Hexacopter Server Software

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Add in camera things.

Class picopter::GPSData

Do we need the uncertainty in the timestamp too? 2D info enough?

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6.1 picopter::gpio Namespace Reference

Functions

- void Init ()
- bool IsAutoMode ()
- void SetBuzzer (bool value)

Variables

- const int MODE_PIN = 5
- const int BUZZER_PIN = 2

6.1.1 Detailed Description

Controls the GPIO pins on the RPi, including PWM functionality.

6.1.2 Function Documentation

6.1.2.1 void picopter::gpio::Init ( )

Initialises the GPIO pins, if necessary.

6.1.2.2 bool picopter::gpio::IsAutoMode ( )

Determines if autonomous mode has been enabled by the user. Assumes that gpio::init has already been called. Probably not thread-safe.

Returns

true iff the user has enabled the switch for autonomous mode

6.1.2.3 void picopter::gpio::SetBuzzer (bool *value*)

Turns the buzzer on or off. Assumes that gpio::init has already been called. Probably not thread-safe.

Parameters

value	Indicates whether the buzzer should be on (true) or off (false).

6.1.3 Variable Documentation

6.1.3.1 const int picopter::gpio::BUZZER_PIN = 2

The GPIO pin of the buzzer (wiringPi numbering)

6.1.3.2 const int picopter::gpio::MODE_PIN = 5

The GPIO pin of the switch for auto mode (wiringPi numbering)

Chapter 7

Class Documentation

7.1 picopter::Buzzer Class Reference

Public Member Functions

- Buzzer ()
- virtual ~Buzzer ()
- void Play (int duration, int frequency, int volume)
- void PlayWait (int duration, int frequency, int volume)
- void Stop ()

7.1.1 Constructor & Destructor Documentation

7.1.1.1 Buzzer::Buzzer ( )

Creates a new Buzzer instance. Starts a worker thread that will play the sounds

7.1.1.2 Buzzer::~Buzzer ( ) [virtual]

Destructor method. Stops the worker thread.

7.1.2 Member Function Documentation

7.1.2.1 void Buzzer::Play (int *duration*, int *frequency*, int *volume*)

Plays a tone, non-blocking. If a tone is already being played, then that is stopped and the new tone is played instead.

Parameters

duration	The length of time to play the sound, in ms
frequency	The frequency of the sound, in Hz (10-5000Hz).
volume	The loudness of the sound, as a percentage (0 - 100%)

7.1.2.2 void Buzzer::PlayWait (int *duration*, int *frequency*, int *volume*)

Plays a tone, blocking until it is complete. If a tone is already being played, then that is stopped and the new tone is played instead.

Parameters

duration	The length of time to play the sound, in ms
frequency	The frequency of the sound, in Hz (10-5000Hz).
volume	The loudness of the sound, as a percentage (0 - 100%)

7.1.2.3 void Buzzer::Stop ( )

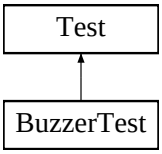
Signals the buzzer to stop if it is running

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

- include/buzzer.h
- src/base/buzzer.cpp

7.2 BuzzerTest Class Reference

Inheritance diagram for BuzzerTest:



Protected Attributes

- Buzzer **b**

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

- test/test_buzzer.cpp

7.3 CamComponent Struct Reference

Public Attributes

- int **M00**
- int **M01**
- int **M10**

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

- src/base/camera_stream.cpp

7.4 picopter::CameraStream Class Reference

Public Types

- enum **CameraMode** {
  MODE_NO_PROCESSING = 0, **MODE_COM** = 1, **MODE_CAMSHIFT** = 2, **MODE_CONNECTED_COM↩**
  PONENTS = 3,
  MODE_LEARN_COLOUR = 999 }

Public Member Functions

- **CameraStream** (Options ∗opts)
- bool **Start** (void)
- void **Stop** (void)
- int **GetInputWidth** ()
- int **GetInputHeight** ()
- CameraMode **GetMode** (void)
- void **SetMode** (CameraMode mode)
- void **SetLearningSize** (bool decrease)
- void **ShowLearningThreshold** (bool show)
- int **GetLearningHue** ()
- void **DoAutoLearning** (std::map< std::string, int32_t > ∗ret)
- void **DoManualLearning** (const std::map< std::string, int32_t > &values, std::map< std::string, int32_t > ∗ret)
- void **GetDetectedObjects** (std::vector< navigation::Point2D > ∗)
- void SetArrow (navigation::Point2D vec)
- double **GetFramerate** (void)
- void **TakePhoto** (std::string)

7.4.1 Member Function Documentation

7.4.1.1 void CameraStream::SetArrow (navigation::Point2D *vec*)

Set an arrow to be displayed from the centre of the image.

Parameters

vec	The arrow vector, as an integer percentage. E.g. 100% vec.x draws an arrow from centre to the right side of the image.

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

- include/camera_stream.h
- src/base/camera_stream.cpp

7.5 picopter::CamWindow Struct Reference

Public Attributes

- int **x**
- int **y**
- int **l**
- int **w**

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

- include/camera_stream.h

7.6 picopter::navigation::Coord2D Struct Reference

`#include <navigation.h>`

Public Attributes

- double lat
- double lon

7.6.1 Detailed Description

Holds 2-dimensional geographical coordinate position information.

7.6.2 Member Data Documentation

7.6.2.1 double picopter::navigation::Coord2D::lat

Latitude

7.6.2.2 double picopter::navigation::Coord2D::lon

Longitud

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

- include/navigation.h

7.7 picopter::navigation::Coord3D Struct Reference

`#include <navigation.h>`

Public Member Functions

- operator Coord2D ()

Public Attributes

- double lat
- double lon
- double alt

7.7.1 Detailed Description

Holds 3-dimensional geographical coordinate position information.

7.7.2 Member Function Documentation

7.7.2.1 picopter::navigation::Coord3D::operator Coord2D ( ) [inline]

Implicit conversion to 2D coordinate

7.7.3 Member Data Documentation

7.7.3.1 double picopter::navigation::Coord3D::alt

Altitude

7.7.3.2 double picopter::navigation::Coord3D::lat

Latitude

7.7.3.3 double picopter::navigation::Coord3D::lon

Longitude

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

- include/navigation.h

7.8 picopter::DataLog Class Reference

`#include <datalog.h>`

Public Member Functions

- DataLog (const char *name, bool log_startstop=true, const char *location=PICOPTER_LOG_LOCATION)
- virtual ~DataLog ()
- void Write (size_t sz, const char *buf)
- void Write (const char *fmt,...)
- void PlainWrite (const char *fmt,...)

7.8.1 Detailed Description

Class to log data in a flexible manner.

7.8.2 Constructor & Destructor Documentation

7.8.2.1 DataLog::DataLog (const char * *file*, bool *log_startstop* = `true`, const char * *location* = `PICOPTER_LOG_LOCATION`)

Creates a log file for logging *data*. The filename will be of the form 'file-*timestamp*.txt'. The *timestamp* is that from FileTimestamp. If the file exists, it will be overwritten.

Parameters

file	The name of the file, excluding any extension.
log_startstop	Whether or not to log the start and stop times of the log. Defaults to true.
location	The folder where the file should be stored. Defaults to PICOPTER_LOG_LOCATION, which is set in config.h. This should be the home folder of the user.

7.8.2.2 DataLog::~DataLog ( ) [virtual]

Destructor. Closes the file pointer.

7.8.3 Member Function Documentation

7.8.3.1 void DataLog::PlainWrite (const char * *fmt*, ...)

Writes a line of text to the file (no timestamp).

Parameters

fmt	A format string.
...	Arguments to be printed according to the format string.

7.8.3.2 void DataLog::Write (size_t *sz*, const char * *buf*)

Writes data to the log file, verbatim.

Parameters

sz	The size of the buffer to be written.
buf	The pointer to the buffer.

7.8.3.3 void DataLog::Write (const char * *fmt*, ...)

Writes a line of text to the file, prepending a timestamp.

Parameters

fmt	A format string.
...	Arguments to be printed according to the format string.

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

- include/datalog.h
- src/base/datalog.cpp

7.9 picopter::navigation::EulerAngle Struct Reference

`#include <navigation.h>`

Public Attributes

- double roll
- double pitch
- double yaw

7.9.1 Detailed Description

Holds a set of Euler angles.

