Club Astronomique de la Région Lilloise

iAstroHub 3.0.7 EQmod modified

Ultimate Mobile Platform for Astrophotography

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01/05/2017

Existing versions

1- My own version based on iAH 3.0.7

iAH 3.0.7 EQmod

My SD image disc is available to be downloaded. It's an 3.0.7 modified to be optimized for the following setup :

- EQmod drive from Skysafari without handset
- Canon DSLR

This manual concern this version only.

2- Officials versions

iAH 3.0.7

- INDI server added
- Lin guider update to be compliant with ZWO ASI camera
- VNC client integration in the web page
- Possibility to install patchs

The most import add of this version is the INDI server. Some INDI clients are missing to be fully usable.

iAH 2.2

It runs well on RPI 3

Revisions

01/05/2017	3 12 31	Revisons creation SD card become 16 to 32 Go Chap. 5.5 EQmod Interface wiring added
29/04/2017	16	The QDSLRdashboard become **4757**
19/03/2017		Initial version
Date	**Page**	**Comment**

Thanks

to Anat to be visionary and drive the project,
to Jean-Luc to EQmod developpements,
to Yves to introduce us iAH,
to Alexandre for his suggestions

Table des matières

1 Introduction

1.1 What is iAstroHub?

iAstroHub is the world's first mobile solution for astrophotography. A user can interact with all astrophotography devices from any mobile device using a web browser. iAstroHub is a software package embedded in ARM Linux platforms. **Raspberry Pi 3 (RPi3)** is used for iAstroHub 3.0.

Laptop

Raspberry Pi 3 and tablet

1.2 Features

- only need a web browser on a mobile device to control everything! ("i" stands for internet)
- control an autoguider
- control a DSLR camera (Canon, Nikon, and Pentax)
- control DSLR setting and Liveview via QDslrDashboard
- control a CCD camera and a filter wheel for imaging
- control a focuser
- control Flip-Flat for flat-fielder and lens cover
- show real-time guiding error graphs and alert logs

- preview images taken by a camera
- perform dithering between frames
- manipulate histogram of images from a CCD camera
- perform plate-solving using the standalone Astrometry.net engine
- re-align mount based on the position from plate solving
- show skychart and control mount from built-in Skychart (Cartes du Ciel)
- show a plate-solving result directly in Skysafari and re-align the mount from Skysafari
- support the control of a mount from Skysafari on iOS and Android
- save all images on a USB flash drive
- speak imaging progress
- push notification to smart phones or smart watches
- low power consumption
- small enough to be installed on the telescope
- open-source software

1.3 How does iAstroHub work??

- iAstroHub is installed on RPi3.
- Astrophotograpy devices are connected to RPi3.
- iAstroHub will function as a web server with all engines running in background.
- A mobile phone or tablet can connect to iAstroHub directly. Control of all devices is done via a web browser.

