DeltaRobot

v0.4

Generated by Doxygen 1.8.9.1

Wed Apr 22 2015 10:32:10

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This project is a Delta robot controller using Dynamixel AX12 servos.This type of robot can pick and place objects

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2.1.1 Detailed Description

Namespace to work with a User Interface Qt Form.

Chapter 3

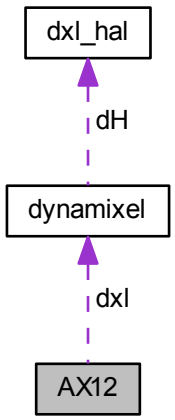
Class Documentation

3.1 AX12 Class Reference

The AX12 class is used to control AX-12 motors from Dynamixel.

`#include <ax12.h>`

Collaboration diagram for AX12:



Public Member Functions

- AX12 (dynamixel *dxl, int ID=-1)

  Default constructor must pass an initialized dynamixel object if ID == -1 no action is done.
- AX12 (const AX12 &a)

  Copy constructor.
- ~AX12 ()

  Default destructor.
- QVector< int > connectedID ()

  Returns all active servos;.
- double getCurrentLoad ()

Returns the current load from -100% to 100%, 100% is ClockWise and -100% is CounterClockWise.

- double getCurrentPos ()

  Returns the current position from 0º to 300º
- int getCurrentTemp ()

  Returns the current Temperature in Celsius.
- double getCurrentSpeed ()

  Returns the current speed from -100% to 100%, 100% is ClockWise and -100% is CounterClockWise.
- double getCurrentVoltage ()

  Returns the current voltage in Volts.
- int getID ()

  To get the current ID.
- void setGoalPosition (double goal)

  Sets the Goal's position (in degrees) or speed depending on the mode.
- void setID (int ID)

  To set a new ID.
- void setJointMode (bool mode)

  To set Joint/Wheel mode, true if Joint.
- void setMinMax (double min, double max)

  To set the minimum and maximum angle from 0 to 300º
- void setSpeed (double speed)

  To set the maximum speed from 0% to 100% if joint mode or from -100% to 100% if wheel mode.

Private Types

- enum ROM {
  ModelNumber = 0, VersionFirmware = 2, ID = 3, BaudRate = 4,
  ReturnDelayTime = 5, CWAngleLimit = 6, CCWAngleLimit = 8, HighestLimitTemp = 11,
  LowestLimitVoltage = 12, HighestLimitVoltage = 13, MaxTorque = 14, StatusReturnLevel = 16,
  AlarmLED = 17, AlarmShutdown = 18 }

  Contains all the EEPROM directions enumeration.
- enum RAM {
  TorqueEnable = 24, LED = 25, CWComplianceMargin = 26, CCWComplianceMargin = 27,
  CWComplianceSlope = 28, CCWComplianceSlope = 29, GoalPosition = 30, MovingSpeed = 32,
  TorqueLimit = 34, PresentPosition = 36, PresentSpeed = 38, PresentLoad = 40,
  PresentVoltage = 42, PresentTemperature = 43, Registered = 44, Moving = 46,
  Lock = 47, Punch = 48 }

  Contains all the RAM directions enumerations.

Private Attributes

- dynamixel * dxl

  Contains the dynamixel comunication.
- int _ID

  Stores the current ID.
- bool _mode

  True if we use the joint mode.
- bool _rads

  True if the angle is returned in radians.

3.1.1 Detailed Description

The AX12 class is used to control AX-12 motors from Dynamixel.

3.1.2 Member Enumeration Documentation

3.1.2.1 enum AX12::RAM [private]

Contains all the RAM directions enumerations.

Enumerator

TorqueEnable

LED

CWComplianceMargin

CCWComplianceMargin

CWComplianceSlope

CCWComplianceSlope

GoalPosition

MovingSpeed

TorqueLimit

PresentPosition

PresentSpeed

PresentLoad

PresentVoltage

PresentTemperature

Registered

Moving

Lock

Punch

```
00044     {
00045         TorqueEnable        = 24,
00046         LED                 = 25,
00047         CWComplianceMargin  = 26,
00048         CCWComplianceMargin = 27,
00049         CWComplianceSlope   = 28,
00050         CCWComplianceSlope  = 29,
00051         GoalPosition        = 30,
00052         MovingSpeed         = 32,
00053         TorqueLimit         = 34,
00054         PresentPosition     = 36,
00055         PresentSpeed        = 38,
00056         PresentLoad         = 40,
00057         PresentVoltage      = 42,
00058         PresentTemperature  = 43,
00059         Registered          = 44,
00060         Moving              = 46,
00061         Lock                = 47,
00062         Punch               = 48
00063
00064     };
```

3.1.2.2 enum AX12::ROM [private]

Contains all the EEPROM directions enumeration.

Enumerator

ModelNumber

VersionFirmware

ID

BaudRate
ReturnDelayTime
CWAngleLimit
CCWAngleLimit
HighestLimitTemp
LowestLimitVoltage
HighestLimitVoltage
MaxTorque
StatusReturnLevel
AlarmLED
AlarmShutdown

```
00025     {
00026         ModelNumber         = 0,
00027         VersionFirmware     = 2,
00028         ID                  = 3,
00029         BaudRate            = 4,
00030         ReturnDelayTime     = 5,
00031         CWAngleLimit        = 6,
00032         CCWAngleLimit       = 8,
00033         HighestLimitTemp    = 11,
00034         LowestLimitVoltage  = 12,
00035         HighestLimitVoltage = 13,
00036         MaxTorque           = 14,
00037         StatusReturnLevel   = 16,
00038         AlarmLED            = 17,
00039         AlarmShutdown       = 18
00040     };
```

3.1.3 Constructor & Destructor Documentation

3.1.3.1 AX12::AX12 (dynamixel * *dxl*, int *ID* = -1)

Default constructor must pass an initialized dynamixel object if ID == -1 no action is done.

```
00005                                   :
00006     dxl(dxl),
00007     _ID(ID),
00008    _mode(true),
00009    _rads(false)
00010 {
00011     if (_ID < 0) return;
00012     dxl->write_byte(_ID, RAM::TorqueEnable, true);
00013 }
```

3.1.3.2 AX12::AX12 (const AX12 & *a*)

Copy constructor.

```
00015                         :
00016     dxl(a.dxl),
00017     _ID(a._ID),
00018     _mode(a._mode),
00019     _rads(a._rads)
00020 {
00021
00022 }
```

3.1.3.3 AX12::~AX12 ( )

Default destructor.

```
00025 {
00026
00027 }
```

3.1.4 Member Function Documentation

3.1.4.1 QVector< int > AX12::connectedID ( )

Returns all active servos;.

```
00030 {
00031     QVector <int> res;
00032     for (int i = 0; i < 256; ++i) {
00033         dxl->ping(i);
00034         if (dxl->get_comm_result() == COMM_RXSUCCESS) res.push_back(i);
00035     }
00036 
00037     return res;
00038 }
```

3.1.4.2 double AX12::getCurrentLoad ( )

Returns the current load from -100% to 100%, 100% is ClockWise and -100% is CounterClockWise.

```
00041 {
00042     if (_ID < 0) return 0;
00043     int load = dxl->read_word(_ID, RAM::PresentLoad);
00044     load -= 1024;
00045     if (load == -1024) load = 0;
00046     return double((load/1023)*100);
00047 }
```

3.1.4.3 double AX12::getCurrentPos ( )

Returns the current position from 0º to 300º

```
00050 {
00051     if (_ID < 0) return 0;
00052     int pos = dxl->read_word(_ID, RAM::PresentPosition);
00053     if (dxl->get_comm_result() != COMM_RXSUCCESS) return -1;
00054 
00055     if (_rads) return double((pos/1023.0)*5*M_PI/3);
00056     return double((pos/1023.0)*300);
00057 }
```

3.1.4.4 double AX12::getCurrentSpeed ( )

Returns the current speed from -100% to 100%, 100% is ClockWise and -100% is CounterClockWise.

```
00068 {
00069     if (_ID < 0) return 0;
00070     int speed = dxl->read_word(_ID, RAM::PresentSpeed);
00071     if (dxl->get_comm_result() != COMM_RXSUCCESS) return -1;
00072     speed -= 1024;
00073     if (speed == -1024) speed = 0;
00074     return double((speed/1023.0)*100);
00075 }
```

3.1.4.5 int AX12::getCurrentTemp ( )

Returns the current Temperature in Celsius.

```
00060 {
00061     if (_ID < 0) return 0;
00062     int temp = dxl->read_byte(_ID, RAM::PresentTemperature);
00063     if (dxl->get_comm_result() != COMM_RXSUCCESS) return -1;
00064     return temp;
00065 }
```

3.1.4.6 double AX12::getCurrentVoltage ( )

