCondition](#).

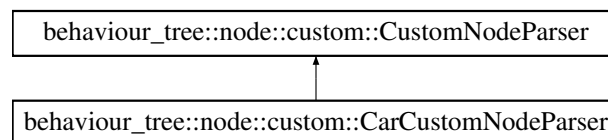
The documentation for this class was generated from the following file:

- [behaviour\\_tree/include/behaviour\\_tree/node/blackboard/BlackboardNode.hpp](#)

## 7.4 behaviour\_tree::node::custom::CarCustomNodeParser Class Reference

```
#include <CarCustomNodeParser.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::CarCustomNodeParser:



### Public Member Functions

- [CarCustomNodeParser](#) ()
- `tl::expected< std::shared_ptr< custom::CustomNode >, std::string >` [parseCustomNode](#) (const pugi::xml\_node &node, const int index) override

### 7.4.1 Constructor & Destructor Documentation

#### 7.4.1.1 CarCustomNodeParser()

```
behaviour_tree::node::custom::CarCustomNodeParser::CarCustomNodeParser ( ) [inline]
```

### 7.4.2 Member Function Documentation



### 7.4.2.1 parseCustomNode()

```
tl::expected< std::shared_ptr< custom::CustomNode >, std::string > behaviour_tree::node←
::custom::CarCustomNodeParser::parseCustomNode (
    const pugi::xml_node & node,
    const int index ) [inline], [override], [virtual]
```

Implements [behaviour\\_tree::node::custom::CustomNodeParser](#).

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

- behaviour\_tree\_car/include/behaviour\_tree/node/custom/[CarCustomNodeParser.hpp](#)

## 7.5 behaviour\_tree::node::blackboard::ChangeInteger Class Reference

```
#include <ChangeInteger.hpp>
```

Inheritance diagram for behaviour\_tree::node::blackboard::ChangeInteger:



### Public Member Functions

- [ChangeInteger](#) (const std::string &name, const std::string variable\_name, const [IntegerChangeType](#) integer\_change\_type, const int value)
- const [BlackboardType](#) type () const final override
- const [Status](#) run (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string [toString](#) () const final override

### Private Attributes

- const std::string [variable\\_name](#)
- const [IntegerChangeType](#) [integer\\_change\\_type](#)
- const int [value](#)

### Additional Inherited Members

#### 7.5.1 Constructor & Destructor Documentation

### 7.5.1.1 ChangeInteger()

```
behaviour_tree::node::blackboard::ChangeInteger::ChangeInteger (
    const std::string & name,
    const std::string variable_name,
    const IntegerChangeType integer_change_type,
    const int value ) [inline]
```

## 7.5.2 Member Function Documentation

### 7.5.2.1 run()

```
const Status behaviour_tree::node::blackboard::ChangeInteger::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.5.2.2 toString()

```
const std::string behaviour_tree::node::blackboard::ChangeInteger::toString ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.5.2.3 type()

```
const BlackboardType behaviour_tree::node::blackboard::ChangeInteger::type ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::blackboard::BlackboardNode](#).

## 7.5.3 Member Data Documentation

### 7.5.3.1 integer\_change\_type

```
const IntegerChangeType behaviour_tree::node::blackboard::ChangeInteger::integer_change_type
[private]
```

### 7.5.3.2 value

```
const int behaviour_tree::node::blackboard::ChangeInteger::value [private]
```

### 7.5.3.3 variable\_name

```
const std::string behaviour_tree::node::blackboard::ChangeInteger::variable_name [private]
```

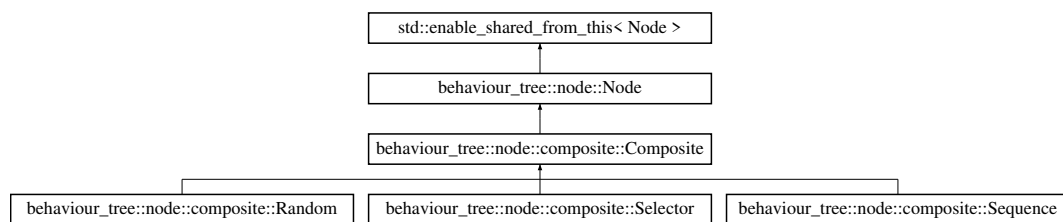
The documentation for this class was generated from the following file:

- behaviour\_tree/include/behaviour\_tree/node/blackboard/[ChangeInteger.hpp](#)

## 7.6 behaviour\_tree::node::composite::Composite Class Reference

```
#include <Composite.hpp>
```

Inheritance diagram for behaviour\_tree::node::composite::Composite:



### Public Member Functions

- [Composite](#) (const std::string &name, std::vector< std::shared\_ptr< [Node](#) > > children)
- [Status tick](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context, const int start\_index)
- virtual const [Status run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context, const int start\_index)=0
- virtual const [CompositeType type](#) () const =0

### Protected Attributes

- std::vector< std::shared\_ptr< [Node](#) > > children

### 7.6.1 Constructor & Destructor Documentation

### 7.6.1.1 Composite()

```
behaviour_tree::node::composite::Composite::Composite (
    const std::string & name,
    std::vector< std::shared_ptr< Node > > children ) [inline]
```

## 7.6.2 Member Function Documentation

### 7.6.2.1 run()

```
virtual const Status behaviour_tree::node::composite::Composite::run (
    const int tick_count,
    std::shared_ptr< Context > context,
    const int start_index ) [pure virtual]
```

Implemented in [behaviour\\_tree::node::composite::Random](#), [behaviour\\_tree::node::composite::Selector](#), and [behaviour\\_tree::node::composite::Sequence](#).

### 7.6.2.2 tick()

```
Status behaviour_tree::node::composite::Composite::tick (
    const int tick_count,
    std::shared_ptr< Context > context,
    const int start_index ) [inline]
```

### 7.6.2.3 type()

```
virtual const CompositeType behaviour_tree::node::composite::Composite::type ( ) const [pure virtual]
```

Implemented in [behaviour\\_tree::node::composite::Random](#), [behaviour\\_tree::node::composite::Selector](#), and [behaviour\\_tree::node::composite::Sequence](#).

## 7.6.3 Member Data Documentation

### 7.6.3.1 children

```
std::vector<std::shared_ptr<Node> > behaviour_tree::node::composite::Composite::children
[protected]
```

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

- behaviour\_tree/include/behaviour\_tree/node/composite/[Composite.hpp](#)

## 7.7 behaviour\_tree::Context Class Reference

```
#include <Context.h>
```

Inheritance diagram for behaviour\_tree::Context:



### Public Member Functions

- [Context](#) (std::shared\_ptr< [BehaviourTree](#) > [behaviour\\_tree](#))
- void [update](#) (const int tick\_count)
- [Status UseRoot](#) (const int tick\_count, const std::string &id)
- std::shared\_ptr< [BehaviourTree](#) > [getBehaviourTree](#) () const
- void [pushNodeTrace](#) (std::pair< std::shared\_ptr< [node::Node](#) >, int > node\_trace)
- void [popNode](#) ()
- bool [canRun](#) () const
- void [setBlackboard](#) (const std::string &key, const int value)
- int [getBlackboard](#) (const std::string &key) const
- int [containsBlackboard](#) (const std::string &key) const
- virtual void [\\_](#) ()

### Private Attributes

- std::shared\_ptr< [BehaviourTree](#) > [behaviour\\_tree](#)
- std::vector< std::pair< std::shared\_ptr< [node::Node](#) >, int > > [node\\_trace\\_list](#)
- std::unordered\_map< std::string, int > [blackboard](#)

### 7.7.1 Constructor & Destructor Documentation

### 7.7.1.1 Context()

```
behaviour_tree::Context::Context (
    std::shared_ptr< BehaviourTree > behaviour_tree )
```

## 7.7.2 Member Function Documentation

### 7.7.2.1 \_()

```
virtual void behaviour_tree::Context::_ ( ) [inline], [virtual]
```

### 7.7.2.2 canRun()

```
bool behaviour_tree::Context::canRun ( ) const
```

### 7.7.2.3 containsBlackboard()

```
int behaviour_tree::Context::containsBlackboard (
    const std::string & key ) const
```

### 7.7.2.4 getBehaviourTree()

```
std::shared_ptr< BehaviourTree > behaviour_tree::Context::getBehaviourTree ( ) const [inline]
```

### 7.7.2.5 getBlackboard()

```
int behaviour_tree::Context::getBlackboard (
    const std::string & key ) const
```

### 7.7.2.6 popNode()

```
void behaviour_tree::Context::popNode ( )
```

### 7.7.2.7 pushNodeTrace()

```
void behaviour_tree::Context::pushNodeTrace (
    std::pair< std::shared_ptr< node::Node >, int > node_trace )
```

### 7.7.2.8 setBlackboard()

```
void behaviour_tree::Context::setBlackboard (
    const std::string & key,
    const int value )
```

### 7.7.2.9 update()

```
void behaviour_tree::Context::update (
    const int tick_count )
```

### 7.7.2.10 UseRoot()

```
Status behaviour_tree::Context::UseRoot (
    const int tick_count,
    const std::string & id )
```

## 7.7.3 Member Data Documentation

### 7.7.3.1 behaviour\_tree

```
std::shared_ptr<BehaviourTree> behaviour_tree::Context::behaviour_tree [private]
```

### 7.7.3.2 blackboard

```
std::unordered_map<std::string, int> behaviour_tree::Context::blackboard [private]
```

### 7.7.3.3 node\_trace\_list

```
std::vector<std::pair<std::shared_ptr<node::Node>, int> > behaviour_tree::Context::node_↵
trace_list [private]
```

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

- [behaviour\\_tree/include/behaviour\\_tree/Context.h](#)
- [behaviour\\_tree/include/behaviour\\_tree/Context.cpp](#)

## 7.8 behaviour\_tree::node::custom::CustomNode Class Reference

```
#include <CustomNode.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::CustomNode:



### Public Member Functions

- [CustomNode](#) (const std::string &[name](#))

### Additional Inherited Members

#### 7.8.1 Constructor & Destructor Documentation



### 7.8.1.1 CustomNode()

```
behaviour_tree::node::custom::CustomNode::CustomNode (
    const std::string & name ) [inline]
```

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

- behaviour\_tree/include/behaviour\_tree/node/custom/[CustomNode.hpp](#)

## 7.9 behaviour\_tree::node::custom::CustomNodeParser Class Reference

```
#include <CustomNodeParser.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::CustomNodeParser:



### Public Member Functions

- virtual tl::expected< std::shared\_ptr< [CustomNode](#) >, std::string > [parseCustomNode](#) (const pugi::xml\_node &node, const int index)=0

### 7.9.1 Member Function Documentation

#### 7.9.1.1 parseCustomNode()

```
virtual tl::expected< std::shared_ptr< CustomNode >, std::string > behaviour_tree::node::
custom::CustomNodeParser::parseCustomNode (
    const pugi::xml_node & node,
    const int index ) [pure virtual]
```

Implemented in [behaviour\\_tree::node::custom::CarCustomNodeParser](#).

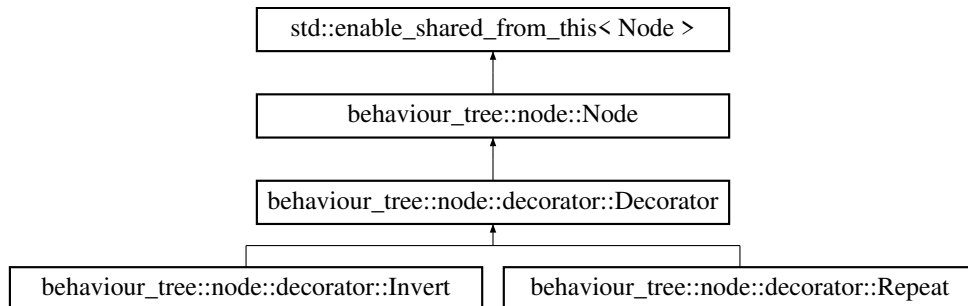
The documentation for this class was generated from the following file:

- behaviour\_tree/include/behaviour\_tree/node/custom/[CustomNodeParser.hpp](#)

## 7.10 behaviour\_tree::node::decorator::Decorator Class Reference

```
#include <Decorator.hpp>
```

Inheritance diagram for behaviour\_tree::node::decorator::Decorator:



### Public Member Functions

- [Decorator](#) (const std::string &name, std::shared\_ptr< [Node](#) > child)
- virtual const [DecoratorType](#) type () const =0

### Protected Attributes

- std::shared\_ptr< [Node](#) > child

### 7.10.1 Constructor & Destructor Documentation

#### 7.10.1.1 Decorator()

```
behaviour_tree::node::decorator::Decorator::Decorator (
    const std::string & name,
    std::shared_ptr< Node > child ) [inline]
```

### 7.10.2 Member Function Documentation

#### 7.10.2.1 type()

```
virtual const DecoratorType behaviour_tree::node::decorator::Decorator::type ( ) const [pure virtual]
```

Implemented in [behaviour\\_tree::node::decorator::Invert](#), and [behaviour\\_tree::node::decorator::Repeat](#).

### 7.10.3 Member Data Documentation

#### 7.10.3.1 child

```
std::shared_ptr<Node> behaviour_tree::node::decorator::Decorator::child [protected]
```

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

- behaviour\_tree/include/behaviour\_tree/node/decorator/[Decorator.hpp](#)

## 7.11 rplidar::DeviceInfo Struct Reference

```
#include <RPLidar.h>
```

### Public Attributes

- uint8\_t [model](#)
- std::pair< uint8\_t, uint8\_t > [firmware](#)
- uint8\_t [hardware](#)
- std::string [serialNumber](#)

### 7.11.1 Member Data Documentation

#### 7.11.1.1 firmware

```
std::pair<uint8_t, uint8_t> rplidar::DeviceInfo::firmware
```

#### 7.11.1.2 hardware

```
uint8_t rplidar::DeviceInfo::hardware
```

#### 7.11.1.3 model

```
uint8_t rplidar::DeviceInfo::model
```

#### 7.11.1.4 serialNumber

```
std::string rplidar::DeviceInfo::serialNumber
```

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

- [rplidar/include/RPLidar.h](#)

## 7.12 behaviour\_tree::node::custom::action::Drive Class Reference

```
#include <Drive.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::action::Drive:



### Public Member Functions

- [Drive](#) (const std::string &[name](#), const int [speed](#), const [DirectionType](#) [direction\\_type](#))
- const [Status](#) [run](#) (const int [tick\\_count](#), std::shared\_ptr< [Context](#) > [context](#)) final override
- const std::string [toString](#) () const final override
- const int [getSpeed](#) () const
- const [DirectionType](#) [getDirectionType](#) () const

### Static Public Member Functions

- static const tl::expected< std::shared\_ptr< [Drive](#) >, std::string > [parse](#) (const pugi::xml\_node &[node](#), const int [index](#), const std::string &[name\\_attribute](#))

### Private Attributes

- const int [speed](#)
- const [DirectionType](#) [direction\\_type](#)

### Additional Inherited Members

#### 7.12.1 Constructor & Destructor Documentation

### 7.12.1.1 Drive()

```
behaviour_tree::node::custom::action::Drive::Drive (
    const std::string & name,
    const int speed,
    const DirectionType direction_type ) [inline]
```

## 7.12.2 Member Function Documentation

### 7.12.2.1 getDirectionType()

```
const DirectionType behaviour_tree::node::custom::action::Drive::getDirectionType ( ) const
[inline]
```

### 7.12.2.2 getSpeed()

```
const int behaviour_tree::node::custom::action::Drive::getSpeed ( ) const [inline]
```

### 7.12.2.3 parse()

```
static const tl::expected< std::shared_ptr< Drive >, std::string > behaviour_tree::node↵
::custom::action::Drive::parse (
    const pugi::xml_node & node,
    const int index,
    const std::string & name_attribute ) [inline], [static]
```

### 7.12.2.4 run()

```
const Status behaviour_tree::node::custom::action::Drive::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.12.2.5 toString()

```
const std::string behaviour_tree::node::custom::action::Drive::toString ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.12.3 Member Data Documentation

#### 7.12.3.1 direction\_type

```
const DirectionType behaviour_tree::node::custom::action::Drive::direction_type [private]
```

#### 7.12.3.2 speed

```
const int behaviour_tree::node::custom::action::Drive::speed [private]
```

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

- behaviour\_tree\_car/include/behaviour\_tree/node/custom/action/Drive.hpp

## 7.13 rplidar::ExpressPacket Class Reference

```
#include <RPLidar.h>
```

### Public Member Functions

- [ExpressPacket](#) (std::vector< uint8\_t > data)

### Static Public Member Functions

- static int [getSign](#) (uint8\_t value)

### Public Attributes

- std::vector< uint16\_t > [distance](#)
- std::vector< float > [angle](#)
- bool [new\\_scan](#)
- float [start\\_angle](#)

### Static Public Attributes

- static const uint8\_t [sync1](#) = 0xa
- static const uint8\_t [sync2](#) = 0x5

## 7.13.1 Constructor & Destructor Documentation

### 7.13.1.1 ExpressPacket()

```
rplidar::ExpressPacket::ExpressPacket (
    std::vector< uint8_t > data ) [inline]
```

## 7.13.2 Member Function Documentation

### 7.13.2.1 getSign()

```
static int rplidar::ExpressPacket::getSign (
    uint8_t value ) [inline], [static]
```

## 7.13.3 Member Data Documentation

### 7.13.3.1 angle

```
std::vector<float> rplidar::ExpressPacket::angle
```

### 7.13.3.2 distance

```
std::vector<uint16_t> rplidar::ExpressPacket::distance
```

### 7.13.3.3 new\_scan

```
bool rplidar::ExpressPacket::new_scan
```

### 7.13.3.4 start\_angle

```
float rplidar::ExpressPacket::start_angle
```

### 7.13.3.5 sync1

```
const uint8_t rplidar::ExpressPacket::sync1 = 0xa [static]
```

### 7.13.3.6 sync2

```
const uint8_t rplidar::ExpressPacket::sync2 = 0x5 [static]
```

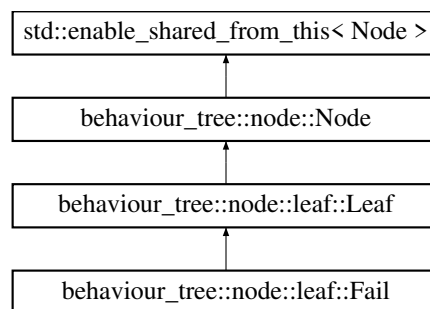
The documentation for this class was generated from the following file:

- [rplidar/include/RPLidar.h](#)

## 7.14 behaviour\_tree::node::leaf::Fail Class Reference

```
#include <Fail.hpp>
```

Inheritance diagram for behaviour\_tree::node::leaf::Fail:



### Public Member Functions

- [Fail](#) (const std::string &name)
- const [LeafType](#) type () const final override
- const [Status](#) run (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string [toString](#) () const final override

### Additional Inherited Members

## 7.14.1 Constructor & Destructor Documentation

### 7.14.1.1 Fail()

```
behaviour_tree::node::leaf::Fail::Fail (
    const std::string & name ) [inline]
```



## 7.14.2 Member Function Documentation

### 7.14.2.1 run()

```
const Status behaviour_tree::node::leaf::Fail::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.14.2.2 toString()

```
const std::string behaviour_tree::node::leaf::Fail::toString ( ) const [inline], [final],
[override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.14.2.3 type()

```
const LeafType behaviour_tree::node::leaf::Fail::type ( ) const [inline], [final], [override],
[virtual]
```

Implements [behaviour\\_tree::node::leaf::Leaf](#).

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

- [behaviour\\_tree/include/behaviour\\_tree/node/leaf/Fail.hpp](#)

## 7.15 rplidar::HealthInfo Struct Reference

Health Info for Lidar Scanner.

```
#include <RPLidar.h>
```

### Public Attributes

- std::string [status](#)  
*'Good', 'Warning' or 'Error' statuses*
- int [errorCode](#)  
*The related error code that caused a warning/error.*

### 7.15.1 Detailed Description

Health Info for Lidar Scanner.

### 7.15.2 Member Data Documentation

#### 7.15.2.1 errorCode

```
int rplidar::HealthInfo::errorCode
```

The related error code that caused a warning/error.

#### 7.15.2.2 status

```
std::string rplidar::HealthInfo::status
```

'Good', 'Warning' or 'Error' statuses

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

- [rplidar/include/RPLidar.h](#)

## 7.16 behaviour\_tree::node::blackboard::IntegerCondition Class Reference

```
#include <IntegerCondition.hpp>
```

Inheritance diagram for behaviour\_tree::node::blackboard::IntegerCondition:



## Public Member Functions

- [IntegerCondition](#) (const std::string &name, const std::string variable\_name, const [ConditionOperatorType](#) condition\_operator, const int value)
- const [BlackboardType](#) type () const final override
- const [Status](#) run (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string toString () const final override

## Private Attributes

- const std::string variable\_name
- const [ConditionOperatorType](#) condition\_operator
- const int value

## Additional Inherited Members

### 7.16.1 Constructor & Destructor Documentation

#### 7.16.1.1 IntegerCondition()

```
behaviour_tree::node::blackboard::IntegerCondition::IntegerCondition (
    const std::string & name,
    const std::string variable_name,
    const ConditionOperatorType condition_operator,
    const int value ) [inline]
```

### 7.16.2 Member Function Documentation

#### 7.16.2.1 run()

```
const Status behaviour_tree::node::blackboard::IntegerCondition::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

#### 7.16.2.2 toString()

```
const std::string behaviour_tree::node::blackboard::IntegerCondition::toString ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.16.2.3 type()

```
const BlackboardType behaviour_tree::node::blackboard::IntegerCondition::type ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::blackboard::BlackboardNode](#).

## 7.16.3 Member Data Documentation

### 7.16.3.1 condition\_operator

```
const ConditionOperatorType behaviour_tree::node::blackboard::IntegerCondition::condition_↔
operator [private]
```

### 7.16.3.2 value

```
const int behaviour_tree::node::blackboard::IntegerCondition::value [private]
```

### 7.16.3.3 variable\_name

```
const std::string behaviour_tree::node::blackboard::IntegerCondition::variable_name [private]
```

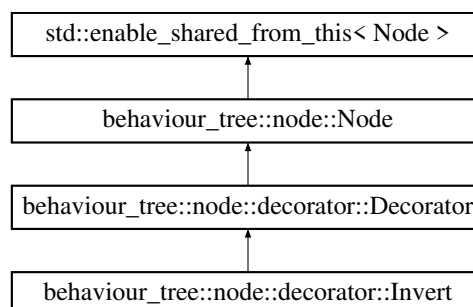
The documentation for this class was generated from the following file:

- [behaviour\\_tree/include/behaviour\\_tree/node/blackboard/IntegerCondition.hpp](#)

## 7.17 behaviour\_tree::node::decorator::Invert Class Reference

```
#include <Invert.hpp>
```

Inheritance diagram for behaviour\_tree::node::decorator::Invert:



## Public Member Functions

- [Invert](#) (const std::string &[name](#), std::shared\_ptr< [Node](#) > [child](#))
- const [DecoratorType type](#) () const final override
- void [start](#) (std::shared\_ptr< [Context](#) > context) final override
- void [finish](#) (std::shared\_ptr< [Context](#) > context) final override
- const [Status run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string [toString](#) () const final override

## Additional Inherited Members

### 7.17.1 Constructor & Destructor Documentation

#### 7.17.1.1 Invert()

```
behaviour_tree::node::decorator::Invert::Invert (  
    const std::string & name,  
    std::shared_ptr< Node > child ) [inline]
```

### 7.17.2 Member Function Documentation

#### 7.17.2.1 finish()

```
void behaviour_tree::node::decorator::Invert::finish (  
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Reimplemented from [behaviour\\_tree::node::Node](#).

#### 7.17.2.2 run()

```
const Status behaviour_tree::node::decorator::Invert::run (  
    const int tick\_count,  
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.17.2.3 start()

```
void behaviour_tree::node::decorator::Invert::start (
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Reimplemented from [behaviour\\_tree::node::Node](#).

### 7.17.2.4 toString()

```
const std::string behaviour_tree::node::decorator::Invert::toString ( ) const [inline], [final],
[override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.17.2.5 type()

```
const DecoratorType behaviour_tree::node::decorator::Invert::type ( ) const [inline], [final],
[override], [virtual]
```

Implements [behaviour\\_tree::node::decorator::Decorator](#).

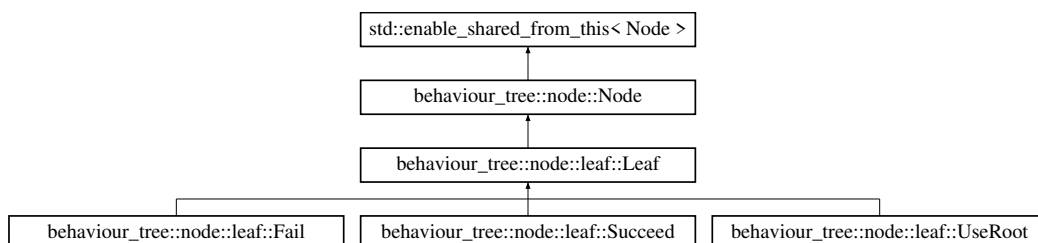
The documentation for this class was generated from the following file:

- [behaviour\\_tree/include/behaviour\\_tree/node/decorator/Invert.hpp](#)

## 7.18 behaviour\_tree::node::leaf::Leaf Class Reference

```
#include <Leaf.hpp>
```

Inheritance diagram for behaviour\_tree::node::leaf::Leaf:



### Public Member Functions

- [Leaf](#) (const std::string &name)
- virtual const [LeafType](#) type ( ) const =0

## Additional Inherited Members

### 7.18.1 Constructor & Destructor Documentation

#### 7.18.1.1 Leaf()

```
behaviour_tree::node::leaf::Leaf::Leaf (
    const std::string & name ) [inline]
```

### 7.18.2 Member Function Documentation

#### 7.18.2.1 type()

```
virtual const LeafType behaviour_tree::node::leaf::Leaf::type ( ) const [pure virtual]
```

Implemented in [behaviour\\_tree::node::leaf::Fail](#), [behaviour\\_tree::node::leaf::Succeed](#), and [behaviour\\_tree::node::leaf::UseRoot](#).

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

- [behaviour\\_tree/include/behaviour\\_tree/node/leaf/Leaf.hpp](#)

## 7.19 rplidar::Measure Struct Reference

```
#include <RPLidar.h>
```

### Public Attributes

- bool [newScan](#)
- int [quality](#)
- double [angle](#)
- double [distance](#)

### 7.19.1 Member Data Documentation

#### 7.19.1.1 angle

```
double rplidar::Measure::angle
```





## 7.20.1 Constructor & Destructor Documentation

### 7.20.1.1 Node()

```
behaviour_tree::node::Node::Node (
    const std::string & name ) [inline]
```

## 7.20.2 Member Function Documentation

### 7.20.2.1 finish()

```
virtual void behaviour_tree::node::Node::finish (
    std::shared_ptr< Context > context ) [inline], [virtual]
```

Reimplemented in [behaviour\\_tree::node::decorator::Invert](#), and [behaviour\\_tree::node::custom::action::PauseExecution](#).

### 7.20.2.2 getName()

```
const std::string & behaviour_tree::node::Node::getName ( ) const [inline]
```

### 7.20.2.3 run()

```
virtual const Status behaviour_tree::node::Node::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [pure virtual]
```

Implemented in [behaviour\\_tree::node::blackboard::ChangeInteger](#), [behaviour\\_tree::node::blackboard::IntegerCondition](#), [behaviour\\_tree::node::composite::Random](#), [behaviour\\_tree::node::composite::Selector](#), [behaviour\\_tree::node::composite::Sequence](#), [behaviour\\_tree::node::decorator::Invert](#), [behaviour\\_tree::node::decorator::Repeat](#), [behaviour\\_tree::node::leaf::Fail](#), [behaviour\\_tree::node::leaf::Succeed](#), [behaviour\\_tree::node::leaf::UseRoot](#), [behaviour\\_tree::node::custom::action::Drive](#), [behaviour\\_tree::node::custom::action::PauseExecution](#), [behaviour\\_tree::node::custom::action::Print](#), [behaviour\\_tree::node::custom::action::SetSpeed](#), [behaviour\\_tree::node::custom::action::SetWheelDirection](#), [behaviour\\_tree::node::custom::action::Turn](#), [behaviour\\_tree::node::custom::condition::SucceedOnAnyNearbyScan](#), [behaviour\\_tree::node::custom::condition::SucceedOnAverageColour](#), and [behaviour\\_tree::node::custom::condition::SucceedOnAverage](#).