1.4 Software

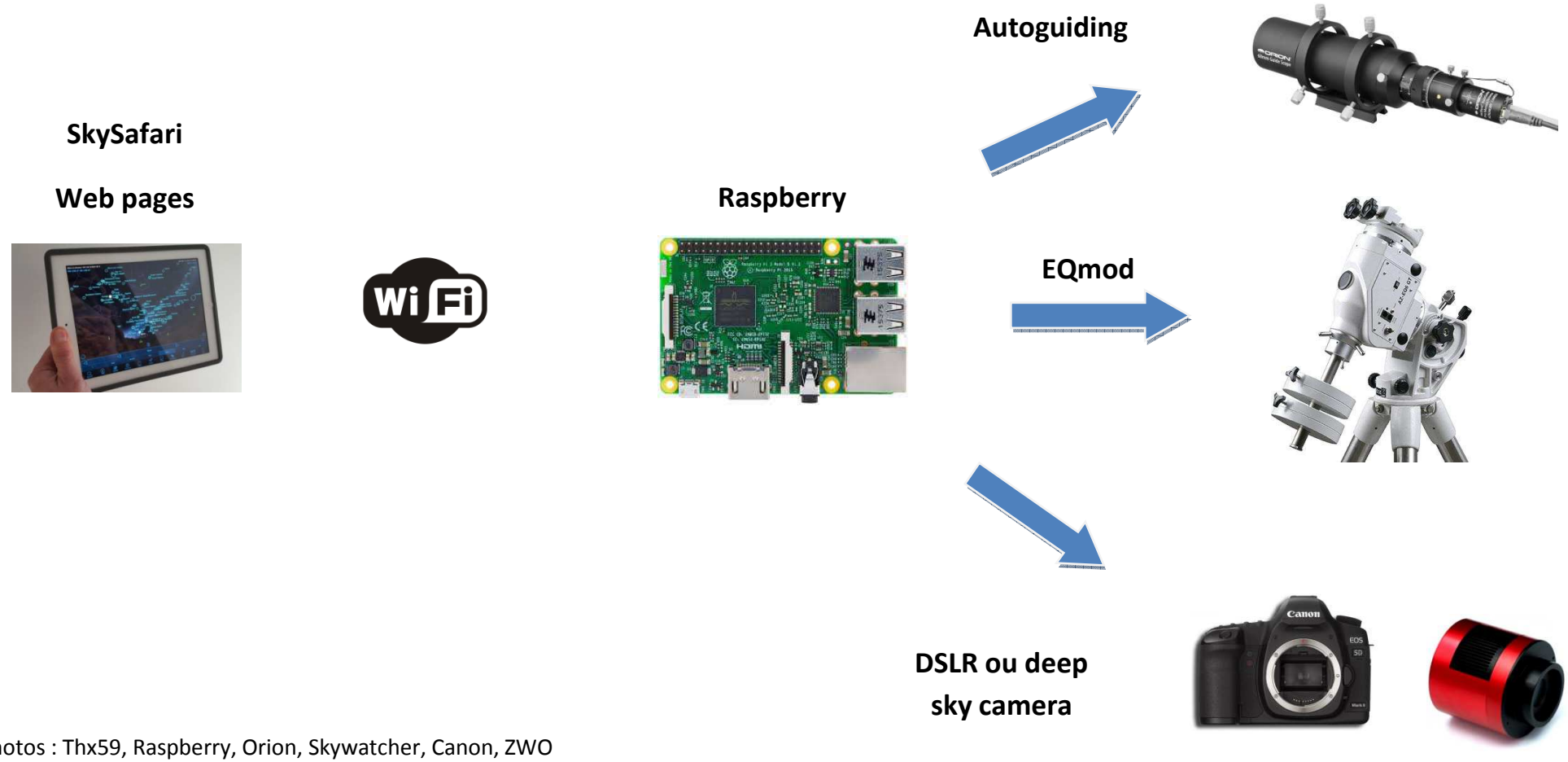
1.4.1 Software structure

The following diagram shows the structure of iAstroHub.

