

RIG InMoov Project

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Chapter 1

Introduction

This is the official documentation for the Conestoga Robotics Innovation Group's InMoov project. It is not meant to be read linearly or all at once. Rather, readers should skim relevant pages and skip information that requires more context. More in depth information is provided for those that wish to modify the source code. Examples are provided when possible for quick reference and experimentation. Note that colored phrases are links for both html and pdf. This project has a git repository located [here](#).

1.1 Dependencies

The project currently depends on [Python](#) for an example script, [Arduino](#), [Doxygen](#) (if you wish to remake the documentation) and [Make](#) (if you wish to build the project).

1.2 Quick Start

To quickly demo the right hand, do the following. Copy the file [arduino/settings/rhand.h](#) to [arduino/src/servo/settings](#).
[h](#). Copy the **servo** folder to your Arduino sketch folder. Open the Arduino software. Select your board and the port it is connected to. Open your sketch, and hit upload. Instructions for the Arduino software are located [on its website](#).

To transmit commands to the board, run this from the command line.

```
1 python -i example/rhand.py
```

You can now run commands defined in that python script.

The python script needs the pyserial library. Its website is located [here](#).

Call this to connect to the board (replace COM0 with the name of the port you set in Arduino).

```
1 connect ('COM0')
```

To demo some movements, run this.

```
1 demo()
```

Read the [rhand](#) documentation for more. Read the [Examples](#) section to understand how it formulates commands.

1.3 Installation

You can build this documentation with the command

```
1 make documentation
```

from the root directory.

To upload the right hand code to the connected Arduino, run

```
1 make rhand
```

Be sure to customize the **PORT** and **BOARD** variables in the **Makefile**.

The build system is in its infancy, so please feel free to modify it as needed and add support for other build systems.

1.4 Arduino Protocol

The Arduinos controlling the various parts of the bot communicate over their serial ports. All information is sent and recieved using 8 bit unsigned raw integers instead of text. This allows extremely fast and simple code, but limits programs to 255 signals, identifiers, and values.

However, the Arduino boards only have one function; to pass commands to their servos.

Servo Position

Unless otherwise instructed, the Arduino accepts two values at a time. First, it accepts a servo number, and a value to write to the pin associated with that servo number.

Servo numbers start at 0 and should be uniquely identified on every board, allowing a maximum of 255 servos on each bot, not including signals. They should be assigned different values because if commands are routed through a central board, it allows the protocol to remain the same. If an invalid servo number is passed to any given board, the board will still read another value from the serial port to avoid syncing issues, but it will do nothing to its servos.

Servo Values

The value passed to the servo can be from 0-180. If it exceeds 180 and is not a valid signal, the board will change the angle to 180. On positional rotation servos, this number represents the servo's target angle. On continuous rotation servos, 90 represents stillness, 180 represents full speed in one direction, and 0 represents full speed in the other.

Each board has callibrations for each servo that scale the angles from 0-180 to some minimum angle and some maximum angle. The host program has no need to know these values. When the board reports current values, they are non-scaled.

To ensure that the board is reading the correct information (servo number or servo position), there is a cancel signal.

Signals

The boards accept some pre-defined signals that break the default flow. It can recieve these signals at any time and will terminate its current servo command. In addition, the board may print some signals to output. Both kinds of signals, incoming and outgoing, are assigned starting from 255 and going down. In the arduino code, incoming signals are denoted by ***_SIGNAL**, and the outgoing signals are denoted by ***_RESPONSE**. We will use this convention.

CANCEL_SIGNAL

This signal exists to cancel all pending input and synchronize the host and master. If a host connects to an Arduino and does not know its current state, it can send this signal and know that the board is waiting on a servo number.

WAIT_RESPONSE

This signal indicates that the board has no bytes left to read and is ready for input. A host does not need to wait for this signal, but it may want to if it is experiencing difficulties or the board may have crashed.