Returns the current voltage in Volts.

```
00078 {
00079     if (_ID < 0) return 0;
00080     char voltage = dxl->read_byte(_ID, RAM::PresentVoltage);
00081     if (dxl->get_comm_result() != COMM_RXSUCCESS) return -1;
00082     return double(voltage/10.0);
00083 }
```

3.1.4.7 int AX12::getID ( ) [inline]

To get the current ID.

```
00111 { return _ID; }
```

3.1.4.8 void AX12::setGoalPosition (double *goal*)

Sets the Goal's position (in degrees) or speed depending on the mode.

```
00086 {
00087     if (_ID < 0) return;
00088     if (goal > 300.0) goal = 300.0;
00089     else if (goal < 0) goal = 0;
00090     dxl->write_word(_ID, RAM::GoalPosition, int((goal/300.0)*1023));
00091 }
```

3.1.4.9 void AX12::setID (int *ID*)

To set a new ID.

```
00094 {
00095     _ID = ID;
00096     if (ID < 0) return;
00097     dxl->write_byte(_ID, RAM::TorqueEnable, true);
00098 }
```

3.1.4.10 void AX12::setJointMode (bool *mode*)

To set Joint/Wheel mode, true if Joint.

```
00101 {
00102     if (_ID < 0) return;
00103     _mode = mode;
00104     if (_mode) {
00105         dxl->write_word(_ID, ROM::CWAngleLimit, 0);
00106         dxl->write_word(_ID, ROM::CCWAngleLimit, 1023);
00107     }
00108     else {
00109         dxl->write_word(_ID, ROM::CWAngleLimit, 0);
00110         dxl->write_word(_ID, ROM::CCWAngleLimit, 0);
00111     }
00112 }
```

3.1.4.11 void AX12::setMinMax (double *min*, double *max*)

To set the minimum and maximum angle from 0 to 300º

```
00115 {
00116     if (_ID < 0) return;
00117
00118     if (min > max) std::swap(min, max);
00119
00120     if (min < 0.0) min = 0;
00121     if (max > 300.0) max = 300;
00122
00123     min = (min/300)*1023;
00124     max = (max/300)*1023;
00125
00126     dxl->write_word(_ID, ROM::CWAngleLimit, int (min));
00127     dxl->write_word(_ID, ROM::CCWAngleLimit, int (max));
00128 }
```

3.1.4.12 void AX12::setSpeed (double *speed*)

To set the maximum speed from 0% to 100% if joint mode or from -100% to 100% if wheel mode.

```
00131 {
00132     if (_ID < 0) return;
00133     if (speed > 100.0) speed = 100.0;
00134     if (_mode) {
00135         if (speed < 0.0) speed = 0.0;
00136
00137         int byte = int((speed/100.0) * 1024.0);
00138         if (speed == 100.0) byte = 0;
00139         dxl->write_byte(_ID, RAM::MovingSpeed, byte);
00140     }
00141     else {
00142         if (speed < -100.0) speed = -100.0;
00143
00144         int byte = int(((speed + 100)/100.0) * 1024);
00145         dxl->write_byte(_ID, RAM::MovingSpeed, byte);
00146     }
00147
00148 }
```

3.1.5 Member Data Documentation

3.1.5.1 int AX12::_ID [private]

Stores the current ID.

3.1.5.2 bool AX12::_mode [private]

True if we use the joint mode.

3.1.5.3 bool AX12::_rads [private]

True if the angle is returned in radians.

3.1.5.4 dynamixel* AX12::dxl [private]

Contains the dynamixel comunication.

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

- dxl/ax12.h
- dxl/ax12.cpp

3.2 dxl_hal Class Reference

Dynamixel SDK platform dependent.

`#include <dxl_hal.h>`

Public Member Functions

- bool open (QString &devName, int baudrate)
- void close (void)
- void clear (void)
- int change_baudrate (float baudrate)
- int write (unsigned char *pPacket, int numPacket)
- int read (unsigned char *pPacket, int numPacket)
- double get_curr_time ()
- bool isOpen ()

Private Attributes

- QSerialPort _serial
- int _time = 30
- bool _timed = false
- bool _open = false

3.2.1 Detailed Description

Dynamixel SDK platform dependent.

3.2.2 Member Function Documentation

3.2.2.1 int dxl_hal::change_baudrate (float *baudrate*)

```
00039 {
00040     bool res = _serial.setBaudRate(qint32(baudrate));
00041     return int(res);
00042
00043 }
```

3.2.2.2 void dxl_hal::clear (void)

```
00032 {
00033     // Clear communication buffer
00034     _serial.clear();
00035
00036 }
```

3.2.2.3 void dxl_hal::close (void)

```
00025 {
00026     // Closing device
00027     _serial.close();
00028     _open = false;
00029 }
```

3.2.2.4 double dxl_hal::get_curr_time ( )

```
00080 {
00081     return (double)QTime::currentTime().msecsSinceStartOfDay();
00082 }
```

3.2.2.5 bool dxl_hal::isOpen ( ) [inline]

```
00030 { return _open; }
```

3.2.2.6 bool dxl_hal::open (QString & *devName*, int *baudrate*)

```
00007 {
00008     // Opening device
00009     // devIndex: Device index
00010     // baudrate: Real baudrate (ex> 115200, 57600, 38400...)
00011     // Return: 0(Failed), 1(Succeed)
00012
00013     _serial.setPortName(devName);
00014     _serial.setBaudRate(qint32(baudrate));
00015     _serial.setDataBits(QSerialPort::Data8);
00016     _serial.setParity(QSerialPort::NoParity);
00017     _serial.setStopBits(QSerialPort::OneStop);
00018     _serial.setFlowControl(QSerialPort::NoFlowControl);
00019     if(not _serial.open(QIODevice::ReadWrite)) return false;
00020     _open = true;
00021     return true;
00022 }
```

3.2.2.7 int dxl_hal::read (unsigned char * *pPacket*, int *numPacket*)

```
00063 {
00064     // Recieving date
00065     // *pPacket: data array pointer
00066     // numPacket: number of data array
00067     // Return: number of data recieved. -1 is error.
00068     _timed = false;
00069     if (_serial.isOpen()) {
00070         int n = _serial.read((char*)pPacket, numPacket);
00071         _timed = _serial.waitForReadyRead(_time);
00072         _timed = not _timed;
00073         return n;
00074     }
00075     else return -1;
00076
00077 }
```

3.2.2.8 int dxl_hal::write (unsigned char * *pPacket*, int *numPacket*)

```
00046 {
00047     // Transmiting date
00048     // *pPacket: data array pointer
00049     // numPacket: number of data array
00050     // Return: number of data transmitted. -1 is error.
00051     _timed = false;
00052     if (_serial.isOpen()) {
00053         int n = _serial.write((char*)pPacket, numPacket);
00054         _timed = _serial.waitForBytesWritten(_time);
00055         _timed = not _timed;
00056         return n;
00057     }
00058     else return -1;
00059
00060 }
```

3.2.3 Member Data Documentation

3.2.3.1 bool dxl_hal::_open = false [private]

3.2.3.2 QSerialPort dxl_hal::_serial [private]

3.2.3.3 int dxl_hal::_time = 30 [private]

3.2.3.4 bool dxl_hal::_timed = false [private]

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

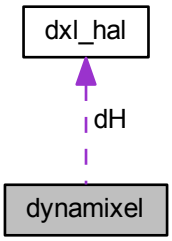
- dxl/dxl_hal.h
- dxl/dxl_hal.cpp

3.3 dynamixel Class Reference

Dynamixel 1.0 protocol class.

`#include <dynamixel.h>`

Collaboration diagram for dynamixel:



Public Member Functions

- dynamixel (QString port_num, int baud_rate=1000000)
  Initialization constructor.
- bool isOpen ()
  True if the port is open.
- int initialize (QString port_num, int baud_rate)
  Initializates the port.
- int change_baudrate (int baud_rate)
  Changes the current baud rate.
- int terminate (void)
  Closes the comunication.
- int get_comm_result ()
  Returns the current com status.
- void tx_packet (void)
  Sends a packet.
- void rx_packet (void)

Receives a packet.

- void txrx_packet (void)

  Sends and receives a packet.
- void set_txpacket_id (int id)

  Sets the sending packet ID.
- void set_txpacket_instruction (int instruction)

  Sets the sending packet instruction.
- void set_txpacket_parameter (int index, int value)

  Sets the sending packet parameter.
- void set_txpacket_length (int length)

  Sets the sending packet length.
- bool get_rxpacket_error (int error)

  Returns false if no receive error and true if there's an error.
- int get_rxpacket_error_byte (void)

  Returns the error byte.
- int get_rxpacket_parameter (int index)

  Returns the received parameter.
- int get_rxpacket_length ()

  Returns the received packet length.
- void ping (int id)

  Ping to the selected id, check com status for the ping result.
- int read_byte (int id, int address)

  Reads a byte from the selected ID at the selected address.
- void write_byte (int id, int address, int value)

  Writes a byte to the selected ID at the selected address.
- int read_word (int id, int address)

  Reads a word to the selected ID at the selected address.
- void write_word (int id, int address, int value)

  Writes a word to the selected ID at the selected address.
- double get_packet_time ()

  Returns the packet time.
- void set_packet_timeout (int NumRcvByte)

  Sets the timeout in number of received bytes.
- void set_packet_timeout_ms (int msec)

  Sets the timeout in ms.
- bool is_packet_timeout ()

  Returns true if the packet is timeout.