L

2 Over view

2.1 At a glance

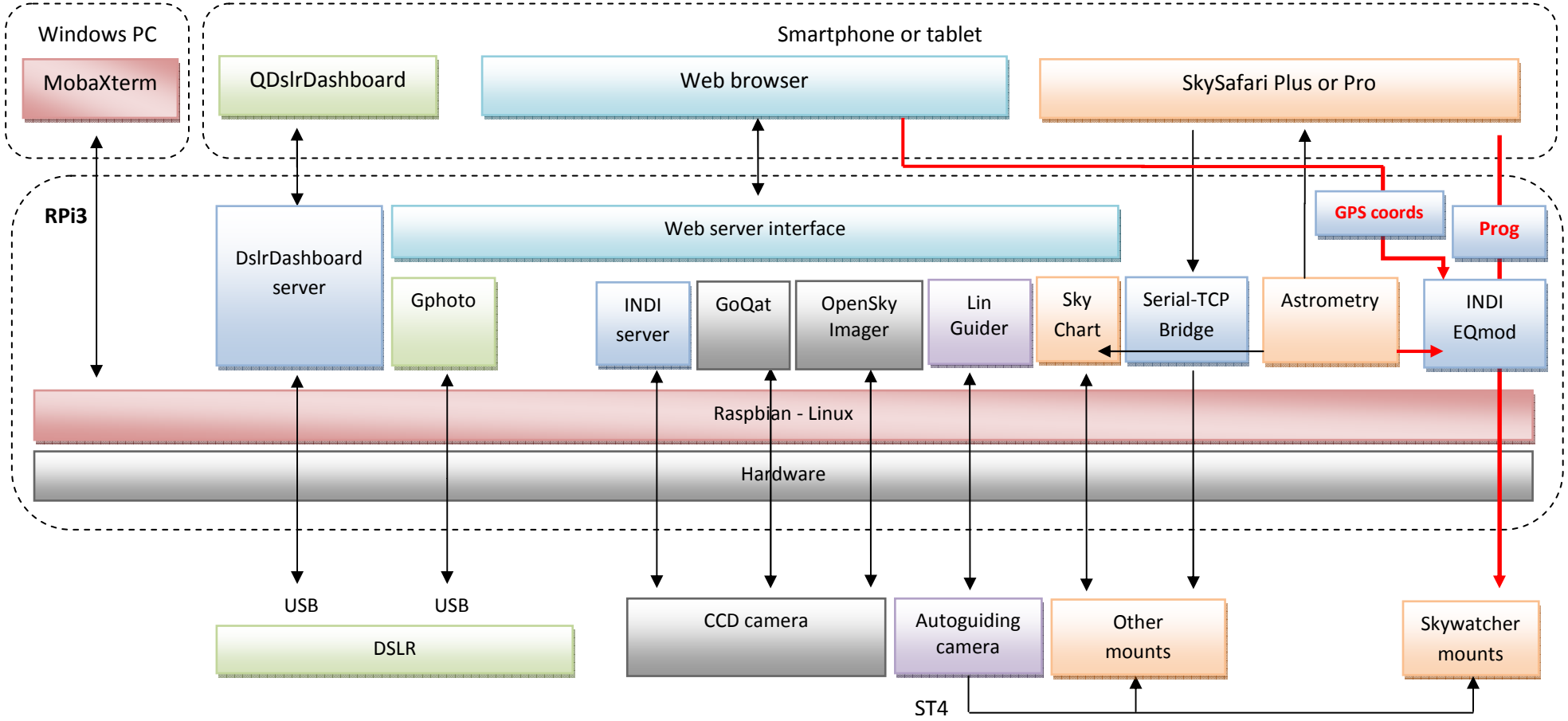


Photos : Thx59, Raspberry, Orion, Skywatcher, Canon, ZWO

2.2 Software structure

The following figure shows the structure of iAstroHub.

In reed : what it have been added at v 3.0.7



1.5 Hardware

1.5.1 Supported hardware

Autoguiders

- Orion Starshoot autoguider, QHY5, QHY5-II, QHY5L-II, QHY6, ATIK, Starlight Xpress, ZWO ASI cameras

DSLR Cameras

- Canon (since 300D) and Nikon (since D50) DSLR cameras. Pentax DSLR cameras (Refer to http://pktriggercord.melda.info/)

CCD Cameras and Filter Wheels

- Native control with GoQat: QSI and Starlight Xpress
- Native control with OpenSkyImager: SBIG, ATIK, and QHY (5, 5ii, 6, 8, 8L, 9, 10, 11,12, IC8300
- INDI driver: FLI, Apogee, Moravian, ATIK, ZWO ASI, SX, SBIG, QSI, etc.

Mounts

- Controlled by Skychart: mounts using LX200, iOptron, Nexstar/Skywatcher, TheSkyX protocols
- Controlled by SkySafari: Almost all mounts are supported. (Refer to http://skysafariastronomy.com/),
- Skywatcher / Orion mounts can be drived from Skysafari with (Nexstar protocol) or without handset (EQmod).

