PiQuantum the raspbery pi powered quantum computer simulator

Alpha1.0

Generated by Doxygen 1.8.13

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1.1 Class Hierarchy

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

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Here is a list of all files with brief descriptions:

Chapter 4

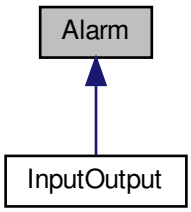
Data Structure Documentation

4.1 Alarm Class Reference

Interrupts in Linux.

`#include <io.hpp>`

Inheritance diagram for Alarm:



Public Member Functions

- Alarm (int delay_us)

4.1.1 Detailed Description

Interrupts in Linux.

This class implements the SIGALARM function in Linux. SIGALARM can be setup to call a function at regular intervals. The function (interrupt) does not have an implementation in this class. It is defined in the derived Input↩ Output class. The constructor sets up the SIGALARM (defining the period, etc.)

4.1.2 Constructor & Destructor Documentation

4.1.2.1 Alarm()

```
Alarm::Alarm (
            int delay_us )
```

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

- /home/oliver/Documents/piquantum/src/final/io.hpp
- /home/oliver/Documents/piquantum/src/final/io.cpp

4.2 Button Class Reference

`#include <buttons.hpp>`

Public Member Functions

- Button (Position position)
- ~Button ()
- int get_state ()
- std::vector< double > rgb ()
- Position get_position ()
- Button (Position position)
- int get_state ()
- Position get_position ()

Friends

- class InputOutput

4.2.1 Constructor & Destructor Documentation

4.2.1.1 Button() [1/2]

```
Button::Button (
            Position position )
```

4.2.1.2 ~Button()

```
Button::~Button ( )
```

4.2.1.3 Button() [2/2]

```
Button::Button (
            Position position )
```

4.2.2 Member Function Documentation

4.2.2.1 get_position() [1/2]

```
Position Button::get_position ( )  [inline]
```

4.2.2.2 get_position() [2/2]

```
Position Button::get_position ( )  [inline]
```

4.2.2.3 get_state() [1/2]

```
int Button::get_state ( )
```

4.2.2.4 get_state() [2/2]

```
int Button::get_state ( )
```

4.2.2.5 rgb()

```
std::vector<double> Button::rgb ( )  [inline]
```

4.2.3 Friends And Related Function Documentation

4.2.3.1 InputOutput

```
InputOutput  [friend]
```

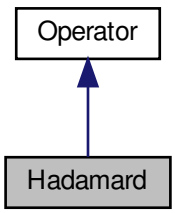
The documentation for this class was generated from the following files:

- /home/oliver/Documents/piquantum/src/final/buttons.hpp
- /home/oliver/Documents/piquantum/src/final/interface.hpp
- /home/oliver/Documents/piquantum/src/final/buttons.cpp
- /home/oliver/Documents/piquantum/src/final/interface.cpp

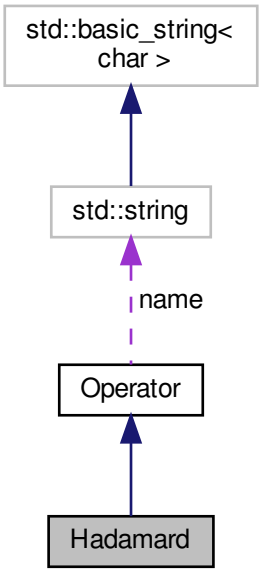
4.3 Hadamard Class Reference

```
#include <state.hpp>
```

Inheritance diagram for Hadamard:



Collaboration diagram for Hadamard:



Public Member Functions

- Hadamard (std::shared_ptr< Button > btn_ptr_in=nullptr, int num_qubits_act_on=1)

Additional Inherited Members

4.3.1 Constructor & Destructor Documentation

4.3.1.1 Hadamard()

```
Hadamard::Hadamard (
            std::shared_ptr< Button > btn_ptr_in = nullptr,
            int num_qubits_act_on = 1 )
```

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

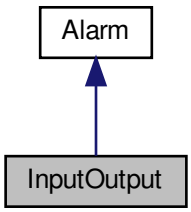
- /home/oliver/Documents/piquantum/src/final/state.hpp
- /home/oliver/Documents/piquantum/src/final/state.cpp

4.4 InputOutput Class Reference

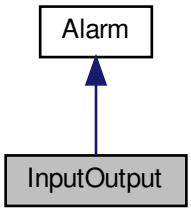
Class for reading buttons and writing to LEDs.

`#include <io.hpp>`

Inheritance diagram for InputOutput:



Collaboration diagram for InputOutput:



Public Member Functions

- InputOutput (std::shared_ptr< SpiChannel > spi)
- void print ()
- int set_leds (std::vector< byte > data)

  Send data to the LEDs.
- std::vector< byte > read_button_states (int num)

  Read all the button states.
- int register_led (Led *led)

  Register and deregister LEDs and buttons.
- void deregister_led (int id)
- int register_button (Button *btn)
- void deregister_button (int id)

4.4.1 Detailed Description

Class for reading buttons and writing to LEDs.

There are two main parts to the class. The first part is two arrays of pointers (one for button objects and one for LEDs) which are 'registered' with this class automatically when they are instantiated.

The second part is a function, called interrupt(), which is called at regular intervals by the SIGALARM signal (a linux thing). This function is responsible for updating the states of the LEDs and reading the state of all the buttons.

The LEDs are controlled using a pulse width modulation type scheme, which interrupt() simulates. I keeps track of a counter, which is incremented by 1 every time interrupt() is called. When it gets to period, it is reset to zero. As the counter ranges through 0 to period, each registered LED object is queried to get an RGB values (between 0 and 1). If this value exceeds counter/period (also between 0 and 1), then the LED is turned off. The LEDs are all switched back on when the counter is reset to zero

The user program never uses this program. It is implicitely instantiated when Led and Button objects are instantiated.

4.4.2 Constructor & Destructor Documentation

4.4.2.1 InputOutput()

```
InputOutput::InputOutput (
            std::shared_ptr< SpiChannel > spi )
```

4.4.3 Member Function Documentation

4.4.3.1 deregister_button()

```
void InputOutput::deregister_button (
            int id )
```

4.4.3.2 deregister_led()

```
void InputOutput::deregister_led (
            int id )
```

4.4.3.3 print()

```
void InputOutput::print ( )
```

4.4.3.4 read_button_states()

```
std::vector< unsigned char > InputOutput::read_button_states (
            int num )
```

Read all the button states.

Read a number

Parameters

num	of bytes from the button shift registers and return it in a standard vector. The SIGALARM function (func) calls this function to update the state of all the button objects

4.4.3.5 register_button()

```
int InputOutput::register_button (
            Button * btn )
```

4.4.3.6 register_led()

```
int InputOutput::register_led (
            Led * led )
```

Register and deregister LEDs and buttons.

Register a objects with the driver. The function stores a pointer to the object. There's a problem still to solve: how to remove the entry when the Led object no longer exists. That can be fixed later.