#### 7.20.2.4 start()

```
virtual void behaviour_tree::node::Node::start (
    std::shared_ptr< Context > context ) [inline], [virtual]
```

Reimplemented in [behaviour\\_tree::node::composite::Selector](#), [behaviour\\_tree::node::composite::Sequence](#), [behaviour\\_tree::node::decorator::Invert](#), [behaviour\\_tree::node::decorator::Repeat](#), and [behaviour\\_tree::node::custom::action::PauseE](#)

#### 7.20.2.5 tick()

```
Status behaviour_tree::node::Node::tick (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline]
```

#### 7.20.2.6 toString()

```
virtual const std::string behaviour_tree::node::Node::toString ( ) const [pure virtual]
```

Implemented in [behaviour\\_tree::node::blackboard::ChangeInteger](#), [behaviour\\_tree::node::blackboard::IntegerCondition](#), [behaviour\\_tree::node::composite::Random](#), [behaviour\\_tree::node::composite::Selector](#), [behaviour\\_tree::node::composite::Sequence](#), [behaviour\\_tree::node::decorator::Invert](#), [behaviour\\_tree::node::decorator::Repeat](#), [behaviour\\_tree::node::leaf::Fail](#), [behaviour\\_tree::node::leaf::Succeed](#), [behaviour\\_tree::node::leaf::UseRoot](#), [behaviour\\_tree::node::custom::action::Drive](#), [behaviour\\_tree::node::custom::action::PauseExecution](#), [behaviour\\_tree::node::custom::action::Print](#), [behaviour\\_tree::node::custom::a](#), [behaviour\\_tree::node::custom::action::SetSpeed](#), [behaviour\\_tree::node::custom::action::SetWheelDirection](#), [behaviour\\_tree::node::custom::action::Turn](#), [behaviour\\_tree::node::custom::condition::SucceedOnAnyNearbyScan](#), [behaviour\\_tree::node::custom::condition::SucceedOnAverageColour](#), and [behaviour\\_tree::node::custom::condition::SucceedOnAvera](#)

### 7.20.3 Member Data Documentation

#### 7.20.3.1 name

```
const std::string behaviour_tree::node::Node::name [protected]
```

#### 7.20.3.2 started

```
bool behaviour_tree::node::Node::started = false [protected]
```

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

- [behaviour\\_tree/include/behaviour\\_tree/node/Node.hpp](#)

## 7.21 behaviour\_tree::node::custom::action::PauseExecution Class Reference

```
#include <PauseExecution.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::action::PauseExecution:



### Public Member Functions

- [PauseExecution](#) (const std::string &[name](#), const int [ms](#))
- void [start](#) (std::shared\_ptr< [Context](#) > context) final override
- void [finish](#) (std::shared\_ptr< [Context](#) > context) final override
- const [Status](#) [run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string [toString](#) () const final override
- const int [getMS](#) () const

### Static Public Member Functions

- static const tl::expected< std::shared\_ptr< [PauseExecution](#) >, std::string > [parse](#) (const pugi::xml\_node &node, const int index, const std::string &name\_attribute)

### Private Attributes

- std::chrono::steady\_clock::time\_point [start\\_time](#)
- const int [ms](#)

### Additional Inherited Members

#### 7.21.1 Constructor & Destructor Documentation

##### 7.21.1.1 PauseExecution()

```
behaviour_tree::node::custom::action::PauseExecution::PauseExecution (
    const std::string & name,
    const int ms ) [inline]
```

## 7.21.2 Member Function Documentation

### 7.21.2.1 finish()

```
void behaviour_tree::node::custom::action::PauseExecution::finish (
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Reimplemented from [behaviour\\_tree::node::Node](#).

### 7.21.2.2 getMS()

```
const int behaviour_tree::node::custom::action::PauseExecution::getMS ( ) const [inline]
```

### 7.21.2.3 parse()

```
static const tl::expected< std::shared_ptr< PauseExecution >, std::string > behaviour_tree↵
::node::custom::action::PauseExecution::parse (
    const pugi::xml_node & node,
    const int index,
    const std::string & name_attribute ) [inline], [static]
```

### 7.21.2.4 run()

```
const Status behaviour_tree::node::custom::action::PauseExecution::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.21.2.5 start()

```
void behaviour_tree::node::custom::action::PauseExecution::start (
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Reimplemented from [behaviour\\_tree::node::Node](#).

### 7.21.2.6 toString()

```
const std::string behaviour_tree::node::custom::action::PauseExecution::toString ( ) const
[inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

## 7.21.3 Member Data Documentation

### 7.21.3.1 ms

```
const int behaviour_tree::node::custom::action::PauseExecution::ms [private]
```

### 7.21.3.2 start\_time

```
std::chrono::steady_clock::time_point behaviour_tree::node::custom::action::PauseExecution↔
::start_time [private]
```

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

- [behaviour\\_tree\\_car/include/behaviour\\_tree/node/custom/action/PauseExecution.hpp](#)

## 7.22 behaviour\_tree::node::custom::action::Print Class Reference

```
#include <Print.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::action::Print:



## Public Member Functions

- [Print](#) (const std::string &[name](#), const std::string &[text](#))
- const [Status run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string & [getText](#) () const
- const std::string [toString](#) () const final override

## Static Public Member Functions

- static const tl::expected< std::shared\_ptr< [Print](#) >, std::string > [parse](#) (const pugi::xml\_node &node, const int index, const std::string &name\_attribute)

## Private Attributes

- const std::string [text](#)

## Additional Inherited Members

### 7.22.1 Constructor & Destructor Documentation

#### 7.22.1.1 Print()

```
behaviour_tree::node::custom::action::Print::Print (  
    const std::string & name,  
    const std::string & text ) [inline]
```

### 7.22.2 Member Function Documentation

#### 7.22.2.1 getText()

```
const std::string & behaviour_tree::node::custom::action::Print::getText ( ) const [inline]
```

#### 7.22.2.2 parse()

```
static const tl::expected< std::shared_ptr< Print >, std::string > behaviour_tree::node←  
::custom::action::Print::parse (  
    const pugi::xml_node & node,  
    const int index,  
    const std::string & name_attribute ) [inline], [static]
```

### 7.22.2.3 run()

```
const Status behaviour_tree::node::custom::action::Print::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.22.2.4 toString()

```
const std::string behaviour_tree::node::custom::action::Print::toString ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

## 7.22.3 Member Data Documentation

### 7.22.3.1 text

```
const std::string behaviour_tree::node::custom::action::Print::text [private]
```

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

- [behaviour\\_tree\\_car/include/behaviour\\_tree/node/custom/action/Print.hpp](#)

## 7.23 behaviour\_tree::node::composite::Random Class Reference

```
#include <Random.hpp>
```

Inheritance diagram for behaviour\_tree::node::composite::Random:



## Public Member Functions

- [Random](#) (const std::string &name, std::vector< std::shared\_ptr< [Node](#) > > children)
- const [CompositeType type](#) () const final override
- const [Status run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const [Status run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context, const int start\_index) final override
- const std::string [toString](#) () const final override

## Additional Inherited Members

### 7.23.1 Constructor & Destructor Documentation

#### 7.23.1.1 Random()

```
behaviour_tree::node::composite::Random::Random (
    const std::string & name,
    std::vector< std::shared_ptr< Node > > children ) [inline]
```

### 7.23.2 Member Function Documentation

#### 7.23.2.1 run() [1/2]

```
const Status behaviour_tree::node::composite::Random::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

#### 7.23.2.2 run() [2/2]

```
const Status behaviour_tree::node::composite::Random::run (
    const int tick_count,
    std::shared_ptr< Context > context,
    const int start_index ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::composite::Composite](#).



### 7.23.2.3 toString()

```
const std::string behaviour_tree::node::composite::Random::toString ( ) const [inline], [final],  
[override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.23.2.4 type()

```
const CompositeType behaviour_tree::node::composite::Random::type ( ) const [inline], [final],  
[override], [virtual]
```

Implements [behaviour\\_tree::node::composite::Composite](#).

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

- [behaviour\\_tree/include/behaviour\\_tree/node/composite/Random.hpp](#)

## 7.24 utils::RawTypeNameFormat Struct Reference

```
#include <TypeName.hpp>
```

### Public Attributes

- `std::size_t` [leading\\_junk](#) = 0
- `std::size_t` [trailing\\_junk](#) = 0

### 7.24.1 Member Data Documentation

#### 7.24.1.1 leading\_junk

```
std::size_t utils::RawTypeNameFormat::leading_junk = 0
```

#### 7.24.1.2 trailing\_junk

```
std::size_t utils::RawTypeNameFormat::trailing_junk = 0
```

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

- [utils/include/utils/TypeName.hpp](#)

## 7.25 behaviour\_tree::node::decorator::Repeat Class Reference

```
#include <Repeat.hpp>
```

Inheritance diagram for behaviour\_tree::node::decorator::Repeat:



### Public Member Functions

- [Repeat](#) (const std::string &name, std::shared\_ptr< [Node](#) > child, const unsigned long amount, const bool break\_on\_fail)
- const [DecoratorType](#) type () const final override
- void [start](#) (std::shared\_ptr< [Context](#) > context) final override
- const [Status](#) run (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string [toString](#) () const final override
- const unsigned long [getAmount](#) () const
- const bool [getBreakOnFail](#) () const
- const unsigned long [getCount](#) () const

### Private Attributes

- const unsigned long amount
- const bool break\_on\_fail
- unsigned long count = 0

### Additional Inherited Members

#### 7.25.1 Constructor & Destructor Documentation

##### 7.25.1.1 Repeat()

```
behaviour_tree::node::decorator::Repeat::Repeat (
    const std::string & name,
    std::shared_ptr< Node > child,
    const unsigned long amount,
    const bool break_on_fail ) [inline]
```

## 7.25.2 Member Function Documentation

### 7.25.2.1 getAmount()

```
const unsigned long behaviour_tree::node::decorator::Repeat::getAmount ( ) const [inline]
```

### 7.25.2.2 getBreakOnFail()

```
const bool behaviour_tree::node::decorator::Repeat::getBreakOnFail ( ) const [inline]
```

### 7.25.2.3 getCount()

```
const unsigned long behaviour_tree::node::decorator::Repeat::getCount ( ) const [inline]
```

### 7.25.2.4 run()

```
const Status behaviour_tree::node::decorator::Repeat::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.25.2.5 start()

```
void behaviour_tree::node::decorator::Repeat::start (
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Reimplemented from [behaviour\\_tree::node::Node](#).

### 7.25.2.6 toString()

```
const std::string behaviour_tree::node::decorator::Repeat::toString ( ) const [inline], [final],
[override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.25.2.7 type()

```
const DecoratorType behaviour_tree::node::decorator::Repeat::type ( ) const [inline], [final],
[override], [virtual]
```

Implements [behaviour\\_tree::node::decorator::Decorator](#).

## 7.25.3 Member Data Documentation

### 7.25.3.1 amount

```
const unsigned long behaviour_tree::node::decorator::Repeat::amount [private]
```

### 7.25.3.2 break\_on\_fail

```
const bool behaviour_tree::node::decorator::Repeat::break_on_fail [private]
```

### 7.25.3.3 count

```
unsigned long behaviour_tree::node::decorator::Repeat::count = 0 [private]
```

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

- [behaviour\\_tree/include/behaviour\\_tree/node/decorator/Repeat.hpp](#)

## 7.26 behaviour\_tree::Root Class Reference

```
#include <Root.hpp>
```

### Public Member Functions

- [Root](#) (std::string [id](#), std::shared\_ptr< [node::Node](#) > [child](#))
- const [Status tick](#) (const int tick\_count, std::shared\_ptr< [Context](#) > &context)
- const std::string [toString](#) () const
- const std::string & [getId](#) () const

### Private Attributes

- std::string [id](#)
- std::shared\_ptr< [node::Node](#) > [child](#)

## 7.26.1 Constructor & Destructor Documentation

### 7.26.1.1 Root()

```
behaviour_tree::Root::Root (
    std::string id,
    std::shared_ptr< node::Node > child ) [inline]
```

## 7.26.2 Member Function Documentation

### 7.26.2.1 getId()

```
const std::string & behaviour_tree::Root::getId ( ) const [inline]
```

### 7.26.2.2 tick()

```
const Status behaviour_tree::Root::tick (
    const int tick_count,
    std::shared_ptr< Context > & context ) [inline]
```

### 7.26.2.3 toString()

```
const std::string behaviour_tree::Root::toString ( ) const [inline]
```

## 7.26.3 Member Data Documentation

### 7.26.3.1 child

```
std::shared_ptr<node::Node> behaviour_tree::Root::child [private]
```

### 7.26.3.2 id

```
std::string behaviour_tree::Root::id [private]
```

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

- behaviour\_tree/include/behaviour\_tree/[Root.hpp](#)

## 7.27 rplidar::RPLidar Class Reference

Class for communicating with [RPLidar](#) rangefinder scanners.

```
#include <RPLidar.h>
```

### Public Member Functions

- [RPLidar](#) (const std::string &port, uint32\_t baudrate, std::unique\_ptr< serial::Serial > serial)  
*Initialize [RPLidar](#) object for communicating with the sensor.*
- [~RPLidar](#) ()
- void [disconnect](#) ()
- void [set\\_motor\\_speed](#) (int pwm)
- void [start\\_motor](#) ()  
*Starts sensor motor.*
- void [stop\\_motor](#) ()  
*Stops sensor motor.*
- tl::expected< [DeviceInfo](#), std::string > [get\\_info](#) ()  
*Get device information.*
- tl::expected< [HealthInfo](#), std::string > [get\\_health](#) ()  
*Get device health state. When the core system detects some potential risk that may cause hardware failure in the future, the returned status value will be 'Warning'. But sensor can still work as normal. When sensor is in the Protection Stop state, the returned status value will be 'Error'. In case of warning or error statuses non-zero error code will be returned.*
- void [clean\\_input](#) ()  
*Clean input buffer by reading all available data.*
- void [stop](#) ()  
*Stops scanning process, disables laser diode and the measurement system, moves sensor to the idle state.*
- tl::expected< nullptr\_t, std::string > [start](#) ([ScanType](#) scanType=[ScanType::NORMAL](#))  
*Start the scanning process.*
- void [reset](#) ()  
*Resets sensor core, reverting it to a similar state as it has just been powered up.*
- std::function< tl::expected< [Measure](#), std::string >()> [iter\\_measures](#) ([ScanType](#) scanType=[ScanType::NORMAL](#), int maxBufMeas=3000)
- std::function< std::vector< [Measure](#) >()> [iter\\_scans](#) ([ScanType](#) scanType=[ScanType::NORMAL](#), int maxBufMeas=3000, int minLen=5)  
*Iterate over scans. Note that consumer must be fast enough, otherwise data will be accumulated inside buffer and consumer will get data with increasing lag.*

## Static Public Member Functions

- static `tl::expected< std::unique_ptr< RPLidar >, std::string > create` (const std::string &port, uint32\_t baudrate=115200U) noexcept

## Private Member Functions

- void `_set_pwm` (int pwm)
- void `_send_payload_cmd` (uint8\_t cmd, const std::string &payload)  
*Sends cmd command with payload to the sensor.*
- void `_send_cmd` (uint8\_t cmd)  
*Sends cmd command to the sensor.*
- `tl::expected< std::tuple< uint8_t, bool, uint8_t >, std::string > _read_descriptor` ()  
*Reads descriptor packet.*
- `std::vector< uint8_t > _read_response` (int dsize)  
*Reads response packet with length of dsize bytes.*
- `std::string convertToHexString` (uint8\_t value)
- `tl::expected< Measure, std::string > _process_scan` (const std::vector< uint8\_t > &raw)
- `Measure _process_express_scan` (std::unique\_ptr< ExpressPacket > &data, float newAngle, int frame)  
*Iterate over measures. Note that consumer must be fast enough, otherwise data will be accumulated inside buffer and consumer will get data with increasing lag.*

## Private Attributes

- `std::unique_ptr< serial::Serial > _serial` = nullptr
- `std::string port`
- `uint32_t baudrate`
- `int _motor_speed` = DEFAULT\_MOTOR\_PWM
- `bool motor_running` = false
- `ScanInfo scanning` = ScanInfo{false, 0, ScanType::NORMAL}
- `int express_frame` = 32
- `std::unique_ptr< ExpressPacket > express_data` = nullptr
- `std::unique_ptr< ExpressPacket > express_old_data` = nullptr

### 7.27.1 Detailed Description

Class for communicating with [RPLidar](#) rangefinder scanners.

### 7.27.2 Constructor & Destructor Documentation

#### 7.27.2.1 RPLidar()

```
rplidar::RPLidar::RPLidar (
    const std::string & port,
    uint32_t baudrate,
    std::unique_ptr< serial::Serial > serial ) [inline]
```

Initialize [RPLidar](#) object for communicating with the sensor.

## Parameters

<i>port</i>	Serial port name to which sensor is connected
<i>baudrate</i>	Baudrate for serial connection (the default is 115200)

## 7.27.2.2 ~RPLidar()

```
rplidar::RPLidar::~~RPLidar ( ) [inline]
```

## 7.27.3 Member Function Documentation

## 7.27.3.1 \_process\_express\_scan()

```
Measure rplidar::RPLidar::_process_express_scan (
    std::unique_ptr< ExpressPacket > & data,
    float newAngle,
    int trame ) [inline], [private]
```

Iterate over measures. Note that consumer must be fast enough, otherwise data will be accumulated inside buffer and consumer will get data with increasing lag.

## Parameters

<i>scanType</i>	
<i>maxBufMeas</i>	int or False if you want unlimited buffer Maximum number of bytes to be stored inside the buffer. Once numbe exceeds this limit buffer will be emptied out.

## Returns

```
std::function<Measure()>
```

## 7.27.3.2 \_process\_scan()

```
tl::expected< Measure, std::string > rplidar::RPLidar::_process_scan (
    const std::vector< uint8_t > & raw ) [inline], [private]
```



### 7.27.3.3 \_read\_descriptor()

```
tl::expected< std::tuple< uint8_t, bool, uint8_t >, std::string > rplidar::RPLidar::_read_descriptor ( ) [inline], [private]
```

Reads descriptor packet.

#### Returns

tl::expected<std::tuple<uint8\_t, bool, uint8\_t>, std::string>

### 7.27.3.4 \_read\_response()

```
std::vector< uint8_t > rplidar::RPLidar::_read_response (
    int dsize ) [inline], [private]
```

Reads response packet with length of *dsize* bytes.

#### Parameters

<i>dsize</i>	
--------------	--

#### Returns

std::vector<uint8\_t>

### 7.27.3.5 \_send\_cmd()

```
void rplidar::RPLidar::_send_cmd (
    uint8_t cmd ) [inline], [private]
```

Sends *cmd* command to the sensor.

#### Parameters

<i>cmd</i>	
------------	--

### 7.27.3.6 \_send\_payload\_cmd()

```
void rplidar::RPLidar::_send_payload_cmd (
    uint8_t cmd,
    const std::string & payload ) [inline], [private]
```

Sends `cmd` command with `payload` to the sensor.

## Parameters

<i>cmd</i>	
<i>payload</i>	

**7.27.3.7 \_set\_pwm()**

```
void rplidar::RPLidar::_set_pwm (
    int pwm ) [inline], [private]
```

**7.27.3.8 clean\_input()**

```
void rplidar::RPLidar::clean_input ( ) [inline]
```

Clean input buffer by reading all available data.

**7.27.3.9 convertToHexString()**

```
std::string rplidar::RPLidar::convertToHexString (
    uint8_t value ) [inline], [private]
```

**7.27.3.10 create()**

```
static tl::expected< std::unique_ptr< RPLidar >, std::string > rplidar::RPLidar::create (
    const std::string & port,
    uint32_t baudrate = 115200U ) [inline], [static], [noexcept]
```

**7.27.3.11 disconnect()**

```
void rplidar::RPLidar::disconnect ( ) [inline]
```

### 7.27.3.12 get\_health()

```
tl::expected< HealthInfo, std::string > rplidar::RPLidar::get_health ( ) [inline]
```

Get device health state. When the core system detects some potential risk that may cause hardware failure in the future, the returned status value will be 'Warning'. But sensor can still work as normal. When sensor is in the Protection Stop state, the returned status value will be 'Error'. In case of warning or error statuses non-zero error code will be returned.

#### Returns

```
tl::expected<HealthInfo, std::string>
```

### 7.27.3.13 get\_info()

```
tl::expected< DeviceInfo, std::string > rplidar::RPLidar::get_info ( ) [inline]
```

Get device information.

#### Returns

```
tl::expected<DeviceInfo, std::string>
```

### 7.27.3.14 iter\_measures()

```
std::function< tl::expected< Measure, std::string >()> rplidar::RPLidar::iter_measures (
    ScanType scanType = ScanType::NORMAL,
    int maxBufMeas = 3000 ) [inline]
```

### 7.27.3.15 iter\_scans()

```
std::function< std::vector< Measure >()> rplidar::RPLidar::iter_scans (
    ScanType scanType = ScanType::NORMAL,
    int maxBufMeas = 3000,
    int minLen = 5 ) [inline]
```

Iterate over scans. Note that consumer must be fast enough, otherwise data will be accumulated inside buffer and consumer will get data with increasing lag.

#### Parameters

<i>scanType</i>	
<i>maxBufMeas</i>	Maximum number of measures to be stored inside the buffer. Once numbe exceeds this limit buffer will be emptied out.
<i>minLen</i>	Minimum number of measures in the scan for it to be yelded.

## Returns

`std::function<std::vector<Measure>()>`

**7.27.3.16 reset()**

```
void rplidar::RPLidar::reset ( ) [inline]
```

Resets sensor core, reverting it to a similar state as it has just been powered up.

**7.27.3.17 set\_motor\_speed()**

```
void rplidar::RPLidar::set_motor_speed (
    int pwm ) [inline]
```

**7.27.3.18 start()**

```
tl::expected< nullptr_t, std::string > rplidar::RPLidar::start (
    ScanType scanType = ScanType::NORMAL ) [inline]
```

Start the scanning process.

## Parameters

<i>scanType</i>	NORMAL, FORCE or EXPRESS
-----------------	--------------------------

**7.27.3.19 start\_motor()**

```
void rplidar::RPLidar::start_motor ( ) [inline]
```

Starts sensor motor.

**7.27.3.20 stop()**

```
void rplidar::RPLidar::stop ( ) [inline]
```

Stops scanning process, disables laser diode and the measurement system, moves sensor to the idle state.

### 7.27.3.21 stop\_motor()

```
void rplidar::RPLidar::stop_motor ( ) [inline]
```

Stops sensor motor.

## 7.27.4 Member Data Documentation

### 7.27.4.1 \_motor\_speed

```
int rplidar::RPLidar::_motor_speed = DEFAULT_MOTOR_PWM [private]
```

### 7.27.4.2 \_serial

```
std::unique_ptr<serial::Serial> rplidar::RPLidar::_serial = nullptr [private]
```

### 7.27.4.3 baudrate

```
uint32_t rplidar::RPLidar::baudrate [private]
```

### 7.27.4.4 express\_data

```
std::unique_ptr<ExpressPacket> rplidar::RPLidar::express_data = nullptr [private]
```

### 7.27.4.5 express\_old\_data

```
std::unique_ptr<ExpressPacket> rplidar::RPLidar::express_old_data = nullptr [private]
```

### 7.27.4.6 express\_trame

```
int rplidar::RPLidar::express_trame = 32 [private]
```

#### 7.27.4.7 motor\_running

```
bool rplidar::RPLidar::motor_running = false [private]
```

#### 7.27.4.8 port

```
std::string rplidar::RPLidar::port [private]
```

#### 7.27.4.9 scanning

```
ScanInfo rplidar::RPLidar::scanning = ScanInfo{false, 0, ScanType::NORMAL} [private]
```

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

- rplidar/include/[RPLidar.h](#)

## 7.28 rplidar::ScanInfo Struct Reference

```
#include <RPLidar.h>
```

### Public Attributes

- int [currently\\_scanning](#)
- int [dsize](#)
- [ScanType](#) type

### 7.28.1 Member Data Documentation

#### 7.28.1.1 currently\_scanning

```
int rplidar::ScanInfo::currently_scanning
```

#### 7.28.1.2 dsize

```
int rplidar::ScanInfo::dsize
```

### 7.28.1.3 type

`ScanType` `rplidar::ScanInfo::type`

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

- `rplidar/include/RPLidar.h`

## 7.29 behaviour\_tree::node::composite::Selector Class Reference

```
#include <Selector.hpp>
```

Inheritance diagram for `behaviour_tree::node::composite::Selector`:



### Public Member Functions

- `Selector` (const std::string &`name`, std::vector< std::shared\_ptr< `Node` > > `children`)
- const `CompositeType type` () const final override
- void `start` (std::shared\_ptr< `Context` > context) final override
- const `Status run` (const int tick\_count, std::shared\_ptr< `Context` > context) final override
- const `Status run` (const int tick\_count, std::shared\_ptr< `Context` > context, const int start\_index) final override
- const std::string `toString` () const final override

### Private Attributes

- int `previous_start_index` = -1

### Additional Inherited Members

#### 7.29.1 Constructor & Destructor Documentation

##### 7.29.1.1 Selector()

```
behaviour_tree::node::composite::Selector::Selector (
    const std::string & name,
    std::vector< std::shared_ptr< Node > > children ) [inline]
```



## 7.29.2 Member Function Documentation

### 7.29.2.1 run() [1/2]

```
const Status behaviour_tree::node::composite::Selector::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.29.2.2 run() [2/2]

```
const Status behaviour_tree::node::composite::Selector::run (
    const int tick_count,
    std::shared_ptr< Context > context,
    const int start_index ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::composite::Composite](#).

### 7.29.2.3 start()

```
void behaviour_tree::node::composite::Selector::start (
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Reimplemented from [behaviour\\_tree::node::Node](#).

### 7.29.2.4 toString()

```
const std::string behaviour_tree::node::composite::Selector::toString ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.29.2.5 type()

```
const CompositeType behaviour_tree::node::composite::Selector::type ( ) const [inline], [final],
[override], [virtual]
```

Implements [behaviour\\_tree::node::composite::Composite](#).

### 7.29.3 Member Data Documentation

#### 7.29.3.1 previous\_start\_index

```
int behaviour_tree::node::composite::Selector::previous_start_index = -1 [private]
```

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

- [behaviour\\_tree/include/behaviour\\_tree/node/composite/Selector.hpp](#)

### 7.30 behaviour\_tree::node::composite::Sequence Class Reference

```
#include <Sequence.hpp>
```

Inheritance diagram for behaviour\_tree::node::composite::Sequence:



#### Public Member Functions

- [Sequence](#) (const std::string &[name](#), std::vector< std::shared\_ptr< [Node](#) > > [children](#))
- const [CompositeType](#) [type](#) () const final override
- void [start](#) (std::shared\_ptr< [Context](#) > context) final override
- const [Status](#) [run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const [Status](#) [run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context, const int start\_index) final override
- const std::string [toString](#) () const final override

#### Private Attributes

- int [previous\\_start\\_index](#) = -1

#### Additional Inherited Members

#### 7.30.1 Constructor & Destructor Documentation

### 7.30.1.1 Sequence()

```
behaviour_tree::node::composite::Sequence::Sequence (
    const std::string & name,
    std::vector< std::shared_ptr< Node > > children ) [inline]
```

## 7.30.2 Member Function Documentation

### 7.30.2.1 run() [1/2]

```
const Status behaviour_tree::node::composite::Sequence::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.30.2.2 run() [2/2]

```
const Status behaviour_tree::node::composite::Sequence::run (
    const int tick_count,
    std::shared_ptr< Context > context,
    const int start_index ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::composite::Composite](#).