Focusers

- Native control: Robofocus

2.3 What v3.07 EQmod add to v3.0.7 ?

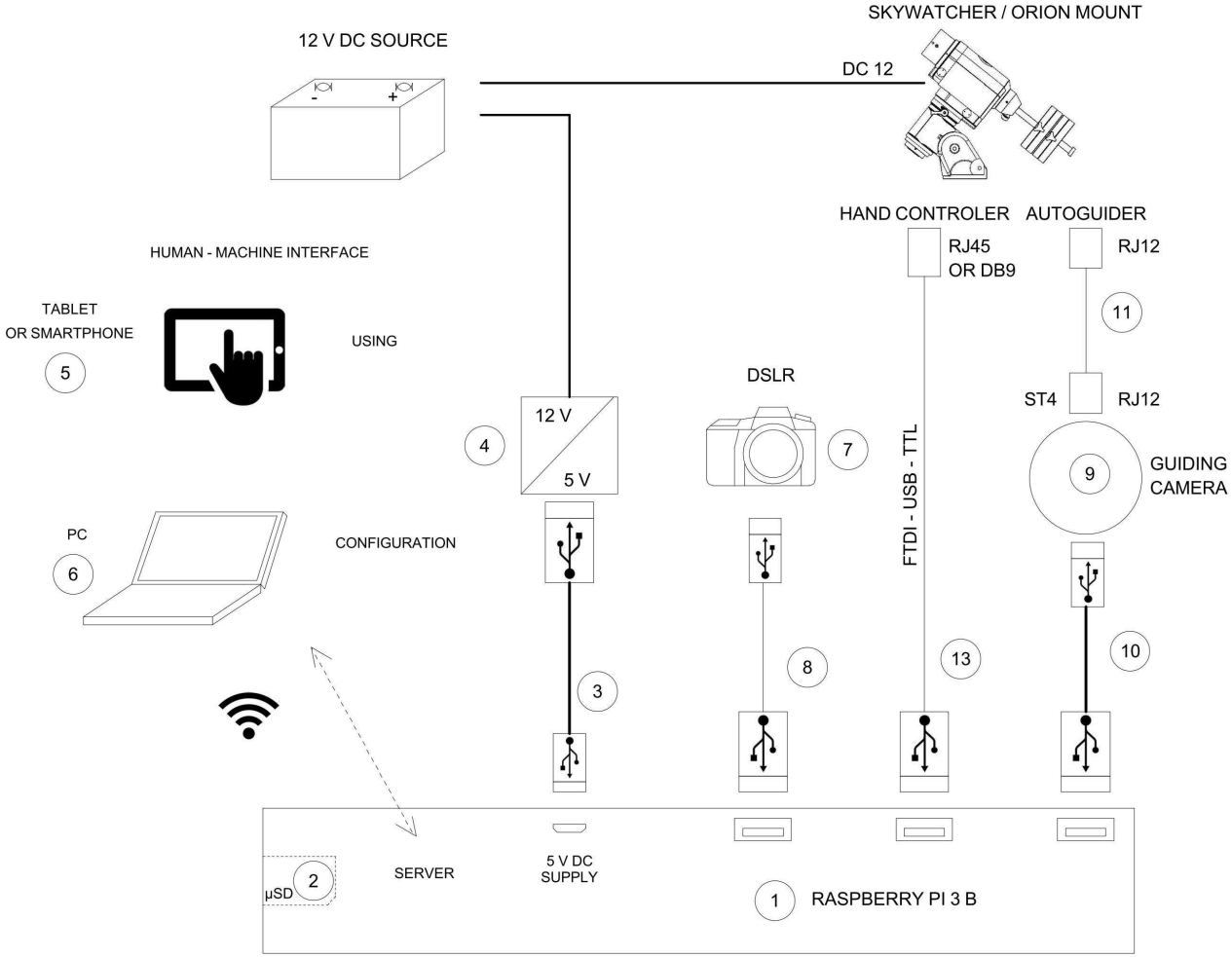
V3.07 EQmod optimize the control of theSkywatcher mounts and Canon DSLR. The most improvement are:

- **EQmod direct drive from Skysafari**
- One button start EQmod sequence
- GPS geolocalisation from a smartphone
- EQmod alignement from the plate solving result
- DSLR ISO remote control

Throughout the rest of the document, to be clear as possible, the explanations will be focused to a specific setup with could be consider as typical and which have been approuved.

2.4 Wiring Diagram

Take care about the supply of the Rpi 3. The consumption can drop the voltage and so can disturb the Rpi 3 running.



2.5 Component list

tag	Désignation	Price
1	Raspberry Rpi 3 and its enclosure	36 €
2	**Scandisk Ultra 32 Go** Classe 10Go µSD Ccard	10 €
3	USB micro B – USB type A wire - **20 AWG or short lenght**	
4	12 -> 5V **3A** converter	4 €
5	Tablet (or smartphone) android or iOS	
6	Laptop SD port equiped	
7	Canon 1100d DSLR with its SD card	
8	USB wire delivered with the DSLR	
9	QHY5II L monochrome autoguiding camera	20 €
10	USB type A – type B male wire delivered with the camera	
11	ST4 wire delivered with the camera	
12	Skywatcher or Orion mount	
13	FTDI TTL-232R-5V-WE cord + RJ45 plug : http://www.ftdichip.com/Products/Cables/USBTTLSerial.htm http://eq-mod.sourceforge.net/eqdirect2.htm)	

2.6 Sofware list

At the tab	Price	
SkySafari 4, 5, Plus or Pro	16 €	Planetarium for Go To
QDSLR Dashboard	9 €	Live view focus facility
At Windows PC		
7-Zip	0 €	To decompress .7Z files
Win32 drive Imager	0 €	To write SD card
MobaXterm	0 €	To manage Raspberry's Linux from the PC • SSH terminal to control Linux • Sftp to transfert files from/to the PC