4.4.3.7 set_leds()

```
int InputOutput::set_leds (
            std::vector< byte > data )
```

Send data to the LEDs.

Turn on an LED via the external display driver TLC591x.

Send a std::vector of bytes to the LED drivers. This function is called repeatedly in the func SIGALARM function to update the state of the LEDs

On power on, the chip (TLC591x) is in normal mode which means that the clocked bytes sent to the chip set which LEDs are on and which are off (as opposed to setting the current of the LEDs).

This function assumes that a number of the TLC591 chips are connected together. Data is sent via SPI to the first chip and passed along the chain to other devices.

To write to the device:

1) Write a number of bytes to the SPI port, equal to the number of chips connected together 2) Momentarily set the LE(ED1) pin to latch the data onto the output register. 3) Bring the OE(ED2) pin low to enable the current sinking to turn on the LEDs.

See the timing diagram on page 17 of the datasheet for details.

Arguments: a std::vector of the data to write to the display chips

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

- /home/oliver/Documents/piquantum/src/final/io.hpp
- /home/oliver/Documents/piquantum/src/final/io.cpp

4.5 Led Class Reference

RGB Led class.

`#include <interface.hpp>`

Public Member Functions

- Led (Position r, Position g, Position b)
- Led (std::vector< Position > pos)
- void set_rgb (double red, double green, double blue)
- std::vector< double > get_rgb ()
- std::vector< Position > get_positions ()

4.5.1 Detailed Description

RGB Led class.

Objects of this class represent RGB LEDs. When the class is instantiated, it creates an InputOutput class driver automatically (if on does not already exist) and then registers itself with it, so that its RGB values are automatically sent to the device.

The constructor takes three arguments which are the positions on the driver chips of the R, G and B lines. They are specified in the form {chip, line}, where chip is the chip number and line is the line number on that chip.

RGB values are updated using the set_rgb function. RGB values are between 0 and 1, with 0 representing off and 1 representing maximum brightness. The new state will be written immediately to the LEDs. To turn the LED off write RGB values of 0.

4.5.2 Constructor & Destructor Documentation

4.5.2.1 Led() [1/2]

```
Led::Led (
            Position r,
            Position g,
            Position b )
```

4.5.2.2 Led() [2/2]

```
Led::Led (
            std::vector< Position > pos )
```

4.5.3 Member Function Documentation

4.5.3.1 get_positions()

```
std::vector< Position > Led::get_positions ( )
```

4.5.3.2 get_rgb()

```
std::vector< double > Led::get_rgb ( )
```

4.5.3.3 set_rgb()

```
void Led::set_rgb (
            double red,
            double green,
            double blue )
```

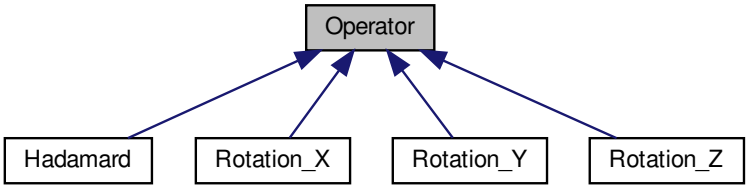
The documentation for this class was generated from the following files:

- /home/oliver/Documents/piquantum/src/final/interface.hpp
- /home/oliver/Documents/piquantum/src/final/interface.cpp

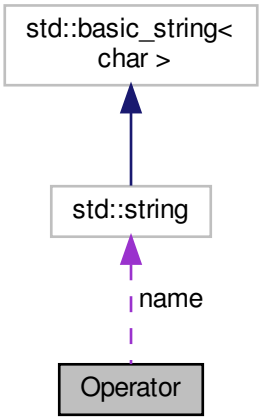
4.6 Operator Class Reference

```
#include <state.hpp>
```

Inheritance diagram for Operator:



Collaboration diagram for Operator:



Public Member Functions

- int get_num_qubits (void)
- void print ()
- void set_btn (std::shared_ptr< Button > btn_ptr_in)
- bool selected (void)
- Operator ()

Data Fields

- int num_qubits
- std::string name
- Eigen::Matrix2cd matrix
- std::shared_ptr< Button > btn_ptr

4.6.1 Constructor & Destructor Documentation

4.6.1.1 Operator()

```
Operator::Operator ( )  [inline]
```

4.6.2 Member Function Documentation

4.6.2.1 get_num_qubits()

```
int Operator::get_num_qubits (
            void  )
```

4.6.2.2 print()

```
void Operator::print (
            void  )
```

4.6.2.3 selected()

```
bool Operator::selected (
            void  )
```

4.6.2.4 set_btn()

```
void Operator::set_btn (
            std::shared_ptr< Button > btn_ptr_in )
```

4.6.3 Field Documentation

4.6.3.1 btn_ptr

```
std::shared_ptr<Button> Operator::btn_ptr
```

4.6.3.2 matrix

```
Eigen::Matrix2cd Operator::matrix
```

4.6.3.3 name

```
std::string Operator::name
```

4.6.3.4 num_qubits

```
int Operator::num_qubits
```

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

- /home/oliver/Documents/piquantum/src/final/state.hpp
- /home/oliver/Documents/piquantum/src/final/state.cpp

4.7 PIN Class Reference

```
#include <pin_mappings.hpp>
```

Static Public Attributes

- static const int LE = 0
- static const int OE = 1
- static const int SHLD = 23

4.7.1 Field Documentation

4.7.1.1 LE

```
const int PIN::LE = 0  [static]
```

4.7.1.2 OE

```
const int PIN::OE = 1  [static]
```

4.7.1.3 SHLD

```
const int PIN::SHLD = 23  [static]
```

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

- /home/oliver/Documents/piquantum/src/final/pin_mappings.hpp

4.8 Position Struct Reference

Chip/line structure.

`#include <io.hpp>`

Data Fields

- int chip
- int line

4.8.1 Detailed Description

Chip/line structure.

Store the chip and line number for a particular LED or button.

4.8.2 Field Documentation

4.8.2.1 chip

```
int Position::chip
```

4.8.2.2 line

```
int Position::line
```

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

- /home/oliver/Documents/piquantum/src/final/io.hpp

4.9 Qubit Class Reference

`#include <state.hpp>`

Data Structures

- struct Qubit_state

  define a struct to hold the qubit properties

Public Member Functions

- Qubit (std::vector< Position > led_rgb_loc, Position btn_loc, int pos=-1)
- void set_led (void)
- bool selected (void)
- void set_amps (double zero, double one, double phases)
- void set_amps (const Qubit_state &qubit_vals)
- void set_zero (double amp)
- void set_one (double amp)
- void set_phase (double phi)
- void set_uptodate (bool true_false)
- double get_zero_amp ()
- double get_one_amp ()
- double get_phase ()
- bool check_uptodate ()

4.9.1 Constructor & Destructor Documentation

4.9.1.1 Qubit()

```
Qubit::Qubit (
            std::vector< Position > led_rgb_loc,
            Position btn_loc,
            int pos = -1 )
```

4.9.2 Member Function Documentation

4.9.2.1 check_uptodate()

```
bool Qubit::check_uptodate (
            void  )
```