Private Attributes

- dxl_hal dH

  Conains the serial port comunication.
- unsigned char gbInstructionPacket [MAXNUM_TXPACKET] = {0}

  Contains all the instructions.
- unsigned char gbStatusPacket [MAXNUM_RXPACKET] = {0}

  Contains the status.
- unsigned int gbRxPacketLength = 0

  Received packet length.
- unsigned int gbRxGetLength = 0

  Temporal length from the received packet.

- double gdPacketStartTime = 0.0

  Packet start time.
- double gdByteTransTime = 0.0

  Byte transmission time.
- double gdRcvWaitTime = 0.0

  Receive wait time.
- int gbCommStatus = COMM_RXSUCCESS

  Current communication status.
- int giBusUsing = 0

  True if the bus if being used.

3.3.1 Detailed Description

Dynamixel 1.0 protocol class.

3.3.2 Constructor & Destructor Documentation

3.3.2.1 dynamixel::dynamixel (QString *port_num*, int *baud_rate* = 1000000)

Initialization constructor.

```
00011 {
00012     initialize(port_num, baud_rate);
00013 }
```

3.3.3 Member Function Documentation

3.3.3.1 int dynamixel::change_baudrate (int *baud_rate*)

Changes the current baud rate.

```
00031 {
00032     int result = 0;
00033     float baudrate = (float)baud_rate;
00034
00035     result = dH.change_baudrate(baudrate);
00036     if(result == 1)
00037         gdByteTransTime = 1000.0f / baudrate * 10.0; // 1000/baudrate(bit per msec) *
      10(start bit + data bit + stop bit)
00038
00039     return result;
00040 }
```

3.3.3.2 int dynamixel::get_comm_result ( ) [inline]

Returns the current com status.

```
00112 { return gbCommStatus; }
```

3.3.3.3 double dynamixel::get_packet_time (void)

Returns the packet time.

```
00050 {
00051     double elapsed_time;
00052
00053     elapsed_time = (double)(dH.get_curr_time() -
      gdPacketStartTime);
00054
00055     // Overflow
00056     if(elapsed_time < 0) gdPacketStartTime = dH.get_curr_time();
00057
00058     return elapsed_time;
00059 }
```

3.3.3.4 bool dynamixel::get_rxpacket_error (int *error*)

Returns false if no receive error and true if there's an error.

Parameters

error	Selects the error to check

```
00271 {
00272     if( gbStatusPacket[PRT1_PKT_ERRBIT] & (unsigned char)error )
00273         return true;
00274
00275     return false;
00276 }
```

3.3.3.5 int dynamixel::get_rxpacket_error_byte (void)

Returns the error byte.

```
00279 {
00280     return gbStatusPacket[PRT1_PKT_ERRBIT];
00281 }
```

3.3.3.6 int dynamixel::get_rxpacket_length ( )

Returns the received packet length.

```
00289 {
00290     return (int)gbStatusPacket[PRT1_PKT_LENGTH];
00291 }
```

3.3.3.7 int dynamixel::get_rxpacket_parameter (int *index*)

Returns the received parameter.

```
00284 {
00285     return (int)gbStatusPacket[PRT1_PKT_PARAMETER0+index];
00286 }
```

3.3.3.8 int dynamixel::initialize (QString *port_num*, int *baud_rate*)

Initializates the port.

```
00016 {
00017     if( baud_rate < 1900 ) return 0;
00018
00019     if( not dH.open(port_num, baud_rate) ) return false;
00020
```

```
00021     // 1000/baudrate(bit per msec) * 10(start bit + data bit + stop bit)
00022     gdByteTransTime = 1000.0 / (double)baud_rate * 10.0;
00023
00024     gbCommStatus = COMM_RXSUCCESS;
00025     giBusUsing = 0;
00026
00027     return true;
00028 }
```

3.3.3.9 bool dynamixel::is_packet_timeout (void)

Returns true if the packet is timeout.

Returns

True if the packet is timeout

```
00074 {
00075     if(this->get_packet_time() > gdRcvWaitTime)
00076         return true;
00077     return false;
00078 }
```

3.3.3.10 bool dynamixel::isOpen ( ) [inline]

True if the port is open.

```
00100 { return dH.isOpen(); }
```

3.3.3.11 void dynamixel::ping (int *id*)

Ping to the selected id, check com status for the ping result.

Parameters

id	ID where the ping is done

```
00294 {
00295     while(giBusUsing);
00296
00297     gbInstructionPacket[PRT1_PKT_ID] = (unsigned char)id;
00298     gbInstructionPacket[PRT1_PKT_INSTRUCTION] = INST_PING;
00299     gbInstructionPacket[PRT1_PKT_LENGTH] = 2;
00300
00301     txrx_packet();
00302 }
```

3.3.3.12 int dynamixel::read_byte (int *id*, int *address*)

Reads a byte from the selected ID at the selected address.

Parameters

id	Selects the ID to read the byte
address	Selects the address to read the byte

```
00305 {
00306     while(giBusUsing);
00307
00308     gbInstructionPacket[PRT1_PKT_ID] = (unsigned char)id;
00309     gbInstructionPacket[PRT1_PKT_INSTRUCTION] = INST_READ;
00310     gbInstructionPacket[PRT1_PKT_PARAMETER0+0] = (unsigned char)address;
```

```
00311     gbInstructionPacket[PRT1_PKT_PARAMETER0+1] = 1;
00312     gbInstructionPacket[PRT1_PKT_LENGTH] = 4;
00313
00314     txrx_packet();
00315
00316     return (int)gbStatusPacket[PRT1_PKT_PARAMETER0];
00317 }
```

3.3.3.13 int dynamixel::read_word (int *id*, int *address*)

Reads a word to the selected ID at the selected address.

Parameters

id	Selects the ID to read the word
address	Selects the address to read the word

```
00333 {
00334     while(giBusUsing);
00335
00336     gbInstructionPacket[PRT1_PKT_ID] = (unsigned char)id;
00337     gbInstructionPacket[PRT1_PKT_INSTRUCTION] = INST_READ;
00338     gbInstructionPacket[PRT1_PKT_PARAMETER0+0] = (unsigned char)address;
00339     gbInstructionPacket[PRT1_PKT_PARAMETER0+1] = 2;
00340     gbInstructionPacket[PRT1_PKT_LENGTH] = 4;
00341
00342     txrx_packet();
00343
00344     return MAKEWORD((int)gbStatusPacket[PRT1_PKT_PARAMETER0+0], (int)
      gbStatusPacket[PRT1_PKT_PARAMETER0+1]);
00345 }
```

3.3.3.14 void dynamixel::rx_packet (void)

Receives a packet.

```
00144 {
00145     unsigned char i = 0, j = 0, nRead = 0;
00146     unsigned char checksum = 0;
00147
00148     if( giBusUsing == 0 )
00149         return;
00150
00151     if( gbInstructionPacket[PRT1_PKT_ID] == BROADCAST_ID )
00152     {
00153         gbCommStatus = COMM_RXSUCCESS;
00154         giBusUsing = 0;
00155         return;
00156     }
00157
00158     if( gbCommStatus == COMM_TXSUCCESS )
00159     {
00160         gbRxGetLength = 0;
00161         //gbRxPacketLength = 6; //minimum wait length
00162     }
00163
00164     while(1)
00165     {
00166         nRead = dH.read( &gbStatusPacket[gbRxGetLength],
      gbRxPacketLength - gbRxGetLength );
00167         gbRxGetLength += nRead;
00168
00169         if(gbRxGetLength > 4)
00170             gbRxPacketLength = gbStatusPacket[PRT1_PKT_LENGTH] + 4;
00171
00172         if( gbRxGetLength < gbRxPacketLength )
00173         {
00174             if( is_packet_timeout() == 1 )
00175             {
00176                 if(gbRxGetLength == 0)
00177                     gbCommStatus = COMM_RXTIMEOUT;
00178                 else
00179                     gbCommStatus = COMM_RXCORRUPT;
00180                 giBusUsing = 0;
00181                 return;
```

```
00182             }
00183             gbCommStatus = COMM_RXWAITING;
00184             //return;
00185         }
00186         else
00187         {
00188             break;
00189         }
00190     }
00191
00192     // Find packet header
00193     for( i=0; i<(gbRxGetLength-1); i++ )
00194     {
00195         if( gbStatusPacket[i] == 0xff && gbStatusPacket[i+1] == 0xff )
00196             break;
00197         else if( i == gbRxGetLength-2 && gbStatusPacket[gbRxGetLength-1] == 0xff )
00198             break;
00199         else {
00200             gbCommStatus = COMM_RXCORRUPT;
00201             return;
00202         }
00203     }
00204
00205     if( i > 0 )
00206     {
00207         for( j=0; j<(gbRxGetLength-i); j++ )
00208             gbStatusPacket[j] = gbStatusPacket[j + i];
00209
00210         gbRxGetLength -= i;
00211     }
00212
00213     // Check id pairing
00214     if( gbInstructionPacket[PRT1_PKT_ID] != gbStatusPacket[PRT1_PKT_ID])
00215     {
00216         gbCommStatus = COMM_RXCORRUPT;
00217         giBusUsing = 0;
00218         return;
00219     }
00220
00221     // Check checksum
00222     for( i=0; i<(gbStatusPacket[PRT1_PKT_LENGTH]+1); i++ )
00223         checksum += gbStatusPacket[i+2];
00224     checksum = ~checksum;
00225
00226     if( gbStatusPacket[gbStatusPacket[PRT1_PKT_LENGTH]+3] != checksum )
00227     {
00228         gbCommStatus = COMM_RXCORRUPT;
00229         giBusUsing = 0;
00230         return;
00231     }
00232
00233     gbCommStatus = COMM_RXSUCCESS;
00234     giBusUsing = 0;
00235 }
```