7.9.2 Member Data Documentation

7.9.2.1 double picopter::navigation::EulerAngle::pitch

Pitch of the IMU, -pi to pi

7.9.2.2 double picopter::navigation::EulerAngle::roll

Roll of the IMU, -pi to pi

7.9.2.3 double picopter::navigation::EulerAngle::yaw

Yaw of the IMU, -pi to pi

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

- include/navigation.h

7.10 gps_data_t::fix Struct Reference

Public Attributes

- double **time**
- double **latitude**
- double **epy**
- double **longitude**
- double **epx**
- double **speed**
- double **eps**
- double **track**
- double **epd**

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

- emulation/gps-emu/libgpsmm.h

7.11 picopter::FlightBoard Class Reference

```
#include <flightboard.h>
```

Public Member Functions

- FlightBoard ()
- FlightBoard (Options *opts)
- virtual ~FlightBoard ()
- void Stop ()
- void GetData (FlightData *d)
- void SetData (FlightData *d)
- void SetAileron (int speed)
- void SetElevator (int speed)
- void SetRudder (int speed)
- void SetGimbal (int pos)

7.11.1 Detailed Description

Controls the actuation of the hexacopter. This class is not thread-safe.

7.11.2 Constructor & Destructor Documentation

7.11.2.1 FlightBoard::FlightBoard ( )

Constructor. Constructs a new flight board with default settings.

7.11.2.2 FlightBoard::FlightBoard (Options * *opts*)

Constructor; initiates a connection to ServoBlaster. Assumes that ServoBlaster has already been started and initialised.

Parameters

opts	A pointer to options, if any (NULL for defaults)

Exceptions

std::invalid_argument	if it can't connect to ServoBlaster.

7.11.2.3 FlightBoard::~FlightBoard ( ) [virtual]

Destructor. Closes the connection to ServoBlaster.

7.11.3 Member Function Documentation

7.11.3.1 void FlightBoard::GetData (FlightData * *d*)

Returns a copy of the current flight data.

Parameters

d	A pointer to the output location.

7.11.3.2 void FlightBoard::SetAileron (int *speed*)

Sets the aileron speed.

Parameters

speed	The aileron speed, as a percentage (-100% to 100%)

7.11.3.3 void FlightBoard::SetData (FlightData * *d*)

Sets the flight data and actuates the hexacopter.

Parameters

d	Specifies the flight data for how the hexacopter should be actuated.

7.11.3.4 void FlightBoard::SetElevator (int *speed*)

Sets the elevator speed.

Parameters

speed	The elevator speed, as a percentage (-100% to 100%)

7.11.3.5 void FlightBoard::SetGimbal (int *pos*)

Sets the gimbal angle.

Parameters

pos	The gimbal angle, in degrees (0 to 90)

7.11.3.6 void FlightBoard::SetRudder (int *speed*)

Sets the rudder speed.

Parameters

speed	The rudder speed, as a percentage (-100% to 100%)

7.11.3.7 void FlightBoard::Stop (void)

Stops the hexacopter. Note: Stopping refers to making it hold its current position. Sets all speeds and the gimbal angle to 0.

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

- include/flightboard.h
- src/base/flightboard.cpp

7.12 picopter::FlightController Class Reference

`#include <flightcontroller.h>`

Public Member Functions

- FlightController ()
- FlightController (Options ∗opts)
- virtual ∼FlightController ()
- ControllerState GetCurrentState ()
- TaskIdentifier GetCurrentTaskId ()
- void Stop ()
- bool CheckForStop ()
- bool Sleep (int ms)
- bool WaitForAuth ()
- bool RunTask (TaskIdentifier tid, FlightTask ∗task, void ∗opts)
- bool InferBearing (double ∗ret, int move_time=5000)

Public Attributes

- FlightBoard ∗const & fb
- IMU ∗const & imu

- GPS ∗const & gps
- Buzzer ∗const & buzzer
- CameraStream ∗const & cam

Friends

- std::ostream & operator<< (std::ostream &stream, FlightController &fc)

7.12.1 Detailed Description

The base controller for the hexacopter. It ties in all the actuators and sensors for access from a central point.

7.12.2 Constructor & Destructor Documentation

7.12.2.1 FlightController::FlightController ( )

Constructor. Constructs a new flight controller with default settings.

7.12.2.2 FlightController::FlightController (Options ∗ *opts*)

The flight controller constructor. Initialises all members as necessary.

Exceptions

std::invalid_argument	if a required component fails to initialise.

7.12.2.3 FlightController::∼FlightController ( ) [virtual]

Destructor. Stops/cleans up the base components (depends on RAII)

7.12.3 Member Function Documentation

7.12.3.1 bool FlightController::CheckForStop ( )

Check whether a stop should occur or not.

7.12.3.2 ControllerState FlightController::GetCurrentState ( )

Retrieves the current state of the flight controller.

Returns

The current state.

7.12.3.3 TaskIdentifier FlightController::GetCurrentTaskId ( )

Retrieves the current ID oft the task being run.

Returns

The current task ID.

7.12.3.4 bool FlightController::InferBearing (double * *ret,* int *move_time* = 5000)

Infer the current bearing by moving forwards and using the GPS heading.

Parameters

ret	The return location (bearing in radians).
move_time	The time spent moving forwards in ms (default is 5000ms).

Returns

true iff the bearing could be inferred.

7.12.3.5 bool FlightController::RunTask (TaskIdentifier *tid,* FlightTask * *task,* void * *opts*)

Runs a given task, if no task is currently being run.

Parameters

tid	The task identifier of the task to be run.
task	The task instance to be run.
opts	The task-specific options to be passed to its handler.

Returns

true iff the task was started.

7.12.3.6 bool FlightController::Sleep (int *ms*)

Perform a checked sleep which can be interrupted by the stop signal.

Parameters

ms	The sleep time, in milliseconds.

Returns

true iff the sleep completed normally (i.e. not interrupted).

7.12.3.7 void FlightController::Stop (void)

Send an indication that the flight controller should stop the running task.

7.12.3.8 bool FlightController::WaitForAuth ( )

Wait for the user to give authorisation for autonomous mode.

Returns

true iff authorisation was given. Will return false when the 'all stop' signal is returned.

7.12.4 Friends And Related Function Documentation

7.12.4.1 std::ostream& operator<< (std::ostream & *stream,* FlightController & *fc*) [friend]

Stream operator of the Flight Controller.

Returns

The current state of the flight controller (description).

7.12.5 Member Data Documentation

7.12.5.1 Buzzer* const& picopter::FlightController::buzzer

A pointer to the Buzzer instance.

7.12.5.2 CameraStream* const& picopter::FlightController::cam

A pointer to the Camera stream instance.

7.12.5.3 FlightBoard* const& picopter::FlightController::fb

A pointer to the flight board controller instance.

7.12.5.4 GPS* const& picopter::FlightController::gps

A pointer to the GPS instance.

7.12.5.5 IMU* const& picopter::FlightController::imu

A pointer to the IMU instance, or nullptr if not present.

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

- include/flightcontroller.h
- src/base/flightcontroller.cpp

7.13 picopter::FlightData Struct Reference

```
#include <flightboard.h>
```

Public Attributes

- int aileron
- int elevator
- int rudder
- int gimbal

7.13.1 Detailed Description

Contains information about the actuation of the hexacopter

7.13.2 Member Data Documentation

7.13.2.1 int picopter::FlightData::aileron

Aileron speed, -100 to 100

7.13.2.2 int picopter::FlightData::elevator

Elevator speed, -100 to 100

7.13.2.3 int picopter::FlightData::gimbal

Gimbal angle, 0 to 90

7.13.2.4 int picopter::FlightData::rudder

Rudder speed, -100 to 100

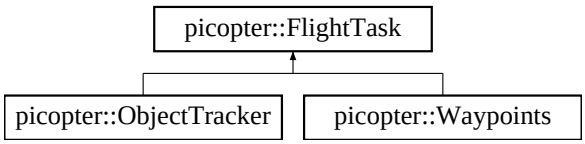
The documentation for this struct was generated from the following file:

- include/flightboard.h

7.14 picopter::FlightTask Class Reference

`#include <flightcontroller.h>`

Inheritance diagram for picopter::FlightTask:



Public Member Functions

- virtual ~FlightTask ()
- virtual void Run (FlightController *fc, void *opts)=0

Static Protected Member Functions

- static ControllerState SetCurrentState (FlightController *fc, ControllerState state)

7.14.1 Detailed Description

The base class for all flight tasks. All flight tasks must inherit from this class and implement its methods.

7.14.2 Constructor & Destructor Documentation

7.14.2.1 virtual picopter::FlightTask::~FlightTask ( ) [inline], [virtual]

The destructor. Will be called immediately after Run() exits.

7.14.3 Member Function Documentation

7.14.3.1 virtual void picopter::FlightTask::Run (FlightController * *fc*, void * *opts*) [pure virtual]

The method that will be called by the flight controller to perform the task.

Parameters

fc	The pointer to the calling flight controller
opts	Task-specific options.

Implemented in picopter::ObjectTracker, and picopter::Waypoints.

7.14.3.2 static ControllerState picopter::FlightTask::SetCurrentState (FlightController * *fc*, ControllerState *state*) [inline], [static], [protected]

Sets the current state of the parent flight controller.

Returns

The previous controller state.