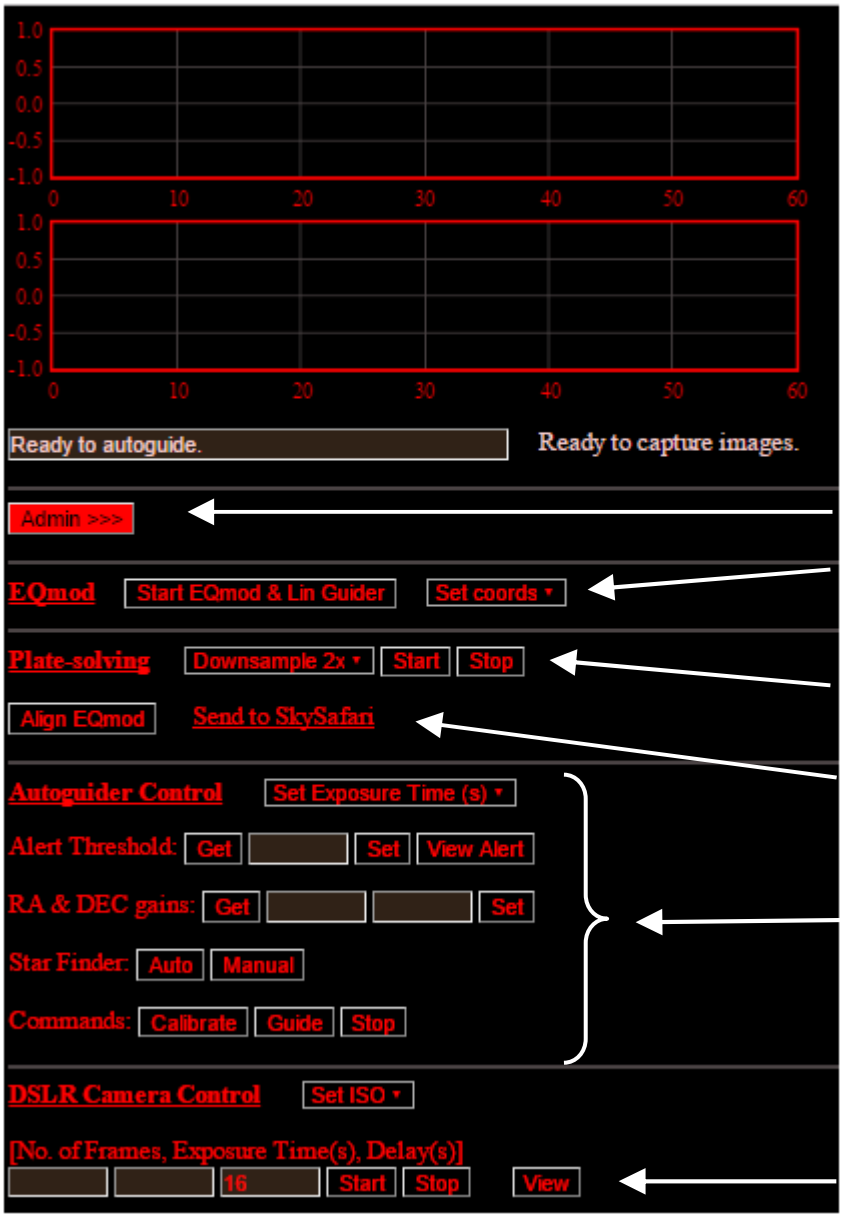
3 Commissioning

3.1 iAH program copying into Rpi3

- Download the image file
- Uncompress this file with **7-ZIP**
- Use **Win32 Disk Imager** to write the image into the µSD card
- Insert the µSD card into the Rpi3
- Supply the Rpi3
- The Rpi3 emit an **iAstroHub** Wifi Acces Point
- Connect with a PC or a tablet. The Wifi password is **1234512345123**.

3.2 Main web pages

Main web page - http://10.0.0.1



Autoguiding curves

- Top : Right Ascension
- Bottom : Declination

Open **Admin** web page

Start EQmod and autoguiding software - Geolocalisation

Plate solving ef the last picture displaved

EQmod Alignement then transmit the result to Skysafari

Autoguider controls

DSLR control

Autoguider and CCD Camera

Start Apps

Camera Control using OpenSkyImager (for SBIG ATIK and QHY cameras)

Status Camera List #1 Connect

Gain [0-100] Get Set

Offset [0-255] Get Set

Camera Control using GoQat (for QSI and SX cameras)

Status Connect

General Setting

Delay (s) [5-60] Get Set

Report Imaging Progress via Speaker: Press to Enable

Dithering: Press to Enable

View Calibration Log View Guiding Log View Alert Log

DELETE Guiding and Alert Logs

DSLR

DslrDashboard Server: Start Stop

Camera Protocol: Canon 6D/60D/550D/1100D Canon 40D Canon 1000D and Nikon Pentax GPIO11

FTDI-based shutter cable (ttyUSB0) FTDI-based shutter cable (ttyUSB1)

FTDI Driver: Load Unload

Image Download: Press to Disable

Plate Solving

Minimum FOV (deg) 0.1 Set

View Astrometry Log

Mount Control and Skychart

Start Skychart Skychart (direct mount control) Skychart (via TheSkyX)