3.3.3.15 void dynamixel::set_packet_timeout (int *NumRcvByte*)

Sets the timeout in number of received bytes.

Parameters

NumRcvByte	Number of received bytes to do a timeout

```
00062 {
00063     gdPacketStartTime = dH.get_curr_time();
00064     gdRcvWaitTime = (gdByteTransTime*(double)NumRcvByte + 2.0*LATENCY_TIME + 2.
      0);
00065 }
```

3.3.3.16 void dynamixel::set_packet_timeout_ms (int *msec*)

Sets the timeout in ms.

Parameters

msec	Miliseconds for the timeout

```
00068 {
00069     gdPacketStartTime = dH.get_curr_time();
00070     gdRcvWaitTime = (double)msec;
00071 }
```

3.3.3.17 void dynamixel::set_txpacket_id (int *id*)

Sets the sending packet ID.

```
00250 {
00251     gbInstructionPacket[PRT1_PKT_ID] = (unsigned char)id;
00252 }
```

3.3.3.18 void dynamixel::set_txpacket_instruction (int *instruction*)

Sets the sending packet instruction.

```
00255 {
00256     gbInstructionPacket[PRT1_PKT_INSTRUCTION] = (unsigned char)instruction;
00257 }
```

3.3.3.19 void dynamixel::set_txpacket_length (int *length*)

Sets the sending packet length.

```
00266 {
00267     gbInstructionPacket[PRT1_PKT_LENGTH] = (unsigned char)length;
00268 }
```

3.3.3.20 void dynamixel::set_txpacket_parameter (int *index*, int *value*)

Sets the sending packet parameter.

```
00260 {
00261     gbInstructionPacket[PRT1_PKT_PARAMETER0+index] = (unsigned char)value;
00262
00263 }
```

3.3.3.21 int dynamixel::terminate (void)

Closes the comunication.

```
00043 {
00044     dH.close();
00045     return 0;
00046 }
```

3.3.3.22 void dynamixel::tx_packet (void)

Sends a packet.

```
00082 {
00083     unsigned char pkt_idx = 0;
00084     unsigned char TxNumByte, RealTxNumByte;
00085     unsigned char checksum = 0;
00086
00087     if( giBusUsing == 1 )
00088     {
00089         gbCommStatus = COMM_TXFAIL;
00090         return;
00091     }
00092
00093     giBusUsing = 1;
00094
00095     if( gbInstructionPacket[PRT1_PKT_INSTRUCTION] != INST_PING
00096         && gbInstructionPacket[PRT1_PKT_INSTRUCTION] != INST_READ
00097         && gbInstructionPacket[PRT1_PKT_INSTRUCTION] != INST_WRITE
00098         && gbInstructionPacket[PRT1_PKT_INSTRUCTION] != INST_REG_WRITE
00099         && gbInstructionPacket[PRT1_PKT_INSTRUCTION] != INST_ACTION
00100         && gbInstructionPacket[PRT1_PKT_INSTRUCTION] != INST_RESET
00101         && gbInstructionPacket[PRT1_PKT_INSTRUCTION] != INST_SYNC_WRITE )
00102     {
00103         gbCommStatus = COMM_TXERROR;
00104         giBusUsing = 0;
00105         return;
00106     }
00107
00108     gbInstructionPacket[0] = 0xff;
00109     gbInstructionPacket[1] = 0xff;
00110     for( pkt_idx = 0; pkt_idx < (gbInstructionPacket[PRT1_PKT_LENGTH]+1); pkt_idx++ )
00111         checksum += gbInstructionPacket[pkt_idx+2];
00112     gbInstructionPacket[gbInstructionPacket[PRT1_PKT_LENGTH]+3] = ~
      checksum;
00113
00114     //if( gbCommStatus == COMM_RXTIMEOUT || gbCommStatus == COMM_RXCORRUPT )
00115     //  dH.clear();
00116
00117     dH.clear();
00118
00119     TxNumByte = gbInstructionPacket[PRT1_PKT_LENGTH] + 4;
00120     RealTxNumByte = dH.write( gbInstructionPacket, TxNumByte );
00121
00122     if( TxNumByte != RealTxNumByte )
00123     {
00124         gbCommStatus = COMM_TXFAIL;
00125         giBusUsing = 0;
00126         return;
00127     }
00128
00129     if( gbInstructionPacket[PRT1_PKT_INSTRUCTION] == INST_READ )
00130     {
00131         gbRxPacketLength =  gbInstructionPacket[PRT1_PKT_PARAMETER0+1] + 6;
00132         set_packet_timeout( gbInstructionPacket[PRT1_PKT_PARAMETER0+1] + 6 );
00133     }
00134     else
00135     {
00136         gbRxPacketLength = 6;
00137         set_packet_timeout( 6 );
00138     }
00139
00140     gbCommStatus = COMM_TXSUCCESS;
00141 }
```

3.3.3.23 void dynamixel::txrx_packet (void)

Sends and receives a packet.

```
00238 {
00239     tx_packet();
00240
00241     if( gbCommStatus != COMM_TXSUCCESS )
00242         return;
00243
00244
00245     rx_packet();
00246 }
```

3.3.3.24 void dynamixel::write_byte (int *id*, int *address*, int *value*)

Writes a byte to the selected ID at the selected address.

Parameters

id	Selects the ID to write the byte
address	Selects the address to write the byte
value	Value to set at the selected location

```
00320 {
00321     while(giBusUsing);
00322
00323     gbInstructionPacket[PRT1_PKT_ID] = (unsigned char)id;
00324     gbInstructionPacket[PRT1_PKT_INSTRUCTION] = INST_WRITE;
00325     gbInstructionPacket[PRT1_PKT_PARAMETER0+0] = (unsigned char)address;
00326     gbInstructionPacket[PRT1_PKT_PARAMETER0+1] = (unsigned char)value;
00327     gbInstructionPacket[PRT1_PKT_LENGTH] = 4;
00328
00329     txrx_packet();
00330 }
```

3.3.3.25 void dynamixel::write_word (int *id*, int *address*, int *value*)

Writes a word to the selected ID at the selected address.

Parameters

id	Selects the ID to write the word
address	Selects the address to write the word
value	Value to set at the selected location

```
00348 {
00349     while(giBusUsing);
00350
00351     gbInstructionPacket[PRT1_PKT_ID] = (unsigned char)id;
00352     gbInstructionPacket[PRT1_PKT_INSTRUCTION] = INST_WRITE;
00353     gbInstructionPacket[PRT1_PKT_PARAMETER0+0] = (unsigned char)address;
00354     gbInstructionPacket[PRT1_PKT_PARAMETER0+1] = (unsigned char)LOBYTE(value);
00355     gbInstructionPacket[PRT1_PKT_PARAMETER0+2] = (unsigned char)HIBYTE(value);
00356     gbInstructionPacket[PRT1_PKT_LENGTH] = 5;
00357
00358     txrx_packet();
00359 }
```

3.3.4 Member Data Documentation

3.3.4.1 dxl_hal dynamixel::dH [private]

Conains the serial port comunication.

3.3.4.2 int dynamixel::gbCommStatus = COMM_RXSUCCESS [private]

Current communication status.

3.3.4.3 unsigned char dynamixel::gbInstructionPacket[MAXNUM_TXPACKET] = {0} [private]

Contains all the instructions.

3.3.4.4 unsigned int dynamixel::gbRxGetLength = 0 [private]

Temporal length from the received packet.

3.3.4.5 unsigned int dynamixel::gbRxPacketLength = 0 [private]

Received packet length.