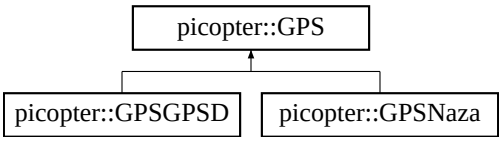
The documentation for this class was generated from the following file:

- include/flightcontroller.h

7.15 picopter::GPS Class Reference

`#include <gps_feed.h>`

Inheritance diagram for picopter::GPS:



Public Member Functions

- GPS ()
- GPS (Options *opts)
- virtual ~GPS ()
- virtual void GetLatest (GPSData *d)
- int TimeSinceLastFix ()
- bool HasFix ()
- bool WaitForFix (int timeout=-1)

Protected Attributes

- int **m_fix_timeout**
- std::atomic< GPSData > **m_data**
- std::atomic< int > **m_last_fix**
- std::atomic< bool > **m_quit**

Static Protected Attributes

- static const int FIX_TIMEOUT_DEFAULT = 2
- static const int WAIT_PERIOD = 200

7.15.1 Detailed Description

Class that interacts with the GPS.

7.15.2 Constructor & Destructor Documentation

7.15.2.1 GPS::GPS ( )

Constructor. Constructs a new GPS with default settings.

7.15.2.2 GPS::GPS (Options * *opts*)

Constructor. Intialises default stuff.

7.15.2.3 GPS::~GPS ( ) [virtual]

Destructor. Sets m_quit to true.

7.15.3 Member Function Documentation

7.15.3.1 void GPS::GetLatest (GPSData * *d*) [virtual]

Returns the latest GPS fix, if any.

Parameters

d	A pointer to the output location. If no value is present for that parameter, then that value is filled with NaN.

7.15.3.2 bool GPS::HasFix ( )

Determines if there is a current GPS fix or not

Returns

true iff there is a GPS fix.

7.15.3.3 int GPS::TimeSinceLastFix ( )

Returns the amount of time since the last GPS fix was acquired.

Returns

The time (in seconds) since the last GPS fix

7.15.3.4 bool GPS::WaitForFix (int *timeout* = -1)

Waits for a GPS fix.

Parameters

timeout	The timeout (in ms) before this method returns. Default is no timeout (-1).

Returns

true iff a GPS fix was acquired.

7.15.4 Member Data Documentation

7.15.4.1 const int picopter::GPS::FIX_TIMEOUT_DEFAULT = 2 [static],[protected]

The GPS fix timeout (in s)

7.15.4.2 const int GPS::WAIT_PERIOD = 200 [static],[protected]

The time checks waits when waiting for a fix (in ms)

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

- include/gps_feed.h
- src/base/gps.cpp

7.16 gps_data_t Struct Reference

Classes

- struct fix

Public Attributes

- struct gps_data_t::fix **fix**
- int **set**

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

- emulation/gps-emu/libgpsmm.h

7.17 picopter::GPSData Struct Reference

`#include <gps_feed.h>`

Public Member Functions

- **operator navigation::Coord2D** ()

Public Attributes

- GPSFix fix
- Uncertainty err
- double timestamp

7.17.1 Detailed Description

Stores information about the current GPS fix.

Todo Do we need the uncertainty in the timestamp too? 2D info enough?

7.17.2 Member Data Documentation

7.17.2.1 Uncertainty picopter::GPSData::err

The uncertainty in the current fix

7.17.2.2 GPSFix picopter::GPSData::fix

The coordinates of the current GPS fix

7.17.2.3 double picopter::GPSData::timestamp

The timestamp of the fix (Unix epoch in seconds w/ fractional)

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

- include/gps_feed.h

7.18 picopter::GPSFix Struct Reference

Public Attributes

- double lat
- double lon
- double alt
- double speed
- double heading
- double bearing

7.18.1 Member Data Documentation

7.18.1.1 double picopter::GPSFix::alt

The GPS altitude, in metres. Uncertainty in metres.

7.18.1.2 double picopter::GPSFix::bearing

The magnetic bearing, in radians, if available.

7.18.1.3 double picopter::GPSFix::heading

The heading (track angle), in radians. Uncertainty in radians.

7.18.1.4 double picopter::GPSFix::lat

The latitude, in radians. Uncertainty in metres.

7.18.1.5 double picopter::GPSFix::lon

The longitude, in radians. Uncertainty in metres.

7.18.1.6 double picopter::GPSFix::speed

The speed, in m/s. Uncertainty in m/s.

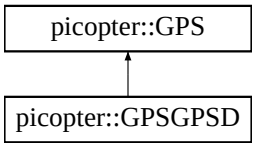
The documentation for this struct was generated from the following file:

- include/gps_feed.h

7.19 picopter::GPSGPSD Class Reference

`#include <gps_gpsd.h>`

Inheritance diagram for picopter::GPSGPSD:



Public Member Functions

- GPSGPSD ()
- GPSGPSD (Options *opts)
- virtual ~GPSGPSD () override

Additional Inherited Members

7.19.1 Detailed Description

Class that interacts with the GPS.

7.19.2 Constructor & Destructor Documentation

7.19.2.1 GPSGPSD::GPSGPSD ( )

Constructor. Constructs a new GPS with default settings.

7.19.2.2 GPSGPSD::GPSGPSD (Options * *opts*)

Constructor. Establishes a connection to gpsd, assuming it is running on the default gpsd port. Starts the worker thread to receive GPS data.

Parameters

opts	A pointer to options, if any (NULL for defaults)

Exceptions

std::invalid_argument	if a connection to gpsd cannot be established.

7.19.2.3 GPSGPSD::~GPSGPSD ( ) [override], [virtual]

Destructor. Stops the worker thread and waits for it to exit.

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

- include/gps_gpsd.h
- src/base/gps_gpsd.cpp

7.20 gpsmm Class Reference

Public Member Functions

- **gpsmm** (const char *host, const char *port)
- void * **stream** (int a)
- bool **waiting** (int timeout)
- struct gps_data_t * **read** ()

Public Attributes

- **LATLON_SET**

7.20.1 Member Data Documentation

7.20.1.1 gpsmm::LATLON_SET

Initial value:

```
{
            srand(time(NULL))
```

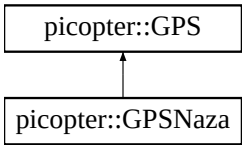
The documentation for this class was generated from the following file:

- emulation/gps-emu/libgpsmm.h

7.21 picopter::GPSNaza Class Reference

```
#include <gps_naza.h>
```

Inheritance diagram for picopter::GPSNaza:



Public Member Functions

- GPSNaza ()
- GPSNaza (Options *opts)
- virtual ~GPSNaza () override

Additional Inherited Members

7.21.1 Detailed Description

Class that interacts with the GPS.

7.21.2 Constructor & Destructor Documentation

7.21.2.1 GPSNaza::GPSNaza ( )

Constructor. Constructs a new GPS with default settings.

7.21.2.2 GPSNaza::GPSNaza (Options * *opts*)

Constructor. Opens the RPi's serial port and reads off data.

7.21.2.3 GPSNaza::~GPSNaza ( ) [override], [virtual]

Destructor. Stops the worker thread and waits for it to exit.

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

- include/gps_naza.h
- src/base/gps_naza.cpp

7.22 picopter::IMU Class Reference

`#include <imu_feed.h>`

Public Member Functions

- IMU ()
- IMU (Options *opts)
- virtual ~IMU ()
- void GetLatest (IMUData *d)

7.22.1 Detailed Description

Reads data from the IMU

7.22.2 Constructor & Destructor Documentation

7.22.2.1 IMU::IMU ( )

Constructor. Constructs IMU with default options.

7.22.2.2 IMU::IMU (Options * *opts*)

Constructor. Uses the XSens library to establish a connection to the IMU. Once established, starts the worker thread to receive data from the IMU.

Parameters

opts	A pointer to options, if any (NULL for defaults)

Exceptions

std::invalid_argument	if IMU intialisation fails (e.g. disconnected)

7.22.2.3 IMU::~IMU ( ) [virtual]

Destructor. Stops the worker thread and closes the connection to the IMU.

7.22.3 Member Function Documentation

7.22.3.1 void IMU::GetLatest (IMUData * *d*)

Get the latest IMU data, if available. Unavailable values are indicated with NaN.

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

- include/imu_feed.h
- src/base/imu.cpp

7.23 picopter::Lawnmower Class Reference

`#include <lawnmower.h>`

Public Member Functions

- **Lawnmower** (FlightController &fc, Options *opts)
- void **Run** (Coordinates p1, Coordinates p2)

7.23.1 Detailed Description

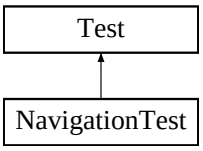
Class to fly the hexacopter in a lawnmower pattern.