Stop Skychart

Protocol: LX200 iOptron Nexstar/Skywatcher TheSkyX

IP Address of TheSkyX Server: Set

Focuser

Swap Focuser Directions

View Focus Log

DELETE Focus Log

Pushover Notification

Application Key: User Key: Set

Completion of imaging sequence: Press to Enable

Guiding errors when exceeding tolerance: Press to Enable

File Management

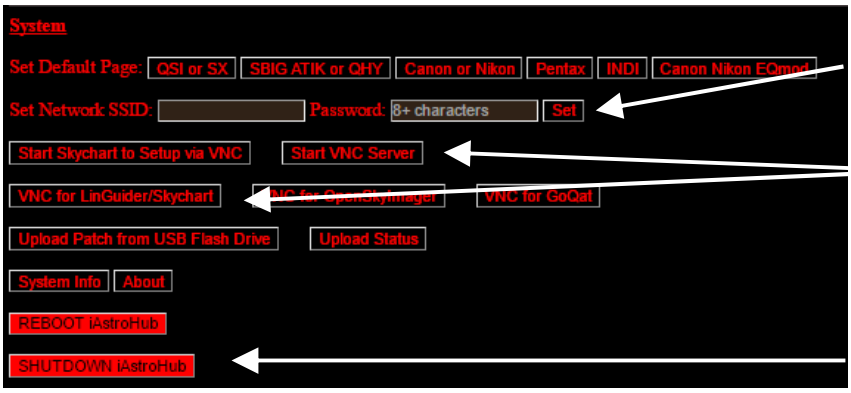
Mount USB Flash Drive Unmount USB Flash Drive

Download Images to USB Flash Drive File Status

DELETE Images

Allowed **QDSLR Dashboard** app to communicate with the DSLR

DSLR driver selection



SSID and password modification

To configure Lin Guider

Raspberry Shutdown

Notes :

- QDSLR Dashboard is usefull at the beguining to help the focus in Live view mode
- Your iAH is now ready to be configured
- **Don't forget to tap** 

before disconnect supply

4 Configurations

4.1 Wifi aces point

Page Admin \ System

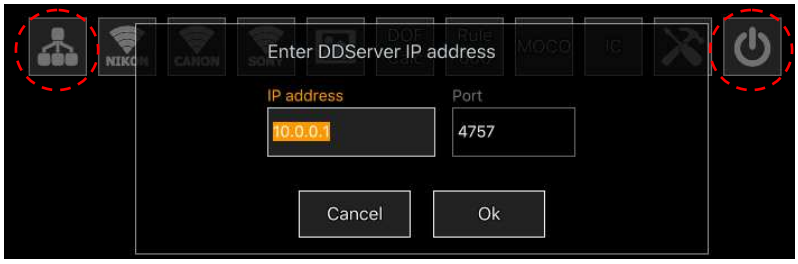
Rename your wifi acces point in order to be able to run with others iAH in the same area. **Note porperly your new password because it doesn't ask you to confirm.**

4.2 QDSLR Dashboard

- From Web Admin page
  - Tap on **Start DSLRDashboard Server** (a message appear at the bottom of the page)

- From the tab, start **QDSLR Dashboard** app
  - **Extended tap** on the top left button, enter IP **10.0.0.1**, Port **4757** and tap Ok
  - You are now connected to the DSLR and have a total control



- To quit properly :
  - From QDSLR Dashboard, tap on 
  - from Admin page, tap on **Stop DSLR Dashboard Server**

4.3 DSLR camera control

- The DSLR must be configured as :
  - Manual
  - Bulb
  - RAW + jpeg
- From Web Admin page
  - In system defaut page, tap 

    . (it modifies the main web page)
  - In DSLR section, select 

- In the main web page **DSLR Camera Control**, test the Link as below :

- Enter the number of frames and exposure time
- The delay cannot be less than 16 s
- Tap on Start
- Wait the **Dowloaded** message
- Tap on View to display the picture

4.4 EQmod starting

The mount is plugged to the Raspberry and is supplied.

Start EQmod & Lin Guider do the following sequence :

- Start Indi Server
- Start and connect EQmod
- EQmod writing :
  - default geographic coords (City of Lille)
  - standard autoguiding speed (0,5)
- Lin Guider, OpenSkyImager and GoQat starting

You must keep in mind that Skysafari and EQmod must be configured with the same values. (time and geo coordinates)

Both INDI Web Manager INDI Control Panel allows to check EQmod running. Normaly, you don't to write anything on.

You could modify some EQmod paramaters for example if the tracking stop after be under the horizon.