### 7.30.2.3 start()

```
void behaviour_tree::node::composite::Sequence::start (
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Reimplemented from [behaviour\\_tree::node::Node](#).

### 7.30.2.4 toString()

```
const std::string behaviour_tree::node::composite::Sequence::toString ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.30.2.5 type()

```
const CompositeType behaviour_tree::node::composite::Sequence::type ( ) const [inline], [final],
[override], [virtual]
```

Implements [behaviour\\_tree::node::composite::Composite](#).

## 7.30.3 Member Data Documentation

### 7.30.3.1 previous\_start\_index

```
int behaviour_tree::node::composite::Sequence::previous_start_index = -1 [private]
```

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

- [behaviour\\_tree/include/behaviour\\_tree/node/composite/Sequence.hpp](#)

## 7.31 behaviour\_tree::node::custom::action::SetAngle Class Reference

```
#include <SetAngle.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::action::SetAngle:



### Public Member Functions

- [SetAngle](#) (const std::string &name, const [ServoType](#) servo\_type, const int angle)
- const [Status](#) run (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string [toString](#) () const final override
- const [ServoType](#) [getServoType](#) () const
- const int [getAngle](#) () const

### Static Public Member Functions

- static const tl::expected< std::shared\_ptr< [SetAngle](#) >, std::string > [parse](#) (const pugi::xml\_node &node, const int index, const std::string &name\_attribute)

## Private Attributes

- const int [angle](#)
- const [ServoType](#) [servo\\_type](#)

## Additional Inherited Members

### 7.31.1 Constructor & Destructor Documentation

#### 7.31.1.1 SetAngle()

```
behaviour_tree::node::custom::action::SetAngle::SetAngle (
    const std::string & name,
    const ServoType servo_type,
    const int angle ) [inline]
```

### 7.31.2 Member Function Documentation

#### 7.31.2.1 getAngle()

```
const int behaviour_tree::node::custom::action::SetAngle::getAngle ( ) const [inline]
```

#### 7.31.2.2 getServoType()

```
const ServoType behaviour_tree::node::custom::action::SetAngle::getServoType ( ) const [inline]
```

#### 7.31.2.3 parse()

```
static const tl::expected< std::shared_ptr< SetAngle >, std::string > behaviour_tree::node↵
::custom::action::SetAngle::parse (
    const pugi::xml_node & node,
    const int index,
    const std::string & name_attribute ) [inline], [static]
```

#### 7.31.2.4 run()

```
const Status behaviour_tree::node::custom::action::SetAngle::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

#### 7.31.2.5 toString()

```
const std::string behaviour_tree::node::custom::action::SetAngle::toString ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.31.3 Member Data Documentation

#### 7.31.3.1 angle

```
const int behaviour_tree::node::custom::action::SetAngle::angle [private]
```

#### 7.31.3.2 servo\_type

```
const ServoType behaviour_tree::node::custom::action::SetAngle::servo_type [private]
```

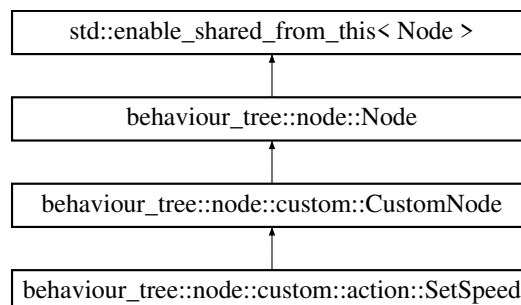
The documentation for this class was generated from the following file:

- [behaviour\\_tree\\_car/include/behaviour\\_tree/node/custom/action/SetAngle.hpp](#)

## 7.32 behaviour\_tree::node::custom::action::SetSpeed Class Reference

```
#include <SetSpeed.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::action::SetSpeed:



## Public Member Functions

- [SetSpeed](#) (const std::string &[name](#), const [WheelType](#) [wheel\\_type](#), const int [speed](#))
- const [Status](#) [run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string [toString](#) () const final override
- const [WheelType](#) [getWheelType](#) () const
- const int [getSpeed](#) () const

## Static Public Member Functions

- static const tl::expected< std::shared\_ptr< [SetSpeed](#) >, std::string > [parse](#) (const pugixml\_node &node, const int index, const std::string &name\_attribute)

## Private Attributes

- const int [speed](#)
- const [WheelType](#) [wheel\\_type](#)

## Additional Inherited Members

### 7.32.1 Constructor & Destructor Documentation

#### 7.32.1.1 SetSpeed()

```
behaviour_tree::node::custom::action::SetSpeed::SetSpeed (  
    const std::string & name,  
    const WheelType wheel_type,  
    const int speed ) [inline]
```

### 7.32.2 Member Function Documentation

#### 7.32.2.1 getSpeed()

```
const int behaviour_tree::node::custom::action::SetSpeed::getSpeed ( ) const [inline]
```

#### 7.32.2.2 getWheelType()

```
const WheelType behaviour_tree::node::custom::action::SetSpeed::getWheelType ( ) const [inline]
```

### 7.32.2.3 parse()

```
static const tl::expected< std::shared_ptr< SetSpeed >, std::string > behaviour_tree::node↵
::custom::action::SetSpeed::parse (
    const pugi::xml_node & node,
    const int index,
    const std::string & name_attribute ) [inline], [static]
```

### 7.32.2.4 run()

```
const Status behaviour_tree::node::custom::action::SetSpeed::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.32.2.5 toString()

```
const std::string behaviour_tree::node::custom::action::SetSpeed::toString ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

## 7.32.3 Member Data Documentation

### 7.32.3.1 speed

```
const int behaviour_tree::node::custom::action::SetSpeed::speed [private]
```

### 7.32.3.2 wheel\_type

```
const WheelType behaviour_tree::node::custom::action::SetSpeed::wheel_type [private]
```

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

- [behaviour\\_tree\\_car/include/behaviour\\_tree/node/custom/action/SetSpeed.hpp](#)



## 7.33 behaviour\_tree::node::custom::action::SetWheelDirection Class Reference

```
#include <SetWheelDirection.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::action::SetWheelDirection:



### Public Member Functions

- `SetWheelDirection` (const std::string &name, const WheelType wheel\_type, const DirectionType direction\_type)
- const Status run (const int tick\_count, std::shared\_ptr< Context > context) final override
- const std::string toString () const final override
- const DirectionType getDirectionType () const
- const WheelType getWheelType () const

### Static Public Member Functions

- static const tl::expected< std::shared\_ptr< SetWheelDirection >, std::string > parse (const pugi::xml\_node &node, const int index, const std::string &name\_attribute)

### Private Attributes

- const DirectionType direction\_type
- const WheelType wheel\_type

### Additional Inherited Members

#### 7.33.1 Constructor & Destructor Documentation

##### 7.33.1.1 SetWheelDirection()

```
behaviour_tree::node::custom::action::SetWheelDirection::SetWheelDirection (
    const std::string & name,
    const WheelType wheel_type,
    const DirectionType direction_type ) [inline]
```

## 7.33.2 Member Function Documentation

### 7.33.2.1 getDirectionType()

```
const DirectionType behaviour_tree::node::custom::action::SetWheelDirection::getDirectionType  
( ) const [inline]
```

### 7.33.2.2 getWheelType()

```
const WheelType behaviour_tree::node::custom::action::SetWheelDirection::getWheelType ( )  
const [inline]
```

### 7.33.2.3 parse()

```
static const tl::expected< std::shared_ptr< SetWheelDirection >, std::string > behaviour_↵  
tree::node::custom::action::SetWheelDirection::parse (   
    const pugi::xml_node & node,  
    const int index,  
    const std::string & name_attribute ) [inline], [static]
```

### 7.33.2.4 run()

```
const Status behaviour_tree::node::custom::action::SetWheelDirection::run (   
    const int tick_count,  
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.33.2.5 toString()

```
const std::string behaviour_tree::node::custom::action::SetWheelDirection::toString ( ) const  
[inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

## 7.33.3 Member Data Documentation

### 7.33.3.1 direction\_type

```
const DirectionType behaviour_tree::node::custom::action::SetWheelDirection::direction_type
[private]
```

### 7.33.3.2 wheel\_type

```
const WheelType behaviour_tree::node::custom::action::SetWheelDirection::wheel_type [private]
```

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

- behaviour\_tree\_car/include/behaviour\_tree/node/custom/action/[SetWheelDirection.hpp](#)

## 7.34 behaviour\_tree::node::leaf::Succeed Class Reference

```
#include <Succeed.hpp>
```

Inheritance diagram for behaviour\_tree::node::leaf::Succeed:



### Public Member Functions

- [Succeed](#) (const std::string &name)
- const [LeafType type](#) () const final override
- const [Status run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string [toString](#) () const final override

### Additional Inherited Members

#### 7.34.1 Constructor & Destructor Documentation

### 7.34.1.1 Succeed()

```
behaviour_tree::node::leaf::Succeed::Succeed (
    const std::string & name ) [inline]
```

## 7.34.2 Member Function Documentation

### 7.34.2.1 run()

```
const Status behaviour_tree::node::leaf::Succeed::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.34.2.2 toString()

```
const std::string behaviour_tree::node::leaf::Succeed::toString ( ) const [inline], [final],
[override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.34.2.3 type()

```
const LeafType behaviour_tree::node::leaf::Succeed::type ( ) const [inline], [final], [override],
[virtual]
```

Implements [behaviour\\_tree::node::leaf::Leaf](#).

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

- [behaviour\\_tree/include/behaviour\\_tree/node/leaf/Succeed.hpp](#)

## 7.35 behaviour\_tree::node::custom::condition::SucceedOnAnyNearbyScan Class Reference

```
#include <SucceedOnAnyNearbyScan.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::condition::SucceedOnAnyNearbyScan:



## Public Member Functions

- [SucceedOnAnyNearbyScan](#) (const std::string &[name](#), const int [min\\_angle](#), const int [max\\_angle](#), const double [cm](#))
- const [Status](#) [run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const int [getMinAngle](#) () const
- const int [getMaxAngle](#) () const
- const double [getMinimumDistanceUnit](#) () const
- const double [getCentimeters](#) () const
- const std::string [toString](#) () const final override

## Static Public Member Functions

- static const tl::expected< std::shared\_ptr< [SucceedOnAnyNearbyScan](#) >, std::string > [parse](#) (const pugixml::xml\_node &node, const int index, const std::string &name\_attribute)

## Private Attributes

- const int [min\\_angle](#)
- const int [max\\_angle](#)
- const double [cm](#)
- const double [minimum\\_distance\\_unit](#)

## Additional Inherited Members

### 7.35.1 Constructor & Destructor Documentation

#### 7.35.1.1 SucceedOnAnyNearbyScan()

```
behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::SucceedOnAnyNearbyScan (
    const std::string & name,
    const int min_angle,
    const int max_angle,
    const double cm ) [inline]
```

### 7.35.2 Member Function Documentation

#### 7.35.2.1 getCentimeters()

```
const double behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::getCentimeters (
) const [inline]
```

### 7.35.2.2 getMaxAngle()

```
const int behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::getMaxAngle ( )
const [inline]
```

### 7.35.2.3 getMinAngle()

```
const int behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::getMinAngle ( )
const [inline]
```

### 7.35.2.4 getMinimumDistanceUnit()

```
const double behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::getMinimum↵
DistanceUnit ( ) const [inline]
```

### 7.35.2.5 parse()

```
static const tl::expected< std::shared_ptr< SucceedOnAnyNearbyScan >, std::string > behaviour↵
_tree::node::custom::condition::SucceedOnAnyNearbyScan::parse (
    const pugi::xml_node & node,
    const int index,
    const std::string & name_attribute ) [inline], [static]
```

### 7.35.2.6 run()

```
const Status behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.35.2.7 toString()

```
const std::string behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::toString (
) const [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.35.3 Member Data Documentation

#### 7.35.3.1 cm

```
const double behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::cm [private]
```

#### 7.35.3.2 max\_angle

```
const int behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::max_angle [private]
```

#### 7.35.3.3 min\_angle

```
const int behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::min_angle [private]
```

#### 7.35.3.4 minimum\_distance\_unit

```
const double behaviour_tree::node::custom::condition::SucceedOnAnyNearbyScan::minimum_distance←  
_unit [private]
```

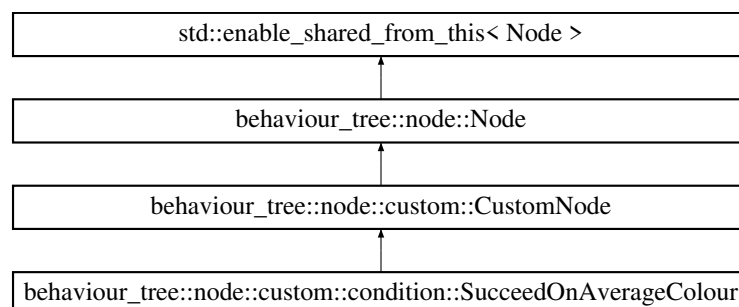
The documentation for this class was generated from the following file:

- behaviour\_tree\_car/include/behaviour\_tree/node/custom/condition/[SucceedOnAnyNearbyScan.hpp](#)

## 7.36 behaviour\_tree::node::custom::condition::SucceedOnAverageColour Class Reference

```
#include <SucceedOnAverageColour.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::condition::SucceedOnAverageColour:



## Public Member Functions

- [SucceedOnAverageColour](#) (const std::string &name, const std::string hex\_colour, const double tolerance)
- const [Status](#) run (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- int [calculateColorDifference](#) (const std::string &color1, const std::string &color2)
- cv::Scalar [hexToRGB](#) (const std::string &hexColor)
- int [calculateMaxColorDifference](#) (double percentage)
- const std::string [getHexColour](#) () const
- const double [getTolerance](#) () const
- const std::string [toString](#) () const final override

## Static Public Member Functions

- static const tl::expected< std::shared\_ptr< [SucceedOnAverageColour](#) >, std::string > [parse](#) (const pugixml::xml\_node &node, const int index, const std::string &name\_attribute)

## Private Attributes

- const std::string [hex\\_colour](#)
- const double [tolerance](#)

## Additional Inherited Members

### 7.36.1 Constructor & Destructor Documentation

#### 7.36.1.1 SucceedOnAverageColour()

```
behaviour_tree::node::custom::condition::SucceedOnAverageColour::SucceedOnAverageColour (
    const std::string & name,
    const std::string hex_colour,
    const double tolerance ) [inline]
```

### 7.36.2 Member Function Documentation

#### 7.36.2.1 calculateColorDifference()

```
int behaviour_tree::node::custom::condition::SucceedOnAverageColour::calculateColorDifference
(
    const std::string & color1,
    const std::string & color2 ) [inline]
```



### 7.36.2.2 `calculateMaxColorDifference()`

```
int behaviour_tree::node::custom::condition::SucceedOnAverageColour::calculateMaxColorDifference
(
    double percentage ) [inline]
```

### 7.36.2.3 `getHexColour()`

```
const std::string behaviour_tree::node::custom::condition::SucceedOnAverageColour::getHex↵
Colour ( ) const [inline]
```

### 7.36.2.4 `getTolerance()`

```
const double behaviour_tree::node::custom::condition::SucceedOnAverageColour::getTolerance ( )
const [inline]
```

### 7.36.2.5 `hexToRGB()`

```
cv::Scalar behaviour_tree::node::custom::condition::SucceedOnAverageColour::hexToRGB (
    const std::string & hexColor ) [inline]
```

### 7.36.2.6 `parse()`

```
static const tl::expected< std::shared_ptr< SucceedOnAverageColour >, std::string > behaviour↵
_tree::node::custom::condition::SucceedOnAverageColour::parse (
    const pugi::xml_node & node,
    const int index,
    const std::string & name_attribute ) [inline], [static]
```

### 7.36.2.7 `run()`

```
const Status behaviour_tree::node::custom::condition::SucceedOnAverageColour::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements `behaviour_tree::node::Node`.

### 7.36.2.8 toString()

```
const std::string behaviour_tree::node::custom::condition::SucceedOnAverageColour::toString (
) const [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

## 7.36.3 Member Data Documentation

### 7.36.3.1 hex\_colour

```
const std::string behaviour_tree::node::custom::condition::SucceedOnAverageColour::hex_colour
[private]
```

### 7.36.3.2 tolerance

```
const double behaviour_tree::node::custom::condition::SucceedOnAverageColour::tolerance [private]
```

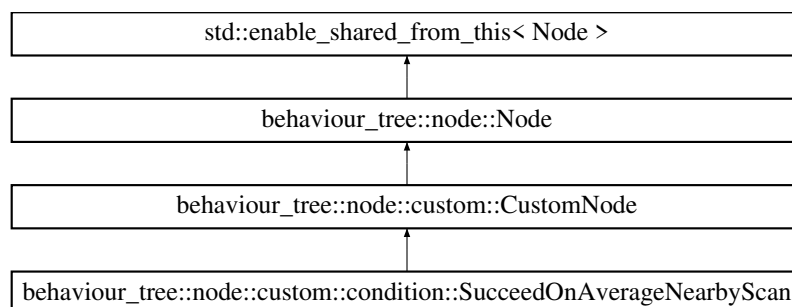
The documentation for this class was generated from the following file:

- [behaviour\\_tree\\_car/include/behaviour\\_tree/node/custom/condition/SucceedOnAverageColour.hpp](#)

## 7.37 behaviour\_tree::node::custom::condition::SucceedOnAverageNearbyScan Class Reference

```
#include <SucceedOnAverageNearbyScan.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::condition::SucceedOnAverageNearbyScan:



## Public Member Functions

- [SucceedOnAverageNearbyScan](#) (const std::string &name, const int min\_angle, const int max\_angle, const double cm, const int smallest\_measure\_amount\_used)
- const [Status run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const int [getMinAngle](#) () const
- const int [getMaxAngle](#) () const
- const double [getAverageDistanceUnit](#) () const
- const double [getCentimeters](#) () const
- const int [getSmallestMeasureAmountUsed](#) () const
- const std::string [toString](#) () const final override

## Static Public Member Functions

- static const tl::expected< std::shared\_ptr< [SucceedOnAverageNearbyScan](#) >, std::string > [parse](#) (const pugi::xml\_node &node, const int index, const std::string &name\_attribute)

## Private Attributes

- const int min\_angle
- const int max\_angle
- const double cm
- const int smallest\_measure\_amount\_used
- const double average\_distance\_unit

## Additional Inherited Members

### 7.37.1 Constructor & Destructor Documentation

#### 7.37.1.1 SucceedOnAverageNearbyScan()

```
behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::SucceedOnAverageNearbyScan (
    const std::string & name,
    const int min_angle,
    const int max_angle,
    const double cm,
    const int smallest_measure_amount_used ) [inline]
```

### 7.37.2 Member Function Documentation

### 7.37.2.1 `getAverageDistanceUnit()`

```
const double behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::getAverage↵  
DistanceUnit ( ) const [inline]
```

### 7.37.2.2 `getCentimeters()`

```
const double behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::getCentimeters  
( ) const [inline]
```

### 7.37.2.3 `getMaxAngle()`

```
const int behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::getMaxAngle ( )  
const [inline]
```

### 7.37.2.4 `getMinAngle()`

```
const int behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::getMinAngle ( )  
const [inline]
```

### 7.37.2.5 `getSmallestMeasureAmountUsed()`

```
const int behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::getSmallest↵  
MeasureAmountUsed ( ) const [inline]
```

### 7.37.2.6 `parse()`

```
static const tl::expected< std::shared_ptr< SucceedOnAverageNearbyScan >, std::string > behaviour↵  
_tree::node::custom::condition::SucceedOnAverageNearbyScan::parse (   
    const pugi::xml_node & node,  
    const int index,  
    const std::string & name_attribute ) [inline], [static]
```

### 7.37.2.7 run()

```
const Status behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.37.2.8 toString()

```
const std::string behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::to←
String ( ) const [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

## 7.37.3 Member Data Documentation

### 7.37.3.1 average\_distance\_unit

```
const double behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::average_←
distance_unit [private]
```

### 7.37.3.2 cm

```
const double behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::cm [private]
```

### 7.37.3.3 max\_angle

```
const int behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::max_angle [private]
```

### 7.37.3.4 min\_angle

```
const int behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::min_angle [private]
```

### 7.37.3.5 smallest\_measure\_amount\_used

```
const int behaviour_tree::node::custom::condition::SucceedOnAverageNearbyScan::smallest_↔
measure_amount_used [private]
```

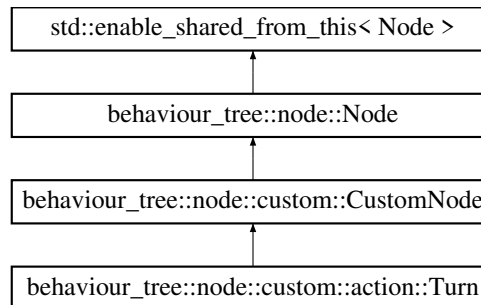
The documentation for this class was generated from the following file:

- [behaviour\\_tree\\_car/include/behaviour\\_tree/node/custom/condition/SucceedOnAverageNearbyScan.hpp](#)

## 7.38 behaviour\_tree::node::custom::action::Turn Class Reference

```
#include <Turn.hpp>
```

Inheritance diagram for behaviour\_tree::node::custom::action::Turn:



### Public Member Functions

- [Turn](#) (const std::string &[name](#), const int [angle](#))
- const [Status](#) [run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string [toString](#) () const final override
- const int [getAngle](#) () const

### Static Public Member Functions

- static const tl::expected< std::shared\_ptr< [Turn](#) >, std::string > [parse](#) (const pugi::xml\_node &node, const int index, const std::string &name\_attribute)

### Private Attributes

- const int [angle](#)

### Additional Inherited Members

#### 7.38.1 Constructor & Destructor Documentation

### 7.38.1.1 Turn()

```
behaviour_tree::node::custom::action::Turn::Turn (
    const std::string & name,
    const int angle ) [inline]
```

## 7.38.2 Member Function Documentation

### 7.38.2.1 getAngle()

```
const int behaviour_tree::node::custom::action::Turn::getAngle ( ) const [inline]
```

### 7.38.2.2 parse()

```
static const tl::expected< std::shared_ptr< Turn >, std::string > behaviour_tree::node↵
::custom::action::Turn::parse (
    const pugi::xml_node & node,
    const int index,
    const std::string & name_attribute ) [inline], [static]
```

### 7.38.2.3 run()

```
const Status behaviour_tree::node::custom::action::Turn::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.38.2.4 toString()

```
const std::string behaviour_tree::node::custom::action::Turn::toString ( ) const [inline],
[final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

## 7.38.3 Member Data Documentation

### 7.38.3.1 angle

```
const int behaviour_tree::node::custom::action::Turn::angle [private]
```

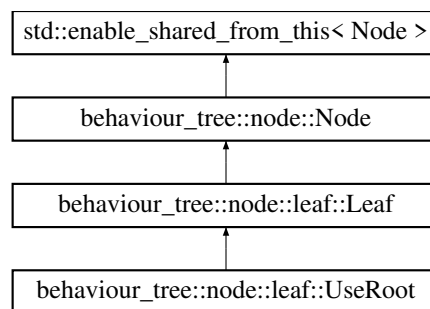
The documentation for this class was generated from the following file:

- [behaviour\\_tree\\_car/include/behaviour\\_tree/node/custom/action/Turn.hpp](#)

## 7.39 behaviour\_tree::node::leaf::UseRoot Class Reference

```
#include <UseRoot.hpp>
```

Inheritance diagram for behaviour\_tree::node::leaf::UseRoot:



### Public Member Functions

- [UseRoot](#) (const std::string &[name](#), const std::string &[id](#))
- const [LeafType type](#) () const final override
- const [Status run](#) (const int tick\_count, std::shared\_ptr< [Context](#) > context) final override
- const std::string & [getId](#) () const
- const std::string [toString](#) () const final override

### Private Attributes

- const std::string [id](#)

### Additional Inherited Members

## 7.39.1 Constructor & Destructor Documentation

### 7.39.1.1 UseRoot()

```
behaviour_tree::node::leaf::UseRoot::UseRoot (
    const std::string & name,
    const std::string & id ) [inline]
```



## 7.39.2 Member Function Documentation

### 7.39.2.1 getId()

```
const std::string & behaviour_tree::node::leaf::UseRoot::getId ( ) const [inline]
```

### 7.39.2.2 run()

```
const Status behaviour_tree::node::leaf::UseRoot::run (
    const int tick_count,
    std::shared_ptr< Context > context ) [inline], [final], [override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.39.2.3 toString()

```
const std::string behaviour_tree::node::leaf::UseRoot::toString ( ) const [inline], [final],
[override], [virtual]
```

Implements [behaviour\\_tree::node::Node](#).

### 7.39.2.4 type()

```
const LeafType behaviour_tree::node::leaf::UseRoot::type ( ) const [inline], [final], [override],
[virtual]
```

Implements [behaviour\\_tree::node::leaf::Leaf](#).

## 7.39.3 Member Data Documentation

### 7.39.3.1 id

```
const std::string behaviour_tree::node::leaf::UseRoot::id [private]
```

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

- [behaviour\\_tree/include/behaviour\\_tree/node/leaf/UseRoot.hpp](#)



## Chapter 8

# File Documentation

### 8.1 behaviour\_tree/include/behaviour\_tree/BehaviourTree.hpp File Reference

```
#include "Root.hpp"
```

#### Classes

- class [behaviour\\_tree::BehaviourTree](#)

#### Namespaces

- namespace [behaviour\\_tree](#)

### 8.2 BehaviourTree.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_HPP
2 #define BEHAVIOUR_TREE_HPP
3
4 #pragma once
5
6 /*
7 XML format inspired by: https://github.com/telcy/modular-behavior-tree &
8 https://github.com/Defaultio/BehaviorTree3
9 */
10 #include "Root.hpp"
11
12 namespace behaviour_tree
13 {
14     class BehaviourTree
15     {
16     public:
17         BehaviourTree(unsigned int cycle_limit, std::vector<std::shared_ptr<Root>> roots) :
18             cycle_limit(cycle_limit), roots(std::move(roots))
19         {
20
21         void start()
22         {
23             for (auto& root : this->roots)
```

```

24         {
25             if (root->getId() == "Main")
26             {
27                 this->root_to_use = root;
28                 return;
29             }
30         }
31         this->root_to_use = this->roots[0];
32     }
33
34     Status tick(const int tick_count, std::shared_ptr<Context> context)
35     {
36         const Status status = this->root_to_use->tick(tick_count, context);
37         if (status != Status::Running)
38         {
39             this->cycles++;
40         }
41         return status;
42     }
43
44     Status UseRoot(const int tick_count, std::shared_ptr<Context> context, const std::string& id) {
45         for (auto& root : this->roots)
46         {
47             if (root->getId() == id)
48             {
49                 return root->tick(tick_count, context);
50             }
51         }
52         return Status::Failure;
53     }
54
55     bool canRun() const {
56         if (this->cycle_limit <= 0)
57         {
58             return true;
59         }
60         return this->cycles < this->cycle_limit;
61     }
62
63     void incrementCycle() {
64         this->cycles++;
65     }
66
67     void resetCycles() {
68         this->cycles = 0;
69     }
70
71     const std::string toString() const {
72         std::string out;
73         for (auto& root : this->roots)
74         {
75             out += root->toString();
76         }
77         return fmt::format(R"(<BehaviourTree cycle_limit='{}'>{}</BehaviourTree>)",
78             this->cycle_limit, out);
79     }
80 private:
81     int cycles = 0;
82     std::shared_ptr<Root> root_to_use;
83
84     const std::vector<std::shared_ptr<Root>> roots;
85     const unsigned int cycle_limit;
86 };
87 }
88
89 #endif