DUMP_SIGNAL

This signal makes the board return various information about itself and its servos. As of writing, it returns **DUMP_START_RESPONSE**, an ID, its number of servos, the values last sent to its servos, and **DUMP_END_RESPONSE**. Board IDs start from 181 and go up. It is recommended that if we build more modular bots such as this one in the future using the same protocol, they receive unique board identifiers. The response is likely to change in the near future as we add sensors and other types of devices.

1.4.1 Examples

```
1 CANCEL_SIGNAL 0 180 1 135 2 90
```

This would send the servo with ID 0 a value of 180, servo 1 135, and servo 2 90. The board would then respond with **WAIT_RESPONSE**.

```
1 CANCEL_SIGNAL 0 180 1 135 22 CANCEL_SIGNAL 4 45
```

This would send the servo with ID 0 a value of 180, servo 1 135, begin to read a command for servo 22 but cancel, then send 45 to servo 4.

```
1 CANCEL_SIGNAL 0 0 1 45 2 90 3 135 4 180 DUMP_SIGNAL
```

On a board with ID **BOARD_ID** and 5 servos identified as 0-4, this would return the response

```
1 DUMP_START_RESPONSE BOARD_ID 4 0 45 90 135 180 DUMP_END_RESPONSE WAIT_RESPONSE
```

```
1 CANCEL_SIGNAL 0 0 0 45 0 90 0 135 0 180
```

If this stream of bytes were sent instantly, it would essentially move servo 0 directly to 180 degrees (if it was a positional servo) because of the speed of the commands. However, if we inserted a slight delay, we could slowly move the servo from its starting position to its ending position.

```
1 CANCEL_SIGNAL 0 0 1 0 0 45 1 45 0 90 1 90 0 135 1 135 0 180 1 180
```

This would move servo 0 and servo 1 from their start to end positions. If we were to send these bytes immediately, they would essentially both move instantaneously to 180 degrees (if they were positional servos). However, if we were to insert a delay, they would both appear to move together slowly to their end location despite the delay between commands. Putting this functionality on the Arduino boards themselves would cause the boards to lock and use up resources, but formulating commands like this allows computation to occur on other systems.

1.4.2 Values

Board IDs

181	Right hand
-----	------------

Servo IDs

0	Right hand wrist
1	Right hand thumb
2	Right hand index finger
3	Right hand middle finger
4	Right hand ring finger
5	Right hand pinky finger

Signals

CANCEL_SIGNAL	255
WAIT_RESPONSE	254
DUMP_SIGNAL	253
DUMP_START_RESPONSE	252
DUMP_END_RESPONSE	251

See also

[servo.ino rhand](#)

Chapter 2

Namespace Documentation

2.1 rhand Namespace Reference

Documentation for the [rhand.py](#) script.

Functions

- def [connect](#) (port)
Sets the global [ser](#) variable.
- def [sweep](#) (initial, servos, starts, ends, steps)
Produces complex command chains.
- def [unsweep](#) (servos, ends, steps)
Produces a command chain that resets all servos to 0.
- def [servowrite](#) (commands, delay)
Writes commands to the serial port.
- def [gesture](#) (initial, servos, starts, ends, steps, delay)
Sets the servos to a position, waits for input, then resets them to 0.
- def [reset](#) ()
Immediately sets the servos to 0.
- def [cmd](#) ()
Sends the input to the serial port until a blank line is given.
- def [dump](#)
Retrieves information about the board.
- def [peace](#)
Makes a peace sign.
- def [ok](#)
Makes an ok sign.
- def [grab](#)
Makes a fist.
- def [rockon](#)
Makes a rock on sign.
- def [wiggle](#)
Wiggles the fingers.
- def [count](#) ()
Counts to 5 on the fingers.
- def [demo](#) ()
Performs all movements.