3.3.4.6 unsigned char dynamixel::gbStatusPacket[MAXNUM_RXPACKET] = {0} [private]

Contains the status.

3.3.4.7 double dynamixel::gdByteTransTime = 0.0 [private]

Byte transmission time.

3.3.4.8 double dynamixel::gdPacketStartTime = 0.0 [private]

Packet start time.

3.3.4.9 double dynamixel::gdRcvWaitTime = 0.0 [private]

Receive wait time.

3.3.4.10 int dynamixel::giBusUsing = 0 [private]

True if the bus if being used.

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

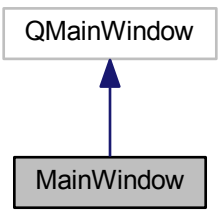
- dxl/dynamixel.h
- dxl/dynamixel.cpp

3.4 MainWindow Class Reference

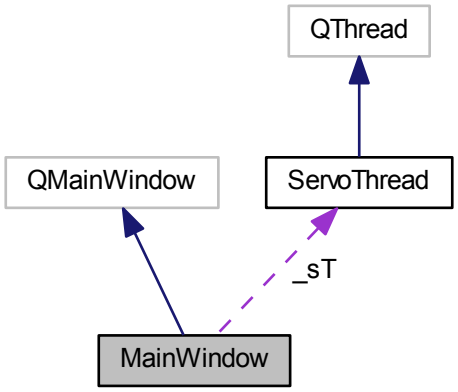
Contains all the windows and other classes.

`#include <mainwindow.h>`

Inheritance diagram for MainWindow:



Collaboration diagram for MainWindow:



Signals

- void joystickChanged ()
  Emmitted when a joystick changes.

Public Member Functions

- MainWindow (QWidget *parent=0)
  Default constructor.
- ~MainWindow ()
  Default destructor.

Private Slots

- void joyChanged ()
  Handles a joystick update.
- void on_actionOptions_triggered ()
  To select the options.
- void update ()
  Updates all data to the servo thread.
- void on_start_clicked ()

Private Attributes

- QVector< QLabel * > _axis
  Handles all the axis labels.
- QVector< float > _axisV
  Contains the axis value;.
- QVector< QLabel * > _buts
  Handles all the button labels.

- QVector< bool > _butsV

  Handles all buttons values.
- QString _dataP

  Contains the path to the data location.
- int _jAxisX = -1

  Axis for the X value.
- int _jAxisY = -1

  Axis for the Y value.
- int _jAxisZ = -1

  AXis for the Z value.
- XJoystick _joy

  To handle the joystick.
- ServoThread _sT

  Contains the thread controlling all the servos and external hardware.
- QTimer _timer

  To update the joystick value.
- Ui::MainWindow * ui

  Contains the user interface.

Static Private Attributes

- static const int sCount = 3

  Contains the number of minimun servos to work.
- static const int aSCount = 0

  Contains the number of additional servos used.

3.4.1 Detailed Description

Contains all the windows and other classes.

3.4.2 Constructor & Destructor Documentation

3.4.2.1 MainWindow::MainWindow (QWidget * *parent* = 0) [explicit]

Default constructor.

```
00005                                       :
00006     QMainWindow(parent),
00007     _axis(XJoystick::AxisCount),
00008     _axisV(XJoystick::AxisCount),
00009     _buts(XJoystick::ButtonCount),
00010     _butsV(XJoystick::ButtonCount),
00011     ui(new Ui::MainWindow)
00012 {
00013     ui->setupUi(this);
00014
00015     _sT.start();
00016
00017     connect(&_joy, SIGNAL(changed()), this, SLOT(joyChanged()));
00018     connect(&_timer, SIGNAL(timeout()), this, SLOT(update()));
00019     connect(&_sT, SIGNAL(statusBar(QString)),
00020             ui->statusbar, SLOT(showMessage(QString)));
00021
00022
00023     _timer.setInterval(10);
00024     _timer.start();
00025
00026     // JOYSTICK
00027     QVector< QString > V(_joy.getAllAxis());
00028     // Adding axis
```

```
00029     QGridLayout *wL = new QGridLayout;
00030     for (int i = 0; i < XJoystick::AxisCount; ++i) {
00031         QHBoxLayout *L = new QHBoxLayout;
00032         L->addWidget(new QLabel(V[i].append(":"), this));
00033         _axis[i] = new QLabel("#");
00034         L->addWidget(_axis[i]);
00035         L->addStretch();
00036         wL->addLayout(L, i%3, i/3);
00037     }
00038     ui->joyAxis->setLayout(wL);
00039
00040     // Adding buttons
00041     wL = new QGridLayout;
00042     for (int i = 0; i < XJoystick::ButtonCount; ++i) {
00043         _buts[i] = new QLabel(QString::number(i + 1));
00044         wL->addWidget(_buts[i], i/8, i%8);
00045         _buts[i]->setEnabled(false);
00046         _buts[i]->hide();
00047     }
00048     ui->joyButs->setLayout(wL);
00049     ui->joyAxis->hide();
00050     ui->joyButs->hide();
00051     ui->line->hide();
00052
00053
00054     // Creating data Path
00055     _dataP = QStandardPaths::writableLocation(QStandardPaths::AppDataLocation);
00056     QDir dir(_dataP);
00057     if (!dir.exists()) dir.mkpath(_dataP);
00058 }
```

3.4.2.2 MainWindow::~MainWindow ( )

Default destructor.

```
00061 {
00062     delete ui;
00063 }
```

3.4.3 Member Function Documentation

3.4.3.1 void MainWindow::joyChanged ( ) [private],[slot]

Handles a joystick update.

```
00066 {
00067     int sel = _joy.current();
00068
00069     QVector< XJoystick::Info > V(_joy.available());
00070     bool found = false;
00071     int i = 0;
00072     while (i < V.size() and not found) { found = V[i].ID == sel; ++i; }
00073     if (not found) {
00074         if (V.size() > 0) {
00075             _joy.select(V[0].ID);
00076             ui->line->hide();
00077
00078             // Showing axis
00079             ui->joyAxis->show();
00080
00081             // Showing buttons
00082             for (QLabel *l : _buts) l->hide();
00083             ui->joyButs->show();
00084             int n = _joy.buttonCount();
00085             for (int i = 0; i < n; ++i) _buts[i]->show();
00086         }
00087         else {
00088             _joy.select(-1);
00089             ui->joyAxis->hide();
00090             ui->joyButs->hide();
00091             ui->line->hide();
00092         }
00093     }
00094     emit joystickChanged();
00095 }
```

3.4.3.2 void MainWindow::joystickChanged ( ) [signal]

Emmitted when a joystick changes.

3.4.3.3 void MainWindow::on_actionOptions_triggered ( ) [private], [slot]

To select the options.

```
00099 {
00100     OptionsWindow o(_joy, &_sT, this);
00101     o.exec();
00102
00103     connect(this, SIGNAL(joystickChanged()), &o, SLOT(
      joystickChanged()));
00104
00105     if (o.result()) o.storeData();
00106 }
```

3.4.3.4 void MainWindow::on_start_clicked ( ) [private], [slot]

```
00121 {
00122     QString text = ui->start->text();
00123
00124     if (text == "Start") {
00125         _sT.wakeUp();
00126         ui->start->setText("Stop");
00127     }
00128     else if (text == "Stop") {
00129         _sT.pause();
00130         ui->start->setText("Start");
00131     }
00132 }
```

3.4.3.5 void MainWindow::update ( ) [private], [slot]

Updates all data to the servo thread.

```
00109 {
00110     _joy.update();
00111     for (int i = 0; i < XJoystick::AxisCount; ++i) _axisV[i] = _joy[i];
00112     for (int i = 0; i < XJoystick::ButtonCount; ++i) _butsV[i] = _joy.button(i);
00113
00114     _sT.setData(_axisV, _butsV);
00115     QVector<ServoThread::Servo> servo(_sT.getServosInfo());
00116
00117     // TODO: Finish update function
00118 }
```

3.4.4 Member Data Documentation

3.4.4.1 QVector< QLabel *> MainWindow::_axis [private]

Handles all the axis labels.

3.4.4.2 QVector< float > MainWindow::_axisV [private]

Contains the axis value;.

3.4.4.3 QVector< QLabel *> MainWindow::_buts [private]

Handles all the button labels.

3.4.4.4 QVector< bool > MainWindow::_butsV [private]

Handles all buttons values.

3.4.4.5 QString MainWindow::_dataP [private]

Contains the path to the data location.

3.4.4.6 int MainWindow::_jAxisX = -1 [private]

Axis for the X value.

3.4.4.7 int MainWindow::_jAxisY = -1 [private]

Axis for the Y value.

3.4.4.8 int MainWindow::_jAxisZ = -1 [private]

AXis for the Z value.

3.4.4.9 XJoystick MainWindow::_joy [private]

To handle the joystick.