```

### 8.3 behaviour\_tree/include/behaviour\_tree/BehaviourTreeParser.hpp File Reference

```

#include <filesystem>
#include <string>
#include <numeric>
#include <tl/expected.hpp>
#include <pugixml.hpp>
#include <fmt/format.h>

```

```

#include "utils/Utility.hpp"
#include "BehaviourTree.hpp"
#include "Root.hpp"
#include "node/Node.hpp"
#include "node/composite/Composite.hpp"
#include "node/composite/Sequence.hpp"
#include "node/composite/Selector.hpp"
#include "node/composite/Random.hpp"
#include "node/decorator/Decorator.hpp"
#include "node/decorator/Repeat.hpp"
#include "node/decorator/Invert.hpp"
#include "node/leaf/Leaf.hpp"
#include "node/leaf/Succeed.hpp"
#include "node/leaf/Fail.hpp"
#include "node/leaf/UseRoot.hpp"
#include "node/blackboard/ChangeInteger.hpp"
#include "node/blackboard/IntegerCondition.hpp"
#include "node/custom/CustomNode.hpp"
#include "node/custom/CustomNodeParser.hpp"

```

## Classes

- class [behaviour\\_tree::BehaviourTreeParser](#)

## Namespaces

- namespace [behaviour\\_tree](#)

## 8.4 BehaviourTreeParser.hpp

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```

1 #ifndef BEHAVIOUR_TREE_PARSER_HPP
2 #define BEHAVIOUR_TREE_PARSER_HPP
3
4 #pragma once
5
6 #include <filesystem>
7 #include <string>
8 #include <numeric>
9
10 #include <tl/expected.hpp>
11 #include <pugixml.hpp>
12 #include <fmt/format.h>
13
14 #include "utils/Utility.hpp"
15
16 #include "BehaviourTree.hpp"
17 #include "Root.hpp"
18 #include "node/Node.hpp"
19
20 #include "node/composite/Composite.hpp"
21 #include "node/composite/Sequence.hpp"
22 #include "node/composite/Selector.hpp"
23 #include "node/composite/Random.hpp"
24
25 #include "node/decorator/Decorator.hpp"
26 #include "node/decorator/Repeat.hpp"
27 #include "node/decorator/Invert.hpp"
28
29 #include "node/leaf/Leaf.hpp"
30 #include "node/leaf/Succeed.hpp"
31 #include "node/leaf/Fail.hpp"
32 #include "node/leaf/UseRoot.hpp"

```

```

33
34 #include "node/blackboard/ChangeInteger.hpp"
35 #include "node/blackboard/IntegerCondition.hpp"
36
37 #include "node/custom/CustomNode.hpp"
38
39 #include "node/custom/CustomNodeParser.hpp"
40
41 using namespace behaviour_tree::node;
42 using namespace behaviour_tree::node::composite;
43 using namespace behaviour_tree::node::decorator;
44 using namespace behaviour_tree::node::leaf;
45 using namespace behaviour_tree::node::blackboard;
46 using namespace behaviour_tree::node::custom;
47
48 namespace behaviour_tree
49 {
50     static constexpr int STARTING_INDEX = 1;
51
52     class BehaviourTreeParser
53     {
54     public:
55         BehaviourTreeParser(BehaviourTreeParser const&) = delete;
56         void operator=(BehaviourTreeParser const&) = delete;
57
58         static BehaviourTreeParser& instance()
59         {
60             static BehaviourTreeParser instance;
61             return instance;
62         }
63
64         void setCustomNodeParser(std::shared_ptr<CustomNodeParser> custom_node_parser)
65         {
66             this->custom_node_parser = std::move(custom_node_parser);
67         }
68
69         tl::expected<std::shared_ptr<BehaviourTree>, std::string> parseXML(const std::string& xml)
70         {
71             pugi::xml_document doc;
72             pugi::xml_parse_result result = doc.load_string(xml.c_str());
73             if (!result)
74             {
75                 return tl::make_unexpected("XML parse error: " + std::string(result.description()));
76             }
77             return parse(doc);
78         }
79
80         tl::expected<std::shared_ptr<BehaviourTree>, std::string> parseFileXML(const std::string&
file_path)
81         {
82             if (std::filesystem::exists(file_path) == false)
83             {
84                 return tl::make_unexpected("File [" + file_path + "] does not exist");
85             }
86             pugi::xml_document doc;
87             pugi::xml_parse_result result = doc.load_file(file_path.c_str());
88             if (!result)
89             {
90                 return tl::make_unexpected("XML [" + file_path + "] parsed with errors");
91             }
92             return parse(doc);
93         }
94
95     private:
96         BehaviourTreeParser() {}
97
98         std::shared_ptr<CustomNodeParser> custom_node_parser;
99
100         tl::expected<std::shared_ptr<BehaviourTree>, std::string> parse(pugi::xml_document& doc)
101         {
102             pugi::xml_node behaviour_tree_node = doc.child("BehaviourTree");
103             if (!behaviour_tree_node)
104             {
105                 return tl::make_unexpected(R"(No "BehaviourTree" node found)");
106             }
107             std::vector<std::shared_ptr<Root>> roots;
108             for (pugi::xml_node node = behaviour_tree_node.child("Root"); node; node =
node.next_sibling("Root"))
109             {
110                 const auto maybe_root = parseRoot(node, STARTING_INDEX + roots.size());
111                 if (!maybe_root.has_value())
112                 {
113                     return tl::make_unexpected(maybe_root.error());
114                 }
115                 roots.push_back(std::move(maybe_root.value()));
116             }
117             if (roots.size() <= 0)

```

```

118         {
119             return tl::make_unexpected(R"(No "Root" nodes found in BehaviourTree)");
120         }
121         const int cycle_limit = behaviour_tree_node.attribute("cycle_limit").as_int(0);
122         return std::make_shared<BehaviourTree>(
123             BehaviourTree(cycle_limit, std::move(roots)));
124     }
125
126     private:
127     tl::expected<std::shared_ptr<Root>, std::string> parseRoot(const pugi::xml_node& node, const int
index)
128     {
129         int child_count = 0;
130         for (pugi::xml_node child = node.first_child(); child; child = child.next_sibling())
131             ++child_count;
132         const std::string id = node.attribute("id").as_string();
133         if (child_count == 0)
134         {
135             return std::make_shared<Root>(
136                 Root(id, nullptr));
137         }
138         if (child_count != 1)
139         {
140             return tl::make_unexpected(fmt::format(R"(Root node must have only at most one child |
Root: ['{}', {}])", id, index));
141         }
142         const pugi::xml_node child = node.first_child();
143         const auto maybe_child_node = parseChild(child, STARTING_INDEX);
144         if (!maybe_child_node.has_value())
145         {
146             return tl::make_unexpected(fmt::format(R"({}<-Root: ['{}', {}])",
maybe_child_node.error(), id, index));
147         }
148         return std::make_shared<Root>(
149             Root(id, std::move(maybe_child_node.value())));
150     }
151
152     tl::expected<std::shared_ptr<node::Node>, std::string> parseChild(const pugi::xml_node& node,
const int index)
153     {
154         const std::string name_attribute = node.attribute("name").as_string();
155         const std::string& node_name = node.name();
156         switch (utils::hash(node_name))
157         {
158 #pragma region Composite Node
159             case utils::hash("Sequence"):
160             {
161                 return parseComposite(node, index, CompositeType::Sequence);
162             }
163             case utils::hash("Selector"):
164             {
165                 return parseComposite(node, index, CompositeType::Selector);
166             }
167             case utils::hash("Random"):
168             {
169                 return parseComposite(node, index, CompositeType::Random);
170             }
171 #pragma endregion
172 #pragma region Decorator Node
173             case utils::hash("Repeat"):
174             {
175                 return parseDecorator(node, index, DecoratorType::Repeat);
176             }
177             case utils::hash("Invert"):
178             {
179                 return parseDecorator(node, index, DecoratorType::Invert);
180             }
181 #pragma endregion
182 #pragma region Leaf Node
183             case utils::hash("Succeed"):
184             {
185                 return std::make_shared<Succeed>(Succeed(name_attribute));
186             }
187             case utils::hash("Fail"):
188             {
189                 return std::make_shared<Fail>(Fail(name_attribute));
190             }
191             case utils::hash("UseRoot"):
192             {
193                 return std::make_shared<UseRoot>(
194                     UseRoot(
195                         name_attribute,
196                         node.attribute("id").as_string()));
197             }
198 #pragma endregion
199 #pragma region Blackboard Leaf Node
200             case utils::hash("Blackboard:ChangeInteger"):

```

```

201         {
202             return parseBlackboardNode(node, index, BlackboardType::ChangeInteger);
203         }
204         case utils::hash("Blackboard:IntegerCondition"):
205         {
206             return parseBlackboardNode(node, index, BlackboardType::IntegerCondition);
207         }
208 #pragma endregion
209         default:
210         {
211             return this->parseCustomNode(node, index);
212         }
213     }
214 }
215
216 tl::expected<std::shared_ptr<node::decorator::Decorator>, std::string> parseDecorator(const
pugi::xml_node& node, const int index, const DecoratorType decorator_type)
217 {
218     const std::string name_attribute = node.attribute("name").as_string();
219     const pugi::xml_node child = node.first_child();
220     if (!child)
221     {
222         return tl::make_unexpected(fmt::format(R"(Decorator node must have a child |
{}:['{}',{}])", std::string(node.name()), name_attribute, index));
223     }
224     const auto maybe_child_node = parseChild(child, STARTING_INDEX);
225     if (!maybe_child_node.has_value())
226     {
227         return tl::make_unexpected(maybe_child_node.error());
228     }
229     switch (decorator_type)
230     {
231     case DecoratorType::Invert:
232     {
233         return std::make_shared<Invert>(
234             Invert(
235                 name_attribute,
236                 std::move(maybe_child_node.value())));
237     }
238     case DecoratorType::Repeat:
239     {
240         std::string amount_string = node.attribute("amount").as_string();
241         // Convert to lower case: https://stackoverflow.com/a/313990
242         std::transform(amount_string.begin(), amount_string.end(), amount_string.begin(),
243             [](unsigned char c)
244             { return std::tolower(c); });
245         unsigned long count = 0;
246         if (amount_string == "inf")
247         {
248             count = std::numeric_limits<unsigned long>::max();
249         }
250         else
251         {
252             try
253             {
254                 count = std::stoll(amount_string);
255                 if (count < 0)
256                 {
257                     return tl::make_unexpected(fmt::format(R"(Invalid amount: '{}' |
Repeat:['{}',{}])", amount_string, name_attribute, index));
258                 }
259             }
260             catch (const std::exception& _)
261             {
262                 return tl::make_unexpected(fmt::format(R"(Invalid amount: '{}' |
Repeat:['{}',{}])", amount_string, name_attribute, index));
263             }
264         }
265
266         return std::make_shared<Repeat>(
267             Repeat(
268                 name_attribute,
269                 std::move(maybe_child_node.value()),
270                 count,
271                 node.attribute("break_on_fail").as_bool(false));
272     }
273     default:
274         return tl::make_unexpected(fmt::format(R"(Got an invalid Decorator node type |
{}:['{}',{}])", std::string(node.name()), name_attribute, index));
275     }
276 }
277
278 tl::expected<std::shared_ptr<node::blackboard::BlackboardNode>, std::string>
parseBlackboardNode(const pugi::xml_node& node, const int index, const BlackboardType
blackboard_node_type)
279 {
280     const std::string name_attribute = node.attribute("name").as_string();

```



```

281         const std::string variable_name = node.attribute("variable_name").as_string();
282         if (variable_name.empty()) {
283             return tl::make_unexpected(fmt::format(R"(variable_name cannot be empty |
Blackboard:ChangeInteger:['{}','{}']", name_attribute, index));
284         }
285         const int value = node.attribute("value").as_int();
286         switch (blackboard_node_type)
287         {
288             case BlackboardType::ChangeInteger:
289             {
290                 const tl::expected<IntegerChangeType, std::string> maybe_integer_change_type = [&]() {
291                     const std::string integer_change_type_attribute =
node.attribute("integer_change_type").as_string();
292                     tl::expected<IntegerChangeType, std::string> result;
293                     switch (utils::hash(integer_change_type_attribute))
294                     {
295                         case utils::hash("Set"):
296                         {
297                             result = IntegerChangeType::Set;
298                             break;
299                         }
300                         case utils::hash("Add"):
301                         {
302                             result = IntegerChangeType::Add;
303                             break;
304                         }
305                         case utils::hash("Subtract"):
306                         {
307                             result = IntegerChangeType::Subtract;
308                             break;
309                         }
310                         default:
311                         {
312                             result = tl::make_unexpected(fmt::format(R"(Invalid integer_change_type: '{}' |
Blackboard:ChangeInteger:['{}','{}']", integer_change_type_attribute, name_attribute, index));
313                             break;
314                         }
315                     };
316                     return result;
317                 }();
318                 if (!maybe_integer_change_type.has_value()) {
319                     return tl::make_unexpected(maybe_integer_change_type.error());
320                 }
321                 return std::make_shared<ChangeInteger>(ChangeInteger(
322                     name_attribute,
323                     variable_name,
324                     maybe_integer_change_type.value(),
325                     value
326                 ));
327             }
328             case BlackboardType::IntegerCondition:
329             {
330                 const tl::expected<ConditionOperatorType, std::string> maybe_condition_operator_type =
[&]() {
331                     const std::string condition_operator_type_attribute =
node.attribute("condition_operator_type").as_string();
332                     tl::expected<ConditionOperatorType, std::string> result;
333                     switch (utils::hash(condition_operator_type_attribute))
334                     {
335                         case utils::hash("="):
336                         {
337                             result = ConditionOperatorType::Equal;
338                             break;
339                         }
340                         case utils::hash(">"):
341                         {
342                             result = ConditionOperatorType::GreaterThan;
343                             break;
344                         }
345                         case utils::hash(">="):
346                         {
347                             result = ConditionOperatorType::GreaterThanOrEqual;
348                             break;
349                         }
350                         case utils::hash("<"):
351                         {
352                             result = ConditionOperatorType::LessThan;
353                             break;
354                         }
355                         case utils::hash("<="):
356                         {
357                             result = ConditionOperatorType::LessThanOrEqual;
358                             break;
359                         }
360                         case utils::hash("!="):
361                         {
362                             result = ConditionOperatorType::NotEqual;
363                             break;
364                         }
365                         default:
366                         {
367                             result = tl::make_unexpected(fmt::format(R"(Invalid condition_operator_type:

```

```

'{}' | Blackboard:IntegerCondition:['{}',{}])", condition_operator_type_attribute, name_attribute,
index));
363         break;
364     }
365     };
366     return result;
367 }
368 ();
369 if (!maybe_condition_operator_type.has_value()) {
370     return tl::make_unexpected(maybe_condition_operator_type.error());
371 }
372 return std::make_shared<IntegerCondition>(IntegerCondition(
373     name_attribute,
374     variable_name,
375     maybe_condition_operator_type.value(),
376     value
377 ));
378 }
379 default:
380     return tl::make_unexpected(fmt::format(R"(Got an invalid Blackboard node type |
{}:['{}',{}])", std::string(node.name()), name_attribute, index));
381 }
382 }
383
384 tl::expected<std::shared_ptr<Composite>, std::string> parseComposite(const pugi::xml_node& node,
const int index, const CompositeType composite_type)
385 {
386     const std::string name_attribute = node.attribute("name").as_string();
387     std::vector<std::shared_ptr<node::Node> children;
388     for (pugi::xml_node child = node.first_child(); child; child = child.next_sibling())
389     {
390         auto maybe_node = parseChild(child, STARTING_INDEX + children.size());
391         if (!maybe_node.has_value())
392         {
393             return tl::make_unexpected(fmt::format(R"({}<-{}:['{}',{}])", maybe_node.error(),
std::string(node.name()), name_attribute, index));
394         }
395         children.push_back(std::move(maybe_node.value()));
396     }
397     if (children.size() <= 0)
398     {
399         return tl::make_unexpected(fmt::format(R"(Composite node must have at least one child |
{}:['{}',{}])", std::string(node.name()), name_attribute, index));
400     }
401     switch (composite_type)
402     {
403     case CompositeType::Sequence:
404         return std::make_shared<Sequence>(Sequence(name_attribute, std::move(children)));
405     case CompositeType::Selector:
406         return std::make_shared<Selector>(Selector(name_attribute, std::move(children)));
407     case CompositeType::Random:
408         return std::make_shared<Random>(Random(name_attribute, std::move(children)));
409     default:
410         return tl::make_unexpected(fmt::format(R"(Got an invalid Composite node type |
{}:['{}',{}])", std::string(node.name()), name_attribute, index));
411     }
412 }
413
414 tl::expected<std::shared_ptr<node::custom::CustomNode>, std::string> parseCustomNode(const
pugi::xml_node& node, const int index)
415 {
416     return this->custom_node_parser->parseCustomNode(node, index);
417 }
418 };
419 }
420
421 #endif

```

## 8.5 behaviour\_tree/include/behaviour\_tree/Context.cpp File Reference

```

#include "Context.h"
#include "BehaviourTree.hpp"
#include "node/Node.hpp"
#include "node/composite/Composite.hpp"

```

### Namespaces

- namespace [behaviour\\_tree](#)

## 8.6 behaviour\_tree/include/behaviour\_tree/Context.h File Reference

```
#include <algorithm>
#include <memory>
#include <string>
#include <vector>
#include <variant>
#include <unordered_map>
#include "Status.hpp"
```

### Classes

- class [behaviour\\_tree::Context](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::composite](#)

## 8.7 Context.h

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_CONTEXT_HPP
2 #define BEHAVIOUR_TREE_CONTEXT_HPP
3
4 #pragma once
5
6 #include <algorithm>
7 #include <memory>
8 #include <string>
9 #include <vector>
10 #include <variant>
11 #include <unordered_map>
12
13 #include "Status.hpp"
14
15 namespace behaviour_tree
16 {
17     class BehaviourTree;
18     namespace node
19     {
20         class Node;
21         namespace composite
22         {
23             class Composite;
24         }
25     }
26 }
27
28 namespace behaviour_tree
29 {
30     class Context : public std::enable_shared_from_this<Context>
31     {
32     public:
33         Context(std::shared_ptr<BehaviourTree> behaviour_tree);
34         void update(const int tick_count);
35         Status UseRoot(const int tick_count, const std::string& id);
36
37         std::shared_ptr<BehaviourTree> getBehaviourTree() const { return this->behaviour_tree; };
38
39         void pushNodeTrace(std::pair<std::shared_ptr<node::Node>, int> node_trace);
40         void popNode();
41
42         bool canRun() const;
```

```

43
44     void setBlackboard(const std::string& key, const int value);
45     int getBlackboard(const std::string& key) const;
46     int containsBlackboard(const std::string& key) const;
47
48     // Necessary for the class to be a polymorphic
49     virtual void _() {};
50 private:
51     std::shared_ptr<BehaviourTree> behaviour_tree;
52     std::vector<std::pair<std::shared_ptr<node::Node>, int> node_trace_list;
53
54     std::unordered_map<std::string, int> blackboard;
55 };
56 }
57
58 #endif

```

## 8.8 `behaviour_tree/include/behaviour_tree/node/blackboard/BlackboardNode.hpp` File Reference ↩

```

#include "../Node.hpp"
#include "BlackboardType.hpp"

```

### Classes

- class `behaviour_tree::node::blackboard::BlackboardNode`

### Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`
- namespace `behaviour_tree::node::blackboard`

## 8.9 `BlackboardNode.hpp`

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_BLACKBOARD_NODE_HPP
2 #define BEHAVIOUR_TREE_BLACKBOARD_NODE_HPP
3
4 #pragma once
5
6 #include "../Node.hpp"
7
8 #include "BlackboardType.hpp"
9
10 namespace behaviour_tree::node::blackboard
11 {
12     class BlackboardNode : public Node
13     {
14     public:
15         BlackboardNode(const std::string& name) : Node(name)
16         {
17         }
18
19         virtual const BlackboardType type() const = 0;
20     };
21 }
22
23 #endif

```

## 8.10 behaviour\_tree/include/behaviour\_tree/node/blackboard/↵ BlackboardType.hpp File Reference

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::blackboard](#)

### Enumerations

- enum class [behaviour\\_tree::node::blackboard::BlackboardType](#) { [behaviour\\_tree::node::blackboard::ChangeInteger](#), [behaviour\\_tree::node::blackboard::IntegerCondition](#) }

## 8.11 BlackboardType.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_BLACKBOARD_TYPE_HPP
2 #define BEHAVIOUR_TREE_BLACKBOARD_TYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::blackboard
7 {
8     enum class BlackboardType
9     {
10         ChangeInteger,
11         IntegerCondition,
12     };
13 }
14
15 #endif
```

## 8.12 behaviour\_tree/include/behaviour\_tree/node/blackboard/Change↵ Integer.hpp File Reference

```
#include "BlackboardNode.hpp"
#include "enum/IntegerChangeType.hpp"
```

### Classes

- class [behaviour\\_tree::node::blackboard::ChangeInteger](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::blackboard](#)

## 8.13 ChangeInteger.hpp

[Go to the documentation of this file.](#)

```

1  #ifndef BEHAVIOUR_TREE_CHANGE_INTEGER_HPP
2  #define BEHAVIOUR_TREE_CHANGE_INTEGER_HPP
3
4  #pragma once
5
6  #include "BlackboardNode.hpp"
7
8  #include "enum/IntegerChangeType.hpp"
9
10 namespace behaviour_tree::node::blackboard
11 {
12     class ChangeInteger final : public BlackboardNode
13     {
14     public:
15         ChangeInteger(const std::string& name, const std::string variable_name, const IntegerChangeType
integer_change_type, const int value) : BlackboardNode(name), variable_name(variable_name),
integer_change_type(integer_change_type), value(value) {}
16
17         const BlackboardType type() const final override { return BlackboardType::ChangeInteger; }
18
19         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
20         {
21             if (!context->containsBlackboard(this->variable_name)) {
22                 context->setBlackboard(this->variable_name, 0);
23             }
24             int value = context->getBlackboard(this->variable_name);
25             switch (this->integer_change_type) {
26                 case IntegerChangeType::Set: {
27                     context->setBlackboard(this->variable_name, this->value);
28                     break;
29                 }
30                 case IntegerChangeType::Add: {
31                     context->setBlackboard(this->variable_name, value + this->value);
32                     break;
33                 }
34                 case IntegerChangeType::Subtract: {
35                     context->setBlackboard(this->variable_name, value - this->value);
36                     break;
37                 }
38             }
39             return Status::Success;
40         }
41
42         const std::string toString() const final override
43         {
44             const std::string& name = this->getName();
45             const std::string integer_change_type = [&]() {
46                 switch (this->integer_change_type)
47                 {
48                     case IntegerChangeType::Set:
49                         return "Set";
50                     case IntegerChangeType::Add:
51                         return "Add";
52                     case IntegerChangeType::Subtract:
53                         return "Subtract";
54                     default:
55                         return "Invalid";
56                 }
57             }();
58             if (name != "")
59                 return fmt::format(R"(<Blackboard:ChangeInteger name='{}' variable_name='{}'
integer_change_type='{}' value='{}'/>)", name, this->variable_name, integer_change_type,
this->value);
60             else
61                 return fmt::format(R"(<Blackboard:ChangeInteger variable_name='{}'
integer_change_type='{}' value='{}'/>)", this->variable_name, integer_change_type, this->value);
62         }
63     private:
64         const std::string variable_name;
65         const IntegerChangeType integer_change_type;
66         const int value;
67     };
68 }
69
70 #endif

```

## 8.14 behaviour\_tree/include/behaviour\_tree/node/blackboard/enum/ConditionOperatorType.hpp File Reference

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::blackboard](#)

### Enumerations

- enum class [behaviour\\_tree::node::blackboard::ConditionOperatorType](#) { [behaviour\\_tree::node::blackboard::Equal](#), [behaviour\\_tree::node::blackboard::NotEqual](#), [behaviour\\_tree::node::blackboard::GreaterThan](#), [behaviour\\_tree::node::blackboard::GreaterThanOrEqual](#), [behaviour\\_tree::node::blackboard::LessThan](#), [behaviour\\_tree::node::blackboard::LessThanOrEqual](#) }

## 8.15 ConditionOperatorType.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_CONDITION_OPERATOR_TYPE_HPP
2 #define BEHAVIOUR_TREE_CONDITION_OPERATOR_TYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::blackboard
7 {
8     enum class ConditionOperatorType
9     {
10         Equal,
11         NotEqual,
12         GreaterThan,
13         GreaterThanOrEqual,
14         LessThan,
15         LessThanOrEqual,
16     };
17 }
18
19 #endif
```

## 8.16 behaviour\_tree/include/behaviour\_tree/node/blackboard/enum/IntegerChangeType.hpp File Reference

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::blackboard](#)

### Enumerations

- enum class [behaviour\\_tree::node::blackboard::IntegerChangeType](#) { [behaviour\\_tree::node::blackboard::Set](#), [behaviour\\_tree::node::blackboard::Add](#), [behaviour\\_tree::node::blackboard::Subtract](#) }

## 8.17 IntegerChangeType.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_INTEGER_CHANGE_TYPE_HPP
2 #define BEHAVIOUR_TREE_INTEGER_CHANGE_TYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::blackboard
7 {
8     enum class IntegerChangeType
9     {
10         Set,
11         Add,
12         Subtract,
13     };
14 }
15
16 #endif
```

## 8.18 behaviour\_tree/include/behaviour\_tree/node/blackboard/IntegerCondition.hpp File Reference

```
#include "BlackboardNode.hpp"
#include "enum/ConditionOperatorType.hpp"
```

### Classes

- class [behaviour\\_tree::node::blackboard::IntegerCondition](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::blackboard](#)

## 8.19 IntegerCondition.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_INTEGER_CONDITION_HPP
2 #define BEHAVIOUR_TREE_INTEGER_CONDITION_HPP
3
4 #pragma once
5
6 #include "BlackboardNode.hpp"
7
8 #include "enum/ConditionOperatorType.hpp"
9
10 namespace behaviour_tree::node::blackboard
11 {
12     class IntegerCondition final : public BlackboardNode
13     {
14     public:
15         IntegerCondition(const std::string& name, const std::string variable_name, const
            ConditionOperatorType condition_operator, const int value) : BlackboardNode(name),
            variable_name(variable_name), condition_operator(condition_operator), value(value) {}
16
17         const BlackboardType type() const final override { return BlackboardType::IntegerCondition; }
18
19         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
```



```

20     {
21         if (!context->containsBlackboard(this->variable_name)) {
22             context->setBlackboard(this->variable_name, 0);
23         }
24         switch (this->condition_operator)
25         {
26             case ConditionOperatorType::Equal:
27                 return context->getBlackboard(this->variable_name) == this->value ? Status::Success :
Status::Failure;
28             case ConditionOperatorType::GreaterThan:
29                 return context->getBlackboard(this->variable_name) > this->value ? Status::Success :
Status::Failure;
30             case ConditionOperatorType::GreaterThanOrEqual:
31                 return context->getBlackboard(this->variable_name) >= this->value ? Status::Success :
Status::Failure;
32             case ConditionOperatorType::LessThan:
33                 return context->getBlackboard(this->variable_name) < this->value ? Status::Success :
Status::Failure;
34             case ConditionOperatorType::LessThanOrEqual:
35                 return context->getBlackboard(this->variable_name) <= this->value ? Status::Success :
Status::Failure;
36             case ConditionOperatorType::NotEqual:
37                 return context->getBlackboard(this->variable_name) != this->value ? Status::Success :
Status::Failure;
38             default:
39                 return Status::Failure;
40         }
41     }
42
43     const std::string toString() const final override
44     {
45         const std::string& name = this->getName();
46         const std::string condition_operator = [&]() {
47             switch (this->condition_operator)
48             {
49                 case ConditionOperatorType::Equal:
50                     return "=";
51                 case ConditionOperatorType::GreaterThan:
52                     return ">";
53                 case ConditionOperatorType::GreaterThanOrEqual:
54                     return ">=";
55                 case ConditionOperatorType::LessThan:
56                     return "<";
57                 case ConditionOperatorType::LessThanOrEqual:
58                     return "<=";
59                 case ConditionOperatorType::NotEqual:
60                     return "!=";
61                 default:
62                     return "Invalid";
63             }
64         }();
65         if (name != "")
66             return fmt::format(R"(<Blackboard:IntegerCondition name='{}' variable_name='{}'
condition_operator='{}' value='{}'/>)", name, this->variable_name, condition_operator, this->value);
67         else
68             return fmt::format(R"(<Blackboard:IntegerCondition variable_name='{}'
condition_operator='{}' value='{}'/>)", this->variable_name, condition_operator, this->value);
69     }
70
71 private:
72     const std::string variable_name;
73     const ConditionOperatorType condition_operator;
74     const int value;
75 };
76
77 }
78
79 #endif

```

## 8.20 behaviour\_tree/include/behaviour\_tree/node/composite/Composite.hpp File Reference