Variables

- int `CANCEL_SIGNAL` = 255
The signal to send to terminate any pending input.
- int `DUMP_SIGNAL` = 253
The signal to send to retrieve information about the board.
- int `DUMP_START_RESPONSE` = 252
The signal recieved indicating the beginning of information about the board.
- int `DUMP_END_RESPONSE` = 251
The signal recieved indicating the end of information about the board.
- int `RHAND_ID` = 181
The identification byte of the right hand board.
- tuple `ser` = `serial.Serial()`
The serial connection for input and output.

2.1.1 Detailed Description

Documentation for the `rhand.py` script.

An example script for controlling the right hand. This script requires python with a library called pyserial. After install python 3.4, pyserial can be installed by calling

```
1 pip install pyserial
```

This may vary from system to system. See the [python](#) and [pyserial](#) websites for help.

To run the script, execute

```
1 python -i rhand.py
```

or in python

```
1 import rhand
```

This will allow you to call the functions from a command interpreter. It is recommended you experiment with all functions and view the source to understand how you might produce commands. Also try `demo()` while connected.

The movements included are quickly written and for demo purposes only.

See also

[servo.ino](#)

2.1.2 Function Documentation

2.1.2.1 `def rhand.cmd ()`

Sends the input to the serial port until a blank line is given.

Must enter integers between 0-255.

Definition at line 194 of file `rhand.py`.

2.1.2.2 `def rhand.connect (port)`

Sets the global `ser` variable.

Definition at line 63 of file `rhand.py`.

2.1.2.3 `def rhand.count ()`

Counts to 5 on the fingers.

See also

[sweep\(\)](#)

Definition at line 284 of file `rhand.py`.

2.1.2.4 `def rhand.demo ()`

Performs all movements.

Definition at line 292 of file `rhand.py`.

2.1.2.5 `def rhand.dump (servos = 6)`

Retrieves information about the board.

The command sends the [DUMP_SIGNAL](#) to the serial port and reads back the response. The response is described in [servo.ino](#).

When you write your own similar function, timing is important.

We may need to increase the response delay on the Arduino if you are unable to receive a response. View the source of this function to understand how it works, but keep in mind it is untested. Also keep in mind that the function is very non-general as it always reads 10 bytes instead of looking for the end signal.

Note

While this function could be used to change dynamically between gestures instead of resetting the servos to 0, this function did not exist when this script was first written.

Definition at line 204 of file `rhand.py`.

2.1.2.6 `def rhand.gesture (initial, servos, starts, ends, steps, delay)`

Sets the servos to a position, waits for input, then resets them to 0.

See also

[sweep\(\)](#) [servowrite\(\)](#)

Definition at line 177 of file `rhand.py`.

2.1.2.7 `def rhand.grab (delay = 0.02)`

Makes a fist.

See also

[gesture\(\)](#)

Definition at line 258 of file `rhand.py`.

2.1.2.8 `def rhand.ok (delay = 0.01)`

Makes an ok sign.

See also

[gesture\(\)](#)

Definition at line 254 of file rhand.py.

2.1.2.9 `def rhand.peace (delay = 0)`

Makes a peace sign.

See also

[gesture\(\)](#)

Definition at line 250 of file rhand.py.

2.1.2.10 `def rhand.reset ()`

Immediately sets the servos to 0.

Definition at line 190 of file rhand.py.

2.1.2.11 `def rhand.rockon (delay = 0.01)`

Makes a rock on sign.

See also

[gesture\(\)](#)

Definition at line 262 of file rhand.py.

2.1.2.12 `def rhand.servowrite (commands, delay)`

Writes commands to the serial port.

If **delay** is 0, immediately writes a list of ints to [ser](#) as bytes. Otherwise, writes a list of ints to [ser](#) as bytes one at a time.

Inserting a delay controls the speed of the movements.

See also

[connect\(\)](#)

Definition at line 160 of file rhand.py.

2.1.2.13 `def rhand.sweep (initial, servos, starts, ends, steps)`

Produces complex command chains.

The output returned from the function is formatted in such a way that the commands can be transmitted to the serial port at variable speeds.