3.4.4.10 ServoThread MainWindow::_sT [private]

Contains the thread controlling all the servos and external hardware.

3.4.4.11 QTimer MainWindow::_timer [private]

To update the joystick value.

3.4.4.12 const int MainWindow::aSCount = 0 [static], [private]

Contains the number of additional servos used.

3.4.4.13 const int MainWindow::sCount = 3 [static], [private]

Contains the number of minimun servos to work.

3.4.4.14 Ui::MainWindow* MainWindow::ui [private]

Contains the user interface.

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

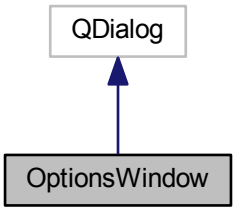
- mainwindow.h
- mainwindow.cpp

3.5 OptionsWindow Class Reference

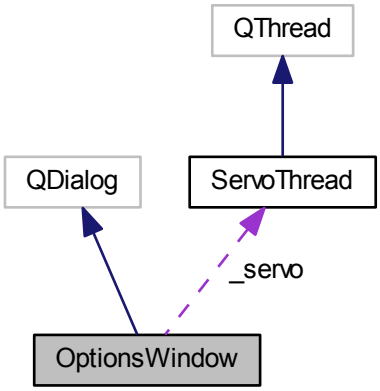
Class used to handle a Window to set the options.

`#include <optionswindow.h>`

Inheritance diagram for OptionsWindow:



Collaboration diagram for OptionsWindow:



Public Slots

- void joystickChanged ()

  To handle the change of a joystick.

Public Member Functions

- OptionsWindow (XJoystick &J, ServoThread ∗servo, QWidget ∗parent=0)

  Default constructor.
- ∼OptionsWindow ()

  Destructor.

- void storeData ()

  Stores all data.

Private Slots

- void events ()

  Handles events that need to be updated continously.
- void on_servoRefresh_clicked ()

  Refreshes all the servos connected to the port.

Private Attributes

- XJoystick & _joy

  Contains the Joystick to handle options.
- int _portSize

  Contains the size of the ports.
- ServoThread * _servo

  Pointer to the servo thread class.
- QTimer _timer

  Waits for a new COM port.
- Ui::OptionsWindow * ui

  Containsh the GUI.

3.5.1 Detailed Description

Class used to handle a Window to set the options.

3.5.2 Constructor & Destructor Documentation

3.5.2.1 OptionsWindow::OptionsWindow (XJoystick & *J*, ServoThread * *servo*, QWidget * *parent* = 0) [explicit]

Default constructor.

```
00005                                                                                :
00006     QDialog(parent),
00007     _joy(J),
00008     _portSize(-1),
00009     _servo(servo),
00010     _timer(this),
00011     ui(new Ui::OptionsWindow)
00012 {
00013     ui->setupUi(this);
00014     this->setWindowTitle("Options");
00015
00016     QVector< QString > A(_joy.getAllAxis());
00017
00018     ui->joyMX->addItem("None", -1);
00019     ui->joyMY->addItem("None", -1);
00020     ui->joyMZ->addItem("None", -1);
00021
00022     for (int i = 0; i < A.size(); ++i) ui->joyMX->addItem(A[i], i);
00023     for (int i = 0; i < A.size(); ++i) ui->joyMY->addItem(A[i], i);
00024     for (int i = 0; i < A.size(); ++i) ui->joyMZ->addItem(A[i], i);
00025
00026     joystickChanged();
00027
00028     _timer.setInterval(500);
00029     _timer.setSingleShot(false);
00030     _timer.start();
00031     connect(&_timer, SIGNAL(timeout()), this, SLOT(events()));
00032
00033 }
```

3.5.2.2 OptionsWindow::~OptionsWindow ( )

Destructor.

```
00036 {
00037     delete ui;
00038 }
```

3.5.3 Member Function Documentation

3.5.3.1 void OptionsWindow::events ( ) [private], [slot]

Handles events that need to be updated continously.

```
00069 {
00070     auto ports = QSerialPortInfo::availablePorts();
00071
00072     if (ports.size() != _portSize) {
00073         _portSize = ports.size();
00074
00075         QString portC(ui->portC->currentData().toString());
00076         QString portS(ui->portS->currentData().toString());
00077
00078         int selC = 0, selS = 0;
00079
00080         ui->portC->clear();
00081         ui->portS->clear();
00082
00083         ui->portC->addItem("None", "");
00084         ui->portS->addItem("None", "");
00085
00086         for (int i = 0; i < ports.size(); ++i) {
00087             QString text(ports[i].portName());
00088             text += ": " + ports[i].description();
00089             ui->portC->addItem(text, ports[i].portName());
00090             ui->portS->addItem(text, ports[i].portName());
00091
00092             if (ports[i].portName() == portC) selC = i + 1;
00093             if (ports[i].portName() == portS) selS = i + 1;
00094         }
00095
00096         ui->portC->setCurrentIndex(selC);
00097         ui->portS->setCurrentIndex(selS);
00098     }
00099 }
```

3.5.3.2 void OptionsWindow::joystickChanged ( ) [slot]

To handle the change of a joystick.

```
00049 {
00050     // Clear all the items and write the new items
00051     ui->joySel->clear();
00052     ui->joySel->addItem("None", -1);
00053
00054     // Adding items and searching the current
00055     int pos = 0;
00056     QVector<XJoystick::Info> V(_joy.available());
00057     for (int i = 0; i < V.size(); ++i) {
00058         QString text(V[i].name);
00059         text += ": " + QString::number(V[i].ID);
00060         if (V[i].ID == _joy.current()) pos = i;
00061         ui->joySel->addItem(text, V[i].ID);
00062     }
00063     ui->joySel->setCurrentIndex(pos);
00064
00065     ui->joyN->setText(QString::number(V.size()));
00066 }
```

3.5.3.3 void OptionsWindow::on_servoRefresh_clicked ( ) [private], [slot]

Refreshes all the servos connected to the port.

```
00102 {
00103     dynamixel dxl;
00104     QString port;
00105     int baud;
00106     _servo->getServoPortInfo(port, baud);
00107
00108     dxl.initialize(port, baud);
00109
00110 }
```

3.5.3.4 void OptionsWindow::storeData ( )

Stores all data.

```
00041 {
00042     // Storing joystick data
00043     _joy.select(ui->joySel->currentData().toInt());
00044
00045
00046 }
```

3.5.4 Member Data Documentation

3.5.4.1 XJoystick& OptionsWindow::_joy [private]

Contains the Joystick to handle options.

3.5.4.2 int OptionsWindow::_portSize [private]

Contains the size of the ports.

3.5.4.3 ServoThread* OptionsWindow::_servo [private]

Pointer to the servo thread class.

3.5.4.4 QTimer OptionsWindow::_timer [private]

Waits for a new COM port.

3.5.4.5 Ui::OptionsWindow* OptionsWindow::ui [private]

Containsh the GUI.

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

- optionswindow.h
- optionswindow.cpp

3.6 ServoThread::Servo Struct Reference

Struct for the AX12 servos.

`#include <servothread.h>`

Public Member Functions

- Servo (int ID=-1, double load=-1, double pos=-1)

  Default constructor.
- Servo (const Servo &s)

  Copy constructor.

Public Attributes

- int ID

  Contains the servo ID.
- double load

  Contains the servo load.
- double pos

  Contains the servo position.

3.6.1 Detailed Description

Struct for the AX12 servos.

3.6.2 Constructor & Destructor Documentation

3.6.2.1 ServoThread::Servo::Servo (int *ID* = −1, double *load* = −1, double *pos* = −1) [inline]

Default constructor.

```
00034             : ID(ID), load(load), pos(pos) {}
```

3.6.2.2 ServoThread::Servo::Servo (const Servo & *s*) [inline]

Copy constructor.

```
00037 : ID(s.ID), load(s.load), pos(s.pos) {}
```

3.6.3 Member Data Documentation

3.6.3.1 int ServoThread::Servo::ID

Contains the servo ID.

3.6.3.2 double ServoThread::Servo::load

Contains the servo load.

3.6.3.3 double ServoThread::Servo::pos

Contains the servo position.

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

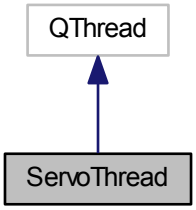
- servothread.h

3.7 ServoThread Class Reference

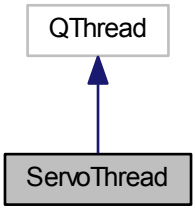
The ServoThread's class handles the comunication between the delta robot servos and the PC.

`#include <servothread.h>`

Inheritance diagram for ServoThread:



Collaboration diagram for ServoThread:



Classes

- struct Servo

  Struct for the AX12 servos.

Public Types

- enum Mode { controlled, manual }

  Contains the working mode.

Signals

- void statusBar (QString)

  Emmitted when the status bar must be changed.