```

#include <vector>
#include "../Node.hpp"
#include "CompositeType.hpp"

```

## Classes

- class [behaviour\\_tree::node::composite::Composite](#)

## Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::composite](#)

## 8.21 Composite.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_COMPOSITE_HPP
2 #define BEHAVIOUR_TREE_COMPOSITE_HPP
3
4 #pragma once
5
6 #include <vector>
7
8 #include "../Node.hpp"
9 #include "CompositeType.hpp"
10
11 namespace behaviour_tree::node::composite
12 {
13     class Composite : public Node
14     {
15     public:
16         Composite(const std::string& name, std::vector<std::shared_ptr<Node>> children) : Node(name),
17         children(std::move(children))
18         {
19
20             Status tick(const int tick_count, std::shared_ptr<Context> context, const int start_index)
21             {
22                 assert(context != nullptr);
23
24                 if (!this->started) {
25                     this->start(context);
26                     this->started = true;
27                 }
28                 Status status = this->run(tick_count, context, start_index);
29                 if (status == Status::Success || status == Status::Failure) {
30                     this->finish(context);
31                     this->started = false;
32                 }
33                 return status;
34             }
35
36             virtual const Status run(const int tick_count, std::shared_ptr<Context> context, const int
37             start_index) = 0;
38             virtual const CompositeType type() const = 0;
39         protected:
40             std::vector<std::shared_ptr<Node>> children;
41     };
42 }
43
44 #endif

```

## 8.22 behaviour\_tree/include/behaviour\_tree/node/composite/CompositeType.hpp File Reference

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::composite](#)

## Enumerations

- enum class [behaviour\\_tree::node::composite::CompositeType](#) { [behaviour\\_tree::node::composite::Sequence](#), [behaviour\\_tree::node::composite::Selector](#), [behaviour\\_tree::node::composite::Random](#) }

## 8.23 CompositeType.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_COMPOSITETYPE_HPP
2 #define BEHAVIOUR_TREE_COMPOSITETYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::composite
7 {
8     enum class CompositeType
9     {
10         Sequence,
11         Selector,
12         Random,
13     };
14 }
15
16 #endif
```

## 8.24 behaviour\_tree/include/behaviour\_tree/node/composite/Random.hpp File Reference

```
#include <effolkronium/random.hpp>
#include "Composite.hpp"
```

## Classes

- class [behaviour\\_tree::node::composite::Random](#)

## Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::composite](#)

## Typedefs

- using [effolkronium\\_Random](#) = effolkronium::random\_static

### 8.24.1 Typedef Documentation

### 8.24.1.1 effolkronium\_Random

```
using effolkronium_Random = effolkronium::random_static
```

## 8.25 Random.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_RANDOM_HPP
2 #define BEHAVIOUR_TREE_RANDOM_HPP
3
4 #pragma once
5
6 #include <effolkronium/random.hpp>
7
8 #include "Composite.hpp"
9
10 using effolkronium_Random = effolkronium::random_static;
11
12 namespace behaviour_tree::node::composite
13 {
14     class Random final : public Composite
15     {
16     public:
17         Random(const std::string& name, std::vector<std::shared_ptr<Node>> children) : Composite(name,
18             std::move(children)) {}
19
20         const CompositeType type() const final override { return CompositeType::Random; }
21
22         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
23         {
24             return this->run(tick_count, context, 0);
25         }
26
27         const Status run(const int tick_count, std::shared_ptr<Context> context, const int start_index)
28         final override
29         {
30             // Random can never be empty from the BehaviourTreeParser
31             return this->children[effolkronium_Random::get(0, static_cast<int>(this->children.size() -
32                 1))]->tick(tick_count, context);
33         }
34
35         const std::string toString() const final override {
36             std::string out;
37             for (auto& child : this->children)
38             {
39                 out += child->toString();
40             }
41             const std::string& name = this->getName();
42             if (name != "")
43                 return fmt::format(R"(<Random name='{}'>{}</Random>)", name, out);
44             else
45                 return fmt::format(R"(<Random>{}</Random>)", out);
46         }
47     };
48 }
```

## 8.26 behaviour\_tree/include/behaviour\_tree/node/composite/Selector.hpp File Reference

```
#include "Composite.hpp"
```

### Classes

- class [behaviour\\_tree::node::composite::Selector](#)

## Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`
- namespace `behaviour_tree::node::composite`

## 8.27 Selector.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_SELECTOR_HPP
2 #define BEHAVIOUR_TREE_SELECTOR_HPP
3
4 #pragma once
5
6 #include "Composite.hpp"
7
8 namespace behaviour_tree::node::composite
9 {
10     class Selector final : public Composite
11     {
12     public:
13         Selector(const std::string& name, std::vector<std::shared_ptr<Node>> children) : Composite(name,
14             std::move(children)) {}
15
16         const CompositeType type() const final override { return CompositeType::Selector; }
17
18         void start(std::shared_ptr<Context> context) final override {
19             this->previous_start_index = -1;
20         }
21
22         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
23         {
24             return this->run(tick_count, context, 0);
25         }
26
27         const Status run(const int tick_count, std::shared_ptr<Context> context, const int start_index)
28         final override
29         {
30             for (int i = start_index; i < this->children.size(); i++)
31             {
32                 if (this->previous_start_index != i) {
33                     context->pushNodeTrace(std::make_pair(shared_from_this(), i));
34                 }
35                 auto& child = this->children[i];
36                 auto status = child->tick(tick_count, context);
37                 switch (status) {
38                     case Status::Running:
39                         this->previous_start_index = i;
40                         return Status::Running;
41                     case Status::Failure:
42                         context->popNode();
43                         continue;
44                     case Status::Success:
45                         context->popNode();
46                         return Status::Success;
47                 }
48             }
49             return Status::Failure;
50         }
51
52         const std::string toString() const final override {
53             std::string out;
54             for (auto& child : this->children)
55             {
56                 out += child->toString();
57             }
58             const std::string& name = this->getName();
59             if (name != "")
60                 return fmt::format(R"(<Selector name='{}'>{</Selector>)", name, out);
61             else
62                 return fmt::format(R"(<Selector>{</Selector>)", out);
63         }
64
65     private:
66         int previous_start_index = -1;
67     };
68 }
69 #endif

```

## 8.28 behaviour\_tree/include/behaviour\_tree/node/composite/↵ Sequence.hpp File Reference

```
#include "Composite.hpp"
```

### Classes

- class [behaviour\\_tree::node::composite::Sequence](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::composite](#)

## 8.29 Sequence.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_SEQUENCE_HPP
2 #define BEHAVIOUR_TREE_SEQUENCE_HPP
3
4 #pragma once
5
6 #include "Composite.hpp"
7
8 namespace behaviour_tree::node::composite
9 {
10     class Sequence final : public Composite
11     {
12     public:
13         Sequence(const std::string& name, std::vector<std::shared_ptr<Node>> children) : Composite(name,
14             std::move(children)) {}
15
16         const CompositeType type() const final override { return CompositeType::Sequence; }
17
18         void start(std::shared_ptr<Context> context) final override {
19             this->previous_start_index = -1;
20         }
21
22         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
23         {
24             return this->run(tick_count, context, 0);
25         }
26
27         const Status run(const int tick_count, std::shared_ptr<Context> context, const int start_index)
28         final override
29         {
30             for (int i = start_index; i < this->children.size(); i++)
31             {
32                 if (this->previous_start_index != i) {
33                     context->pushNodeTrace(std::make_pair(shared_from_this(), i));
34                 }
35                 auto& child = this->children[i];
36                 auto status = child->tick(tick_count, context);
37                 switch (status) {
38                     case Status::Running:
39                         this->previous_start_index = i;
40                         return Status::Running;
41                     case Status::Success:
42                         context->popNode();
43                         continue;
44                     case Status::Failure:
45                         context->popNode();
46                         return Status::Failure;
47                 }
48             }
49             return Status::Success;
50         }
51     };
52 }
```

```

48     }
49
50     const std::string toString() const final override {
51         std::string out;
52         for (auto& child : this->children)
53         {
54             out += child->toString();
55         }
56         const std::string& name = this->getName();
57         if (name != "")
58             return fmt::format(R"(<Sequence name='{}'>{}</Sequence>)", name, out);
59         else
60             return fmt::format(R"(<Sequence>{}</Sequence>)", out);
61     }
62
63 private:
64     int previous_start_index = -1;
65 };
66 }
67
68 #endif

```

## 8.30 behaviour\_tree/include/behaviour\_tree/node/custom/CustomNode.hpp File Reference

```
#include "../Node.hpp"
```

### Classes

- class [behaviour\\_tree::node::custom::CustomNode](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)

## 8.31 CustomNode.hpp

[Go to the documentation of this file.](#)

```

1  #ifndef BEHAVIOUR_TREE_CUSTOM_NODE_HPP
2  #define BEHAVIOUR_TREE_CUSTOM_NODE_HPP
3
4  #pragma once
5
6  #include "../Node.hpp"
7
8  namespace behaviour_tree::node::custom
9  {
10     class CustomNode : public Node
11     {
12     public:
13         CustomNode(const std::string& name) : Node(name) {
14
15         }
16     };
17 }
18
19 #endif

```

## 8.32 `behaviour_tree/include/behaviour_tree/node/custom/CustomNodeParser.hpp` File Reference ↩

```
#include <string>
#include <memory>
#include <pugixml.hpp>
#include <tl/expected.hpp>
#include <fmt/format.h>
#include "CustomNode.hpp"
```

### Classes

- class `behaviour_tree::node::custom::CustomNodeParser`

### Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`
- namespace `behaviour_tree::node::custom`

## 8.33 `CustomNodeParser.hpp`

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_CUSTOM_NODE_PARSER_HPP
2 #define BEHAVIOUR_TREE_CUSTOM_NODE_PARSER_HPP
3
4 #pragma once
5
6 #include <string>
7 #include <memory>
8
9 #include <pugixml.hpp>
10 #include <tl/expected.hpp>
11 #include <fmt/format.h>
12
13 #include "CustomNode.hpp"
14
15 namespace behaviour_tree::node::custom
16 {
17     class CustomNodeParser
18     {
19     public:
20         virtual tl::expected<std::shared_ptr<CustomNode>, std::string> parseCustomNode(const
pugi::xml_node& node, const int index) = 0;
21     };
22 }
23
24 #endif
```

## 8.34 `behaviour_tree/include/behaviour_tree/node/decorator/Decorator.hpp` File Reference ↩

```
#include "../Node.hpp"
#include "DecoratorType.hpp"
```



## Classes

- class [behaviour\\_tree::node::decorator::Decorator](#)

## Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::decorator](#)

## 8.35 Decorator.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_DECORATOR_HPP
2 #define BEHAVIOUR_TREE_DECORATOR_HPP
3
4 #pragma once
5
6 #include "../Node.hpp"
7
8 #include "DecoratorType.hpp"
9
10 namespace behaviour_tree::node::decorator
11 {
12     class Decorator : public Node
13     {
14     public:
15         Decorator(const std::string& name, std::shared_ptr<Node> child) : Node(name),
16             child(std::move(child))
17         {
18         }
19         virtual const DecoratorType type() const = 0;
20     protected:
21         std::shared_ptr<Node> child;
22     };
23 }
24
25
26 #endif

```

## 8.36 [behaviour\\_tree/include/behaviour\\_tree/node/decorator/Decorator](#)↵ Type.hpp File Reference

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::decorator](#)

### Enumerations

- enum class [behaviour\\_tree::node::decorator::DecoratorType](#) { [behaviour\\_tree::node::decorator::Invert](#) , [behaviour\\_tree::node::decorator::Repeat](#) }

## 8.37 DecoratorType.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_DECORORTYPE_HPP
2 #define BEHAVIOUR_TREE_DECORORTYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::decorator
7 {
8     enum class DecoratorType
9     {
10         Invert,
11         Repeat,
12     };
13 }
14
15 #endif
```

## 8.38 behaviour\_tree/include/behaviour\_tree/node/decorator/Invert.hpp

### File Reference

```
#include "Decorator.hpp"
```

### Classes

- class [behaviour\\_tree::node::decorator::Invert](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::decorator](#)

## 8.39 Invert.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_INVERT_HPP
2 #define BEHAVIOUR_TREE_INVERT_HPP
3
4 #pragma once
5
6 #include "Decorator.hpp"
7
8 namespace behaviour_tree::node::decorator
9 {
10     class Invert final : public Decorator
11     {
12     public:
13         Invert(const std::string& name, std::shared_ptr<Node> child) : Decorator(name, std::move(child))
14         {}
15
16         const DecoratorType type() const final override { return DecoratorType::Invert; }
17
18         void start(std::shared_ptr<Context> context) final override {
19             context->pushNodeTrace(std::make_pair(shared_from_this(), 0));
20         }
21
22         void finish(std::shared_ptr<Context> context) final override {
23             context->popNode();
24         }
25     };
26 }
```

```

24
25     const Status run(const int tick_count, std::shared_ptr<Context> context) final override
26     {
27         auto status = this->child->tick(tick_count, context);
28         switch (status)
29         {
30             case Status::Success:
31                 return Status::Failure;
32             case Status::Failure:
33                 return Status::Success;
34             case Status::Running:
35                 return Status::Running;
36         }
37     }
38
39     const std::string toString() const final override {
40         const std::string& name = this->getName();
41         if (name != "")
42             return fmt::format(R"(<Invert name='{}'>{}</Invert>)", name, this->child->toString());
43         else
44             return fmt::format(R"(<Invert>{}</Invert>)", this->child->toString());
45     }
46 };
47 }
48
49 #endif

```

## 8.40 behaviour\_tree/include/behaviour\_tree/node/decorator/Repeat.hpp File Reference

```

#include <numeric>
#include "Decorator.hpp"

```

### Classes

- class [behaviour\\_tree::node::decorator::Repeat](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::decorator](#)

## 8.41 Repeat.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_REPEAT_HPP
2 #define BEHAVIOUR_TREE_REPEAT_HPP
3
4 #pragma once
5
6 #include <numeric>
7
8 #include "Decorator.hpp"
9
10 namespace behaviour_tree::node::decorator
11 {
12     class Repeat final : public Decorator
13     {
14     public:
15         Repeat(const std::string& name, std::shared_ptr<Node> child, const unsigned long amount, const
            bool break_on_fail) : Decorator(name, std::move(child)), amount(amount), break_on_fail(break_on_fail)
16         {

```

```

17     }
18
19     const DecoratorType type() const final override { return DecoratorType::Repeat; }
20
21     void start(std::shared_ptr<Context> context) final override {
22         this->count = 0;
23     }
24
25     const Status run(const int tick_count, std::shared_ptr<Context> context) final override
26     {
27         auto status = this->child->tick(tick_count, context);
28         switch (status)
29         {
30             case Status::Success:
31                 this->count++;
32                 if (this->count >= this->amount)
33                 {
34                     return Status::Success;
35                 }
36                 return Status::Running;
37             case Status::Running:
38                 return Status::Running;
39             case Status::Failure:
40                 if (this->break_on_fail)
41                     return Status::Failure;
42                 return Status::Running;
43         }
44     }
45
46     const std::string toString() const final override {
47         const std::string& name = this->getName();
48         if (name != "")
49             return fmt::format(R"(<Repeat name='{ }' amount='{ }' break_on_fail='{ }>{ }</Repeat>)",
50 name, this->getAmount(), this->getBreakOnFail() ? "true" : "false", this->child->toString());
51         else
52             return fmt::format(R"(<Repeat amount='{ }' break_on_fail='{ }>{ }</Repeat>)",
53 this->getAmount(), this->getBreakOnFail() ? "true" : "false", this->child->toString());
54     }
55
56     const unsigned long getAmount() const {
57         return this->amount;
58     }
59
60     const bool getBreakOnFail() const {
61         return this->break_on_fail;
62     }
63
64     const unsigned long getCount() const {
65         return this->count;
66     }
67
68 private:
69     const unsigned long amount;
70     const bool break_on_fail;
71
72     unsigned long count = 0;
73 };
74 #endif

```

## 8.42 behaviour\_tree/include/behaviour\_tree/node/leaf/Fail.hpp File Reference

```
#include "Leaf.hpp"
```

### Classes

- class [behaviour\\_tree::node::leaf::Fail](#)

## Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::leaf](#)

## 8.43 Fail.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_FAIL_HPP
2 #define BEHAVIOUR_TREE_FAIL_HPP
3
4 #pragma once
5
6 #include "Leaf.hpp"
7
8 namespace behaviour_tree::node::leaf
9 {
10     class Fail final : public Leaf
11     {
12     public:
13         Fail(const std::string& name) : Leaf(name) {}
14
15         const LeafType type() const final override { return LeafType::Fail; }
16
17         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
18         {
19             return Status::Failure;
20         }
21
22         const std::string toString() const final override {
23             const std::string& name = this->getName();
24             if (name != "")
25                 return fmt::format(R"(<Fail name='{}'/>)", name);
26             else
27                 return fmt::format(R"(<Fail/>)");
28         }
29     };
30 }
31
32 #endif

```

## 8.44 behaviour\_tree/include/behaviour\_tree/node/leaf/Leaf.hpp File Reference

```

#include "../Node.hpp"
#include "LeafType.hpp"

```

## Classes

- class [behaviour\\_tree::node::leaf::Leaf](#)

## Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::leaf](#)

## 8.45 Leaf.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_LEAF_HPP
2 #define BEHAVIOUR_TREE_LEAF_HPP
3
4 #pragma once
5
6 #include "../Node.hpp"
7
8 #include "LeafType.hpp"
9
10 namespace behaviour_tree::node::leaf
11 {
12     class Leaf : public Node
13     {
14     public:
15         Leaf(const std::string& name) : Node(name)
16         {
17         }
18
19         virtual const LeafType type() const = 0;
20     };
21 }
22
23 #endif
```

## 8.46 behaviour\_tree/include/behaviour\_tree/node/leaf/LeafType.hpp File Reference

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::leaf](#)

### Enumerations

- enum class [behaviour\\_tree::node::leaf::LeafType](#) { [behaviour\\_tree::node::leaf::Succeed](#), [behaviour\\_tree::node::leaf::Fail](#), [behaviour\\_tree::node::leaf::UseRoot](#) }

## 8.47 LeafType.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_LEAFTYPE_HPP
2 #define BEHAVIOUR_TREE_LEAFTYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::leaf
7 {
8     enum class LeafType
9     {
10         Succeed,
11         Fail,
12         UseRoot,
13     };
14 }
15
16 #endif
```

## 8.48 behaviour\_tree/include/behaviour\_tree/node/leaf/Succeed.hpp File Reference

```
#include "Leaf.hpp"
```

### Classes

- class [behaviour\\_tree::node::leaf::Succeed](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::leaf](#)

## 8.49 Succeed.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_SUCCEED_HPP
2 #define BEHAVIOUR_TREE_SUCCEED_HPP
3
4 #pragma once
5
6 #include "Leaf.hpp"
7
8 namespace behaviour_tree::node::leaf
9 {
10     class Succeed final : public Leaf
11     {
12     public:
13         Succeed(const std::string& name) : Leaf(name) {}
14
15         const LeafType type() const final override { return LeafType::Succeed; }
16
17         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
18         {
19             return Status::Success;
20         }
21
22         const std::string toString() const final override {
23             const std::string& name = this->getName();
24             if (name != "")
25                 return fmt::format(R"(<Succeed name='{}'/>)", name);
26             else
27                 return fmt::format(R"(<Succeed/>)");
28         }
29     };
30 }
31
32 #endif
```

## 8.50 behaviour\_tree/include/behaviour\_tree/node/leaf/UseRoot.hpp File Reference

```
#include "Leaf.hpp"
```

## Classes

- class `behaviour_tree::node::leaf::UseRoot`

## Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`
- namespace `behaviour_tree::node::leaf`

## 8.51 UseRoot.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_UseRoot_HPP
2 #define BEHAVIOUR_TREE_UseRoot_HPP
3
4 #pragma once
5
6 #include "Leaf.hpp"
7
8 namespace behaviour_tree::node::leaf
9 {
10     class UseRoot final : public Leaf
11     {
12     public:
13         UseRoot(const std::string& name, const std::string& id) : Leaf(name), id(id) {}
14
15         const LeafType type() const final override { return LeafType::UseRoot; }
16
17         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
18         {
19             return context->UseRoot(tick_count, this->id);
20         }
21
22         const std::string& getId() const { return this->id; }
23
24         const std::string toString() const final override {
25             const std::string& name = this->getName();
26             if (name != "")
27                 return fmt::format(R"(<UseRoot name='{}' id='{}'/>)", name, this->getId());
28             else
29                 return fmt::format(R"(<UseRoot id='{}'/>)", this->getId());
30         }
31
32     private:
33         const std::string id;
34     };
35 }
36
37 #endif

```

## 8.52 behaviour\_tree/include/behaviour\_tree/node/Node.hpp File Reference

```

#include <cassert>
#include <string>
#include <memory>
#include <fmt/format.h>
#include "../Status.hpp"
#include "../Context.h"

```



## Classes

- class `behaviour_tree::node::Node`

## Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`

## 8.53 Node.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_NODE_HPP
2 #define BEHAVIOUR_TREE_NODE_HPP
3
4 #pragma once
5
6 #include <cassert>
7
8 #include <string>
9 #include <memory>
10
11 #include <fmt/format.h>
12
13 #include "../Status.hpp"
14 #include "../Context.h"
15
16 namespace behaviour_tree::node
17 {
18     class Node : public std::enable_shared_from_this<Node>
19     {
20     public:
21         Node(const std::string& name) : name(name)
22         {
23         }
24
25         virtual void start(std::shared_ptr<Context> context) {}
26         virtual const Status run(const int tick_count, std::shared_ptr<Context> context) = 0;
27         virtual void finish(std::shared_ptr<Context> context) {}
28
29         Status tick(const int tick_count, std::shared_ptr<Context> context)
30         {
31             assert(context != nullptr);
32
33             if (!this->started) {
34                 this->start(context);
35                 this->started = true;
36             }
37             Status status = this->run(tick_count, context);
38             if (status == Status::Success || status == Status::Failure) {
39                 this->finish(context);
40                 this->started = false;
41             }
42             return status;
43         }
44
45         virtual const std::string toString() const = 0;
46
47         const std::string& getName() const
48         {
49             return this->name;
50         }
51
52     protected:
53         const std::string name;
54
55         bool started = false;
56     };
57 }
58
59 #endif

```

## 8.54 behaviour\_tree/include/behaviour\_tree/Root.hpp File Reference

```
#include <string>
#include <fmt/format.h>
#include "node/Node.hpp"
```

### Classes

- class [behaviour\\_tree::Root](#)

### Namespaces

- namespace [behaviour\\_tree](#)

## 8.55 Root.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_ROOT_HPP
2 #define BEHAVIOUR_TREE_ROOT_HPP
3
4 #pragma once
5
6 #include <string>
7 #include <fmt/format.h>
8
9 #include "node/Node.hpp"
10
11 using namespace behaviour_tree::node;
12
13 namespace behaviour_tree
14 {
15     class Root
16     {
17     public:
18         Root(std::string id, std::shared_ptr<node::Node> child) : id(id), child(std::move(child))
19         {
20         }
21
22         const Status tick(const int tick_count, std::shared_ptr<Context>& context)
23         {
24             if (this->child == nullptr) return Status::Success;
25             return this->child->tick(tick_count, context);
26         }
27
28         const std::string toString() const {
29             const std::string& id = this->getId();
30             std::string child_string = this->child != nullptr ? this->child->toString() : "";
31             if (id != "")
32                 return fmt::format(R"(<Root id='{}'>{}/Root>)", id, child_string);
33             else
34                 return fmt::format(R"(<Root>{}/Root>)", child_string);
35         }
36
37         const std::string& getId() const
38         {
39             return this->id;
40         }
41
42     private:
43         std::string id;
44         std::shared_ptr<node::Node> child;
45     };
46 }
47
48 #endif
```



## 8.60 behaviour\_tree\_car/include/behaviour\_tree/node/custom/action/Drive.hpp File Reference

```
#include <fmt/format.h>
#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
#include "behaviour_tree/CarContext.hpp"
#include "enum/DirectionType.hpp"
```

### Classes

- class [behaviour\\_tree::node::custom::action::Drive](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)
- namespace [behaviour\\_tree::node::custom::action](#)

## 8.61 Drive.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_DRIVE_HPP
2 #define BEHAVIOUR_TREE_DRIVE_HPP
3
4 #pragma once
5
6 #include <fmt/format.h>
7
8 #include "behaviour_tree/node/custom/CustomNode.hpp"
9
10 #include "behaviour_tree/Context.h"
11 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
12 #include "behaviour_tree/CarContext.hpp"
13 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
14
15 #include "enum/DirectionType.hpp"
16
17 namespace behaviour_tree::node::custom::action
18 {
19     class Drive final : public CustomNode
20     {
21     public:
22         Drive(const std::string &name, const int speed, const DirectionType direction_type) :
23             CustomNode(name), speed(speed), direction_type(direction_type)
24         {
25
26             const static tl::expected<std::shared_ptr<Drive>, std::string> parse(const pugi::xml_node &node,
27             const int index, const std::string &name_attribute)
28             {
29                 const int speed = node.attribute("speed").as_int();
30                 if (speed < 0 || speed > 100)
31                 {
32                     return tl::unexpected(fmt::format(R"(Invalid speed: '{} | Action:Drive:[ '{}', {} ])",
33                     speed, name_attribute, index));
34                 }
35                 const tl::expected<DirectionType, std::string> maybe_direction_type =
36                     [&]()
37                     {
38                         const std::string direction_type_attribute =
39                             node.attribute("direction_type").as_string();
40                         tl::expected<DirectionType, std::string> result;
```