The following chapter explains how to configure EQmod.

4.5 EQmod configuration

4.5.1 Standard coordinates

EQmod starts with city of **Lille** geo coordinates.

The values are in the `\Home\Pi\www\StartApp.sh` file. Use MobaXterm to modify it.

4.5.2 Scroll menu

This scroll menu allows to select other geo coordinates :

- GPS : load the GPS values only from a smartphone (a tablet is normaly not GPS equiped)
- The others pre setted locations are writted in : `\Home\Pi\www\iAstroHub_INDI.html` file. Use MobaXterm to modify it.

4.5.3 Direct enter

Some Indi clients can talk with EQmod.

- Tap on 

to acces to the "Admin \ INDI Control Panel" web page. The format of the value entered must be like "**nn.n**". Beware, this web page cannot be displayed on my IPAD2. Only **iINDI** app can runs in this case.

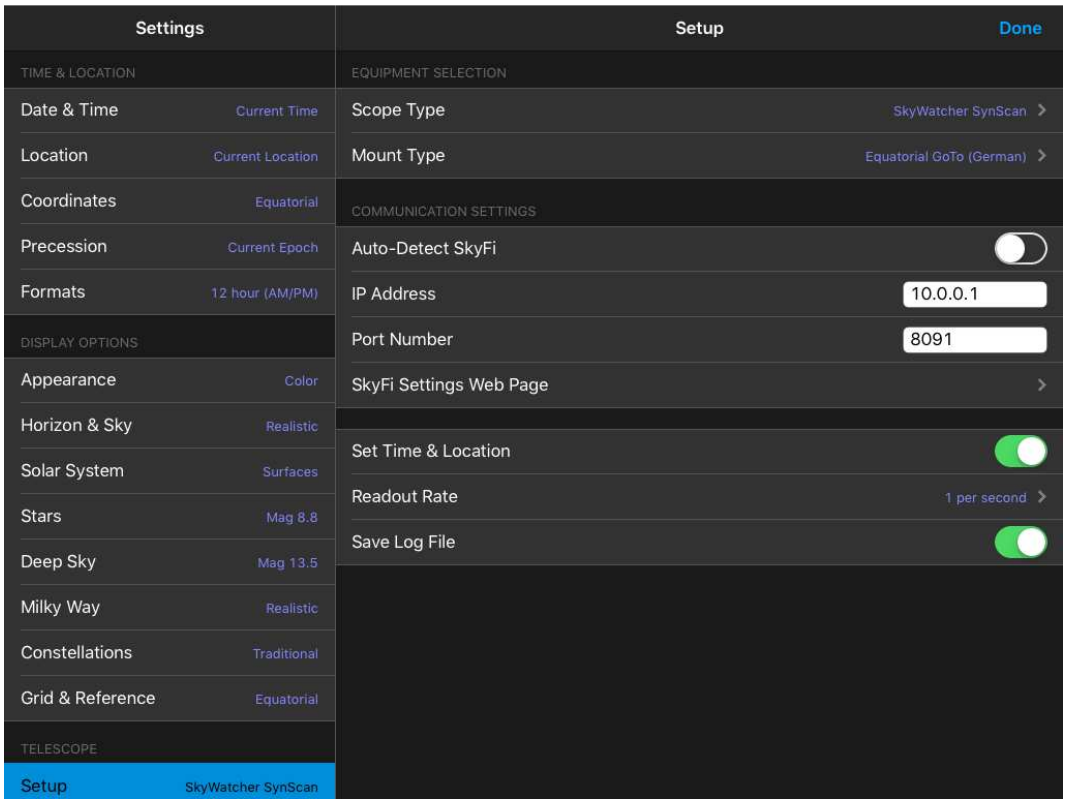
- iOS **"iINDI"** app. (I recommend it)
- Android **"KstarLite"** app.

4.6 Skysafari's Go To function

EQmod is already started so we can now use Skysafari.

- Settings menu, TIME & LOCATION, Location
    - Configure your geographic coords

- Settings menu, TELESCOPE, Setup



- **Save the skysafari's settings at the bottom of the settings menu**

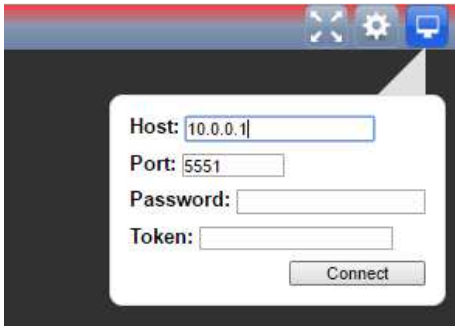
Tap on **Scope** then **Connect**. Skysafari display now the EQmod's position.