4.9.2.2 get_one_amp()

```
double Qubit::get_one_amp (
            void  )
```

4.9.2.3 get_phase()

```
double Qubit::get_phase (
            void  )
```

4.9.2.4 get_zero_amp()

```
double Qubit::get_zero_amp (
            void  )
```

4.9.2.5 selected()

```
bool Qubit::selected (
            void  )
```

4.9.2.6 set_amps() [1/2]

```
void Qubit::set_amps (
            double zero,
            double one,
            double phases )
```

4.9.2.7 set_amps() [2/2]

```
void Qubit::set_amps (
            const Qubit_state & qubit_vals )
```

4.9.2.8 set_led()

```
void Qubit::set_led (
            void  )
```

4.9.2.9 set_one()

```
void Qubit::set_one (
            double amp )
```

4.9.2.10 set_phase()

```
void Qubit::set_phase (
            double phi )
```

4.9.2.11 set_uptodate()

```
void Qubit::set_uptodate (
            bool true_false )
```

4.9.2.12 set_zero()

```
void Qubit::set_zero (
            double amp )
```

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

- /home/oliver/Documents/piquantum/src/final/state.hpp
- /home/oliver/Documents/piquantum/src/final/state.cpp

4.10 Qubit::Qubit_state Struct Reference

define a struct to hold the qubit properties

```
#include <state.hpp>
```

Data Fields

- double zero_amp
- double one_amp
- double phase

4.10.1 Detailed Description

define a struct to hold the qubit properties

4.10.2 Field Documentation

4.10.2.1 one_amp

```
double Qubit::Qubit_state::one_amp
```

4.10.2.2 phase

```
double Qubit::Qubit_state::phase
```

4.10.2.3 zero_amp

```
double Qubit::Qubit_state::zero_amp
```

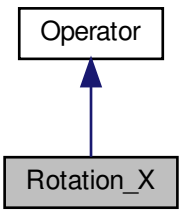
The documentation for this struct was generated from the following file:

- /home/oliver/Documents/piquantum/src/final/state.hpp

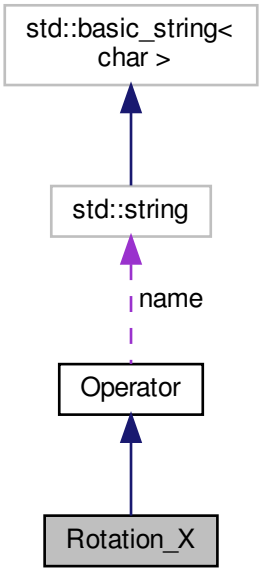
4.11 Rotation_X Class Reference

```
#include <state.hpp>
```

Inheritance diagram for Rotation_X:



Collaboration diagram for Rotation_X:



Public Member Functions

- Rotation_X (std::shared_ptr< Button > btn_ptr_in=nullptr, int num_qubits_act_on=1, double theta=PI)

Additional Inherited Members

4.11.1 Constructor & Destructor Documentation

4.11.1.1 Rotation_X()

```
Rotation_X::Rotation_X (
            std::shared_ptr< Button > btn_ptr_in = nullptr,
            int num_qubits_act_on = 1,
            double theta = PI )
```

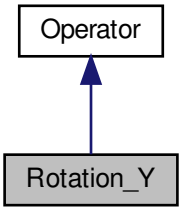
The documentation for this class was generated from the following files:

- /home/oliver/Documents/piquantum/src/final/state.hpp
- /home/oliver/Documents/piquantum/src/final/state.cpp

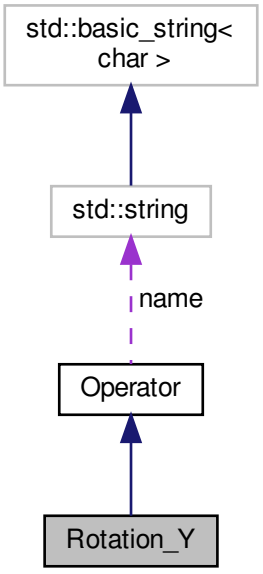
4.12 Rotation_Y Class Reference

`#include <state.hpp>`

Inheritance diagram for Rotation_Y:



Collaboration diagram for Rotation_Y:



Public Member Functions

- Rotation_Y (std::shared_ptr< Button > btn_ptr_in=nullptr, int num_qubits_act_on=1, double theta=PI)

Additional Inherited Members

4.12.1 Constructor & Destructor Documentation

4.12.1.1 Rotation_Y()

```
Rotation_Y::Rotation_Y (
            std::shared_ptr< Button > btn_ptr_in = nullptr,
            int num_qubits_act_on = 1,
            double theta = PI )
```

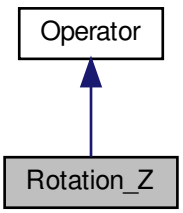
The documentation for this class was generated from the following files:

- /home/oliver/Documents/piquantum/src/final/state.hpp
- /home/oliver/Documents/piquantum/src/final/state.cpp

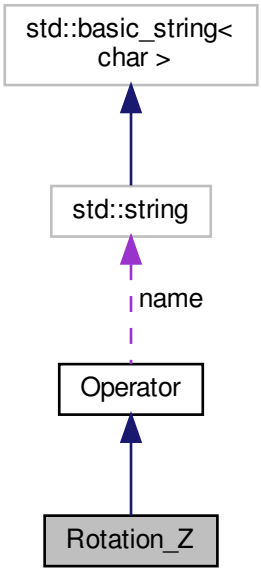
4.13 Rotation_Z Class Reference

```
#include <state.hpp>
```

Inheritance diagram for Rotation_Z:



Collaboration diagram for Rotation_Z:



Public Member Functions

- Rotation_Z (std::shared_ptr< Button > btn_ptr_in=nullptr, int num_qubits_act_on=1, double theta=PI)

Additional Inherited Members

4.13.1 Constructor & Destructor Documentation

4.13.1.1 Rotation_Z()

```
Rotation_Z::Rotation_Z (
            std::shared_ptr< Button > btn_ptr_in = nullptr,
            int num_qubits_act_on = 1,
            double theta = PI )
```

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

- /home/oliver/Documents/piquantum/src/final/state.hpp
- /home/oliver/Documents/piquantum/src/final/state.cpp

4.14 SpiChannel Class Reference

SpiChannel class.

`#include <spi.hpp>`

Public Member Functions

- SpiChannel ()
- void change_frequency (int frequency)
- std::vector< byte > read (int num_bytes)

  Read spi data.
- void write (const std::vector< byte > &write)

  Write spi data.

4.14.1 Detailed Description

SpiChannel class.

This class provides SPI read/write functions on a particular SPI channel using the wiringPi SPI library. The channel is fixed for a particular object when it is constructed, but the frequency can be modified (not sure if that's very helpful).

Use case: as part of an SPI device class to actually read and write data to the device. Other details (such as managing chip selects) would be handled by the higher level class.