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

- include/lawnmower.h

7.24 NavigationTest Class Reference

Inheritance diagram for NavigationTest:



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

- test/test_navigation.cpp

7.25 NazaDecoderLib Class Reference

Public Types

- enum **gps_fix_t** { **NO_FIX** = 0, **FIX_2D** = 2, **FIX_3D** = 3, **FIX_DGPS** = 4 }

Public Member Functions

- uint8_t **decode** (int input)
- double **getLat** ()
- double **getLon** ()
- double **getGpsAlt** ()
- double **getSpeed** ()
- gps_fix_t **getFixType** ()
- uint8_t **getNumSat** ()
- double **getHeadingNc** ()
- double **getCog** ()
- double **getGpsVsi** ()
- double **getHdop** ()
- double **getVdop** ()
- uint8_t **getYear** ()
- uint8_t **getMonth** ()
- uint8_t **getDay** ()
- uint8_t **getHour** ()
- uint8_t **getMinute** ()
- uint8_t **getSecond** ()
- int16_t **getMagXRaw** ()
- int16_t **getMagYRaw** ()
- int16_t **getMagZRaw** ()
- double **getMagXVal** ()
- double **getMagYVal** ()
- double **getMagZVal** ()

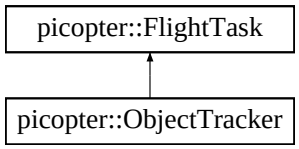
The documentation for this class was generated from the following files:

- include/NazaDecoderLib.h
- src/base/NazaDecoderLib.cpp

7.26 picopter::ObjectTracker Class Reference

`#include <object_tracker.h>`

Inheritance diagram for picopter::ObjectTracker:



Public Types

- enum **TrackMethod** { **TRACK_STRAFE**, **TRACK_ROTATE** }

Public Member Functions

- **ObjectTracker** (int camwidth, int camheight, TrackMethod method=TRACK_STRAFE)
- **ObjectTracker** (Options ∗opts, int camwidth, int camheight, TrackMethod method=TRACK_STRAFE)
- TrackMethod **GetTrackMethod** ()
- void **SetTrackMethod** (TrackMethod method)
- void Run (FlightController ∗fc, void ∗opts) override

Additional Inherited Members

7.26.1 Detailed Description

Class for moving the hexacopter through waypoints.

7.26.2 Member Function Documentation

7.26.2.1 void ObjectTracker::Run (FlightController ∗ *fc*, void ∗ *opts*) [override], [virtual]

The method that will be called by the flight controller to perform the task.

Parameters

fc	The pointer to the calling flight controller
opts	Task-specific options.

Implements picopter::FlightTask.

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

- include/object_tracker.h
- src/modules/object_tracker.cpp

7.27 picopter::Options Class Reference

`#include <opts.h>`

Public Member Functions

- Options ()
- Options (const char *file)
- virtual ~Options ()
- void SetFamily (const char *family)
- int GetInt (const char *key, int otherwise=0)
- bool GetBool (const char *key, bool otherwise=false)
- const char * GetString (const char *key, const char *otherwise="")
- double GetReal (const char *key, double otherwise=0.0f)
- void Set (const char *key, int val)
- void Set (const char *key, bool val)
- void Set (const char *key, const char *val)
- void Set (const char *key, double val)
- bool Remove (const char *key)
- void Save ()
- void Save (const char *file)
- void Save (FILE *fp)

7.27.1 Detailed Description

Provides methods to persistently store and retrieve options. This class is not thread safe.

7.27.2 Constructor & Destructor Documentation

7.27.2.1 Options::Options ( )

Constructs an options class with no initial file. This is the same as calling Options::Options(NULL).

7.27.2.2 Options::Options (const char * *file*)

Constructor. Initialised empty, optionally loading from a file.

Parameters

file	The location of a file containing options, or NULL if not present.

7.27.2.3 Options::~Options ( ) [virtual]

Destructor. Deletes the rapidjson instance.

7.27.3 Member Function Documentation

7.27.3.1 bool Options::GetBool (const char * *key*, bool *otherwise* = false)

Retrieves the Boolean value associated with a key.

Parameters

key	The key to the value.

otherwise	The value to return if it does not exist.

Returns

The retrieved value, or `otherwise` if it does not exist.

7.27.3.2 int Options::GetInt (const char * *key*, int *otherwise* = `0`)

Retrieves the integer value associated with a key.

Parameters

key	The key to the value.
otherwise	The value to return if it does not exist.

Returns

The retrieved value, or `otherwise` if it does not exist.

7.27.3.3 double Options::GetReal (const char * *key*, double *otherwise* = `0.0f`)

Retrieves the Real (double precision) value associated with a key.

Parameters

key	The key to the value.
otherwise	The value to return if it does not exist.

Returns

The retrieved value, or `otherwise` if it does not exist.

7.27.3.4 const char * Options::GetString (const char * *key*, const char * *otherwise* = `""`)

Retrieves the string value associated with a key.

Parameters

key	The key to the value.
otherwise	The value to return if it does not exist.

Returns

The retrieved value, or `otherwise` if it does not exist. This value must not be modified. It will only be valid until this parameter is modified (via Set or Remove), or in the case of `otherwise` being returned, until that value is either freed or goes out of scope.

7.27.3.5 bool Options::Remove (const char * *key*)

Removes a value.

Parameters

key	The key to the value.
val	The value to be stored.

7.27.3.6 void Options::Save ( )

Saves the current settings to a file. Will save to the file that was specified on construction.

Exceptions

std::invalid_argument	If no file has been set previously.

7.27.3.7 void Options::Save (const char * *file*)

Saves the current settings to the specified file. Will keep a copy of the specified path for use with Save().

7.27.3.8 void Options::Save (FILE * *fp*)

Saves the current settings to the specified stream.

7.27.3.9 void Options::Set (const char * *key*, int *val*)

Stores an integer value.

Parameters

key	The key to the value.
val	The value to be stored.

7.27.3.10 void Options::Set (const char * *key*, bool *val*)

Stores an Boolean value.

Parameters

key	The key to the value.
val	The value to be stored.

7.27.3.11 void Options::Set (const char * *key*, const char * *val*)

Specialisation of Options::SetImpl to store strings. This specialisation is necessary because the value must be copied. rapidjson requires that (a.) it explicitly be copied, or that (b.) it will retain a reference that is guaranteed to be valid for longer than itself.

Parameters

key	The key to the value.
val	The value to be stored.

7.27.3.12 void Options::Set (const char * *key*, double *val*)

Stores an Real value.

Parameters

key	The key to the value.
val	The value to be stored.

7.27.3.13 void Options::SetFamily (const char * *family*)

Sets the family under which to store and retrieve settings from.

Parameters

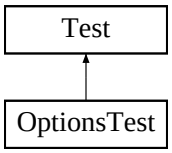
family	The name of the family. If NULL, it will default to Options::FAMILY_DEFAULT.

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

- include/opts.h
- src/base/opts.cpp

7.28 OptionsTest Class Reference

Inheritance diagram for OptionsTest:



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

- test/test_opts.cpp

7.29 picopter::PID Class Reference

`#include <PID.h>`

Public Member Functions

- PID (float Kc, float tauI, float tauD, float interval)
- void SetInputLimits (float inMin, float inMax)
- void SetOutputLimits (float outMin, float outMax)
- void SetTunings (float Kc, float tauI, float tauD)
- void Reset (void)
- void SetMode (int mode)
- void SetInterval (float interval)
- void SetSetPoint (float sp)
- void SetProcessValue (float pv)
- void SetBias (float bias)
- float Compute (void)
- float **GetInMin** ()
- float **GetInMax** ()
- float **GetOutMin** ()

- float **GetOutMax** ()
- float **GetInterval** ()
- float **GetPParam** ()
- float **GetIParam** ()
- float **GetDParam** ()

7.29.1 Detailed Description

Proportional-integral-derivative controller.

7.29.2 Constructor & Destructor Documentation

7.29.2.1 PID::PID (float *Kc,* float *taul,* float *tauD,* float *interval*)

Constructor.

Sets default limits [0-3.3V], calculates tuning parameters, and sets manual mode with no bias.

Parameters

Kc	- Tuning parameter
taul	- Tuning parameter
tauD	- Tuning parameter
interval	PID calculation performed every interval seconds.

7.29.3 Member Function Documentation

7.29.3.1 float PID::Compute (void)

PID calculation.

Returns

The controller output as a float between outMin and outMax.

7.29.3.2 void PID::Reset (void)

Reinitializes controller internals. Automatically called on a manual to auto transition.

7.29.3.3 void PID::SetBias (float *bias*)

Set the bias.

Parameters

bias	The bias for the controller output.

7.29.3.4 void PID::SetInputLimits (float *inMin,* float *inMax*)

Scale from inputs to 0-100%.

Parameters

InMin	The real world value corresponding to 0%.
InMax	The real world value corresponding to 100%.

7.29.3.5 void PID::SetInterval (float *interval*)

Set how fast the PID loop is run.

Parameters

interval	PID calculation peformed every interval seconds.

7.29.3.6 void PID::SetMode (int *mode*)

Set PID to manual or auto mode.