```

38         switch (utils::hash(direction_type_attribute))
39         {
40         case utils::hash("Forward"):
41         {
42             result = DirectionType::Forward;
43             break;
44         }
45         case utils::hash("Backward"):
46         {
47             result = DirectionType::Backward;
48             break;
49         }
50         default:
51         {
52             result = tl::make_unexpected(fmt::format(R"(Invalid direction_type: '{} ' |
Action:Drive:['{}',{})]", direction_type_attribute, name_attribute, index));
53             break;
54         }
55         };
56         return result;
57     }();
58     if (!maybe_direction_type.has_value())
59     {
60         return tl::make_unexpected(maybe_direction_type.error());
61     }
62     return std::make_shared<Drive>(
63         Drive(
64             name_attribute,
65             speed,
66             maybe_direction_type.value());
67     )
68
69     const Status run(const int tick_count, std::shared_ptr<Context> context) final override
70     {
71     #ifndef BEHAVIOUR_TREE_DISABLE_RUN
72         std::shared_ptr<CarContext> car_context = std::dynamic_pointer_cast<CarContext>(context);
73         auto car_system = car_context->getCarSystem();
74         const MovementSystem *movement_system = car_system->getMovementSystem();
75         switch (this->getDirectionType())
76         {
77         case DirectionType::Backward:
78         {
79             movement_system->setRearWheelsDirectionToBackward();
80             break;
81         }
82         case DirectionType::Forward:
83         {
84             movement_system->setRearWheelsDirectionToForward();
85             break;
86         }
87         }
88         movement_system->setRearWheelsSpeed(this->getSpeed());
89     #endif // !BEHAVIOUR_TREE_DISABLE_RUN
90         return Status::Success;
91     }
92
93     const std::string toString() const final override
94     {
95         const std::string &name = this->getName();
96         std::string direction_type;
97         switch (this->getDirectionType())
98         {
99         case DirectionType::Forward:
100             direction_type = "Forward";
101             break;
102         case DirectionType::Backward:
103             direction_type = "Backward";
104             break;
105         }
106         if (name != "")
107             return fmt::format(R"(<Action:Drive name='{}' speed='{}' direction_type='{}'/>)", name,
this->getSpeed(), direction_type);
108         else
109             return fmt::format(R"(<Action:Drive speed='{}' direction_type='{}'/>)",
this->getSpeed(), direction_type);
110     }
111
112     const int getSpeed() const
113     {
114         return this->speed;
115     }
116
117     const DirectionType getDirectionType() const
118     {
119         return this->direction_type;
120     }
121

```

```

122     private:
123         const int speed;
124         const DirectionType direction_type;
125     };
126 }
127
128 #endif

```

## 8.62 `behaviour_tree_car/include/behaviour_↵ tree/node/custom/action/enum/ClockDirectionType.hpp` File Reference

### Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`
- namespace `behaviour_tree::node::custom`
- namespace `behaviour_tree::node::custom::action`

### Enumerations

- enum class `behaviour_tree::node::custom::action::ClockDirectionType` { `behaviour_tree::node::custom::action::Clockwise`, `behaviour_tree::node::custom::action::AntiClockwise` }

## 8.63 `ClockDirectionType.hpp`

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_CLOCKDIRECTIONTYPE_HPP
2 #define BEHAVIOUR_TREE_CLOCKDIRECTIONTYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::custom::action
7 {
8     enum class ClockDirectionType
9     {
10         Clockwise,
11         AntiClockwise,
12     };
13 }
14
15 #endif

```

## 8.64 `behaviour_tree_car/include/behaviour_↵ tree/node/custom/action/enum/DirectionType.hpp` File Reference

### Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`
- namespace `behaviour_tree::node::custom`
- namespace `behaviour_tree::node::custom::action`

## Enumerations

- enum class `behaviour_tree::node::custom::action::DirectionType` { `behaviour_tree::node::custom::action::Forward`, `behaviour_tree::node::custom::action::Backward` }

## 8.65 DirectionType.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_DIRECTIONTYPE_HPP
2 #define BEHAVIOUR_TREE_DIRECTIONTYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::custom::action
7 {
8     enum class DirectionType
9     {
10         Forward,
11         Backward,
12     };
13 }
14
15 #endif
```

## 8.66 behaviour\_tree\_car/include/behaviour\_tree/node/custom/action/enum/ServoType.hpp File Reference

### Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`
- namespace `behaviour_tree::node::custom`
- namespace `behaviour_tree::node::custom::action`

### Enumerations

- enum class `behaviour_tree::node::custom::action::ServoType` { `behaviour_tree::node::custom::action::FrontWheels`, `behaviour_tree::node::custom::action::CameraServo1`, `behaviour_tree::node::custom::action::CameraServo2` }

## 8.67 ServoType.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_SERVOTYPE_HPP
2 #define BEHAVIOUR_TREE_SERVOTYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::custom::action
7 {
8     enum class ServoType
9     {
10         FrontWheels,
11         CameraServo1,
12         CameraServo2,
13     };
14 }
15
16 #endif
```

## 8.68 `behaviour_tree_car/include/behaviour_tree/node/custom/action/enum/WheelType.hpp` File Reference

### Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`
- namespace `behaviour_tree::node::custom`
- namespace `behaviour_tree::node::custom::action`

### Enumerations

- enum class `behaviour_tree::node::custom::action::WheelType` { `behaviour_tree::node::custom::action::Left` , `behaviour_tree::node::custom::action::Right` , `behaviour_tree::node::custom::action::Both` }

## 8.69 `WheelType.hpp`

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_WHEELTYPE_HPP
2 #define BEHAVIOUR_TREE_WHEELTYPE_HPP
3
4 #pragma once
5
6 namespace behaviour_tree::node::custom::action
7 {
8     enum class WheelType
9     {
10         Left,
11         Right,
12         Both,
13     };
14 }
15
16 #endif
```

## 8.70 `behaviour_tree_car/include/behaviour_tree/node/custom/action/PauseExecution.hpp` File Reference

```
#include <chrono>
#include <fmt/format.h>
#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
```

### Classes

- class `behaviour_tree::node::custom::action::PauseExecution`

### Namespaces

- namespace `behaviour_tree`
- namespace `behaviour_tree::node`
- namespace `behaviour_tree::node::custom`
- namespace `behaviour_tree::node::custom::action`



## 8.71 PauseExecution.hpp

[Go to the documentation of this file.](#)

```

1  #ifndef BEHAVIOUR_TREE_PAUSE_EXECUTION_HPP
2  #define BEHAVIOUR_TREE_PAUSE_EXECUTION_HPP
3
4  #pragma once
5
6  #include <chrono>
7  #include <fmt/format.h>
8
9  #include "behaviour_tree/node/custom/CustomNode.hpp"
10
11 #include "behaviour_tree/Context.h"
12
13 namespace behaviour_tree::node::custom::action
14 {
15     class PauseExecution final : public CustomNode
16     {
17     public:
18         PauseExecution(const std::string &name, const int ms) : CustomNode(name), ms(ms)
19         {
20         }
21
22         const static tl::expected<std::shared_ptr<PauseExecution>, std::string> parse(const
pugi::xml_node &node, const int index, const std::string &name_attribute)
23         {
24             int ms = node.attribute("ms").as_int();
25             if (ms < 0)
26             {
27                 return tl::unexpected(fmt::format(R"(Invalid ms: '{}{}' |
Action:PauseExecution:[]{}',{})", ms, name_attribute, index));
28             }
29             return std::make_shared<custom::action::PauseExecution>(
30                 custom::action::PauseExecution(
31                     name_attribute,
32                     ms));
33         }
34
35         void start(std::shared_ptr<Context> context) final override
36         {
37 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
38             this->start_time = std::chrono::steady_clock::now();
39 #endif
40         }
41
42         void finish(std::shared_ptr<Context> context) final override
43         {
44         }
45
46         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
47         {
48 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
49             if (std::chrono::duration_cast<std::chrono::milliseconds>(std::chrono::steady_clock::now() -
this->start_time).count() < this->ms)
50             {
51                 return Status::Running;
52             }
53 #endif
54             return Status::Success;
55         }
56
57         const std::string toString() const final override
58         {
59             const std::string &name = this->getName();
60             if (name != "")
61                 return fmt::format(R"(<Action:PauseExecution name='{}' ms='{}'/>)", name, this->getMS());
62             else
63                 return fmt::format(R"(<Action:PauseExecution ms='{}'/>)", this->getMS());
64         }
65
66         const int getMS() const
67         {
68             return this->ms;
69         }
70
71     private:
72         std::chrono::steady_clock::time_point start_time;
73         const int ms;
74     };
75 }
76
77 #endif

```

## 8.72 behaviour\_tree\_car/include/behaviour\_tree/node/custom/action/Print.hpp File Reference

```
#include <iostream>
#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
#include "behaviour_tree/CarContext.hpp"
#include <spdlog/spdlog.h>
```

### Classes

- class [behaviour\\_tree::node::custom::action::Print](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)
- namespace [behaviour\\_tree::node::custom::action](#)

## 8.73 Print.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_PRINT_HPP
2 #define BEHAVIOUR_TREE_PRINT_HPP
3
4 #pragma once
5
6 #include <iostream>
7
8 #include "behaviour_tree/node/custom/CustomNode.hpp"
9
10 #include "behaviour_tree/Context.h"
11 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
12 #include "behaviour_tree/CarContext.hpp"
13 #include <spdlog/spdlog.h>
14 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
15
16 namespace behaviour_tree::node::custom::action
17 {
18     class Print final : public CustomNode
19     {
20     public:
21         Print(const std::string &name, const std::string &text) : CustomNode(name), text(text)
22         {
23         }
24
25         const static tl::expected<std::shared_ptr<Print>, std::string> parse(const pugi::xml_node &node,
26 const int index, const std::string &name_attribute)
27         {
28             return std::make_shared<Print>(<
29                 Print(
30                     name_attribute,
31                     node.attribute("text").as_string());
32         }
33
34         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
35         {
36             std::shared_ptr<CarContext> car_context = std::dynamic_pointer_cast<CarContext>(context);
37             spdlog::info(this->getText());
38         }
39         std::cout << this->getText();
40     }
41 }
```

```

41         return Status::Success;
42     }
43
44     const std::string &getText() const
45     {
46         return this->text;
47     }
48
49     const std::string toString() const final override
50     {
51         const std::string &name = this->getName();
52         if (name != "")
53             return fmt::format(R"(<Action:Print name='{}' text='{}'/>)", name, this->getText());
54         else
55             return fmt::format(R"(<Action:Print text='{}'/>)", this->getText());
56     }
57
58     private:
59         const std::string text;
60     };
61 }
62
63 #endif

```

## 8.74 behaviour\_tree\_car/include/behaviour\_tree/node/custom/action/SetAngle.hpp File Reference

```

#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
#include "behaviour_tree/CarContext.hpp"
#include "enum/ServoType.hpp"

```

### Classes

- class [behaviour\\_tree::node::custom::action::SetAngle](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)
- namespace [behaviour\\_tree::node::custom::action](#)

## 8.75 SetAngle.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_SETANGLE_HPP
2 #define BEHAVIOUR_TREE_SETANGLE_HPP
3
4 #pragma once
5
6 #include "behaviour_tree/node/custom/CustomNode.hpp"
7
8 #include "behaviour_tree/Context.h"
9 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
10 #include "behaviour_tree/CarContext.hpp"
11 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
12
13 #include "enum/ServoType.hpp"
14
15 namespace behaviour_tree::node::custom::action

```

```

16 {
17     class SetAngle final : public CustomNode
18     {
19     public:
20         SetAngle(const std::string &name, const ServoType servo_type, const int angle) :
21             CustomNode(name), servo_type(servo_type), angle(angle)
22         {
23         }
24
25         const static tl::expected<std::shared_ptr<SetAngle>, std::string> parse(const pugi::xml_node
26             &node, const int index, const std::string &name_attribute)
27         {
28             const tl::expected<ServoType, std::string> maybe_servo_type = [&]()
29             {
30                 const std::string servo_type_attribute = node.attribute("servo_type").as_string();
31                 tl::expected<ServoType, std::string> result;
32                 switch (utils::hash(servo_type_attribute))
33                 {
34                     case utils::hash("FrontWheels"):
35                     {
36                         result = ServoType::FrontWheels;
37                         break;
38                     }
39                     case utils::hash("CameraServo1"):
40                     {
41                         result = ServoType::CameraServo1;
42                         break;
43                     }
44                     case utils::hash("CameraServo2"):
45                     {
46                         result = ServoType::CameraServo2;
47                         break;
48                     }
49                     default:
50                     {
51                         result = tl::unexpected(fmt::format(R"(Invalid servo_type: '{}{}' |
52                             Action:SetAngle:['{}',{}])", servo_type_attribute, name_attribute, index));
53                     }
54                 };
55                 return result;
56             }();
57             const int angle = node.attribute("angle").as_int();
58             if (angle < 0 || angle > 180)
59             {
60                 return tl::unexpected(fmt::format(R"(Invalid angle: '{}{}' | Action:SetAngle:['{}',{}])",
61                     angle, name_attribute, index));
62             }
63             return std::make_shared<SetAngle>(SetAngle(name_attribute, maybe_servo_type.value(), angle));
64         }
65
66         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
67         {
68             #ifndef BEHAVIOUR_TREE_DISABLE_RUN
69             std::shared_ptr<CarContext> car_context = std::dynamic_pointer_cast<CarContext>(context);
70             auto car_system = car_context->getCarSystem();
71             const MovementSystem *movement_system = car_system->getMovementSystem();
72             switch (this->getServoType())
73             {
74                 case ServoType::FrontWheels:
75                 {
76                     movement_system->setFrontWheelsAngle(this->getAngle());
77                     break;
78                 }
79                 case ServoType::CameraServo1:
80                 {
81                     movement_system->setCameraServo1Angle(this->getAngle());
82                     break;
83                 }
84                 case ServoType::CameraServo2:
85                 {
86                     movement_system->setCameraServo2Angle(this->getAngle());
87                     break;
88                 }
89             }
90             #endif // !BEHAVIOUR_TREE_DISABLE_RUN
91             return Status::Success;
92         }
93
94         const std::string toString() const final override
95         {
96             std::string servo_type;
97             switch (this->getServoType())
98             {
99                 case ServoType::FrontWheels:
100                 {
101                     servo_type = "FrontWheels";
102                     break;
103                 }
104                 case ServoType::CameraServo1:
105                 {
106                     servo_type = "CameraServo1";
107                     break;
108                 }
109                 case ServoType::CameraServo2:
110                 {
111                     servo_type = "CameraServo2";
112                     break;
113                 }
114             }
115         }
116     };
117 }

```

```

99         const std::string &name = this->getName();
100         if (name != "")
101             return fmt::format(R"(<Action:SetAngle name='{}' servo_type='{}' angle='{}'/>)", name,
102                               servo_type, this->getAngle());
103         else
104             return fmt::format(R"(<Action:SetAngle servo_type='{}' angle='{}'/>)", servo_type,
105                               this->getAngle());
106     }
107     const ServoType getServoType() const
108     {
109         return this->servo_type;
110     }
111     const int getAngle() const
112     {
113         return this->angle;
114     }
115 private:
116     const int angle;
117     const ServoType servo_type;
118 };
119 }
120 }
121
122 #endif

```

## 8.76 behaviour\_tree\_car/include/behaviour\_tree/node/custom/action/SetSpeed.hpp File Reference

```

#include <fmt/format.h>
#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
#include "behaviour_tree/CarContext.hpp"
#include "enum/WheelType.hpp"

```

### Classes

- class [behaviour\\_tree::node::custom::action::SetSpeed](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)
- namespace [behaviour\\_tree::node::custom::action](#)

## 8.77 SetSpeed.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_SETSPEED_HPP
2 #define BEHAVIOUR_TREE_SETSPEED_HPP
3
4 #pragma once
5
6 #include <fmt/format.h>
7
8 #include "behaviour_tree/node/custom/CustomNode.hpp"
9
10 #include "behaviour_tree/Context.h"
11 #ifndef BEHAVIOUR_TREE_DISABLE_RUN

```

```

12 #include "behaviour_tree/CarContext.hpp"
13 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
14
15 #include "enum/WheelType.hpp"
16
17 namespace behaviour_tree::node::custom::action
18 {
19     class SetSpeed final : public CustomNode
20     {
21     public:
22         SetSpeed(const std::string &name, const WheelType wheel_type, const int speed) :
23             CustomNode(name), wheel_type(wheel_type), speed(speed)
24         {
25
26             const static tl::expected<std::shared_ptr<SetSpeed>, std::string> parse(const pugi::xml_node
27                 &node, const int index, const std::string &name_attribute)
28             {
29                 const tl::expected<WheelType, std::string> maybe_wheel_type = [&]()
30                 {
31                     const std::string wheel_type_attribute = node.attribute("wheel_type").as_string();
32                     tl::expected<WheelType, std::string> result;
33                     switch (utils::hash(wheel_type_attribute))
34                     {
35                         case utils::hash("Left"):
36                         {
37                             result = WheelType::Left;
38                             break;
39                         }
40                         case utils::hash("Right"):
41                         {
42                             result = WheelType::Right;
43                             break;
44                         }
45                         case utils::hash("Both"):
46                         {
47                             result = WheelType::Both;
48                             break;
49                         }
50                         default:
51                         {
52                             result = tl::unexpected(fmt::format(R"(Invalid wheel_type: '{} ' |
53                                 Action:SetSpeed:[]{}]", wheel_type_attribute, name_attribute, index));
54                             break;
55                         }
56                     }
57                     return result;
58                 }();
59                 if (!maybe_wheel_type.has_value())
60                 {
61                     return tl::make_unexpected(maybe_wheel_type.error());
62                 }
63                 const int speed = node.attribute("speed").as_int();
64                 if (speed < 0 || speed > 100)
65                 {
66                     return tl::unexpected(fmt::format(R"(Invalid speed: '{} ' | Action:SetSpeed:[]{}]",
67                         speed, name_attribute, index));
68                 }
69                 return std::make_shared<SetSpeed>(SetSpeed(name_attribute, maybe_wheel_type.value(), speed));
70             }
71
72             const Status run(const int tick_count, std::shared_ptr<Context> context) final override
73             {
74 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
75                 std::shared_ptr<CarContext> car_context = std::dynamic_pointer_cast<CarContext>(context);
76                 auto car_system = car_context->getCarSystem();
77                 const MovementSystem *movement_system = car_system->getMovementSystem();
78                 switch (this->getWheelType())
79                 {
80                     case WheelType::Left:
81                     {
82                         movement_system->setRearLeftWheelSpeed(this->getSpeed());
83                         break;
84                     }
85                     case WheelType::Right:
86                     {
87                         movement_system->setRearRightWheelSpeed(this->getSpeed());
88                         break;
89                     }
90                     case WheelType::Both:
91                     {
92                         movement_system->setRearWheelsSpeed(this->getSpeed());
93                         break;
94                     }
95                 }
96 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
97                 return Status::Success;
98             }
99
100             const std::string toString() const final override
101             {
102                 std::string wheel_type;
103                 switch (this->getWheelType())

```

```

95         {
96             case WheelType::Left:
97                 wheel_type = "Forward";
98                 break;
99             case WheelType::Right:
100                 wheel_type = "Backward";
101                 break;
102             case WheelType::Both:
103                 wheel_type = "Both";
104                 break;
105         }
106         const std::string &name = this->getName();
107         if (name != "")
108             return fmt::format(R"(<Action:SetSpeed name='{}' wheel_type='{}' speed='{}'/>)", name,
wheel_type, this->getSpeed());
109         else
110             return fmt::format(R"(<Action:SetSpeed wheel_type='{}' speed='{}'/>)", wheel_type,
this->getSpeed());
111     }
112
113     const WheelType getWheelType() const
114     {
115         return this->wheel_type;
116     }
117
118     const int getSpeed() const
119     {
120         return this->speed;
121     }
122
123 private:
124     const int speed;
125     const WheelType wheel_type;
126 };
127 }
128
129 #endif

```

## 8.78 behaviour\_tree\_car/include/behaviour\_tree/node/custom/action/SetWheelDirection.hpp File Reference

```

#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
#include "behaviour_tree/CarContext.hpp"
#include "enum/DirectionType.hpp"
#include "enum/WheelType.hpp"

```

### Classes

- class [behaviour\\_tree::node::custom::action::SetWheelDirection](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)
- namespace [behaviour\\_tree::node::custom::action](#)

## 8.79 SetWheelDirection.hpp

[Go to the documentation of this file.](#)

```

1  #ifndef BEHAVIOUR_TREE_SETWHEELDIRECTION_HPP
2  #define BEHAVIOUR_TREE_SETWHEELDIRECTION_HPP
3
4  #pragma once
5
6  #include "behaviour_tree/node/custom/CustomNode.hpp"
7
8  #include "behaviour_tree/Context.h"
9  #ifndef BEHAVIOUR_TREE_DISABLE_RUN
10 #include "behaviour_tree/CarContext.hpp"
11 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
12
13 #include "enum/DirectionType.hpp"
14 #include "enum/WheelType.hpp"
15
16 namespace behaviour_tree::node::custom::action
17 {
18     class SetWheelDirection final : public CustomNode
19     {
20     public:
21         SetWheelDirection(const std::string &name, const WheelType wheel_type, const DirectionType
direction_type) : CustomNode(name), wheel_type(wheel_type), direction_type(direction_type)
22         {
23         }
24
25         const static tl::expected<std::shared_ptr<SetWheelDirection>, std::string> parse(const
pugi::xml_node &node, const int index, const std::string &name_attribute)
26         {
27             const tl::expected<WheelType, std::string> maybe_wheel_type = [&]()
28             {
29                 const std::string wheel_type_attribute = node.attribute("wheel_type").as_string();
30                 tl::expected<WheelType, std::string> result;
31                 switch (utils::hash(wheel_type_attribute))
32                 {
33                     case utils::hash("Left"):
34                     {
35                         result = WheelType::Left;
36                         break;
37                     }
38                     case utils::hash("Right"):
39                     {
40                         result = WheelType::Right;
41                         break;
42                     }
43                     case utils::hash("Both"):
44                     {
45                         result = WheelType::Both;
46                         break;
47                     }
48                     default:
49                     {
50                         result = tl::unexpected(fmt::format(R"(Invalid wheel_type: '{} ' |
Action:SetWheelDirection:['{}',{}])", wheel_type_attribute, name_attribute, index));
51                         break;
52                     }
53                 };
54                 return result;
55             }();
56             if (!maybe_wheel_type.has_value())
57             {
58                 return tl::make_unexpected(maybe_wheel_type.error());
59             }
60             const tl::expected<DirectionType, std::string> maybe_direction_type =
61             [&]()
62             {
63                 const std::string direction_type_attribute =
node.attribute("direction_type").as_string();
64                 tl::expected<DirectionType, std::string> result;
65                 switch (utils::hash(direction_type_attribute))
66                 {
67                     case utils::hash("Forward"):
68                     {
69                         result = DirectionType::Forward;
70                     }
71                     case utils::hash("Backward"):
72                     {
73                         result = DirectionType::Backward;
74                     }
75                     default:
76                     {
77                         result = tl::make_unexpected(fmt::format(R"(Invalid direction_type: '{} ' |
Action:Drive:['{}',{}])", direction_type_attribute, name_attribute, index));

```



```

78         }
79     };
80     return result;
81 }();
82 if (!maybe_direction_type.has_value())
83 {
84     return tl::make_unexpected(maybe_direction_type.error());
85 }
86 return std::make_shared<SetWheelDirection>(SetWheelDirection(name_attribute,
maybe_wheel_type.value(), maybe_direction_type.value()));
87 }
88
89 const Status run(const int tick_count, std::shared_ptr<Context> context) final override
90 {
91 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
92     std::shared_ptr<CarContext> car_context = std::dynamic_pointer_cast<CarContext>(context);
93     auto car_system = car_context->getCarSystem();
94     const MovementSystem *movement_system = car_system->getMovementSystem();
95     switch (this->getDirectionType())
96     {
97     case DirectionType::Forward:
98     {
99         switch (this->getWheelType())
100         {
101         case WheelType::Left:
102         {
103             movement_system->setRearLeftWheelDirectionToForward();
104             break;
105         }
106         case WheelType::Right:
107         {
108             movement_system->setRearRightWheelDirectionToForward();
109             break;
110         }
111         case WheelType::Both:
112         {
113             movement_system->setRearWheelsDirectionToForward();
114             break;
115         }
116         }
117         break;
118     }
119     case DirectionType::Backward:
120     {
121         switch (this->getWheelType())
122         {
123         case WheelType::Left:
124         {
125             movement_system->setRearLeftWheelDirectionToBackward();
126             break;
127         }
128         case WheelType::Right:
129         {
130             movement_system->setRearRightWheelDirectionToBackward();
131             break;
132         }
133         case WheelType::Both:
134         {
135             movement_system->setRearWheelsDirectionToBackward();
136             break;
137         }
138         }
139         break;
140     }
141     }
142 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
143     return Status::Success;
144 }
145
146 const std::string toString() const final override
147 {
148     std::string direction_type;
149     switch (this->getDirectionType())
150     {
151     case DirectionType::Forward:
152         direction_type = "Forward";
153         break;
154     case DirectionType::Backward:
155         direction_type = "Backward";
156         break;
157     }
158     std::string wheel_type;
159     switch (this->getWheelType())
160     {
161     case WheelType::Left:
162         wheel_type = "Forward";
163         break;

```

```

164         case WheelType::Right:
165             wheel_type = "Backward";
166             break;
167         case WheelType::Both:
168             wheel_type = "Both";
169             break;
170     }
171     const std::string &name = this->getName();
172     if (name != "")
173         return fmt::format(R"(<Action:SetWheelDirection name='{}' direction_type='{}'
wheel_type='{}'/>)", name, direction_type, wheel_type);
174     else
175         return fmt::format(R"(<Action:SetWheelDirection direction_type='{}' wheel_type='{}'/>)",
direction_type, wheel_type);
176     }
177
178     const DirectionType getDirectionType() const
179     {
180         return this->direction_type;
181     }
182
183     const WheelType getWheelType() const
184     {
185         return this->wheel_type;
186     }
187
188 private:
189     const DirectionType direction_type;
190     const WheelType wheel_type;
191 };
192 }
193
194 #endif

```

## 8.80 behaviour\_tree\_car/include/behaviour\_tree/node/custom/action/↵ Turn.hpp File Reference

```

#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
#include "behaviour_tree/CarContext.hpp"

```

### Classes

- class [behaviour\\_tree::node::custom::action::Turn](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)
- namespace [behaviour\\_tree::node::custom::action](#)

## 8.81 Turn.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_TURN_HPP
2 #define BEHAVIOUR_TREE_TURN_HPP
3
4 #pragma once
5
6 #include "behaviour_tree/node/custom/CustomNode.hpp"
7

```

```

8 #include "behaviour_tree/Context.h"
9 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
10 #include "behaviour_tree/CarContext.hpp"
11 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
12
13
14 namespace behaviour_tree::node::custom::action
15 {
16     class Turn final : public CustomNode
17     {
18     public:
19         Turn(const std::string &name, const int angle) : CustomNode(name), angle(angle)
20         {
21         }
22
23         const static tl::expected<std::shared_ptr<Turn>, std::string> parse(const pugi::xml_node &node,
24 const int index, const std::string &name_attribute)
25         {
26             const int angle = node.attribute("angle").as_int();
27             if (angle < 0 || angle > 180)
28             {
29                 return tl::unexpected(fmt::format(R"(Invalid angle: '{} ' | Action:SetAngle:['{}',{}])",
30 angle, name_attribute, index));
31             }
32             return std::make_shared<Turn>(Turn(name_attribute, angle));
33         }
34
35         const Status run(const int tick_count, std::shared_ptr<Context> context) final override
36         {
37             #ifndef BEHAVIOUR_TREE_DISABLE_RUN
38                 std::shared_ptr<CarContext> car_context = std::dynamic_pointer_cast<CarContext>(context);
39                 auto car_system = car_context->getCarSystem();
40                 const MovementSystem *movement_system = car_system->getMovementSystem();
41                 movement_system->setFrontWheelsAngle(this->getAngle());
42             #endif // !BEHAVIOUR_TREE_DISABLE_RUN
43             return Status::Success;
44         }
45
46         const std::string toString() const final override
47         {
48             const std::string &name = this->getName();
49             if (name != "")
50                 return fmt::format(R"(<Action:Turn name='{}' angle='{}'/>)", name, this->getAngle());
51             else
52                 return fmt::format(R"(<Action:Turn angle='{}'/>)", this->getAngle());
53         }
54
55         const int getAngle() const
56         {
57             return this->angle;
58         }
59
60     private:
61         const int angle;
62     };
63 #endif

```

## 8.82 behaviour\_tree\_car/include/behaviour\_tree/node/custom/CarCustomNodeParser.hpp File Reference