4.14.2 Constructor & Destructor Documentation

4.14.2.1 SpiChannel()

```
SpiChannel::SpiChannel ( )
```

4.14.3 Member Function Documentation

4.14.3.1 change_frequency()

```
void SpiChannel::change_frequency (
            int frequency )
```

4.14.3.2 read()

```
std::vector< byte > SpiChannel::read (
            int num_bytes )
```

Read spi data.

Function for reading

Parameters

num_bytes	from an spi device. Data is returned as a standard vector.

4.14.3.3 write()

```
void SpiChannel::write (
            const std::vector< byte > & write )
```

Write spi data.

Function for writing

Parameters

write	from an spi device. Data is returned as a standard vector.

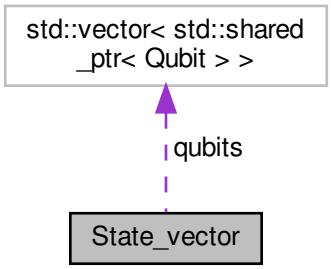
The documentation for this class was generated from the following files:

- /home/oliver/Documents/piquantum/src/final/spi.hpp
- /home/oliver/Documents/piquantum/src/final/spi.cpp

4.15 State_vector Class Reference

```
#include <state.hpp>
```

Collaboration diagram for State_vector:



Public Member Functions

- void display_avg (Qubits_type &qubits, const Eigen::VectorXcd &vect)
- int get_num_qubits (void)
- int get_size (void)
- void print (void)
- State_vector ()
- State_vector (int num, std::vector< std::vector< Position > > qubit_leds, std::vector< Position > qubit_btns)
- int get_qubit (int time=1)
- void set_vacuum ()
- void set_superpos ()
- void apply (const Operator &op, int qubit)
- void apply (const Operator &op, int ctrl, int targ)
- void disp (void)
- int disp_cycle (int n=0)

Data Fields

- Qubits_type qubits

4.15.1 Constructor & Destructor Documentation

4.15.1.1 State_vector() [1/2]

```
State_vector::State_vector ( )  [inline]
```

4.15.1.2 State_vector() [2/2]

```
State_vector::State_vector (
            int num,
            std::vector< std::vector< Position > > qubit_leds,
            std::vector< Position > qubit_btns )
```

4.15.2 Member Function Documentation

4.15.2.1 apply() [1/2]

```
void State_vector::apply (
            const Operator & op,
            int qubit )
```

4.15.2.2 apply() [2/2]

```
void State_vector::apply (
            const Operator & op,
            int ctrl,
            int targ )
```

4.15.2.3 disp()

```
void State_vector::disp (
            void  )
```

4.15.2.4 disp_cycle()

```
int State_vector::disp_cycle (
            int n = 0 )
```

4.15.2.5 display_avg()

```
void State_vector::display_avg (
            Qubits_type & qubits,
            const Eigen::VectorXcd & vect )
```

4.15.2.6 get_num_qubits()

```
int State_vector::get_num_qubits (
            void  )
```

4.15.2.7 get_qubit()

```
int State_vector::get_qubit (
            int time = 1 )
```

4.15.2.8 get_size()

```
int State_vector::get_size (
            void  )
```

4.15.2.9 print()

```
void State_vector::print (
            void  )
```

4.15.2.10 set_superpos()

```
void State_vector::set_superpos (
            void  )
```

4.15.2.11 set_vacuum()

```
void State_vector::set_vacuum (
            void  )
```

4.15.3 Field Documentation

4.15.3.1 qubits

```
Qubits_type State_vector::qubits
```

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

- /home/oliver/Documents/piquantum/src/final/state.hpp
- /home/oliver/Documents/piquantum/src/final/state.cpp

4.16 WiringPi Class Reference

Class for initialising wiringPi.

```
#include <wpi.hpp>
```

Public Member Functions

- WiringPi ()

4.16.1 Detailed Description

Class for initialising wiringPi.

Everything that uses input/output using wiringPi should include a WiringPi private data member. That will make sure that the necessary setup routines get called before anything starts using input/output functions

4.16.2 Constructor & Destructor Documentation

4.16.2.1 WiringPi()

```
WiringPi::WiringPi ( )  [inline]
```

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

- /home/oliver/Documents/piquantum/src/final/wpi.hpp
- /home/oliver/Documents/piquantum/src/final/wpi.cpp

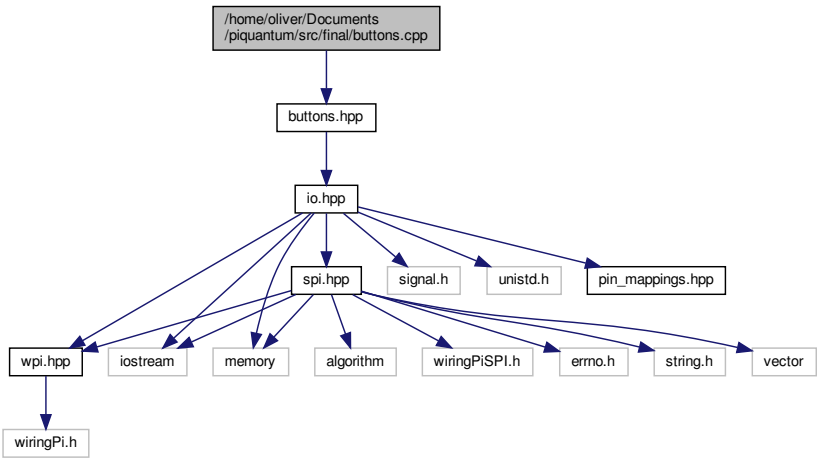
Chapter 5

File Documentation

5.1 /home/oliver/Documents/piquantum/src/final/buttons.cpp File Reference

```
#include "buttons.hpp"
```

Include dependency graph for buttons.cpp:



5.1.1 Detailed Description

Authors

J Scott, O Thomas

Date

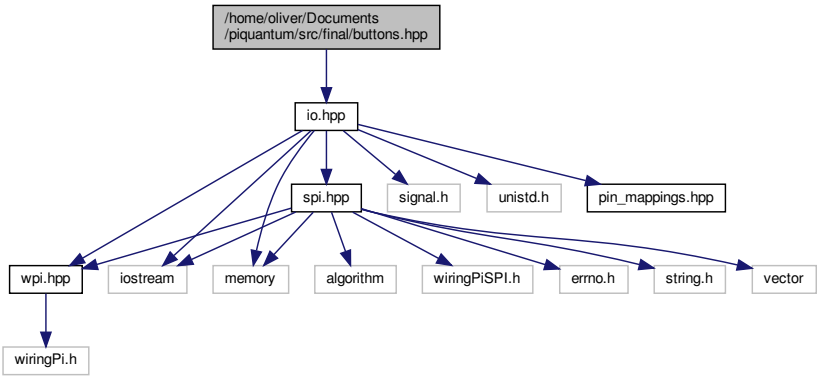
Feb 2019

LED control.