Parameters

mode	0 -> Manual Non-zero -> Auto

7.29.3.7 void PID::SetOutputLimits (float *outMin,* float *outMax*)

Scale from outputs to 0-100%.

Parameters

outMin	The real world value corresponding to 0%.
outMax	The real world value corresponding to 100%.

7.29.3.8 void PID::SetProcessValue (float *pv*)

Set the process value.

Parameters

pv	The process value as a real world value.

7.29.3.9 void PID::SetSetPoint (float *sp*)

Set the set point.

Parameters

sp	The set point as a real world value.

7.29.3.10 void PID::SetTunings (float *Kc,* float *taul,* float *tauD*)

Calculate PID constants.

Allows parameters to be changed on the fly without ruining calculations.

Parameters

Kc	- Tuning parameter
tauI	- Tuning parameter
tauD	- Tuning parameter

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

- include/PID.h
- src/base/PID.cpp

7.30 picopter::navigation::Point2D Struct Reference

`#include <navigation.h>`

Public Member Functions

- double magnitude ()

Public Attributes

- double x
- double y

7.30.1 Detailed Description

Holds a 2-dimensional position in Cartesian space.

7.30.2 Member Function Documentation

7.30.2.1 double picopter::navigation::Point2D::magnitude ( ) [inline]

Returns the vector magnitude.

7.30.3 Member Data Documentation

7.30.3.1 double picopter::navigation::Point2D::x

x-coordinate.

7.30.3.2 double picopter::navigation::Point2D::y

y-coordinate.

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

- include/navigation.h

7.31 picopter::navigation::Point3D Struct Reference

`#include <navigation.h>`

Public Member Functions

- operator Point2D ()
- double magnitude ()

Public Attributes

- double x
- double y
- double z

7.31.1 Detailed Description

Holds a 3-dimensional position in Cartesian space.

7.31.2 Member Function Documentation

7.31.2.1 double picopter::navigation::Point3D::magnitude ( ) [inline]

Returns the vector magnitude.

7.31.2.2 picopter::navigation::Point3D::operator Point2D ( ) [inline]

Implicit conversion to 2D coordinate.

7.31.3 Member Data Documentation

7.31.3.1 double picopter::navigation::Point3D::x

x-coordinate.

7.31.3.2 double picopter::navigation::Point3D::y

y-coordinate.

7.31.3.3 double picopter::navigation::Point3D::z

z-coordinate.

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

- include/navigation.h

7.32 vec2 Struct Reference

Public Attributes

- int **x**
- int **y**

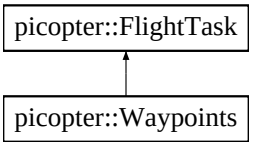
The documentation for this struct was generated from the following file:

- src/base/camera_stream.cpp

7.33 picopter::Waypoints Class Reference

`#include <waypoints.h>`

Inheritance diagram for picopter::Waypoints:



Public Member Functions

- **Waypoints** (std::deque< navigation::Coord2D > pts, WaypointMethod method)
- **Waypoints** (Options *opts, std::deque< navigation::Coord2D > pts, WaypointMethod method)
- void Run (FlightController *fc, void *opts) override

Additional Inherited Members

7.33.1 Detailed Description

Class for moving the hexacopter through waypoints.

7.33.2 Member Function Documentation

7.33.2.1 void Waypoints::Run (FlightController * *fc*, void * *opts*) [override], [virtual]

The method that will be called by the flight controller to perform the task.

Parameters

fc	The pointer to the calling flight controller
opts	Task-specific options.

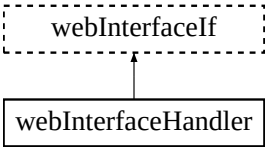
Implements picopter::FlightTask.

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

- include/waypoints.h
- src/modules/waypoints.cpp

7.34 webInterfaceHandler Class Reference

Inheritance diagram for webInterfaceHandler:



Public Member Functions

- **webInterfaceHandler** (Options *opts, std::unique_ptr< picopter::FlightController > &fc)
- bool **beginWaypointsThread** ()
- bool **beginLawnmowerThread** ()
- bool **beginUserTrackingThread** ()
- bool **beginObjectTrackingThread** (const int32_t method)
- int32_t **setCameraMode** (int32_t mode)
- int32_t **requestCameraMode** ()
- bool **setCameraLearningSize** (bool decrease)
- bool **showLearningThreshold** (bool show)
- void **doCameraAutoLearning** (std::map< std::string, int32_t > &_return)
- void **setCameraLearningValues** (std::map< std::string, int32_t > &_return, const std::map< std::string, int32_t > &values)
- int32_t **requestLearningHue** ()
- bool **allStop** ()
- void **requestStatus** (std::string &_return)
- void **requestCoords** (coordDeg &_return)
- double **requestBearing** ()
- void **requestNextWaypoint** (coordDeg &_return)
- bool **updateUserPosition** (const coordDeg &wpt)
- bool **updateWaypoints** (const std::vector< coordDeg > &wpts)
- bool **resetWaypoints** ()

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

- src/server/picopter.cpp

Chapter 8

File Documentation

8.1 emulation/gps-emu/libgpsmm.h File Reference

A *very thin* emulation of libgpsmm. Will always return that there is data, but with all values zeroed. Data will randomly be marked as set or unset.

```
#include <config.h>
#include <thread>
#include <chrono>
#include <cstdlib>
```

Classes

- struct gps_data_t
- struct gps_data_t::fix
- class gpsmm

Macros

- #define **DEFAULT_GPSD_PORT** ""
- #define **WATCH_ENABLE** 1
- #define **WATCH_JSON** 1
- #define **ONLINE_SET** (1llu<<1)
- #define **TIME_SET** (1llu<<2)
- #define **TIMERR_SET** (1llu<<3)
- #define **LATLON_SET** (1llu<<4)
- #define **ALTITUDE_SET** (1llu<<5)
- #define **SPEED_SET** (1llu<<6)
- #define **TRACK_SET** (1llu<<7)
- #define **CLIMB_SET** (1llu<<8)
- #define **STATUS_SET** (1llu<<9)
- #define **MODE_SET** (1llu<<10)
- #define **DOP_SET** (1llu<<11)
- #define **HERR_SET** (1llu<<12)
- #define **VERR_SET** (1llu<<13)
- #define **ATTITUDE_SET** (1llu<<14)
- #define **SATELLITE_SET** (1llu<<15)
- #define **SPEEDERR_SET** (1llu<<16)
- #define **TRACKERR_SET** (1llu<<17)

- #define **CLIMBERR_SET** (1llu<<18)
- #define **DEVICE_SET** (1llu<<19)
- #define **DEVICELIST_SET** (1llu<<20)
- #define **DEVICEID_SET** (1llu<<21)
- #define **RTCM2_SET** (1llu<<22)
- #define **RTCM3_SET** (1llu<<23)
- #define **AIS_SET** (1llu<<24)
- #define **PACKET_SET** (1llu<<25)
- #define **SUBFRAME_SET** (1llu<<26)
- #define **GST_SET** (1llu<<27)
- #define **VERSION_SET** (1llu<<28)
- #define **POLICY_SET** (1llu<<29)
- #define **LOGMESSAGE_SET** (1llu<<30)
- #define **ERROR_SET** (1llu<<31)
- #define **TIMEDRIFT_SET** (1llu<<32)
- #define **EOF_SET** (1llu<<33)

8.1.1 Detailed Description

A *very thin* emulation of libgpsmm. Will always return that there is data, but with all values zeroed. Data will randomly be marked as set or unset.

8.2 emulation/wiringPi.h File Reference

Simple stub file to get 'wiringPi' when not compiling on the RPi.

Macros

- #define **wiringPiSetup**()
- #define **pinMode**(pin, mode)
- #define **digitalRead**(pin) 1
- #define **digitalWrite**(pin, value)
- #define **HIGH** 1
- #define **LOW** 0
- #define **delayMicroseconds**(x) (std::this_thread::sleep_for(std::chrono::microseconds(x)))

8.2.1 Detailed Description

Simple stub file to get 'wiringPi' when not compiling on the RPi.

8.3 emulation/wiringSerial.h File Reference

Simple stub file to get 'wiringSerial' when not compiling on the RPi.

Macros

- #define **serialOpen**(A, B) 0
- #define **serialDataAvail**(fd) 0
- #define **serialGetchar**(fd) fd
- #define **serialClose**(fd)

8.3.1 Detailed Description

Simple stub file to get 'wiringSerial' when not compiling on the RPi.

8.4 include/buzzer.h File Reference

Methods to control the buzzer.

Classes

- class picopter::Buzzer

8.4.1 Detailed Description

Methods to control the buzzer.