The parameters must all be lists of the same length whose indexes correspond with **servos**.

Parameters

<i>initial</i>	An array of initial commands to append to.
<i>servos</i>	The servos to control.
<i>starts</i>	The current positions of the servos.
<i>ends</i>	The desired end positions.
<i>steps</i>	The values to use to decrement/increment. Converted to absolute value.

Returns

Upon success, returns the generated list of commands. The commands are surrounded by the [CANCEL_↔SIGNAL](#) for syncing. The servos will always reach their exact final destination, unless if **steps** at the index of the servo is 0. Upon error, raises '**Invalid sweep command**'. This indicates non-matching list lengths.

Example

```
1 sweep ([], [1,2], [180,0], [90,180], [90,45])
```

Returns

```
1 [CANCEL_SIGNAL, 1, 180, 2, 0, 1, 90, 2, 45, 2, 90, 2, 135, 2, 180, CANCEL_SIGNAL]
```

The protocol this follows is described in [servo.ino](#). By intertwining commands in this way, a delay can be inserted between bytes and fluid motion is still preserved.

Definition at line 68 of file rhand.py.

2.1.2.14 def rhand.unsweep(*servos*, *ends*, *steps*)

Produces a command chain that resets all servos to 0.

See also

[sweep\(\)](#)

Definition at line 152 of file rhand.py.

2.1.2.15 def rhand.wiggle (*n* = 90, *delay* = 0.01, *wiggles* = 1)

Wiggles the fingers.

See also

[sweep\(\)](#)

Definition at line 266 of file rhand.py.

2.1.3 Variable Documentation

2.1.3.1 rhand.DUMP_SIGNAL = 253

The signal to send to retrieve information about the board.

See also

[servo.ino](#)

Definition at line 55 of file rhand.py.

2.1.3.2 `rhand.ser = serial.Serial()`

The serial connection for input and output.

Must be initialized.

See also

[connect\(\)](#)

Definition at line 61 of file `rhand.py`.

Chapter 3

File Documentation

3.1 arduino/settings/rhand.h File Reference

Macros

- `#define SERVOS 6`
- `#define BUFSIZE 16`

Enumerations

- `enum { VERBOSE = 0, BOARD_ID = 181 }`

Functions

- `int getServoFromID (uint8_t servo_id)`

Variables

- `uint8_t limit [SERVOS][2]`
- `uint8_t default_pos [SERVOS] = { 0, 0, 0, 0, 0, 0 }`
- `uint8_t reverse [SERVOS] = { 0, 0, 0, 0, 0, 1 }`
- `uint8_t pin_offset = 2`

3.1.1 Detailed Description

This is an example `settings.h` for `servo.ino`.

Every Arduino board on the bot is to be a simple servo controller that accepts commands from serial input, and so they are all to share the code located in `servo.ino`. Each board needs its own header like this one to define custom information about the board and each servo on the board. This is such a settings file and will be documented as an example.

3.1.2 Macro Definition Documentation

3.1.2.1 `#define BUFSIZE 16`

Size of the print buffer (must be large enough to hold `DUMP_RESPONSE_LEN`).

Definition at line 18 of file `rhand.h`.

3.1.2.2 #define SERVOS 6

Number of servos to assign.

Definition at line 14 of file rhand.h.

3.1.3 Enumeration Type Documentation

3.1.3.1 anonymous enum

Enumerator

VERBOSE Whether to print debug output to the serial port.

BOARD_ID The unique identification for this board.

Definition at line 45 of file rhand.h.

3.1.4 Function Documentation

3.1.4.1 int getServoFromID (uint8_t servo_id)

This function gets array index of a servo using its ID. If the servo does not belong to this board, it returns -1. It is recommended that boards with complex ID assignments use a switch statement or a similar solution to save resources.

See also

[Values](#)

Definition at line 59 of file rhand.h.