```

#include <string>
#include <memory>
#include <tl/expected.hpp>
#include <pugixml.hpp>
#include <fmt/format.h>
#include "behaviour_tree/BehaviourTree.hpp"
#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/node/custom/CustomNodeParser.hpp"
#include "action/PauseExecution.hpp"
#include "action/Print.hpp"
#include "action/Drive.hpp"
#include "action/Turn.hpp"

```

```
#include "action/SetSpeed.hpp"
#include "action/SetWheelDirection.hpp"
#include "action/SetAngle.hpp"
#include "condition/SucceedOnAverageNearbyScan.hpp"
#include "condition/SucceedOnAnyNearbyScan.hpp"
#include "condition/SucceedOnAverageColour.hpp"
#include "utils/Utility.hpp"
```

## Classes

- class [behaviour\\_tree::node::custom::CarCustomNodeParser](#)

## Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)

## 8.83 CarCustomNodeParser.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_CAR_TASK_NODE_PARSER_HPP
2 #define BEHAVIOUR_TREE_CAR_TASK_NODE_PARSER_HPP
3
4 #pragma once
5
6 #include <string>
7 #include <memory>
8
9 #include <tl/expected.hpp>
10 #include <pugixml.hpp>
11 #include <fmt/format.h>
12
13 #include "behaviour_tree/BehaviourTree.hpp"
14 #include "behaviour_tree/node/custom/CustomNode.hpp"
15
16 #include "behaviour_tree/node/custom/CustomNodeParser.hpp"
17
18 #include "action/PauseExecution.hpp"
19
20 #include "action/Print.hpp"
21
22 #include "action/Drive.hpp"
23 #include "action/Turn.hpp"
24 #include "action/SetSpeed.hpp"
25 #include "action/SetWheelDirection.hpp"
26 #include "action/SetAngle.hpp"
27
28 #include "condition/SucceedOnAverageNearbyScan.hpp"
29 #include "condition/SucceedOnAnyNearbyScan.hpp"
30 #include "condition/SucceedOnAverageColour.hpp"
31
32 #include "utils/Utility.hpp"
33
34 namespace behaviour_tree::node::custom
35 {
36     class CarCustomNodeParser : public custom::CustomNodeParser
37     {
38     public:
39         CarCustomNodeParser() {}
40
41         tl::expected<std::shared_ptr<custom::CustomNode>, std::string> parseCustomNode(const
pugi::xml_node &node, const int index) override
42         {
43             const std::string name_attribute = node.attribute("node_name").as_string();
44             const std::string node_name = node.name();
45             switch (utils::hash(node_name))
```

```

46         {
47             case utils::hash("Action:PauseExecution"):
48                 return custom::action::PauseExecution::parse(node, index, name_attribute);
49             case utils::hash("Action:Print"):
50                 return custom::action::Print::parse(node, index, name_attribute);
51             case utils::hash("Action:Drive"):
52                 return custom::action::Drive::parse(node, index, name_attribute);
53             case utils::hash("Action:Turn"):
54                 return custom::action::Turn::parse(node, index, name_attribute);
55             case utils::hash("Action:SetSpeed"):
56                 return custom::action::SetSpeed::parse(node, index, name_attribute);
57             case utils::hash("Action:SetAngle"):
58                 return custom::action::SetAngle::parse(node, index, name_attribute);
59             case utils::hash("Action:SetWheelDirection"):
60                 return custom::action::SetWheelDirection::parse(node, index, name_attribute);
61             case utils::hash("Condition:SucceedOnAverageNearbyScan"):
62                 return custom::condition::SucceedOnAverageNearbyScan::parse(node, index, name_attribute);
63             case utils::hash("Condition:SucceedOnAnyNearbyScan"):
64                 return custom::condition::SucceedOnAnyNearbyScan::parse(node, index, name_attribute);
65             case utils::hash("Condition:SucceedOnAverageColour"):
66                 return custom::condition::SucceedOnAverageColour::parse(node, index, name_attribute);
67             default:
68                 {
69                     return tl::unexpected(fmt::format(R"(Invalid custom node type: '{} | {}:[]{}',{})",
70 node_name, node_name, name_attribute, index));
71                 }
72         }
73     };
74 }
75
76 #endif

```

## 8.84 behaviour\_tree\_car/include/behaviour\_tree/node/custom/condition/SucceedOnAnyNearbyScan.hpp File Reference

```

#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
#include "behaviour_tree/CarContext.hpp"
#include <spdlog/spdlog.h>
#include "behaviour_tree/global/distance.h"

```

### Classes

- class [behaviour\\_tree::node::custom::condition::SucceedOnAnyNearbyScan](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)
- namespace [behaviour\\_tree::node::custom::condition](#)

## 8.85 SucceedOnAnyNearbyScan.hpp

[Go to the documentation of this file.](#)

```

1 #ifndef BEHAVIOUR_TREE_SUCCEED_ON_AVERAGE_ANY_SCAN_HPP
2 #define BEHAVIOUR_TREE_SUCCEED_ON_AVERAGE_ANY_SCAN_HPP
3
4 #pragma once
5
6 #include "behaviour_tree/node/custom/CustomNode.hpp"
7
8 #include "behaviour_tree/Context.h"
9 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
10 #include "behaviour_tree/CarContext.hpp"
11 #include <spdlog/spdlog.h>
12 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
13
14 #include "behaviour_tree/global/distance.h"
15
16 namespace behaviour_tree::node::custom::condition
17 {
18     class SucceedOnAnyNearbyScan final : public CustomNode
19     {
20     public:
21         SucceedOnAnyNearbyScan(const std::string &name, const int min_angle, const int max_angle, const
double cm) : CustomNode(name),
22
23             min_angle(min_angle),
24
25             max_angle(max_angle),
26
27             cm(cm),
28
29             minimum_distance_unit(cm * global::CM_TO_DISTANCE)
30     {
31     }
32
33     const static tl::expected<std::shared_ptr<SucceedOnAnyNearbyScan>, std::string> parse(const
pugi::xml_node &node, const int index, const std::string &name_attribute)
34     {
35         const int min_angle = node.attribute("min_angle").as_int();
36         if (min_angle < 0 || min_angle > 360)
37         {
38             return tl::unexpected(fmt::format(R"(Invalid min_angle: '{} ' |
Condition:SucceedOnAnyNearbyScan:['{}',{}])", min_angle, name_attribute, index));
39         }
40         const int max_angle = node.attribute("max_angle").as_int();
41         if (max_angle < 0 || max_angle > 360)
42         {
43             return tl::unexpected(fmt::format(R"(Invalid max_angle: '{} ' |
Condition:SucceedOnAnyNearbyScan:['{}',{}])", max_angle, name_attribute, index));
44         }
45         const double cm = node.attribute("cm").as_double();
46         if (cm < 0)
47         {
48             return tl::unexpected(fmt::format(R"(Invalid cm: '{} ' |
Condition:SucceedOnAnyNearbyScan:['{}',{}])", cm, name_attribute, index));
49         }
50         return std::make_shared<SucceedOnAnyNearbyScan>(
51             SucceedOnAnyNearbyScan(
52                 name_attribute,
53                 min_angle,
54                 max_angle,
55                 cm));
56     }
57
58     const Status run(const int tick_count, std::shared_ptr<Context> context) final override
59     {
60 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
61         std::shared_ptr<CarContext> car_context = std::dynamic_pointer_cast<CarContext>(context);
62         auto car_system = car_context->getCarSystem();
63         std::vector<Measure> scan_data =
64             car_system->getDeviceManager()->getLidarDevice()->getScanData();
65         for (auto &measure : scan_data)
66         {
67             if (measure.angle > this->getMinAngle() && measure.angle < this->getMaxAngle())
68             {
69                 if (measure.distance < this->getMinimumDistanceUnit())
70                 {
71                     return Status::Success;
72                 }
73             }
74         }
75 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
76         return Status::Failure;
77     }
78 }

```

```

73
74     const int getMinAngle() const
75     {
76         return this->min_angle;
77     }
78
79     const int getMaxAngle() const
80     {
81         return this->max_angle;
82     }
83
84     const double getMinimumDistanceUnit() const
85     {
86         return this->minimum_distance_unit;
87     }
88
89     const double getCentimeters() const
90     {
91         return this->cm;
92     }
93
94     const std::string toString() const final override
95     {
96         const std::string &name = this->getName();
97         if (name != "")
98             return fmt::format(R"(<Condition:SucceedOnAnyNearbyScan name='{}' min_angle='{}'
max_angle='{}' cm='{}'/>)", name, this->getMinAngle(), this->getMaxAngle(), this->getCentimeters());
99         else
100             return fmt::format(R"(<Condition:SucceedOnAnyNearbyScan min_angle='{}' max_angle='{}'
cm='{}'/>)", this->getMinAngle(), this->getMaxAngle(), this->getCentimeters());
101     }
102
103 private:
104     const int min_angle;
105     const int max_angle;
106
107     const double cm;
108
109     const double minimum_distance_unit;
110 };
111 }
112
113 #endif

```

## 8.86 behaviour\_tree\_car/include/behaviour\_tree/node/custom/condition/SucceedOnAverageColour.hpp File Reference

```

#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
#include "behaviour_tree/CarContext.hpp"
#include <spdlog/spdlog.h>
#include <opencv2/opencv.hpp>

```

### Classes

- class [behaviour\\_tree::node::custom::condition::SucceedOnAverageColour](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)
- namespace [behaviour\\_tree::node::custom::condition](#)

## 8.87 SucceedOnAverageColour.hpp

[Go to the documentation of this file.](#)

```

1  #ifndef BEHAVIOUR_TREE_SUCCEED_ON_AVERAGE_COLOUR_HPP
2  #define BEHAVIOUR_TREE_SUCCEED_ON_AVERAGE_COLOUR_HPP
3
4  #pragma once
5
6  #include "behaviour_tree/node/custom/CustomNode.hpp"
7
8  #include "behaviour_tree/Context.h"
9  #ifndef BEHAVIOUR_TREE_DISABLE_RUN
10 #include "behaviour_tree/CarContext.hpp"
11 #include <spdlog/spdlog.h>
12 #include <opencv2/opencv.hpp>
13 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
14
15 namespace behaviour_tree::node::custom::condition
16 {
17     class SucceedOnAverageColour final : public CustomNode
18     {
19     public:
20         SucceedOnAverageColour(const std::string &name, const std::string hex_colour, const double
            tolerance) : CustomNode(name),
21
22             hex_colour(hex_colour),
23
24             tolerance(tolerance)
25         {
26
27             const static tl::expected<std::shared_ptr<SucceedOnAverageColour>, std::string> parse(const
                pugi::xml_node &node, const int index, const std::string &name_attribute)
28             {
29                 std::string hex_colour = node.attribute("hex_colour").as_string();
30                 if (!hex_colour.compare(0, 1, "#"))
31                 {
32                     hex_colour = "#" + hex_colour;
33                 }
34                 if (hex_colour.size() != 7)
35                 {
36                     return tl::unexpected(fmt::format(R"(Invalid hex_colour: '{} ' |
                        Condition:SucceedOnAverageColour:['{}',{}])", hex_colour, name_attribute, index));
37                 }
38                 for (int i = 1; i < hex_colour.size(); i++)
39                 {
40                     if (!std::isxdigit(hex_colour[i]))
41                     {
42                         return tl::unexpected(fmt::format(R"(Invalid hex_colour: '{} ' |
                        Condition:SucceedOnAverageColour:['{}',{}])", hex_colour, name_attribute, index));
43                     }
44                 }
45                 const double tolerance = node.attribute("tolerance").as_double();
46                 if (tolerance < 0 || tolerance > 100)
47                 {
48                     return tl::unexpected(fmt::format(R"(Invalid tolerance: '{} ' |
                        Condition:SucceedOnAverageColour:['{}',{}])", tolerance, name_attribute, index));
49                 }
50                 return std::make_shared<SucceedOnAverageColour>(
51                     name_attribute,
52                     hex_colour,
53                     tolerance));
54             }
55
56             const Status run(const int tick_count, std::shared_ptr<Context> context) final override
57             {
58                 // Following made by ChatGPT
59 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
60                 std::shared_ptr<CarContext> car_context = std::dynamic_pointer_cast<CarContext>(context);
61                 auto car_system = car_context->getCarSystem();
62
63                 std::string frame_buffer =
64                     car_system->getDeviceManager()->getCameraDevice()->getFrameBuffer();
65                 std::vector<uchar> buffer(frame_buffer.begin(), frame_buffer.end());
66                 cv::Mat frame = cv::imdecode(buffer, cv::IMREAD_COLOR);
67                 if (frame.empty())
68                 {
69                     spdlog::error("Failed to decode frame buffer");
70                     return Status::Failure;
71                 }
72
73                 cv::Scalar avg_color = cv::mean(frame);
74                 std::string avg_color_hex = fmt::format("#{:02x}{:02x}{:02x}",
75                     static_cast<int>(avg_color[2]), static_cast<int>(avg_color[1]), static_cast<int>(avg_color[0]));

```



```

74
75     int color_diff = calculateColorDifference(avg_color_hex, this->hex_colour);
76     int max_color_diff = calculateMaxColorDifference(this->tolerance);
77
78     if (color_diff <= max_color_diff)
79     {
80         return Status::Success;
81     }
82     else
83     {
84         return Status::Failure;
85     }
86 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
87     return Status::Failure;
88 }
89
90 // Following made by ChatGPT
91 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
92 // Function to calculate the color difference between two hex colors
93 int calculateColorDifference(const std::string &color1, const std::string &color2)
94 {
95     // Convert hex strings to RGB values
96     cv::Scalar rgb_color1 = hexToRGB(color1);
97     cv::Scalar rgb_color2 = hexToRGB(color2);
98
99     // Calculate the Euclidean distance between the two colors in RGB space
100     return static_cast<int>(cv::norm(rgb_color1, rgb_color2));
101 }
102
103 // Function to convert a hex color string to RGB values
104 cv::Scalar hexToRGB(const std::string &hexColor)
105 {
106     std::string hex = hexColor.substr(1); // remove the '#' character
107     int r, g, b;
108     std::istringstream(hex.substr(0, 2)) >> std::hex >> r;
109     std::istringstream(hex.substr(2, 2)) >> std::hex >> g;
110     std::istringstream(hex.substr(4, 2)) >> std::hex >> b;
111     return cv::Scalar(b, g, r);
112 }
113
114 // Function to calculate the maximum allowable color difference based on the percentage
115 // threshold
116 int calculateMaxColorDifference(double percentage)
117 {
118     // Assuming percentage represents the acceptable deviation from the specified color
119     // We can calculate the maximum allowable color difference based on this percentage
120     // For example, if percentage is 10, it means 10% deviation is acceptable
121
122     // Max color difference will be based on the maximum possible Euclidean distance between two
123     // colors in RGB space
124     // For simplicity, let's assume the maximum distance is between pure black and pure white
125     cv::Scalar black(0, 0, 0);
126     cv::Scalar white(255, 255, 255);
127     int max_color_diff = static_cast<int>(cv::norm(black, white));
128
129     // Now, we scale the maximum color difference based on the percentage
130     return static_cast<int>(max_color_diff * (percentage / 100.0));
131 }
132 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
133
134 const std::string getHexColour() const
135 {
136     return this->hex_colour;
137 }
138
139 const double getTolerance() const
140 {
141     return this->tolerance;
142 }
143
144 const std::string toString() const final override
145 {
146     const std::string &name = this->getName();
147     if (name != "")
148         return fmt::format(R"(<Condition:SucceedOnAverageColour name='{}' hex_colour='{}'
149 tolerance='{}'/>)", name, this->getHexColour(), this->getTolerance());
150     else
151         return fmt::format(R"(<Condition:SucceedOnAverageColour hex_colour='{}'
152 tolerance='{}'/>)", this->getHexColour(), this->getTolerance());
153 }
154
155 private:
156     const std::string hex_colour;
157     const double tolerance;
158 };
159 }
160

```

```
157 #endif
```

## 8.88 behaviour\_tree\_car/include/behaviour\_↵ tree/node/custom/condition/SucceedOnAverageNearbyScan.hpp File Reference

```
#include "behaviour_tree/node/custom/CustomNode.hpp"
#include "behaviour_tree/Context.h"
#include "behaviour_tree/CarContext.hpp"
#include <spdlog/spdlog.h>
#include "behaviour_tree/global/distance.h"
```

### Classes

- class [behaviour\\_tree::node::custom::condition::SucceedOnAverageNearbyScan](#)

### Namespaces

- namespace [behaviour\\_tree](#)
- namespace [behaviour\\_tree::node](#)
- namespace [behaviour\\_tree::node::custom](#)
- namespace [behaviour\\_tree::node::custom::condition](#)

## 8.89 SucceedOnAverageNearbyScan.hpp

[Go to the documentation of this file.](#)

```
1 #ifndef BEHAVIOUR_TREE_SUCCEED_ON_AVERAGE_NEARBY_SCAN_HPP
2 #define BEHAVIOUR_TREE_SUCCEED_ON_AVERAGE_NEARBY_SCAN_HPP
3
4 #pragma once
5
6 #include "behaviour_tree/node/custom/CustomNode.hpp"
7
8 #include "behaviour_tree/Context.h"
9 #ifndef BEHAVIOUR_TREE_DISABLE_RUN
10 #include "behaviour_tree/CarContext.hpp"
11 #include <spdlog/spdlog.h>
12 #endif // !BEHAVIOUR_TREE_DISABLE_RUN
13
14 #include "behaviour_tree/global/distance.h"
15
16 namespace behaviour_tree::node::custom::condition
17 {
18     class SucceedOnAverageNearbyScan final : public CustomNode
19     {
20     public:
21         SucceedOnAverageNearbyScan(const std::string &name, const int min_angle, const int max_angle,
22             const double cm, const int smallest_measure_amount_used) : CustomNode(name),
23
24                                     min_angle(min_angle),
25                                     max_angle(max_angle),
26                                     cm(cm),
27
28                                     smallest_measure_amount_used(smallest_measure_amount_used),
```

```

26                                     average_distance_unit(cm *
27     global::CM_TO_DISTANCE)
28     {
29     }
30     const static tl::expected<std::shared_ptr<SucceedOnAverageNearbyScan>, std::string> parse(const
31     pugi::xml_node &node, const int index, const std::string &name_attribute)
32     {
33         const int min_angle = node.attribute("min_angle").as_int();
34         if (min_angle < 0 || min_angle > 360)
35         {
36             return tl::unexpected(fmt::format(R"(Invalid min_angle: '{}{}' |
37             Condition:SucceedOnAverageNearbyScan: '{}', {}))", min_angle, name_attribute, index));
38         }
39         const int max_angle = node.attribute("max_angle").as_int();
40         if (max_angle < 0 || max_angle > 360)
41         {
42             return tl::unexpected(fmt::format(R"(Invalid max_angle: '{}{}' |
43             Condition:SucceedOnAverageNearbyScan: '{}', {}))", max_angle, name_attribute, index));
44         }
45         const double cm = node.attribute("cm").as_double();
46         if (cm < 0)
47         {
48             return tl::unexpected(fmt::format(R"(Invalid cm: '{}{}' |
49             Condition:SucceedOnAverageNearbyScan: '{}', {}))", cm, name_attribute, index));
50         }
51         const int minimum_measure_amount_used =
52         node.attribute("minimum_measure_amount_used").as_int();
53         if (minimum_measure_amount_used < 0)
54         {
55             return tl::unexpected(fmt::format(R"(Invalid minimum_measure_amount_used: '{}{}' |
56             Condition:SucceedOnAverageNearbyScan: '{}', {}))", minimum_measure_amount_used, name_attribute,
57             index));
58         }
59         return std::make_shared<SucceedOnAverageNearbyScan>(
60             SucceedOnAverageNearbyScan(
61                 name_attribute,
62                 min_angle,
63                 max_angle,
64                 cm,
65                 minimum_measure_amount_used));
66     }
67     const Status run(const int tick_count, std::shared_ptr<Context> context) final override
68     {
69     #ifndef BEHAVIOUR_TREE_DISABLE_RUN
70         std::shared_ptr<CarContext> car_context = std::dynamic_pointer_cast<CarContext>(context);
71         auto car_system = car_context->getCarSystem();
72         double total_distance = 0.0;
73         int angles_between_count = 0;
74         std::vector<Measure> scan_data =
75         car_system->getDeviceManager()->getLidarDevice()->getScanData();
76         if (this->smallest_measure_amount_used > 0)
77         {
78             std::vector<Measure> smallest_measures;
79             std::partial_sort(scan_data.begin(), scan_data.begin() +
80             this->smallest_measure_amount_used, scan_data.end(),
81             [](const Measure &a, const Measure &b)
82             { return a.distance < b.distance; });
83             smallest_measures.insert(smallest_measures.end(), scan_data.begin(), scan_data.begin() +
84             this->smallest_measure_amount_used);
85             scan_data = smallest_measures;
86         }
87         for (auto &measure : scan_data)
88         {
89             if (measure.angle > this->getMinAngle() && measure.angle < this->getMaxAngle())
90             {
91                 total_distance += measure.distance;
92                 ++angles_between_count;
93             }
94         }
95         if (angles_between_count > 0)
96         {
97             double average_distance_unit = total_distance / angles_between_count;
98             if (average_distance_unit < this->getAverageDistanceUnit())
99             {
100                 return Status::Success;
101             }
102         }
103     }
104     #endif // !BEHAVIOUR_TREE_DISABLE_RUN
105     return Status::Failure;
106 }
107 const int getMinAngle() const
108 {
109     return this->min_angle;
110 }

```

```

101     }
102
103     const int getMaxAngle() const
104     {
105         return this->max_angle;
106     }
107
108     const double getAverageDistanceUnit() const
109     {
110         return this->average_distance_unit;
111     }
112
113     const double getCentimeters() const
114     {
115         return this->cm;
116     }
117
118     const int getSmallestMeasureAmountUsed() const
119     {
120         return this->smallest_measure_amount_used;
121     }
122
123     const std::string toString() const final override
124     {
125         const std::string &name = this->getName();
126         if (name != "")
127             return fmt::format(R"(<Condition:SucceedOnAverageNearbyScan name='{}' min_angle='{}'
max_angle='{}' cm='{}' smallest_measure_amount_used='{}'/>)", name, this->getMinAngle(),
this->getMaxAngle(), this->getCentimeters(), this->getSmallestMeasureAmountUsed());
128         else
129             return fmt::format(R"(<Condition:SucceedOnAverageNearbyScan min_angle='{}'
max_angle='{}' cm='{}' smallest_measure_amount_used='{}'/>)", this->getMinAngle(),
this->getMaxAngle(), this->getCentimeters(), this->getSmallestMeasureAmountUsed());
130     }
131
132     private:
133         const int min_angle;
134         const int max_angle;
135
136         const double cm;
137
138         const int smallest_measure_amount_used;
139
140         const double average_distance_unit;
141     };
142 }
143
144 #endif

```

## 8.90 behaviour\_tree\_tester/src/main.cpp File Reference

```

#include <iostream>
#include <chrono>
#include <filesystem>
#include <thread>
#include <memory>
#include <cxxopts.hpp>
#include "behaviour_tree/BehaviourTreeParser.hpp"
#include "behaviour_tree/node/custom/CarCustomNodeParser.hpp"

```

### Functions

- int [main](#) (int argc, const char \*argv[])

#### 8.90.1 Function Documentation

### 8.90.1.1 main()

```
int main (
    int argc,
    const char * argv[] )
```

## 8.91 behaviour\_tree\_validator/src/main.cpp File Reference

```
#include <iostream>
#include <cxxopts.hpp>
#include <rapidjson/document.h>
#include <rapidjson/writer.h>
#include <rapidjson/stringbuffer.h>
#include "behaviour_tree/BehaviourTreeParser.hpp"
#include "behaviour_tree/node/custom/CarCustomNodeParser.hpp"
```

### Functions

- int [main](#) (int argc, char \*argv[])

### 8.91.1 Function Documentation

#### 8.91.1.1 main()

```
int main (
    int argc,
    char * argv[] )
```

## 8.92 README.md File Reference

## 8.93 rplidar/include/RPLidar.h File Reference

```
#include <string>
#include <stdint.h>
#include <serial/serial.h>
#include <iostream>
#include <map>
#include <vector>
#include <chrono>
#include <thread>
#include <sstream>
#include <iomanip>
#include <functional>
#include <tuple>
#include <stdexcept>
#include <memory>
#include <spdlog/spdlog.h>
#include <spdlog/fmt/bin_to_hex.h>
#include <tl/expected.hpp>
```

## Classes

- struct [rplidar::ScanInfo](#)
- struct [rplidar::DeviceInfo](#)
- struct [rplidar::HealthInfo](#)  
*Health Info for Lidar Scanner.*
- struct [rplidar::Measure](#)
- class [rplidar::ExpressPacket](#)
- class [rplidar::RPLidar](#)  
*Class for communicating with [RPLidar](#) rangefinder scanners.*

## Namespaces

- namespace [rplidar](#)

## Enumerations

- enum [rplidar::ScanType](#) { [rplidar::NORMAL](#) = 0 , [rplidar::FORCE](#) , [rplidar::EXPRESS](#) }

## Variables

- constexpr uint8\_t [rplidar::SYNC\\_BYTE](#) = 0xA5
- constexpr uint8\_t [rplidar::SYNC\\_BYTE2](#) = 0x5A
- constexpr uint8\_t [rplidar::GET\\_INFO\\_BYTE](#) = 0x50
- constexpr uint8\_t [rplidar::GET\\_HEALTH\\_BYTE](#) = 0x52
- constexpr uint8\_t [rplidar::STOP\\_BYTE](#) = 0x25
- constexpr uint8\_t [rplidar::RESET\\_BYTE](#) = 0x40
- constexpr int [rplidar::DESCRIPTOR\\_LEN](#) = 7
- constexpr int [rplidar::INFO\\_LEN](#) = 20
- constexpr int [rplidar::HEALTH\\_LEN](#) = 3
- constexpr int [rplidar::INFO\\_TYPE](#) = 4
- constexpr int [rplidar::HEALTH\\_TYPE](#) = 6
- constexpr int [rplidar::MAX\\_MOTOR\\_PWM](#) = 1023
- constexpr int [rplidar::DEFAULT\\_MOTOR\\_PWM](#) = 660
- constexpr uint8\_t [rplidar::SET\\_PWM\\_BYTE](#) = 0xF0

## 8.94 RPLidar.h

[Go to the documentation of this file.](#)

```

1 #ifndef RPLIDAR_H
2 #define RPLIDAR_H
3
4 #pragma once
5
6 // Made with the help of ChatGPT
7
8
9 /*
10 #include <RPLidar.h>
11 #include <memory>
12 #include <spdlog/spdlog.h>
13
14 int main()
15 {
16     using namespace rplidar;
17     spdlog::set_level(spdlog::level::debug);

```

```

18
19 // auto lidar_result = RPLidar::create("/dev/ttyUSB0"); // For Linux
20 // auto lidar_result = RPLidar::create("COM3"); // For Windows
21 if (!lidar_result.has_value())
22 {
23     std::cout << "Unable to open lidar\n";
24     return 0;
25 }
26 auto &lidar = lidar_result.value();
27 std::cout << "Connected to lidar\n";
28
29 auto info_result = lidar->get_info();
30 if (!info_result.has_value())
31 {
32     std::cout << "Unable to get value of get_info() " << info_result.error();
33     return 0;
34 }
35 auto &info = info_result.value();
36 std::cout << fmt::format("model: {}, firmware: ({}, {}), hardware: {}, serialnumber: {}\n",
37     info.model, info.firmware.first, info.firmware.second, info.hardware, info.serialNumber);
38
39 auto health_result = lidar->get_health();
40 if (!health_result.has_value())
41 {
42     std::cout << "Unable to get value of get_health() " << health_result.error();
43     return 0;
44 }
45 auto &health = health_result.value();
46 std::cout << fmt::format("({}, {})\n", health.status, health.errorCode);
47
48 std::function<std::vector<Measure>()> scanGenerator = lidar->iter_scans();
49 for (int i = 0; i < 10; i++)
50 {
51     std::vector<Measure> scan = scanGenerator();
52     std::cout << "Got " << scan.size() << " Measures!\n";
53     for (const Measure &measure : scan)
54     {
55         // Access individual measurements in the scan
56         bool newScan = measure.newScan;
57         int quality = measure.quality;
58         float angle = measure.angle;
59         float distance = measure.distance;
60     }
61 }
62 lidar->stop();
63 lidar->stop_motor();
64 lidar->disconnect();
65 return 1;
66 }
67
68 */
69
70 #include <string>
71 #include <stdint.h>
72
73 #include <serial/serial.h>
74
75 #include <iostream>
76 #include <map>
77 #include <vector>
78
79 // std::this_thread::sleep_for(std::chrono::milliseconds(1));
80 #include <chrono>
81 #include <thread>
82
83 // convertToHexString
84 #include <sstream>
85 #include <iomanip>
86
87 // iter_measures
88 #include <functional>
89
90 #include <tuple>
91 #include <stdexcept>
92
93 #include <memory>
94
95 #include <spdlog/spdlog.h>
96 #include <spdlog/fmt/bin_to_hex.h>
97
98 #include <tl/expected.hpp>
99
100 namespace rplidar
101 {
102     constexpr uint8_t SYNC_BYTE = 0xA5;
103     constexpr uint8_t SYNC_BYTE2 = 0x5A;