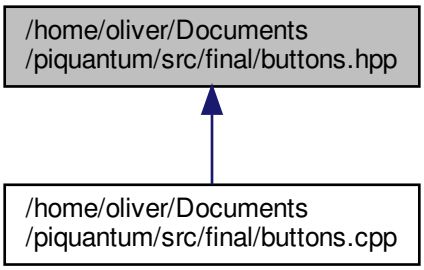
5.2 /home/oliver/Documents/piquantum/src/final/buttons.hpp File Reference

```
#include "io.hpp"
```

Include dependency graph for buttons.hpp:



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



Data Structures

- class Button

5.2.1 Detailed Description

Authors

J Scott, O Thomas

Date

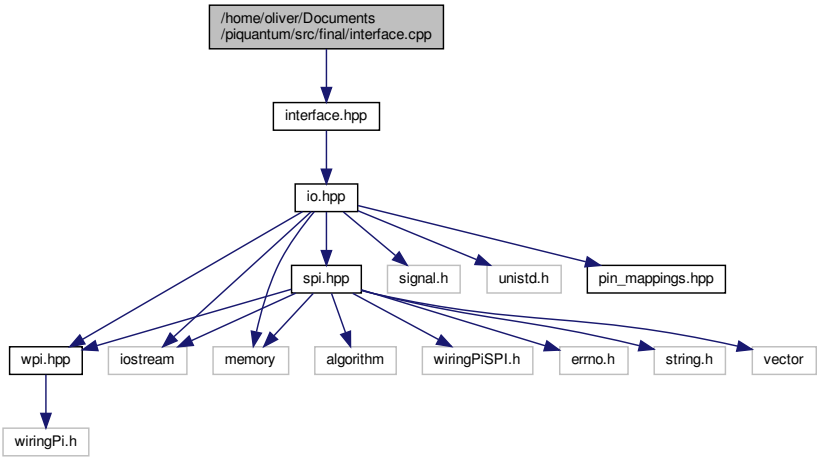
Feb 2019

Header file for Rasp Pi button I/O using SPI.

5.3 /home/oliver/Documents/piquantum/src/final/interface.cpp File Reference

```
#include "interface.hpp"
```

Include dependency graph for interface.cpp:



5.3.1 Detailed Description

Authors

J Scott, O Thomas

Date

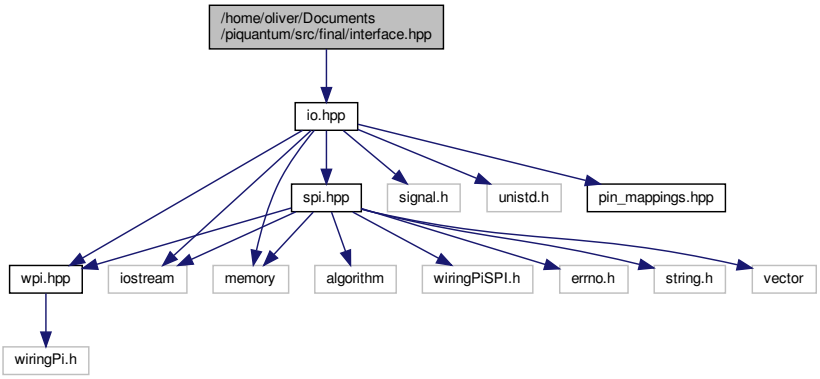
Feb 2019

LED control.

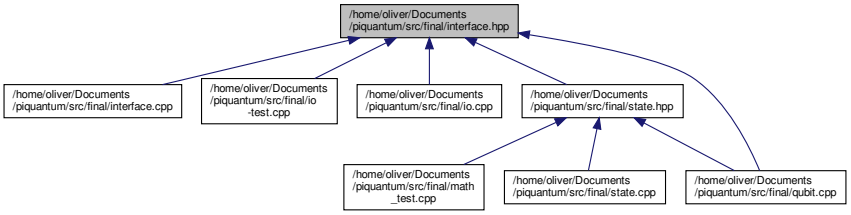
5.4 /home/oliver/Documents/piquantum/src/final/interface.hpp File Reference

```
#include "io.hpp"
```

Include dependency graph for interface.hpp:



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



Data Structures

- class Led

  RGB Led class.
- class Button

5.4.1 Detailed Description

Authors

J Scott, O Thomas

Date

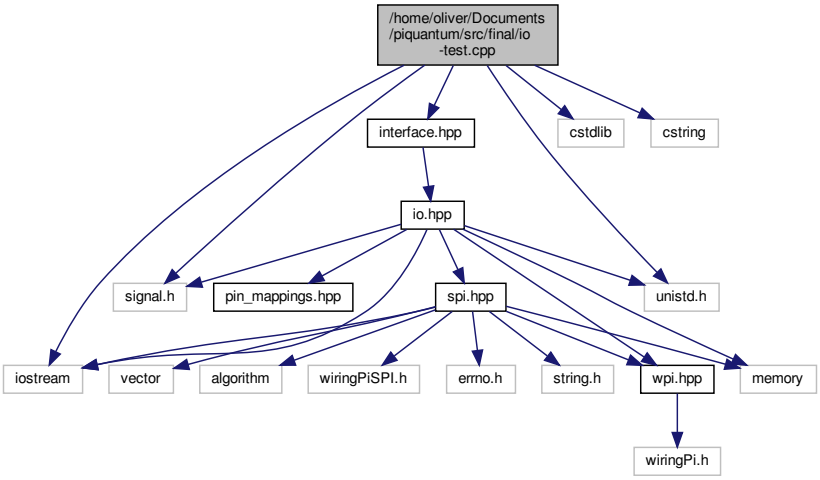
Feb 2019

LED and Button control.

5.5 /home/oliver/Documents/piquantum/src/final/io-test.cpp File Reference

```
#include <iostream>
#include "interface.hpp"
#include <cstdlib>
#include <cstring>
#include <signal.h>
#include <unistd.h>
```

Include dependency graph for io-test.cpp:



Functions

- int main ()

5.5.1 Function Documentation

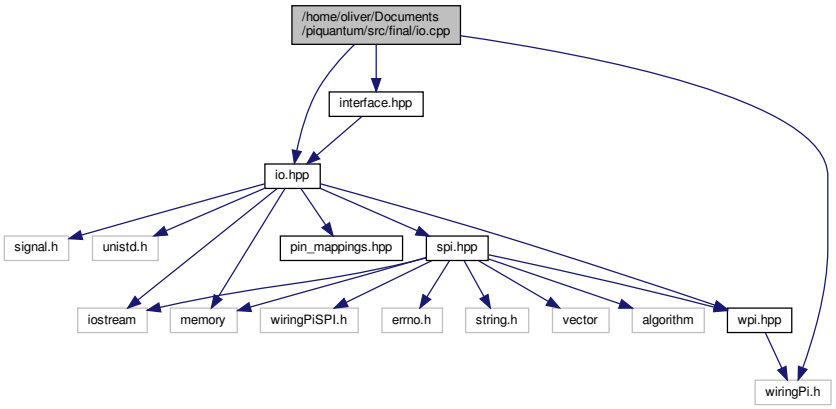
5.5.1.1 main()

```
int main (
            void  )
```

5.6 /home/oliver/Documents/piquantum/src/final/io.cpp File Reference

```
#include <wiringPi.h>
#include "io.hpp"
#include "interface.hpp"
```

Include dependency graph for io.cpp:



Functions

- std::shared_ptr< InputOutput > getInputOutput ()

  Wrapper to return InputOutput class.
- std::ostream & operator<< (std::ostream &stream, Position lines)

  Print the chip/lines for an LED.