3.1.5 Variable Documentation

3.1.5.1 uint8_t default_pos[SERVOS] = { 0, 0, 0, 0, 0, 0 }

The default position to set each servo to. Its index corresponds with [servo](#).

Definition at line 33 of file rhand.h.

3.1.5.2 uint8_t limit[SERVOS][2]

Initial value:

```
= {
    { 15, 114 }, { 10, 123 }, { 17, 100 },
    { 25, 122 }, { 22, 112 }, { 82, 160 },
}
```

This is the calibration for each servo- its minimum then maximum angle (for positional servos) or its minimum then maximum speed (for continuous rotation servos). Its index corresponds with [servo](#).

Definition at line 25 of file rhand.h.

3.1.5.3 uint8_t pin_offset = 2

Pin value to begin assigning pins at. It may be necessary to eventually implement a similar pin retrieval system to [getServoFromID\(\)](#).

Definition at line 43 of file rhand.h.

3.1.5.4 uint8_t reverse[SERVOS] = { 0, 0, 0, 0, 0, 1 }

Indicates whether to reverse the angles for each servo, for servos that turn the wrong way. Its index corresponds with [servo](#).

Definition at line 38 of file rhand.h.

3.2 arduino/src/servo/servo.ino File Reference

```
#include <Servo.h>
#include <stdio.h>
#include <stdint.h>
#include "settings.h"
```

Enumerations

- enum {
MIN_LIM = 0, **MAX_LIM** = 1, **CANCEL_SIGNAL** = 255, **WAIT_RESPONSE** = 254,
DUMP_SIGNAL = 253, **DUMP_START_RESPONSE** = 252, **DUMP_END_RESPONSE** = 251, **DUMP_RESPONSE_LEN** = SERVOS + 4 }
The print buffer.

Functions

- void [setup](#) ()
- void [loop](#) ()
- void [serialPrint](#) (const char *s)
- void [serialPrintInt](#) (uint8_t i)
- void [serialPrintIntPretty](#) (const char *pre, uint8_t i, const char *post)
- int [serialGetByte](#) ()
- void [setAdjustedAngles](#) (uint8_t servo_num)
- uint8_t [getAdjustedAngle](#) (uint8_t servo_num, uint8_t servo_angle)
- void [setServoFromNum](#) (uint8_t servo_num, uint8_t servo_angle)
- void [setServoFromID](#) (int servo_id, uint8_t servo_angle)
- void [dump](#) ()
- void [serialWait](#) ()

Variables

- Servo [servo](#) [[SERVOS](#)]
- uint8_t [adjusted_angles](#) [[SERVOS](#)][181]
- uint8_t [current_pos](#) [[SERVOS](#)] = { 0 }
- char **buf** [[BUFSIZE](#)]

3.2.1 Detailed Description

This is the common code for all Arduino servo boards.

The program is written to be a simple module that can pass values to servos. Each board needs its own settings file. Because of limitations of the Arduino command line interface, these are included as [settings.h](#). The Makefile manages which configuration is currently located in the same directory as this file and named [settings.h](#). A better build system in the future could use the tools **avrduide** or **ino**.

See [rhand.h](#) for an example of a settings header, and [Arduino Protocol](#) for information servo IDs and other relevant values.

3.2.2 Enumeration Type Documentation

3.2.2.1 anonymous enum

The print buffer.

Enumerator

MAX_LIM Index for the [limit](#) variables.

CANCEL_SIGNAL Index for the [limit](#) variables.

WAIT_RESPONSE Incoming signal commanding termination of the current loop.

DUMP_SIGNAL Outgoing signal indicating that we are waiting for input.

DUMP_START_RESPONSE Incoming signal indicating that we are to print information to serial.

DUMP_END_RESPONSE Beginning of our serial response to the dump signal.

DUMP_RESPONSE_LEN End of our serial response to the dump signal.

Definition at line 46 of file servo.ino.