```

```

104
105 constexpr uint8_t GET_INFO_BYTE = 0x50;
106 constexpr uint8_t GET_HEALTH_BYTE = 0x52;
107
108 constexpr uint8_t STOP_BYTE = 0x25;
109 constexpr uint8_t RESET_BYTE = 0x40;
110
111 enum ScanType
112 {
113     NORMAL = 0,
114     FORCE,
115     EXPRESS
116 };
117
118 struct ScanInfo
119 {
120     int currently_scanning;
121     int dsize;
122     ScanType type;
123 };
124
125 static std::map<ScanType, std::map<std::string, uint8_t>> SCAN_TYPE = {
126     {ScanType::NORMAL, {{"byte", 0x20}, {"response", 129}, {"size", 5}}},
127     {ScanType::FORCE, {{"byte", 0x21}, {"response", 129}, {"size", 5}}},
128     {ScanType::EXPRESS, {{"byte", 0x82}, {"response", 130}, {"size", 84}}}};
129
130 constexpr int DESCRIPTOR_LEN = 7;
131 constexpr int INFO_LEN = 20;
132 constexpr int HEALTH_LEN = 3;
133
134 constexpr int INFO_TYPE = 4;
135 constexpr int HEALTH_TYPE = 6;
136
137 constexpr int MAX_MOTOR_PWM = 1023;
138 constexpr int DEFAULT_MOTOR_PWM = 660;
139 constexpr uint8_t SET_PWM_BYTE = 0xF0;
140
141 static std::map<int, std::string> HEALTH_STATUSES = {
142     {0, "Good"},
143     {1, "Warning"},
144     {2, "Error"}};
145
146 struct DeviceInfo
147 {
148     uint8_t model;
149     std::pair<uint8_t, uint8_t> firmware;
150     uint8_t hardware;
151     std::string serialNumber;
152 };
153
154 struct HealthInfo
155 {
156     std::string status;
157     int errorCode;
158 };
159
160 struct Measure
161 {
162     bool newScan;
163     int quality;
164     double angle;
165     double distance;
166 };
167
168 class ExpressPacket
169 {
170 public:
171     static constexpr uint8_t sync1 = 0xa;
172     static constexpr uint8_t sync2 = 0x5;
173
174     ExpressPacket(std::vector<uint8_t> data)
175     {
176         if ((data[0] >> 4) != sync1 || (data[1] >> 4) != sync2)
177         {
178             throw std::invalid_argument("try to parse corrupted data");
179         }
180
181         uint8_t checksum = 0;
182         for (size_t i = 2; i < data.size(); i++)
183         {
184             checksum ^= data[i];
185         }
186
187         if (checksum != ((data[0] & 0x0F) + ((data[1] & 0x0F) << 4)))
188         {
189             throw std::invalid_argument("Invalid checksum");
190         }
191     }
192
193     ~ExpressPacket() {}
194
195     const std::vector<uint8_t> &data() const { return data_; }
196     std::vector<uint8_t> &data() { return data_; }
197
198     const std::string &status() const { return status_; }
199     std::string &status() { return status_; }
200
201     const int &errorCode() const { return errorCode_; }
202     int &errorCode() { return errorCode_; }

```



```

203
204     new_scan = (data[2] >> 7) & 0x01;
205     start_angle = static_cast<float>(((data[1] & 0x0F) << 8 | data[2]) / 64.0f);
206
207     for (size_t i = 4; i < data.size(); i += 5)
208     {
209         distance.push_back(((data[i + 1] >> 2) & 0x3F) | ((data[i] & 0x3F) << 6));
210         angle.push_back((((data[i + 3] & 0x0F) + ((data[i + 1] & 0x01) << 4)) / 8.0f) *
getSign(data[i + 1]));
211         distance.push_back(((data[i + 2] >> 2) & 0x3F) | ((data[i + 1] & 0x3F) << 6));
212         angle.push_back((((data[i + 3] >> 4) & 0x0F) + ((data[i + 2] & 0x01) << 4)) / 8.0f *
getSign(data[i + 2]));
213     }
214 }
215
216 static int getSign(uint8_t value)
217 {
218     return (value & 0x02) ? -1 : 1;
219 }
220
221 public:
222     std::vector<uint16_t> distance;
223     std::vector<float> angle;
224     bool new_scan;
225     float start_angle;
226 };
227
228 class RPLidar
229 {
230 public:
231     static tl::expected<std::unique_ptr<RPLidar>, std::string> create(const std::string &port,
uint32_t baudrate = 115200U) noexcept
232     {
233         try
234         {
235             // Timeout after 60 seconds if nothing read
236             auto timeout = serial::Timeout(1000U, 60000U, 0, 1000U, 0);
237             std::unique_ptr<serial::Serial> serial = std::make_unique<serial::Serial>(port,
baudrate, timeout);
238             std::unique_ptr<RPLidar> lidar = std::make_unique<RPLidar>(port, baudrate,
std::move(serial));
239             return std::move(lidar);
240         }
241         catch (std::exception &e)
242         {
243             return tl::make_unexpected(e.what());
244         }
245     }
246
247     RPLidar(const std::string &port, uint32_t baudrate, std::unique_ptr<serial::Serial> serial) :
port(port), baudrate(baudrate), _serial(std::move(serial)){};
248
249     ~RPLidar() {}
250
251     void disconnect()
252     {
253         if (!this->_serial->isOpen())
254         {
255             return;
256         }
257         this->_serial->close();
258     }
259
260     void set_motor_speed(int pwm)
261     {
262         if (0 <= pwm && pwm <= MAX_MOTOR_PWM)
263         {
264             std::abort();
265         }
266         this->_motor_speed = pwm;
267         if (this->motor_running)
268             this->_set_pwm(this->_motor_speed);
269     }
270
271     void start_motor()
272     {
273         spdlog::info("Starting motor");
274         // For A1
275         this->_serial->setDTR(false);
276
277         // For A2
278         this->_set_pwm(this->_motor_speed);
279         this->motor_running = true;
280     }
281
282     void stop_motor()
283     {
284         spdlog::info("Stopping motor");

```

```

302         // For A2
303         this->_set_pwm(0);
304         std::this_thread::sleep_for(std::chrono::milliseconds(1));
305
306         // For A1
307         this->_serial->setDTR(true);
308         this->motor_running = false;
309     }
310
311     tl::expected<DeviceInfo, std::string> get_info()
312     {
313         // Check if there's data in the buffer
314         if (this->_serial->available() > 0)
315         {
316             throw std::runtime_error("Data in buffer, you can't have info! Run flush() to empty the
317 buffer.");
318         }
319         this->_send_cmd(GET_INFO_BYTE);
320
321         uint8_t dsize;
322         bool isSingle;
323         uint8_t dtype;
324         auto descriptor_result = this->_read_descriptor();
325         if (!descriptor_result.has_value())
326             return tl::make_unexpected(descriptor_result.error());
327         std::tie(dsize, isSingle, dtype) = descriptor_result.value();
328
329         // Check response properties
330         if (dsize != INFO_LEN)
331         {
332             return tl::make_unexpected("Wrong get_info reply length");
333         }
334         if (!isSingle)
335         {
336             return tl::make_unexpected("Not a single response mode");
337         }
338         if (dtype != INFO_TYPE)
339         {
340             return tl::make_unexpected("Wrong response data type");
341         }
342
343         // Read the response
344         std::vector<uint8_t> raw = this->_read_response(dsize);
345
346         // Convert serial number to a hex string
347         std::string serialNumber;
348         for (size_t i = 4; i < raw.size(); ++i)
349         {
350             serialNumber += convertToHexString(raw[i]);
351         }
352
353         // Construct the device info struct
354         DeviceInfo info;
355         info.model = raw[0];
356         info.firmware.first = raw[2];
357         info.firmware.second = raw[1];
358         info.hardware = raw[3];
359         info.serialNumber = serialNumber;
360
361         return info;
362     }
363
364     tl::expected<HealthInfo, std::string> get_health()
365     {
366         // Check if there's data in the buffer
367         if (this->_serial->available() > 0)
368         {
369             return tl::make_unexpected("Data in buffer, you can't get health info! Run cleanInput()
370 to empty the buffer.");
371         }
372         spdlog::info("Asking for health");
373         this->_send_cmd(GET_HEALTH_BYTE);
374
375         // Read the descriptor
376         uint8_t dsize;
377         bool isSingle;
378         uint8_t dtype;
379         auto descriptor_result = this->_read_descriptor();
380         if (!descriptor_result.has_value())
381             return tl::make_unexpected(descriptor_result.error());
382         std::tie(dsize, isSingle, dtype) = descriptor_result.value();
383
384         // Check response properties
385         if (dsize != HEALTH_LEN)
386         {
387             return tl::make_unexpected("Wrong get_health reply length");
388         }
389     }

```

```

402     }
403     if (!isSingle)
404     {
405         return tl::make_unexpected("Not a single response mode");
406     }
407     if (dtype != HEALTH_TYPE)
408     {
409         return tl::make_unexpected("Wrong response data type");
410     }
411
412     // Read the response
413     std::vector<uint8_t> raw = this->_read_response(dsize);
414
415     // Extract status and error code
416     std::string status = HEALTH_STATUSES[raw[0]];
417     int errorCode = (static_cast<int>(raw[1]) << 8) + static_cast<int>(raw[2]);
418
419     return HealthInfo{status, errorCode};
420 }
421
422 void clean_input()
423 {
424     if (this->scanning.currently_scanning)
425     {
426         throw std::runtime_error("Cleaning not allowed during scanning process active!");
427     }
428     this->_serial->flushInput();
429     this->express_trame = 32;
430     this->express_data = nullptr;
431 }
432
433 void stop()
434 {
435     spdlog::info("Stopping scanning");
436     this->_send_cmd(STOP_BYTE);
437     std::this_thread::sleep_for(std::chrono::milliseconds(100));
438     this->scanning.currently_scanning = false;
439     this->clean_input();
440 }
441
442 tl::expected<nullptr_t, std::string> start(ScanType scanType = ScanType::NORMAL)
443 {
444     if (this->scanning.currently_scanning)
445     {
446         return tl::make_unexpected("Scanning already running!");
447     }
448
449     auto health_info_result = this->get_health();
450     if (!health_info_result.has_value())
451         return tl::make_unexpected(health_info_result.error());
452
453     HealthInfo healthInfo = health_info_result.value();
454     std::string status = healthInfo.status;
455     int errorCode = healthInfo.errorCode;
456     spdlog::debug("Health status: {} [{}]", status, errorCode);
457
458     if (status == "Error")
459     {
460         this->reset();
461         health_info_result = this->get_health();
462         if (!health_info_result.has_value())
463             return tl::make_unexpected(health_info_result.error());
464         healthInfo = health_info_result.value();
465         status = healthInfo.status;
466         errorCode = healthInfo.errorCode;
467         if (status == "Error")
468         {
469             return tl::make_unexpected("RPLidar hardware failure. Error code: " +
470 std::to_string(errorCode));
471         }
472     }
473     else if (status == "Warning")
474     {
475         spdlog::warn("Warning sensor status detected! Error code: {}", errorCode);
476     }
477
478     uint8_t cmd = SCAN_TYPE[scanType]["byte"];
479
480     spdlog::warn("starting scan process in {} mode", static_cast<int>(scanType));
481
482     if (scanType == ScanType::EXPRESS)
483     {
484         // Adjust this part according to your payload format
485         std::string payload = "\x00\x00\x00\x00";
486         this->_send_payload_cmd(cmd, payload);
487     }
488     else

```

```

502         {
503             this->_send_cmd(cmd);
504         }
505
506         uint8_t dsize;
507         bool isSingle;
508         uint8_t dtype;
509
510         auto descriptor_result = this->_read_descriptor();
511         if (!descriptor_result.has_value())
512             return tl::make_unexpected(descriptor_result.error());
513
514         std::tie(dsize, isSingle, dtype) = descriptor_result.value();
515
516         if (dsize != SCAN_TYPE[scanType]["size"])
517         {
518             return tl::make_unexpected("Wrong get_info reply length");
519         }
520         if (isSingle)
521         {
522             return tl::make_unexpected("Not a multiple response mode");
523         }
524         if (dtype != SCAN_TYPE[scanType]["response"])
525         {
526             return tl::make_unexpected("Wrong response data type");
527         }
528         this->scanning = ScanInfo{true, dsize, scanType};
529         return nullptr;
530     }
531
532     void reset()
533     {
534         spdlog::info("Resetting the sensor");
535         this->_send_cmd(RESET_BYTE);
536         std::this_thread::sleep_for(std::chrono::milliseconds(2000));
537         this->clean_input();
538     }
539
540     std::function<tl::expected<Measure, std::string>()> iter_measures(ScanType scanType =
541     ScanType::NORMAL, int maxBufMeas = 3000)
542     {
543         if (!this->motor_running)
544         {
545             this->start_motor();
546         }
547
548         if (!this->scanning.currently_scanning)
549         {
550             this->start(scanType);
551         }
552
553         // Define a lambda function to generate measures
554         auto generator = [this, scanType, maxBufMeas]() -> tl::expected<Measure, std::string>
555         {
556             while (true)
557             {
558                 int dsize = scanning.dsize;
559
560                 if (maxBufMeas != 0)
561                 {
562                     int dataInBuf = this->_serial->available();
563                     if (dataInBuf > maxBufMeas)
564                     {
565                         spdlog::warn(
566                             "Too many bytes in the input buffer: {}/{}. \n"
567                             "Cleaning buffer...",
568                             dataInBuf, maxBufMeas);
569                         this->stop();
570                         this->start(scanType);
571                     }
572                 }
573
574                 if (scanType == ScanType::NORMAL)
575                 {
576                     std::vector<uint8_t> raw = this->_read_response(dsize);
577                     return _process_scan(raw);
578                 }
579                 else if (scanType == ScanType::EXPRESS)
580                 {
581                     if (this->express_trame == 32)
582                     {
583                         this->express_trame = 0;
584
585                         if (this->express_data == nullptr)
586                         {
587                             spdlog::debug("reading first time bytes");
588                             this->express_data =

```

```

std::make_unique<ExpressPacket>(ExpressPacket(this->_read_response(dsize)));
593     }
594
595     this->express_old_data = std::move(this->express_data);
596     spdlog::debug("set old_data with start_angle {}",
this->express_old_data->start_angle);
597     this->express_data =
std::make_unique<ExpressPacket>(ExpressPacket(this->_read_response(dsize)));
598     spdlog::debug("set new_data with start_angle {}",
this->express_data->start_angle);
599     }
600     this->express_frame++;
601     spdlog::debug("process scan of frame %d with angle : \n"
602         "%f and angle new : %f",
603         this->express_frame,
604         this->express_old_data->start_angle,
605         this->express_data->start_angle);
606     Measure measure = _process_express_scan(this->express_old_data,
this->express_data->start_angle, this->express_frame);
607     return measure;
608     }
609 }
610 };
611
612     return generator;
613 }
614
626     std::function<std::vector<Measure>()> iter_scans(ScanType scanType = ScanType::NORMAL, int
maxBufMeas = 3000, int minLen = 5)
627     {
628         auto measureIterator = this->iter_measures(scanType, maxBufMeas);
629
630         // Define a lambda function to generate scans
631         auto scanGenerator = [measureIterator, minLen]() -> std::vector<Measure>
632         {
633             std::vector<Measure> scanList;
634             do
635             {
636                 tl::expected<Measure, std::string> maybe_measure = measureIterator();
637                 if (!maybe_measure.has_value())
638                 {
639                     continue;
640                 }
641                 Measure measure = maybe_measure.value();
642                 bool newScan = measure.newScan;
643                 if (newScan)
644                 {
645                     if (scanList.size() > minLen)
646                     {
647                         break;
648                     }
649                     scanList.clear();
650                 }
651                 if (measure.distance > 0)
652                 {
653                     scanList.push_back(measure);
654                 }
655             }
656             while (true);
657             return scanList;
658         };
659         return scanGenerator;
660     }
661
662 private:
663     void _set_pwm(int pwm)
664     {
665         std::string payload;
666         payload.push_back(static_cast<uint8_t>(pwm & 0xFF));
667         payload.push_back(static_cast<uint8_t>((pwm >> 8) & 0xFF));
668         this->_send_payload_cmd(SET_PWM_BYTE, payload);
669     }
670
671     void _send_payload_cmd(uint8_t cmd, const std::string &payload)
672     {
673         // Calculate the size
674         uint8_t size = static_cast<uint8_t>(payload.size());
675
676         // Construct the request string
677         std::string req;
678         req += static_cast<uint8_t>(SYNC_BYTE);
679         req += static_cast<uint8_t>(cmd);
680         req += static_cast<uint8_t>(size);
681         req += payload;
682
683         // Calculate the checksum
684         uint8_t checksum = 0;

```

```

691         for (const uint8_t &c : req)
692         {
693             checksum ^= static_cast<uint8_t>(c);
694         }
695
696         req += static_cast<uint8_t>(checksum);
697
698         this->_serial->write(req);
699         spdlog::debug("Command sent: {}", spdlog::to_hex(req));
700     }
701
702 void __send_cmd(uint8_t cmd)
703 {
704     std::string req;
705     req += static_cast<uint8_t>(SYNC_BYTE);
706     req += static_cast<uint8_t>(cmd);
707
708     this->_serial->write(req);
709     spdlog::debug("Command sent: {}", spdlog::to_hex(req));
710 }
711
712 tl::expected<
713     std::tuple<uint8_t, bool, uint8_t>,
714     std::string>
715 __read_descriptor()
716 {
717     // Read descriptor packet
718     std::array<uint8_t, DESCRIPTOR_LEN> descriptor;
719     memset(descriptor.data(), '\0', sizeof(descriptor));
720     this->_serial->read(descriptor.data(), DESCRIPTOR_LEN);
721     spdlog::debug("Received descriptor: {}", spdlog::to_hex(descriptor));
722
723     if (descriptor.size() != DESCRIPTOR_LEN)
724     {
725         return tl::make_unexpected("Descriptor length mismatch");
726     }
727     else if (descriptor[0] != SYNC_BYTE || descriptor[1] != SYNC_BYTE2)
728     {
729         return tl::make_unexpected("Incorrect descriptor starting bytes");
730     }
731
732     bool isSingle = descriptor[5] == 0;
733     return std::make_tuple(descriptor[2], isSingle, descriptor[6]);
734 }
735
736 std::vector<uint8_t> __read_response(int dsize)
737 {
738     spdlog::debug("Trying to read response: {} bytes", dsize);
739
740     std::vector<uint8_t> data;
741     data.reserve(dsize);
742
743     while (this->_serial->available() < dsize)
744     {
745         std::this_thread::sleep_for(std::chrono::milliseconds(1));
746     }
747
748     this->_serial->read(data, dsize);
749
750     spdlog::debug("Received data: {}", spdlog::to_hex(data));
751     return data;
752 }
753
754 std::string convertToHexString(uint8_t value)
755 {
756     // Convert a uint8_t to a hexadecimal string
757     std::stringstream stream;
758     stream << std::hex << std::uppercase << std::setw(2) << std::setfill('0') <<
static_cast<int>(value);
759     return stream.str();
760 }
761
762 tl::expected<Measure, std::string> __process_scan(const std::vector<uint8_t> &raw)
763 {
764     Measure measurementData;
765
766     bool newScan = static_cast<bool>(raw[0] & 0b1);
767     bool inversedNewScan = static_cast<bool>((raw[0] >> 1) & 0b1);
768     int quality = static_cast<int>(raw[0] >> 2);
769
770     if (newScan == inversedNewScan)
771     {
772         return tl::make_unexpected("New scan flags mismatch");
773     }
774
775     int checkBit = static_cast<int>(raw[1] & 0b1);
776     if (checkBit != 1)

```

```

793         {
794             return t1::make_unexpected("Check bit not equal to 1");
795         }
796
797         int anglePart1 = static_cast<int>(raw[1] >> 1);
798         int anglePart2 = static_cast<int>(raw[2]) << 7;
799         float angle = (anglePart1 + anglePart2) / 64.0;
800
801         int distancePart1 = static_cast<int>(raw[3]);
802         int distancePart2 = static_cast<int>(raw[4]) << 8;
803         float distance = (distancePart1 + distancePart2) / 4.0;
804
805         measurementData.newScan = newScan;
806         measurementData.quality = quality;
807         measurementData.angle = angle;
808         measurementData.distance = distance;
809
810         return measurementData;
811     }
812
813     Measure _process_express_scan(std::unique_ptr<ExpressPacket> &data, float newAngle, int trame)
814     {
815         Measure measurementData;
816
817         bool newScan = (newAngle < data->start_angle) && (trame == 1);
818
819         float angle = std::fmod((data->start_angle + ((newAngle - data->start_angle) / 32 * trame -
820 data->angle[trame - 1])), 360);
821         float distance = data->distance[trame - 1];
822
823         measurementData.newScan = newScan;
824         measurementData.quality = 0; // Replace this with your actual quality value
825         measurementData.angle = angle;
826         measurementData.distance = distance;
827
828         return measurementData;
829     }
830
831 private:
832     std::unique_ptr<serial::Serial> _serial = nullptr;
833
834     std::string port;
835     uint32_t baudrate;
836
837     int _motor_speed = DEFAULT_MOTOR_PWM;
838     bool motor_running = false;
839     ScanInfo scanning = ScanInfo{false, 0, ScanType::NORMAL};
840     int express_trame = 32;
841
842     std::unique_ptr<ExpressPacket> express_data = nullptr;
843     std::unique_ptr<ExpressPacket> express_old_data = nullptr;
844 };
845
846 #endif

```

## 8.95 utils/include/utils/TypeName.hpp File Reference

```

#include <array>
#include <cstdint>

```

### Classes

- struct [utils::RawTypeNameFormat](#)

### Namespaces

- namespace [utils](#)

## Functions

- `template<typename T>`  
`constexpr const auto & utils::RawTypeName ()`
- `constexpr bool utils::GetRawTypeNameFormat (RawTypeNameFormat *format)`
- `template<typename T>`  
`constexpr auto utils::CexprTypeName ()`
- `template<typename T>`  
`const char * utils::TypeName ()`
- `template<typename T>`  
`const char * utils::TypeName (const T &)`

## 8.96 TypeName.hpp

[Go to the documentation of this file.](#)

```

1 // From: https://stackoverflow.com/a/59522794
2
3 #include <array>
4 #include <cstdint>
5
6 namespace utils
7 {
8     template <typename T>
9     constexpr const auto &RawTypeName()
10     {
11 #ifdef _MSC_VER
12         return __FUNCSIG__;
13 #else
14         return __PRETTY_FUNCTION__;
15 #endif
16     }
17
18     struct RawTypeNameFormat
19     {
20         std::size_t leading_junk = 0, trailing_junk = 0;
21     };
22
23     // Returns 'false' on failure.
24     inline constexpr bool GetRawTypeNameFormat(RawTypeNameFormat *format)
25     {
26         const auto &str = RawTypeName<int>();
27         for (std::size_t i = 0; i++)
28         {
29             if (str[i] == 'i' && str[i + 1] == 'n' && str[i + 2] == 't')
30             {
31                 if (format)
32                 {
33                     format->leading_junk = i;
34                     format->trailing_junk = sizeof(str) - i - 3 - 1; // '3' is the length of "int", '1'
35                     // is the space for the null terminator.
36                 }
37                 return true;
38             }
39         }
40         return false;
41     }
42
43     inline static constexpr RawTypeNameFormat format =
44     {
45         static_assert(GetRawTypeNameFormat(nullptr), "Unable to figure out how to generate type names on
46         this compiler.");
47         RawTypeNameFormat format;
48         GetRawTypeNameFormat(&format);
49         return format;
50     };
51
52     // Returns the type name in a 'std::array<char, N>' (null-terminated).
53     template <typename T>
54     [[nodiscard]] constexpr auto CexprTypeName()
55     {
56         constexpr std::size_t len = sizeof(RawTypeName<T>()) - format.leading_junk -
57         format.trailing_junk;
58         std::array<char, len> name{};
59         for (std::size_t i = 0; i < len - 1; i++)
60             name[i] = RawTypeName<T>()[i + format.leading_junk];
61     }
62 }

```



```

59     return name;
60 }
61
62 template <typename T>
63 [[nodiscard]] const char *TypeName()
64 {
65     static constexpr auto name = CexprTypeName<T>();
66     return name.data();
67 }
68 template <typename T>
69 [[nodiscard]] const char *TypeName(const T &)
70 {
71     return TypeName<T>();
72 }
73 }

```

## 8.97 utils/include/utils/Utility.hpp File Reference

```

#include <string>
#include <sstream>
#include <vector>

```

### Namespaces

- namespace [utils](#)

## 8.98 Utility.hpp

[Go to the documentation of this file.](#)

```

1  #ifndef UTILITY_HPP
2  #define UTILITY_HPP
3
4  #pragma once
5
6  #include <string>
7  #include <sstream>
8  #include <vector>
9
10 namespace utils {
11     // https://stackoverflow.com/a/46931770
12     static std::vector<std::string> split(const std::string& s, const int from_index, const int to_index,
13     char delim) {
14         std::vector<std::string> result;
15         std::stringstream ss(s);
16         std::string item;
17         int index = 0;
18
19         while (getline(ss, item, delim)) {
20             if (index >= from_index && index < to_index)
21                 result.push_back(item);
22             index++;
23         }
24         return result;
25     }
26
27     // https://stackoverflow.com/a/46711735
28     static constexpr uint32_t hash(const std::string_view s) noexcept
29     {
30         uint32_t hash = 5381;
31
32         for (const char* c = s.data(); c < s.data() + s.size(); ++c)
33             hash = (hash « 5) + hash + (unsigned char)*c;
34
35         return hash;
36     }
37
38     // From: https://stackoverflow.com/a/5665377
39     // To escape HTML characters

```

```
40     static void encode(std::string& data) {
41         std::string buffer;
42         buffer.reserve(data.size());
43         for (size_t pos = 0; pos != data.size(); ++pos) {
44             switch (data[pos]) {
45                 case '&': buffer.append("&"); break;
46                 case '"': buffer.append("""); break;
47                 case '\\': buffer.append("&apos;"); break;
48                 case '<': buffer.append("&lt;"); break;
49                 case '>': buffer.append("&gt;"); break;
50                 default: buffer.append(&data[pos], 1); break;
51             }
52         }
53         data.swap(buffer);
54     }
55
56     // To get class name without namespace
57     static std::string getStringAfterLastColon(const std::string& input) {
58         size_t last_colon_pos = input.find_last_of(":");
59
60         if (last_colon_pos != std::string::npos) {
61             return input.substr(last_colon_pos + 1);
62         }
63         else {
64             return input;
65         }
66     }
67 }
68
69 #endif
```

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