5.6.1 Detailed Description

Authors

J Scott, O Thomas

Date

Feb 2019

IO control

5.6.2 Function Documentation

5.6.2.1 getInputOutput()

```
std::shared_ptr<InputOutput> getInputOutput ( )
```

Wrapper to return InputOutput class.

Return a shared_ptr object to an InputOutput. Pass a channel to indicate which SPI channel to use

5.6.2.2 operator<<()

```
std::ostream& operator<< (
            std::ostream & stream,
            Position lines )
```

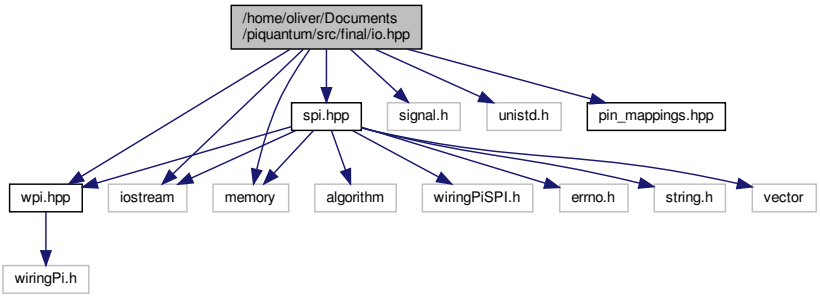
Print the chip/lines for an LED.

Useful for easily printing out Position structs in an easy to read format.

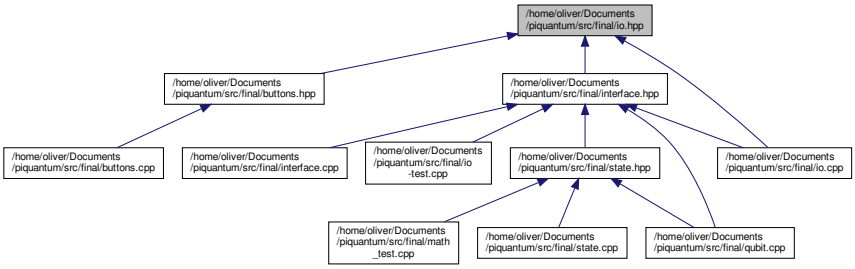
5.7 /home/oliver/Documents/piquantum/src/final/io.hpp File Reference

```
#include "wpi.hpp"
#include <signal.h>
#include <unistd.h>
#include <iostream>
#include <memory>
#include "spi.hpp"
#include "pin_mappings.hpp"
```

Include dependency graph for io.hpp:



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



Data Structures

- class Alarm

  Interrupts in Linux.
- class InputOutput

  Class for reading buttons and writing to LEDs.
- struct Position

  Chip/line structure.

Functions

- std::shared_ptr< class InputOutput > getInputOutput ()

  Wrapper to return InputOutput class.
- std::ostream & operator<< (std::ostream &stream, Position lines)

  Print the chip/lines for an LED.

5.7.1 Detailed Description

Authors

J Scott, O Thomas

Date

Feb 2019

IO control.

5.7.2 Function Documentation

5.7.2.1 getInputOutput()

```
std::shared_ptr<class InputOutput> getInputOutput ( )
```

Wrapper to return InputOutput class.

Return a shared_ptr object to an InputOutput. Functions should use this function to get a shared pointer to the InputOutput object. This function ensures that there is only ever one. Functions should not instantiate InputOutput objects directly

Return a shared_ptr object to an InputOutput. Pass a channel to indicate which SPI channel to use

5.7.2.2 operator<<()

```
std::ostream& operator<< (
            std::ostream & stream,
            Position lines )
```

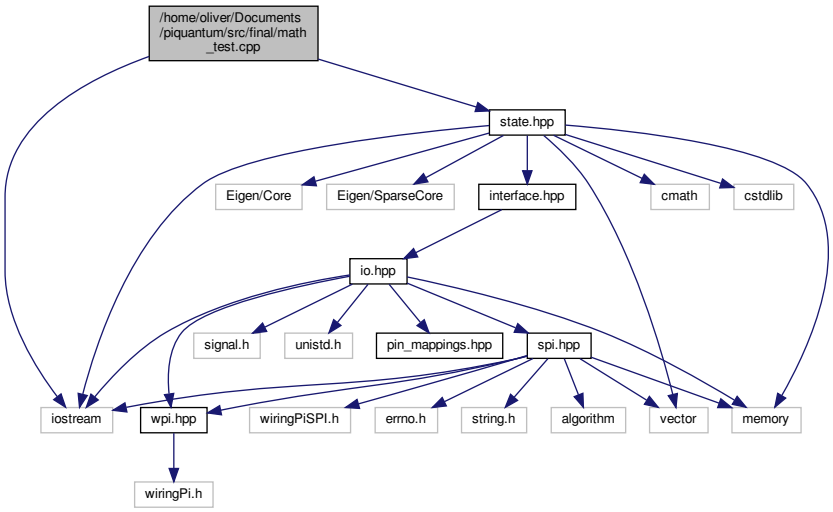
Print the chip/lines for an LED.

Useful for easily printing out Position structs in an easy to read format.

5.8 /home/oliver/Documents/piquantum/src/final/math_test.cpp File Reference

```
#include <iostream>
#include "state.hpp"
```

Include dependency graph for math_test.cpp:



Functions

- std::string delay ()
- void make_leds_light_up (const std::vector< State_vector::Qubit_states > &states, Led &led0, Led &led1, Led &led2, Led &led3)
- int get_qubit_btn (Button &btn_q0, Button &btn_q1, Button &btn_q2, Button &btn_q3)
- int main (void)

5.8.1 Function Documentation

5.8.1.1 delay()

```
std::string delay ( )
```

5.8.1.2 get_qubit_btn()

```
int get_qubit_btn (
            Button & btn_q0,
            Button & btn_q1,
            Button & btn_q2,
            Button & btn_q3 )
```

5.8.1.3 main()

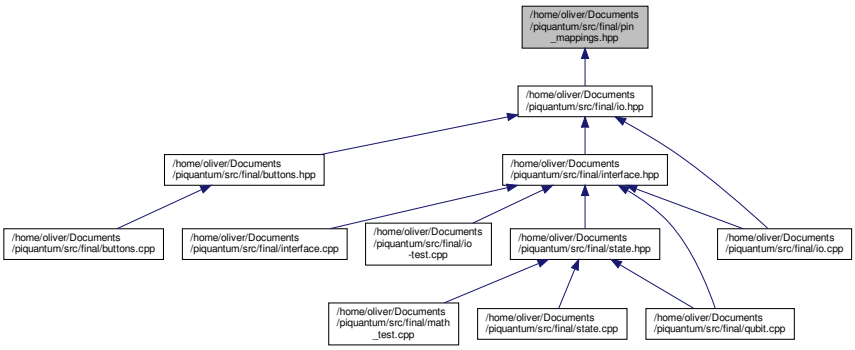
```
int main (
            void  )
```

5.8.1.4 make_leds_light_up()

```
void make_leds_light_up (
            const std::vector< State_vector::Qubit_states > & states,
            Led & led0,
            Led & led1,
            Led & led2,
            Led & led3 )
```