3.2.3 Function Documentation

3.2.3.1 void dump ()

Writes various information about the board to the serial port. Triggered on reception of [DUMP_RESPONSE_LEN](#). Transmits the ID of the board, the number of servos, and the current position of the servos.

See also

[Arduino Protocol](#), [DUMP_START_RESPONSE](#), [DUMP_END_RESPONSE](#), [current_pos](#)

Definition at line 292 of file servo.ino.

3.2.3.2 uint8_t getAdjustedAngle (uint8_t servo_num, uint8_t servo_angle)

Retrieves modified angles for a servo.

Returns

The adjusted angle.

Parameters

<i>servo_num</i>	The servo number to use.
<i>servo_angle</i>	The angle to retrieve.

See also

[setAdjustedAngles\(\)](#), [adjusted_angles](#)

Definition at line 220 of file servo.ino.

3.2.3.3 void loop ()

The **loop** function is called continually until the program exits. It performs actions based on [Arduino Protocol](#). Receives two unsigned 8-bit integers, a servo id and a servo angle, then calls [setServoFromID\(\)](#). If the [DUMP_SIGNAL](#) is received at any time, calls [dump\(\)](#) and continues. If the [CANCEL_SIGNAL](#) is received, it does nothing and continues. If, at the beginning of the function, there is no pending input, it transmits [WAIT_RESPONSE](#), then does nothing until input is available.

Definition at line 94 of file servo.ino.

3.2.3.4 int serialGetByte ()

Retrieves a byte from the serial port.

Returns

If a normal value is received, returns that value as an integer. If [CANCEL_SIGNAL](#) is received, returns -1.

Definition at line 176 of file servo.ino.

3.2.3.5 void serialPrint (const char * s)

Prints a string to the serial port if [VERBOSE](#) is enabled.

Definition at line 136 of file servo.ino.

3.2.3.6 void serialPrintInt (uint8_t i)

Prints an integer to the serial port as a string if [VERBOSE](#) is enabled.

Definition at line 147 of file servo.ino.

3.2.3.7 void serialPrintIntPretty (const char * pre, uint8_t i, const char * post)

Prints an integer as a string surrounded by two strings to the serial port if [VERBOSE](#) is enabled.

Definition at line 161 of file servo.ino.

3.2.3.8 void serialWait ()

Waits for serial input to become available then returns.

Definition at line 317 of file servo.ino.

3.2.3.9 void setAdjustedAngles (uint8_t servo_num)

Calculates modified angles for a servo. The function scales angles from 0-180 to some minimum and maximum calibration, then stores them for later retrieval.

Parameters

<i>servo_num</i>	The servo to calculate angles for.
------------------	------------------------------------

See also

[getAdjustedAngle\(\)](#), [adjusted_angles](#)

Definition at line 197 of file servo.ino.

3.2.3.10 void setServoFromID (int *servo_id*, uint8_t *servo_angle*)

Writes an angle to a pin associated with a servo ID.

See also

[setServoFromNum\(\)](#), [getServoFromID\(\)](#)

Definition at line 272 of file servo.ino.

3.2.3.11 void setServoFromNum (uint8_t *servo_num*, uint8_t *servo_angle*)

Writes an angle to a pin associated with a servo number. Servos are controlled by sending varying pulse widths over their signal wire. The adjusted angle will be sent to the servo. Updates [current_pos](#) with the non-adjusted angle. If the servo number is invalid, the function does nothing and exits, but if the angle is out of range, it is changed to a valid value.

Parameters

<i>servo_num</i>	The servo to write to.
<i>servo_angle</i>	The angle to write after adjusting. It may be reversed.

See also

[getAdjustedAngle\(\)](#), [reverse](#)

Definition at line 237 of file servo.ino.

3.2.3.12 void setup ()

The **setup** function is called at the beginning of the program. In it, we call [setAdjustedAngles](#) for each servo and assign a pin to each [servo](#).

Definition at line 62 of file servo.ino.