8.5 include/camera_stream.h File Reference

```
#include "common.h"
#include "navigation.h"
#include <opencv2/opencv.hpp>
```

Classes

- struct picopter::CamWindow
- class picopter::CameraStream

Macros

- #define **STREAM_FILE** "/mnt/ramdisk/out.jpg"
- #define **LOOKUP_SIZE** 8
- #define **CHAR_SIZE** 256
- #define **CAMERA_OK** 0

8.5.1 Detailed Description

Author

Michael Baxter 20503664@student.uwa.edu.au
Jeremy Tan 20933708@student.uwa.edu.au

Class used to start camera stream.

Wonderful omni-function camera streaming action fun!

8.6 include/common.h File Reference

Commonly included headers.

```
#include "config.h"
#include "log.h"
#include "datalog.h"
#include <cstdio>
#include <cstdlib>
#include <cstring>
#include <iostream>
#include <string>
#include <vector>
#include <deque>
#include <map>
#include <stdint.h>
#include "opts.h"
#include <thread>
#include <future>
#include <mutex>
#include <condition_variable>
#include <atomic>
```

Functions

- template<typename T >
  T **picopter::clamp** (const T &n, const T &lower, const T &upper)

8.6.1 Detailed Description

Commonly included headers.

8.7 include/config.h File Reference

System-specific and compile-time specific configuration parameters.

Macros

- #define **PICOPTER_VERSION** "eddba9ba81c0e3b3b822e310bb862e9c397b9b39"
- #define **PICOPTER_DATE** "2015-05-15 17:17:34 +0800"
- #define **PICOPTER_HOME_LOCATION** "/home/jeremy"
- #define **PICOPTER_LOG_LOCATION** "/home/jeremy/logs"
- #define **USE_SYSLOG**
- #define **IS_REAL_LIBGPS**

8.7.1 Detailed Description

System-specific and compile-time specific configuration parameters.

8.8 include/datalog.h File Reference

Declaration of functions for data logging.

```
#include "config.h"
#include <cstdio>
```

Classes

- class picopter::DataLog

8.8.1 Detailed Description

Declaration of functions for data logging.

8.9 include/flightboard.h File Reference

Defines the FlightBoard class.

Classes

- struct picopter::FlightData
- class picopter::FlightBoard

Typedefs

- typedef struct picopter::FlightData **picopter::FlightData**

8.9.1 Detailed Description

Defines the FlightBoard class.

8.10 include/flightcontroller.h File Reference

Defines the FlightController class.

```
#include "buzzer.h"
#include "gps_gpsd.h"
#include "gps_naza.h"
#include "imu_feed.h"
#include "flightboard.h"
#include "camera_stream.h"
```

Classes

- class picopter::FlightController
- class picopter::FlightTask

Typedefs

- typedef enum picopter::ControllerState **picopter::ControllerState**
- typedef enum picopter::TaskIdentifier **picopter::TaskIdentifier**

Enumerations

- enum **ControllerState** {
  picopter::STATE_STOPPED, **picopter::STATE_GPS_WAIT_FOR_FIX**, **picopter::STATE_AWAITING_↩AUTH**, **picopter::STATE_INFER_BEARING**,
  picopter::STATE_WAYPOINTS_MOVING, **picopter::STATE_WAYPOINTS_IDLING**, **picopter::STATE↩_WAYPOINTS_FINISHED**, **picopter::STATE_TRACKING_SEARCHING**,
  picopter::STATE_TRACKING_LOCKED }
- enum **TaskIdentifier** {
  picopter::TASK_NONE, **picopter::TASK_WAYPOINTS**, **picopter::TASK_LAWNMOWER**, **picopter::T↩ASK_OBJECT_TRACKING**,
  picopter::TASK_USER_TRACKING, **picopter::TASK_SPIRAL_SEARCH** }

8.10.1 Detailed Description

Defines the FlightController class.

8.11 include/gpio.h File Reference

gpio class defines

Namespaces

- picopter::gpio

Functions

- void picopter::gpio::Init ()
- bool picopter::gpio::IsAutoMode ()
- void picopter::gpio::SetBuzzer (bool value)

Variables

- const int picopter::gpio::MODE_PIN = 5
- const int picopter::gpio::BUZZER_PIN = 2

8.11.1 Detailed Description

gpio class defines

8.12 include/gps_feed.h File Reference

Base GPS header.

```
#include "navigation.h"
```

Classes

- struct picopter::GPSFix
- struct picopter::GPSData
- class picopter::GPS

Typedefs

- typedef struct picopter::GPSFix **picopter::GPSFix**
- typedef GPSFix **picopter::Uncertainty**
- typedef struct picopter::GPSData **picopter::GPSData**

8.12.1 Detailed Description

Base GPS header.

8.13 include/gps_gpsd.h File Reference

GPS header for the gpsd implementation.

```
#include "gps_feed.h"
```

Classes

- class picopter::GPSGPSD

8.13.1 Detailed Description

GPS header for the gpsd implementation.

8.14 include/gps_naza.h File Reference

GPS header for the NAZA implementation.

```
#include "gps_feed.h"
```

Classes

- class picopter::GPSNaza

8.14.1 Detailed Description

GPS header for the NAZA implementation.

8.15 include/imu_feed.h File Reference

Defines the IMU class.

```
#include "navigation.h"
```

Classes

- class picopter::IMU

Typedefs

- typedef navigation::EulerAngle **picopter::IMUData**

8.15.1 Detailed Description

Defines the IMU class.

8.16 include/lawnmower.h File Reference

Defines the lawnmower controls.

Classes

- class picopter::Lawnmower

8.16.1 Detailed Description

Defines the lawnmower controls.

8.17 include/log.h File Reference

Declaration of functions for printing log messages and/or terminating program after a fatal error.

```
#include "config.h"
#include <syslog.h>
```

Macros

- #define **Log**(level, ...) LogEx(level, __PRETTY_FUNCTION__, __FILENAME__, __LINE__, __VA_ARGS↩__)
- #define **Fatal**(...) FatalEx(__PRETTY_FUNCTION__, __FILENAME__, __LINE__, __VA_ARGS__)

Functions

- void LogInit ()
- void LogSimple (int level, const char ∗fmt,...)

- void LogEx (int level, const char *funct, const char *file, int line,...)
- void FatalEx (const char *funct, const char *file, int line,...)

8.17.1 Detailed Description

Declaration of functions for printing log messages and/or terminating program after a fatal error.

8.17.2 Function Documentation

8.17.2.1 void FatalEx (const char * *funct*, const char * *file*, int *line*, ...)

Handle a Fatal error in the program by printing a message and exiting the program CALLING THIS FUNCTION WILL CAUSE THE PROGAM TO EXIT

Parameters

funct	- Name of the calling function
file	- Name of the source file containing the calling function
line	- Line in the source file at which Fatal is called
fmt	- A format string
...	- Arguments to be printed according to the format string

8.17.2.2 void LogEx (int *level*, const char * *funct*, const char * *file*, int *line*, ...)

Print a message to stderr and log it via syslog. The message must be less than BUFSIZ characters long, or it will be truncated.

Parameters

level	Specify how severe the message is. If level is higher (less urgent) than the program's verbosity (see options.h) no message will be printed.
funct	String indicating the function name from which this function was called. If this is NULL, Log will show the unspecified_funct string instead.
file	Source file containing the function
line	Line in the source file at which Log is called
fmt	A format string
...	Arguments to be printed according to the format string

8.17.2.3 void LogInit ( )

Initialises the logger. Should be called at the start of a program.

8.17.2.4 void LogSimple (int *level*, const char * *fmt*, ...)

Print a message to stderr and log it via syslog. The message must be less than BUFSIZ characters long, or it will be truncated. This is a simple version that does not print the line number/file from which the call was made.

Parameters

level	Specify how severe the message is. If level is higher (less urgent) than the program's verbosity (see options.h) no message will be printed.

fmt	A format string
...	Arguments to be printed according to the format string

8.18 include/navigation.h File Reference

General navigation code.

```
#include <cmath>
```

Classes

- struct picopter::navigation::Coord2D
- struct picopter::navigation::Coord3D
- struct picopter::navigation::Point2D
- struct picopter::navigation::Point3D
- struct picopter::navigation::EulerAngle

Macros

- #define **_USE_MATH_DEFINES**
- #define RADIUS_OF_EARTH 6364.963
- #define **RAD2DEG**(x) ((x) ∗ (180.0 / M_PI))
- #define **DEG2RAD**(x) ((x) ∗ (M_PI / 180.0))
- #define **sin2**(x) (sin(x) ∗ (sin(x)))

Typedefs

- typedef struct picopter::navigation::Coord2D **picopter::navigation::Coord2D**
- typedef struct picopter::navigation::Coord3D **picopter::navigation::Coord3D**
- typedef struct picopter::navigation::Point2D **picopter::navigation::Point2D**
- typedef struct picopter::navigation::Point3D **picopter::navigation::Point3D**
- typedef struct picopter::navigation::EulerAngle **picopter::navigation::EulerAngle**

Functions

- template<typename Coord1 , typename Coord2 , typename Coord3 >
  bool **picopter::navigation::CoordInBounds** (Coord1 here, Coord2 bl, Coord3 tr)
- template<typename Coord >
  void **picopter::navigation::CoordInRadians** (Coord &a)
- template<typename Coord >
  void **picopter::navigation::CoordInDegrees** (Coord &a)
- template<typename Coord1 , typename Coord2 >
  double **picopter::navigation::CoordDistance** (Coord1 from, Coord2 to)
- template<typename Coord1 , typename Coord2 >
  double **picopter::navigation::CoordBearing** (Coord1 from, Coord2 to)

Variables

- const Coord2D **picopter::navigation::PERTH_BL** = {-33, 115}
- const Coord2D **picopter::navigation::PERTH_TR** = {-31, 117}

8.18.1 Detailed Description

General navigation code.