Public Member Functions

- ServoThread ()
  Default constructor.
- ~ServoThread ()
  Default destructor.
- void end ()
  Ends the execution.
- void load (QString &file)
  Loads the data from the selected file.
- void pause ()
  Pauses the execution.
- int getServoBaud ()
  Returns the current servo Baud rate.
- QString getServoPort ()
  Returns the current servo Port.
- void getServoPortInfo (QString &port, int &baud)
  Returns both servo Port and baud Rate.
- void getServosInfo (QVector< Servo > &V)
  Returns the servos info, with all its load and current position.
- QVector< Servo > getServosInfo ()
  Overloaded function to get the servo info.
- QMutex * mutex ()
  Returns the mutex used in the thread.
- void setData (QVector< float > &aV, QVector< bool > &buts)
  Adds the loaded data.
- void setServoBaud (unsigned int baud)
  Sets the servos port baud rate.
- void setServoPort (QString &port)
  Sets the servos port.
- void setServoPortInfo (QString &port, unsigned int baud)
  Sets the servos port info, data and selected port.
- void setSID (QVector< int > &V)
  Sets the servos ID.
- void wakeUp ()
  Continues program's execution.
- void write (QString &file)
  Writes data to the selected directory.

Private Types

- enum Version { v_1_0 }
  Enum containing all the save file versions.

Private Member Functions

- void run ()
  Used to create another thread.
- void setAngles (double x0, double y0, double z0, double &theta1, double &theta2, double &theta3)
  Used to calculate the servos angles.
- double singleAngle (double x0, double y0, double z0)
  Calculates the angle of one servo in the selected position.

Private Attributes

- const double cos60 = 0.5

  Contains the cosinus of 60.
- const double sin60 = sqrt(3)/2

  Contains the sinus of 60.
- const double a = 17.233

  The arm length.
- const double b = 22.648

  The forearm length.
- const double L1 = 5.000

  The base center lenght.
- const double L2 = 6.000

  The platform center length.
- QVector< float > _axis

  Contains the axis value.
- QVector< bool > _buts

  Contains the buttons value.
- int _cBaud

  Contains the baud rate used to comunicate with the clamp.
- QWaitCondition _cond

  To start and pause the thread.
- QString _cPort

  Contains the selected com port used to comunitate with the clamp.
- bool _dChanged

  True if the data changes.
- bool _end

  True when we must end executino.
- Mode _mod

  Contains the working mode.
- QMutex _mutex

  To prevent memory errors.
- bool _pause

  Pauses the execution of the thread.
- int _sBaud

  Contains the used baud rate to comunicate with the servos.
- QVector< Servo > _servos

  Contains the servos information.
- QString _sPort

  Contains the selected com port used in the comunication with servos.
- bool _sPortChanged

  True if the servos port changes.

3.7.1 Detailed Description

The ServoThread's class handles the comunication between the delta robot servos and the PC.

3.7.2 Member Enumeration Documentation

3.7.2.1 enum ServoThread::Mode

Contains the working mode.

Enumerator

controlled

manual

```
00042     {
00043         controlled,
00044         manual
00045     };
```

3.7.2.2 enum ServoThread::Version [private]

Enum containing all the save file versions.

Enumerator

v_1_0

```
00019     {
00020         v_1_0
00021     };
```

3.7.3 Constructor & Destructor Documentation

3.7.3.1 ServoThread::ServoThread ( )

Default constructor.

```
00004                           :
00005     _axis(XJoystick::AxisCount),
00006     _buts(XJoystick::ButtonCount),
00007     _cBaud(9600),
00008     _cPort("COM3"),
00009     _dChanged(false),
00010     _end(false),
00011     _mod(Mode::manual),
00012     _pause(true),
00013     _sBaud(1000000),
00014     _servos(3),
00015     _sPort("COM9"),
00016     _sPortChanged(false)
00017 {
00018
00019 }
```

3.7.3.2 ServoThread::~ServoThread ( )

Default destructor.

```
00022 {
00023     _mutex.lock();
00024     _end = true;
00025     _cond.wakeOne();
00026     _mutex.unlock();
00027
00028     wait();
00029 }
```

3.7.4 Member Function Documentation

3.7.4.1 void ServoThread::end ( ) [inline]

Ends the execution.

```
00055     {
00056         _mutex.lock();
00057         _end = true;
00058         _cond.wakeOne();
00059         _mutex.unlock();
00060 
00061         wait();
00062     }
```

3.7.4.2 int ServoThread::getServoBaud ( ) [inline]

Returns the current servo Baud rate.

```
00077     {
00078         QMutexLocker mL(&_mutex);
00079         return _sBaud;
00080     }
```

3.7.4.3 QString ServoThread::getServoPort ( ) [inline]

Returns the current servo Port.

```
00084     {
00085         QMutexLocker mL(&_mutex);
00086         return _sPort;
00087     }
```

3.7.4.4 void ServoThread::getServoPortInfo (QString & *port*, int & *baud*) [inline]

Returns both servo Port and baud Rate.

```
00091     {
00092         _mutex.lock();
00093         baud = _sBaud;
00094         port = _sPort;
00095         _mutex.unlock();
00096     }
```

3.7.4.5 void ServoThread::getServosInfo (QVector< Servo > & *V*) [inline]

Returns the servos info, with all its load and current position.

Parameters

V	Servo vector to store information

```
00102     {
00103         _mutex.lock();
00104         V = _servos;
00105         _mutex.unlock();
00106     }
```

3.7.4.6 QVector<Servo> ServoThread::getServosInfo ( ) [inline]

Overloaded function to get the servo info.

```
00110     {
00111         QMutexLocker mL(&_mutex);
00112         return _servos;
00113     }
```

3.7.4.7 void ServoThread::load (QString & *file*)

Loads the data from the selected file.

```
00032 {
00033     _mutex.lock();
00034     QFile f(file);
00035     f.open(QIODevice::ReadOnly);
00036     QDataStream df(&f);
00037
00038     int ver;
00039     df >> ver;
00040     if (ver == Version::v_1_0) {
00041         int n;
00042         df >> _cBaud >> _cPort >> _sBaud >> _sPort >> n;
00043
00044         _servos.resize(n);
00045         for (Servo &s : _servos) df >> s.ID;
00046         _dChanged = true;
00047     }
00048     else qWarning() << "Not a valid file";
00049     _mutex.unlock();
00050 }
```

3.7.4.8 QMutex* ServoThread::mutex ( ) [inline]

Returns the mutex used in the thread.

```
00116 { return &_mutex; }
```

3.7.4.9 void ServoThread::pause ( ) [inline]

Pauses the execution.

```
00069     {
00070         _mutex.lock();
00071         _pause = true;
00072         _mutex.unlock();
00073     }
```

3.7.4.10 void ServoThread::run ( ) [private]

Used to create another thread.

```
00078 {
00079     _mutex.lock();
00080     int sBaud = _sBaud;
00081     QString sPort = _sPort;
00082
00083     _mutex.unlock();
00084     dynamixel dxl(sPort, sBaud);
00085     QVector< AX12 > (_servos.size(), &dxl);
00086
00087     while (not _end) {
00088
```

```
00089         msleep(10);
00090         _mutex.lock();
00091         if (not _end and _pause) {
00092             dxl.terminate();
00093             _cond.wait(&_mutex);
00094             emit statusBar("Changed");
00095             dxl.initialize(sPort, sBaud);
00096         }
00097         if (_dChanged) {
00098             if (sPort != _sPort) {
00099                 sPort = _sPort;
00100                 sBaud = _sBaud;
00101                 dxl.terminate();
00102                 dxl.initialize(sPort, sBaud);
00103             }
00104         }
00105         _dChanged = false;
00106         _mutex.unlock();
00107     }
00108
00109     dxl.terminate();
00110     exit(0);
00111 }
```

3.7.4.11 void ServoThread::setAngles (double *x0*, double *y0*, double *z0*, double & *theta1*, double & *theta2*, double & *theta3*) [private]

Used to calculate the servos angles.

```
00115 {
00116     double x1 = x0 + L2 - L1;
00117     double y1 = y0;
00118     double z1 = z0;
00119     theta1 = singleAngle(x1,y1,z1);
00120
00121     double x2 = z0*sin60 - x0*cos60 + L2 - L1;
00122     double y2 = y0;
00123     double z2 = -z0*cos60 - x0*sin60;
00124     theta2 = singleAngle(x2,y2,z2);
00125
00126     double x3 = -z0*sin60 - x0*cos60 + L2 - L1;
00127     double y3 = y0;
00128     double z3 = -z0*cos60 + x0*sin60;
00129     theta3 = singleAngle(x3,y3,z3);
00130 }
```

3.7.4.12 void ServoThread::setData (QVector< float > & *aV*, QVector< bool > & *buts*)

Adds the loaded data.