3.2.4 Variable Documentation

3.2.4.1 uint8_t adjusted_angles[SERVOS][181]

The adjusted angles of the servos given the [limit](#) of each servo. A table calculated at initialization for optimization purposes. Its index corresponds to [servo](#). The program uses the convention "angles", but continuous rotation servos are technically compatible.

See also

[setAdjustedAngles](#) (), [getAdjustedAngle](#) ()

Definition at line 37 of file servo.ino.

3.2.4.2 uint8_t current_pos[SERVOS] = { 0 }

The current position of each servo. These are updated whenever a servos value is changed and retrieved upon [DUMP_SIGNAL](#).

Definition at line 42 of file servo.ino.

3.2.4.3 Servo servo[SERVOS]

The representation of the servos. Used to keep track of pin assignments and send output.

See also

[getServoFromID\(\)](#), Arduino

Definition at line 27 of file servo.ino.

3.3 arduino/src/servo/settings.h File Reference

Macros

- `#define SERVOS 6`
- `#define BUFSIZE 16`

Enumerations

- `enum { VERBOSE = 0, BOARD_ID = 181 }`

Functions

- `int getServoFromID (uint8_t servo_id)`

Variables

- `uint8_t limit [SERVOS][2]`
- `uint8_t default_pos [SERVOS] = { 0, 0, 0, 0, 0, 0 }`
- `uint8_t reverse [SERVOS] = { 0, 0, 0, 0, 0, 1 }`
- `uint8_t pin_offset = 2`

3.3.1 Detailed Description

This is an example [settings.h](#) for [servo.ino](#).

Every Arduino board on the bot is to be a simple servo controller that accepts commands from serial input, and so they are all to share the code located in [servo.ino](#). Each board needs its own header like this one to define custom information about the board and each servo on the board. This is such a settings file and will be documented as an example.

3.3.2 Macro Definition Documentation

3.3.2.1 `#define BUFSIZE 16`

Size of the print buffer (must be large enough to hold [DUMP_RESPONSE_LEN](#)).

Definition at line 18 of file settings.h.

3.3.2.2 `#define SERVOS 6`

Number of servos to assign.

Definition at line 14 of file settings.h.

3.3.3 Enumeration Type Documentation

3.3.3.1 anonymous enum

Enumerator

VERBOSE Whether to print debug output to the serial port.

BOARD_ID The unique identification for this board.

Definition at line 45 of file settings.h.

3.3.4 Function Documentation

3.3.4.1 int getServoFromID (uint8_t servo_id)

This function gets array index of a servo using its ID. If the servo does not belong to this board, it returns -1. It is recommended that boards with complex ID assignments use a switch statement or a similar solution to save resources.

See also

[Values](#)

Definition at line 59 of file settings.h.

3.3.5 Variable Documentation

3.3.5.1 uint8_t default_pos[SERVOS] = { 0, 0, 0, 0, 0, 0 }

The default position to set each servo to. Its index corresponds with [servo](#).

Definition at line 33 of file settings.h.

3.3.5.2 uint8_t limit[SERVOS][2]

Initial value:

```
= {
  { 15, 114 }, { 10, 123 }, { 17, 100 },
  { 25, 122 }, { 22, 112 }, { 82, 160 },
}
```

This is the calibration for each servo- its minimum then maximum angle (for positional servos) or its minimum then maximum speed (for continuous rotation servos). Its index corresponds with [servo](#).

Definition at line 25 of file settings.h.

3.3.5.3 uint8_t pin_offset = 2

Pin value to begin assigning pins at. It may be necessary to eventually implement a similar pin retrieval system to [getServoFromID\(\)](#).

Definition at line 43 of file settings.h.

3.3.5.4 `uint8_t reverse[SERVOS] = { 0, 0, 0, 0, 0, 1 }`

Indicates whether to reverse the angles for each servo, for servos that turn the wrong way. Its index corresponds with [servo](#).

Definition at line 38 of file settings.h.

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