8.18.2 Macro Definition Documentation

8.18.2.1 #define RADIUS_OF_EARTH 6364.963

Radius of the earth (Australian tuned; in km)

8.19 include/object_tracker.h File Reference

The header file for the object tracking code.

```
#include "flightcontroller.h"
#include "navigation.h"
#include "PID.h"
```

Classes

- class picopter::ObjectTracker

8.19.1 Detailed Description

The header file for the object tracking code.

8.20 include/opts.h File Reference

Header for handling options and persistent configurations.

Classes

- class picopter::Options

8.20.1 Detailed Description

Header for handling options and persistent configurations.

8.21 include/picopter.h File Reference

The main include file.

```
#include "common.h"
#include "gpio.h"
#include "buzzer.h"
#include "navigation.h"
#include "gps_feed.h"
#include "imu_feed.h"
#include "flightboard.h"
#include "flightcontroller.h"
#include "waypoints.h"
#include "object_tracker.h"
```

8.21.1 Detailed Description

The main include file.

8.22 include/waypoints.h File Reference

The header file for the waypoints code.

```
#include "flightcontroller.h"
#include "PID.h"
```

Classes

- class picopter::Waypoints

Typedefs

- typedef enum picopter::WaypointMethod **picopter::WaypointMethod**

Enumerations

- enum **WaypointMethod** { **WAYPOINT_SIMPLE** }

8.22.1 Detailed Description

The header file for the waypoints code.

8.23 src/apps/naza_decoder.cpp File Reference

Sample application to decode and print out NAZA gps data.

```
#include "common.h"
#include "navigation.h"
#include "NazaDecoderLib.h"
#include <cmath>
#include <wiringPi.h>
#include <wiringSerial.h>
```

Functions

- void decodeMessage (NazaDecoderLib &decoder, uint8_t buf)
- int main (int argc, char ∗argv[ ])

8.23.1 Detailed Description

Sample application to decode and print out NAZA gps data.

8.23.2 Function Documentation

8.23.2.1 void decodeMessage (NazaDecoderLib & *decoder,* uint8_t *buf*)

Decode the bytestream and print the decoded message when available.

Parameters

decoder	The NAZA GPS decoder
buf	The current byte in the raw bytestream

8.23.2.2 int main (int *argc,* char ∗ *argv[ ]*)

Main entry point.

8.24 src/apps/speedcal.cpp File Reference

Application to determine relation between input and speed.

```
#include "picopter.h"
#include <signal.h>
```

Functions

- int **main** (int argc, char ∗argv[ ])

8.24.1 Detailed Description

Application to determine relation between input and speed.

8.25 src/base/buzzer.cpp File Reference

Buzzer manipulation code. Uses wiringPi and a GPIO pin for driving the buzzer with software based PWM.

```
#include "common.h"
#include "gpio.h"
#include "buzzer.h"
#include <wiringPi.h>
```

Typedefs

- using **hrc** = std::chrono::high_resolution_clock

8.25.1 Detailed Description

Buzzer manipulation code. Uses wiringPi and a GPIO pin for driving the buzzer with software based PWM.

8.26 src/base/camera_stream.cpp File Reference

```
#include "common.h"
#include "camera_stream.h"
#include <queue>
```

Classes

- struct CamComponent
- struct vec2

Macros

- #define **BLACK** 0
- #define **WHITE** 255

Functions

- template<typename T1 , typename T2 , typename T3 >
  T3 **GetFromMap** (T1 &m, T2 val, T3 otherwise)

8.26.1 Detailed Description

Author

Michael Baxter 20503664@student.uwa.edu.au
Jeremy Tan 20933708@student.uwa.edu.au

Camera functions

8.27 src/base/datalog.cpp File Reference

Implement data logging functions.

```
#include "common.h"
#include "datalog.h"
#include <ctime>
#include <cstdarg>
```

8.27.1 Detailed Description

Implement data logging functions.

8.28 src/base/flightboard-private.h File Reference

Contains calibration data and pin mappings for the FlightBoard class. Note: The unit 'step' is ServoBlaster specific. Usually 1 step is 10us.

Macros

- #define LINEAR_SCALE(x, xl, xh, yl, yh) ((yl) + (((yh) - (yl)) ∗ ((x) - (xl))) / ((xh) - (xl)))
- #define SPEED_SCALE(speed, yl, yh) LINEAR_SCALE(speed, -100, 100, yl, yh)
- #define **INV_SPEED_SCALE**(val, yl, yh) LINEAR_SCALE(val, yl, yh, -100, 100)
- #define AILERON_CHANNEL 0
- #define AILERON_PIN_PHYSICAL 11
- #define AILERON_LOW 111
- #define AILERON_HIGH 193
- #define AILERON_SCALE(x) SPEED_SCALE(x, AILERON_LOW, AILERON_HIGH)
- #define **INV_AILERON_SCALE**(x) INV_SPEED_SCALE(x, AILERON_LOW, AILERON_HIGH)
- #define ELEVATOR_CHANNEL 1
- #define ELEVATOR_PIN_PHYSICAL 12
- #define ELEVATOR_LOW 111
- #define ELEVATOR_HIGH 195
- #define ELEVATOR_SCALE(x) SPEED_SCALE(x, ELEVATOR_LOW, ELEVATOR_HIGH)
- #define **INV_ELEVATOR_SCALE**(x) INV_SPEED_SCALE(x, ELEVATOR_LOW, ELEVATOR_HIGH)
- #define RUDDER_CHANNEL 2
- #define RUDDER_PIN_PHYSICAL 15
- #define RUDDER_LOW 110
- #define RUDDER_HIGH 194
- #define RUDDER_SCALE(x) SPEED_SCALE(x, RUDDER_LOW, RUDDER_HIGH)
- #define **INV_RUDDER_SCALE**(x) INV_SPEED_SCALE(x, RUDDER_LOW, RUDDER_HIGH)
- #define GIMBAL_CHANNEL 3
- #define GIMBAL_PIN_PHYSICAL 16
- #define GIMBAL_LOW 95
- #define GIMBAL_HIGH 210
- #define GIMBAL_SCALE(x) LINEAR_SCALE(x, 0, 90, GIMBAL_LOW, GIMBAL_HIGH)
- #define **INV_GIMBAL_SCALE**(x) LINEAR_SCALE(x, GIMBAL_LOW, GIMBAL_HIGH, 0, 90)

8.28.1 Detailed Description

Contains calibration data and pin mappings for the FlightBoard class. Note: The unit 'step' is ServoBlaster specific. Usually 1 step is 10us.

8.28.2 Macro Definition Documentation

8.28.2.1 #define AILERON_CHANNEL 0

The ServoBlaster channel for the aileron

8.28.2.2 #define AILERON_HIGH 193

The upper bound for the pulse width (in steps) of the aileron

8.28.2.3 #define AILERON_LOW 111

The lower bound for the pulse width (in steps) of the aileron

8.28.2.4 #define AILERON_PIN_PHYSICAL 11

The actual (physical) pin number for the aileron

8.28.2.5 #define AILERON_SCALE(*x*) SPEED_SCALE(x, AILERON_LOW, AILERON_HIGH)

Scales the aileron speed to the corresponding PWM range

8.28.2.6 #define ELEVATOR_CHANNEL 1

The ServoBlaster channel for the elevator

8.28.2.7 #define ELEVATOR_HIGH 195

The upper bound for the pulse width (in steps) of the elevator

8.28.2.8 #define ELEVATOR_LOW 111

The lower bound for the pulse width (in steps) of the elevator

8.28.2.9 #define ELEVATOR_PIN_PHYSICAL 12

The actual (physical) pin number for the elevator

8.28.2.10 #define ELEVATOR_SCALE(*x*) SPEED_SCALE(x, ELEVATOR_LOW, ELEVATOR_HIGH)

Scales the elevator speed to the corresponding PWM range

8.28.2.11 #define GIMBAL_CHANNEL 3

The ServoBlaster channel for the gimbal

8.28.2.12 #define GIMBAL_HIGH 210

The upper bound for the pulse width (in steps) of the gimbal

8.28.2.13 #define GIMBAL_LOW 95

The lower bound for the pulse width (in steps) of the gimbal

8.28.2.14 #define GIMBAL_PIN_PHYSICAL 16

The actual (physical) pin number for the gimbal

8.28.2.15 #define GIMBAL_SCALE(*x*) LINEAR_SCALE(x, 0, 90, GIMBAL_LOW, GIMBAL_HIGH)

Scales the gimbal angle (0 - 90) to the corresponding PWM range

8.28.2.16 #define LINEAR_SCALE(*x, xl, xh, yl, yh*) ((yl) + (((yh) - (yl)) ∗ ((x) - (xl))) / ((xh) - (xl)))

Linearly scales from one range to another range.