5.9 /home/oliver/Documents/piquantum/src/final/pin_mappings.hpp File Reference

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



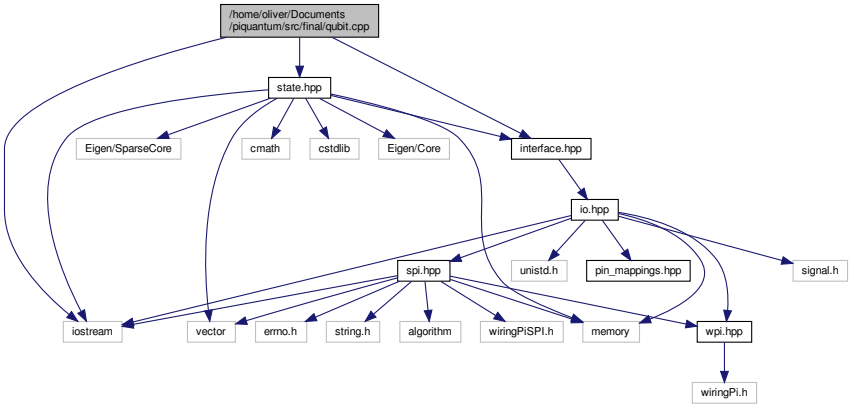
Data Structures

- class PIN

5.10 /home/oliver/Documents/piquantum/src/final/qubit.cpp File Reference

```
#include <iostream>
#include "state.hpp"
#include "interface.hpp"
```

Include dependency graph for qubit.cpp:



Functions

- int main (void)

5.10.1 Function Documentation

5.10.1.1 main()

```
int main (
            void  )
```

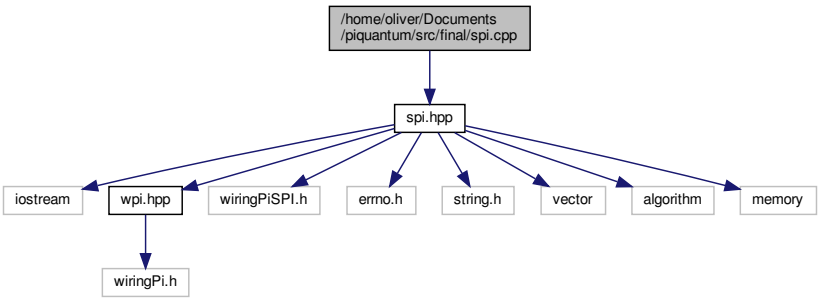
qubit leds RGB positions

vector of qubit btns

5.11 /home/oliver/Documents/piquantum/src/final/spi.cpp File Reference

```
#include "spi.hpp"
```

Include dependency graph for spi.cpp:



Functions

- std::shared_ptr< SpiChannel > getSpiChannel ()

  Wrapper to return SPI class.

5.11.1 Detailed Description

Authors

J Scott, O Thomas

Date

Feb 2019

Implementations relating to SPI communications

5.11.2 Function Documentation

5.11.2.1 getSpiChannel()

```
std::shared_ptr<SpiChannel> getSpiChannel ( )
```

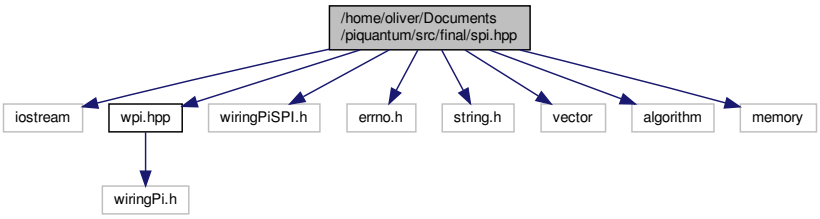
Wrapper to return SPI class.

Return a shared_ptr object to an SPI channel. This function is a kind of singleton implementation, preventing multiple copies of the SPI class. The actual SPI objects are stored in static variables so that they retain their value between function calls.

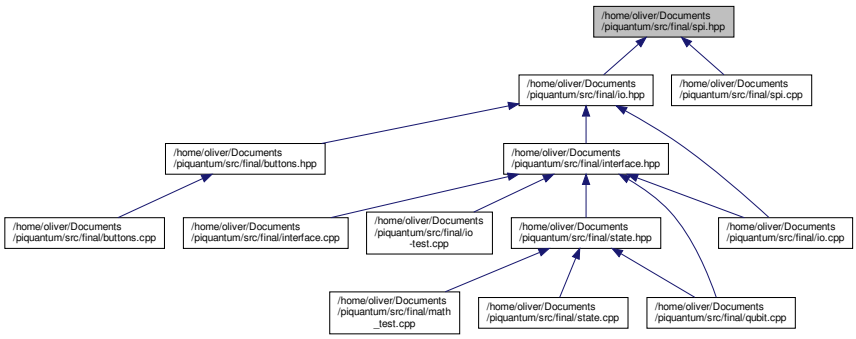
5.12 /home/oliver/Documents/piquantum/src/final/spi.hpp File Reference

```
#include <iostream>
#include "wpi.hpp"
#include <wiringPiSPI.h>
#include <errno.h>
#include <string.h>
#include <vector>
#include <algorithm>
#include <memory>
```

Include dependency graph for spi.hpp:



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



Data Structures

- class SpiChannel

  SpiChannel class.

Typedefs

- typedef unsigned char byte

  Byte (8 bits) type.

Functions

- std::shared_ptr< class SpiChannel > getSpiChannel ()

  Wrapper to return SPI class.

5.12.1 Detailed Description

Authors

J Scott, O Thomas

Date

Feb 2019

Header file for SPI (serial peripheral interface) control using wiringPi. The wiringPi library is available by cloning git://git.drogon.net/wiringPi and running ./build. It has two functions: a setup function and a read/write function. The program needs sudo rights to run. Also the SPI needs to be enabled in raspi-config.

5.12.2 Typedef Documentation

5.12.2.1 byte

```
typedef unsigned char byte
```

Byte (8 bits) type.

Alias for unsigned char. Type to store 8 bits of data for hardware reads and writes.

5.12.3 Function Documentation

5.12.3.1 getSpiChannel()

```
std::shared_ptr<class SpiChannel> getSpiChannel ( )
```

Wrapper to return SPI class.

Return a shared_ptr object to an SPI channel. This function is a kind of singleton implementation, preventing multiple copies of the SPI class. The actual SPI object is stored in a static variables so that it retains its value between function calls.