Parameters

aV	Contains the axis values
buts	Contains the buttons values

```
00053 {
00054     _mutex.lock();
00055     // Copying the joystick values
00056     _axis = aV;
00057     _buts = buts;
00058     _dChanged = true;
00059
00060     _mutex.unlock();
00061 }
```

3.7.4.13 void ServoThread::setServoBaud (unsigned int *baud*) [inline]

Sets the servos port baud rate.

Parameters

baud	Positive number containing the baud rate

```
00126     {
00127         _mutex.lock();
00128         _sBaud = baud;
00129         _mutex.unlock();
00130     }
```

3.7.4.14 void ServoThread::setServoPort (QString & *port*) [inline]

Sets the servos port.

Parameters

port	String containing the port name

```
00135     {
00136         _mutex.lock();
00137         _sPort = port;
00138         _mutex.unlock();
00139     }
```

3.7.4.15 void ServoThread::setServoPortInfo (QString & *port*, unsigned int *baud*) [inline]

Sets the servos port info, data and selected port.

Parameters

port	String containing the selected port
baud	Contains the selected baud rate

```
00145     {
00146         _mutex.lock();
00147         _sPort = port;
00148         _sBaud = baud;
00149         _mutex.unlock();
00150     }
```

3.7.4.16 void ServoThread::setSID (QVector< int > & *V*) [inline]

Sets the servos ID.

Parameters

V	Vector containing all the servos ID

```
00155     {
00156         _mutex.lock();
00157         if (V.size() != _servos.size()) _servos.resize(V.size());
00158
00159         for (int i = 0; i < V.size(); ++i) _servos[i].ID = V[i];
00160         _dChanged = true;
00161         _mutex.unlock();
00162     }
```

3.7.4.17 double ServoThread::singleAngle (double *x0*, double *y0*, double *z0*) [private]

Calculates the angle of one servo in the selected position.

```
00133 {
00134     double n = b * b - a * a - z0 * z0 - x0 * x0 - y0 * y0;
00135     double raiz = sqrt (n*n*y0*y0 - 4*(x0*x0 + y0*y0)*(-x0*x0*a*a + n*n/4));
00136
00137     if (x0 < 0) raiz *= -1;
00138     double y = (-n*y0 + raiz ) / (2*(x0*x0 + y0*y0));
00139
00140     int signe = 1;
00141     if ((b*b - (y0 + a)*(y0 + a)) < (x0*x0 + z0*z0) && x0 < 0) signe *= -1;
00142     double x = sqrt(a*a - y*y)*signe;
00143     return atan2 (y,x);
00144 }
```

3.7.4.18 void ServoThread::statusBar (QString) [signal]

Emmitted when the status bar must be changed.

3.7.4.19 void ServoThread::wakeUp ( ) [inline]

Continues program's execution.

```
00166     {
00167         _mutex.lock();
00168         _pause = false;
00169         _cond.wakeOne();
00170         _mutex.unlock();
00171     }
```

3.7.4.20 void ServoThread::write (QString & *file*)

Writes data to the selected directory.

Parameters

file	Path to the file

```
00064 {
00065     _mutex.lock();
00066     QFile f(file);
00067     f.open(QIODevice::WriteOnly);
00068     QDataStream df(&f);
00069
00070     df << int(Version::v_1_0) << _cBaud << _cPort << _sBaud <<
      _sPort
00071        << _servos.size();
00072     for (const Servo &s : _servos) df << s.ID;
00073
00074     _mutex.unlock();
00075 }
```

3.7.5 Member Data Documentation

3.7.5.1 QVector< float > ServoThread::_axis [private]

Contains the axis value.

3.7.5.2 QVector< bool > ServoThread::_buts [private]

Contains the buttons value.

3.7.5.3 int ServoThread::_cBaud [private]

Contains the baud rate used to comunicate with the clamp.

3.7.5.4 QWaitCondition ServoThread::_cond [private]

To start and pause the thread.

3.7.5.5 QString ServoThread::_cPort [private]

Contains the selected com port used to comunitate with the clamp.

3.7.5.6 bool ServoThread::_dChanged [private]

True if the data changes.

3.7.5.7 bool ServoThread::_end [private]

True when we must end executino.

3.7.5.8 Mode ServoThread::_mod [private]

Contains the working mode.

3.7.5.9 QMutex ServoThread::_mutex [private]

To prevent memory errors.

3.7.5.10 bool ServoThread::_pause [private]

Pauses the execution of the thread.

3.7.5.11 int ServoThread::_sBaud [private]

Contains the used baud rate to comunicate with the servos.

3.7.5.12 QVector< Servo > ServoThread::_servos [private]

Contains the servos information.

3.7.5.13 QString ServoThread::_sPort [private]

Contains the selected com port used in the comunication with servos.

3.7.5.14 bool ServoThread::_sPortChanged [private]

True if the servos port changes.

3.7.5.15 const double ServoThread::a = 17.233 [private]

The arm length.

3.7.5.16 const double ServoThread::b = 22.648 [private]

The forearm length.

3.7.5.17 const double ServoThread::cos60 = 0.5 [private]

Contains the cosinus of 60.

3.7.5.18 const double ServoThread::L1 = 5.000 [private]

The base center lenght.

3.7.5.19 const double ServoThread::L2 = 6.000 [private]

The platform center length.

3.7.5.20 const double ServoThread::sin60 = sqrt(3)/2 [private]

Contains the sinus of 60.

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

- servothread.h
- servothread.cpp

Chapter 4

File Documentation

4.1 dxl/ax12.cpp File Reference

Contains the AX12 class implementation.

4.1.1 Detailed Description

Contains the AX12 class implementation.

4.2 dxl/ax12.h File Reference

Contains the AX12 class declaration.

Classes

- class AX12

  The AX12 class is used to control AX-12 motors from Dynamixel.

4.2.1 Detailed Description

Contains the AX12 class declaration.

4.3 dxl/dxl_hal.cpp File Reference

Contains the Dynamixel SDK platform dependent header source.

4.3.1 Detailed Description

Contains the Dynamixel SDK platform dependent header source.

4.4 dxl/dxl_hal.h File Reference

Contains the Dynamixel SDK platform dependent header declaration.

Classes

- class dxl_hal

  Dynamixel SDK platform dependent.

4.4.1 Detailed Description

Contains the Dynamixel SDK platform dependent header declaration.

4.5 dxl/dynamixel.cpp File Reference

Contains the dynamixel and dynamixel2 classes implementation.

4.5.1 Detailed Description

Contains the dynamixel and dynamixel2 classes implementation.

4.6 dxl/dynamixel.h File Reference

Contains the dynamixel and dynamixel2 classes declaration.

Classes

- class dynamixel

  Dynamixel 1.0 protocol class.

4.6.1 Detailed Description

Contains the dynamixel and dynamixel2 classes declaration.

4.7 main.cpp File Reference

Contains the Main of the program.

Functions

- int main (int argc, char ∗argv[ ])

4.7.1 Detailed Description

Contains the Main of the program.

4.7.2 Function Documentation

4.7.2.1 int main (int *argc*, char * *argv[]*)

```
00009 {
00010     QApplication a(argc, argv);
00011     MainWindow w;
00012     w.show();
00013     return a.exec();
00014 }
```

4.8 mainwindow.cpp File Reference

Contains the MainWindow class implementation.

4.8.1 Detailed Description

Contains the MainWindow class implementation.

4.9 mainwindow.h File Reference

Contains the MainWindow class declaration.

Classes

- class MainWindow

  Contains all the windows and other classes.

Namespaces

- Ui

  Namespace to work with a User Interface Qt Form.

4.9.1 Detailed Description

Contains the MainWindow class declaration.

4.10 optionswindow.cpp File Reference

Contains the OptionsWindow class implementation.

4.10.1 Detailed Description

Contains the OptionsWindow class implementation.

4.11 optionswindow.h File Reference

Contains the OptionsWindow class declaration.

Classes

- class OptionsWindow

  Class used to handle a Window to set the options.

Namespaces

- Ui

  Namespace to work with a User Interface Qt Form.

4.11.1 Detailed Description

Contains the OptionsWindow class declaration.

4.12 servothread.cpp File Reference

4.13 servothread.h File Reference

Contains the ServoThread class implementation.

Classes

- class ServoThread

  The ServoThread's class handles the comunication between the delta robot servos and the PC.
- struct ServoThread::Servo

  Struct for the AX12 servos.

4.13.1 Detailed Description

Contains the ServoThread class implementation.

Contains the ServoThread class declaration.

4.14 stable.h File Reference

Contains all includes in a precompiled header.

4.14.1 Detailed Description

Contains all includes in a precompiled header.

The includes are:

- QApplication
- QDebug
- QDir
- QDialog

- QLabel
- QMainWindow
- QMutex
- QSerialPortInfo
- QStandardPaths
- QStatusBar
- QString
- QThread
- QTime
- QTimer
- QVector
- QWaitCondition
- XJoystick

Index