Parameters

x	The input value (assumed that xl $<$ x $<$ xh)
xl	The lower bound on the input scale
xh	The upper bound on the input scale
yl	The lower bound on the output scale
yh	The upper bound on the output scale

8.28.2.17 #define RUDDER_CHANNEL 2

The ServoBlaster channel for the rudder

8.28.2.18 #define RUDDER_HIGH 194

The upper bound for the pulse width (in steps) of the rudder

8.28.2.19 #define RUDDER_LOW 110

The lower bound for the pulse width (in steps) of the rudder

8.28.2.20 #define RUDDER_PIN_PHYSICAL 15

The actual (physical) pin number for the rudder

8.28.2.21 #define RUDDER_SCALE(*x*) SPEED_SCALE(x, RUDDER_LOW, RUDDER_HIGH)

Scales the rudder speed to the corresponding PWM range

8.28.2.22 #define SPEED_SCALE(*speed, yl, yh*) LINEAR_SCALE(speed, -100, 100, yl, yh)

Helper to scale a speed (-100 to 100) value

8.29 src/base/flightboard.cpp File Reference

Controls the output to the flight board. Calculates the correct PWM pulse width to be sent to the PWM drivers for the aileron, elevator and rudder, as well as camera gimbal. Uses wiringPi and a GPIO pin for driving the buzzer with software based PWM.

```
#include "common.h"
#include "flightboard.h"
#include "flightboard-private.h"
```

8.29.1 Detailed Description

Controls the output to the flight board. Calculates the correct PWM pulse width to be sent to the PWM drivers for the aileron, elevator and rudder, as well as camera gimbal. Uses wiringPi and a GPIO pin for driving the buzzer with software based PWM.

8.30 src/base/flightcontroller.cpp File Reference

Base controller. Ties in all the equipment (sensors and actuators).

```
#include "common.h"
#include "flightcontroller.h"
#include "gpio.h"
```

Typedefs

- using **steady_clock** = std::chrono::steady_clock

Functions

- template<typename Item >
  void InitialiseItem (const char *what, Item *&pt, Options *opts, Buzzer *b, bool required, int tries=-1)
- std::ostream & **picopter::operator**<< (std::ostream &stream, FlightController &fc)

8.30.1 Detailed Description

Base controller. Ties in all the equipment (sensors and actuators).

Todo Add in camera things.

8.30.2 Function Documentation

8.30.2.1 template<typename Item > void InitialiseItem (const char * *what*, Item *& *pt*, Options * *opts*, Buzzer * *b*, bool *required*, int *tries* = -1)

Helper method to initialise a base module.

Template Parameters

Item	The class of the base module to be initialised.

Parameters

what	A description of what the base module is.
pt	A reference to the pointer where the result will be stored.
opts	A pointer to the options instance, or NULL.
b	The buzzer.
required	Indicated if this module is required.
tries	The number of tries to make.

8.31 src/base/gpio.cpp File Reference

GPIO handling code. Uses wiringPi to control the GPIO pins on the RPi.

```
#include "common.h"
#include "gpio.h"
#include <wiringPi.h>
```

8.31.1 Detailed Description

GPIO handling code. Uses wiringPi to control the GPIO pins on the RPi.

8.32 src/base/gps.cpp File Reference

Base GPS interaction code.

```
#include "common.h"
#include "gps_feed.h"
```

Typedefs

- using **steady_clock** = std::chrono::steady_clock

Functions

- **m_last_fix** (999)
- **m_quit** (false)

8.32.1 Detailed Description

Base GPS interaction code.

8.33 src/base/gps_gpsd.cpp File Reference

GPS interaction code. Uses gpsd to interact with the GPS.

```
#include "common.h"
#include "gps_gpsd.h"
#include "libgpsmm.h"
```

Typedefs

- using **steady_clock** = std::chrono::steady_clock

8.33.1 Detailed Description

GPS interaction code. Uses gpsd to interact with the GPS.

8.34 src/base/gps_naza.cpp File Reference

GPS interaction code. Uses the NAZA decoder to interact with the NAZA GPS.

```
#include "common.h"
#include "gps_naza.h"
#include "NazaDecoderLib.h"
#include <wiringSerial.h>
```

Typedefs

- using **steady_clock** = std::chrono::steady_clock

8.34.1 Detailed Description

GPS interaction code. Uses the NAZA decoder to interact with the NAZA GPS.

8.35 src/base/imu.cpp File Reference

IMU interaction code.

```
#include "common.h"
#include "imu_feed.h"
#include "cmt3.h"
```

8.35.1 Detailed Description

IMU interaction code.

8.36 src/base/log.cpp File Reference

Implement logging and error handling functions.

```
#include "common.h"
#include "log.h"
#include <cstdarg>
#include <unistd.h>
```

Functions

- void LogInit ()
- void LogEx (int level, const char *funct, const char *file, int line,...)
- void LogSimple (int level, const char *fmt,...)
- void FatalEx (const char *funct, const char *file, int line,...)

8.36.1 Detailed Description

Implement logging and error handling functions.

8.36.2 Function Documentation

8.36.2.1 void FatalEx (const char * *funct*, const char * *file*, int *line*, ...)

Handle a Fatal error in the program by printing a message and exiting the program CALLING THIS FUNCTION WILL CAUSE THE PROGAM TO EXIT

Parameters

funct	- Name of the calling function
file	- Name of the source file containing the calling function
line	- Line in the source file at which Fatal is called
fmt	- A format string
...	- Arguments to be printed according to the format string

8.36.2.2 void LogEx (int *level*, const char * *funct*, const char * *file*, int *line*, ...)

Print a message to stderr and log it via syslog. The message must be less than BUFSIZ characters long, or it will be truncated.

Parameters

level	Specify how severe the message is. If level is higher (less urgent) than the program's verbosity (see options.h) no message will be printed.
funct	String indicating the function name from which this function was called. If this is NULL, Log will show the unspecified_funct string instead.
file	Source file containing the function
line	Line in the source file at which Log is called
fmt	A format string
...	Arguments to be printed according to the format string

8.36.2.3 void LogInit ( )

Initialises the logger. Should be called at the start of a program.

8.36.2.4 void LogSimple (int *level*, const char * *fmt*, ...)

Print a message to stderr and log it via syslog. The message must be less than BUFSIZ characters long, or it will be truncated. This is a simple version that does not print the line number/file from which the call was made.

Parameters

level	Specify how severe the message is. If level is higher (less urgent) than the program's verbosity (see options.h) no message will be printed.
fmt	A format string
...	Arguments to be printed according to the format string

8.37 src/base/opts.cpp File Reference

Options and persistent configurations handler.

```
#include "common.h"
#include "opts.h"
#include <rapidjson/document.h>
#include <rapidjson/filereadstream.h>
#include <rapidjson/filewritestream.h>
#include <rapidjson/prettywriter.h>
```

8.37.1 Detailed Description

Options and persistent configurations handler.

8.38 src/modules/object_tracker.cpp File Reference

The object tracking code.

```
#include "common.h"
#include "object_tracker.h"
```

8.38.1 Detailed Description

The object tracking code.

8.39 src/modules/waypoints.cpp File Reference

Contains the waypoints handling code.

```
#include "common.h"
#include "waypoints.h"
#include <cmath>
```

8.39.1 Detailed Description

Contains the waypoints handling code.

8.40 src/server/picopter.cpp File Reference

The main entry point to the server.

```
#include "picopter.h"
#include "webInterface.h"
#include <arpa/inet.h>
#include <thrift/concurrency/ThreadManager.h>
#include <thrift/concurrency/PosixThreadFactory.h>
#include <thrift/protocol/TBinaryProtocol.h>
#include <thrift/server/TThreadPoolServer.h>
#include <thrift/transport/TServerSocket.h>
#include <thrift/transport/TBufferTransports.h>
#include <sstream>
#include <csignal>
```

Classes

- class webInterfaceHandler

Functions

- std::unique_ptr< TThreadPoolServer > **g_server** (nullptr)
- std::unique_ptr< picopter::FlightController > **g_fc** (nullptr)
- void terminate (int signum)
- int **main** (int argc, char **argv)

8.40.1 Detailed Description

The main entry point to the server.

8.40.2 Function Documentation

8.40.2.1 void terminate (int *signum*)

SIGINT/SIGTERM interrupt handler

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