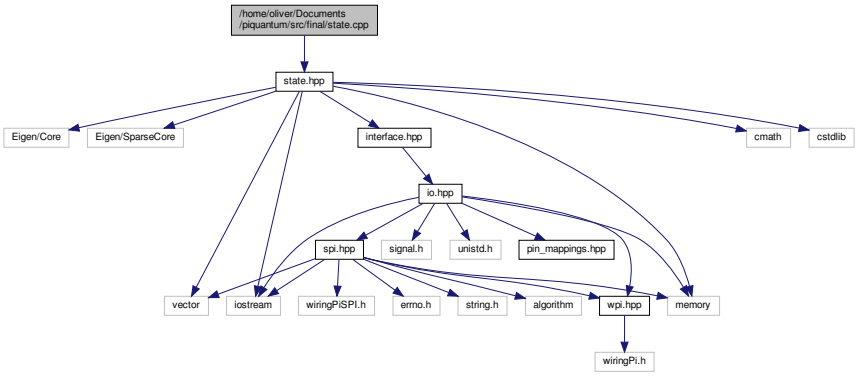
Return a shared_ptr object to an SPI channel. This function is a kind of singleton implementation, preventing multiple copies of the SPI class. The actual SPI objects are stored in static variables so that they retain their value between function calls.

5.13 /home/oliver/Documents/piquantum/src/final/state.cpp File Reference

State vector class.

```
#include "state.hpp"
```

Include dependency graph for state.cpp:



Variables

- std::vector< std::vector< Qubit::Qubit_state > > qubit_disp_cycle

5.13.1 Detailed Description

State vector class.

Authors

J Scott, O Thomas

Date

Feb 2019

5.13.2 Variable Documentation

5.13.2.1 qubit_disp_cycle

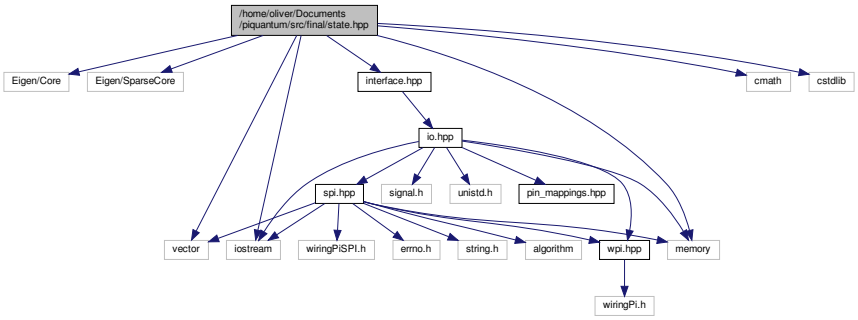
```
std::vector<std::vector<Qubit::Qubit_state> > qubit_disp_cycle
```

5.14 /home/oliver/Documents/piquantum/src/final/state.hpp File Reference

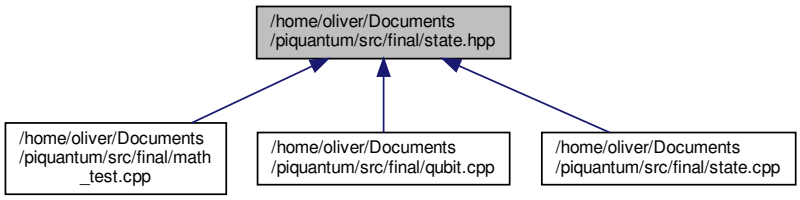
Header for state vector class and operators.

```
#include <Eigen/Core>
#include <Eigen/SparseCore>
#include <iostream>
#include <vector>
#include <memory>
#include <cmath>
#include <cstdlib>
#include "interface.hpp"
```

Include dependency graph for state.hpp:



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



Data Structures

- class Operator
- class Rotation_X
- class Rotation_Y
- class Rotation_Z
- class Hadamard
- class Qubit
- struct Qubit::Qubit_state

  define a struct to hold the qubit properties
- class State_vector

Typedefs

- typedef std::vector< std::shared_ptr< Qubit > > Qubits_type

Functions

- const std::complex< double > I_unit (0.0, 1.0)

Variables

- const double PI =4.0*atan(1.0)

5.14.1 Detailed Description

Header for state vector class and operators.

Authors

J Scott, O Thomas

Date

Feb 2019

5.14.2 Typedef Documentation

5.14.2.1 Qubits_type

```
typedef std::vector<std::shared_ptr<Qubit> > Qubits_type
```

5.14.3 Function Documentation

5.14.3.1 I_unit()

```
const std::complex<double> I_unit (
            0.  0,
            1.  0 )
```

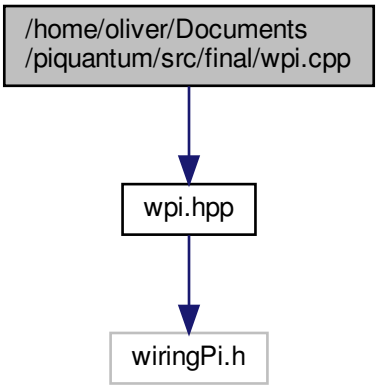
5.14.4 Variable Documentation

5.14.4.1 PI

```
const double PI =4.0*atan(1.0)
```

5.15 /home/oliver/Documents/piquantum/src/final/wpi.cpp File Reference

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



5.15.1 Detailed Description

Authors

J Scott, O Thomas

Date

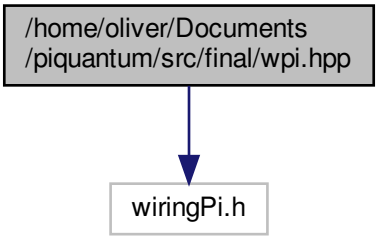
Feb 2019

Source file for WiringPi functions

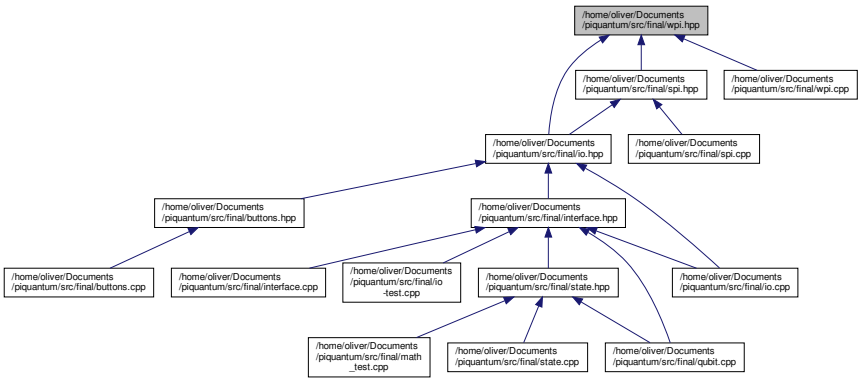
5.16 /home/oliver/Documents/piquantum/src/final/wpi.hpp File Reference

```
#include <wiringPi.h>
```

Include dependency graph for wpi.hpp:



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



Data Structures

- class WiringPi

  Class for initialising wiringPi.

5.16.1 Detailed Description

Authors

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Date

Feb 2019

Header file for WiringPi functions

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