Now it's possible to move the mount from Skysafari (N E W S or Go To buttons).

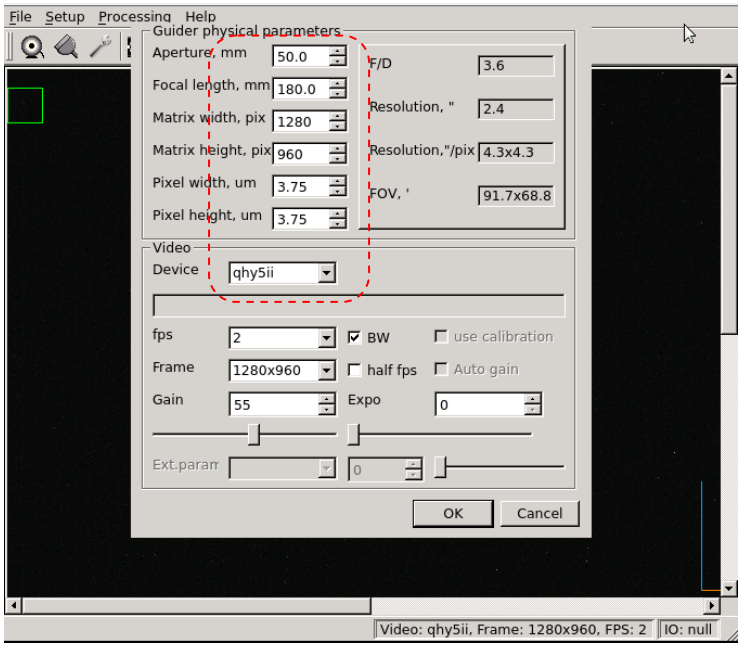
4.7 Autoguiding configuration

Lin guider is already started.

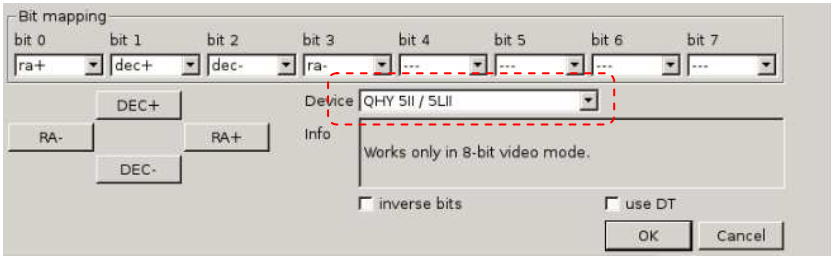
- From the main web page,
  - Admin \ system menu, tap on:
    - Start VNC Server
    - then on VNC for LinGuider/Skychart
  - A new tag appear. Tap on **connect** if necessary



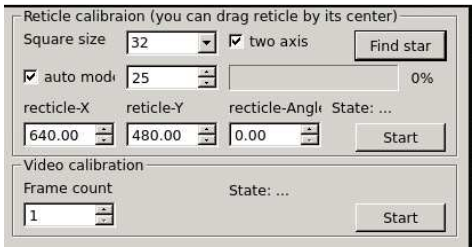
  - Enter your camera infos in Linguider : **Setup \ Video settings**
  - Tap on ESC to close the **Video Settings** windows
  - Tap on **File** then **Exit** to save
  - Reboot iAH



SkyWatcher 9 x 50 finder and QHY5L II B & W camera example



Select the device which will drive the ST4 mount port

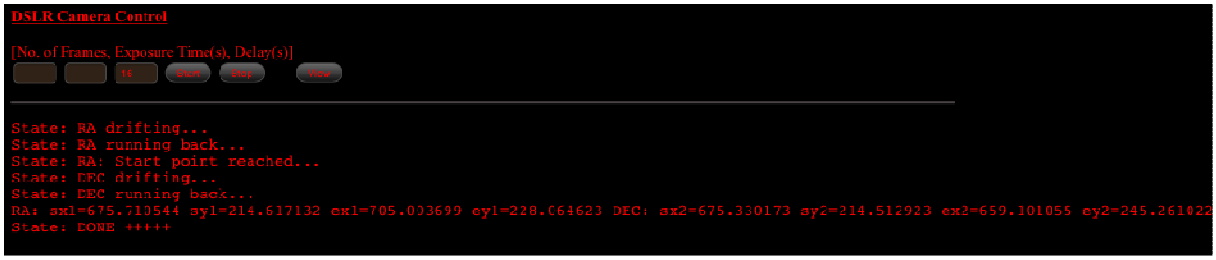


Don't change this parameters

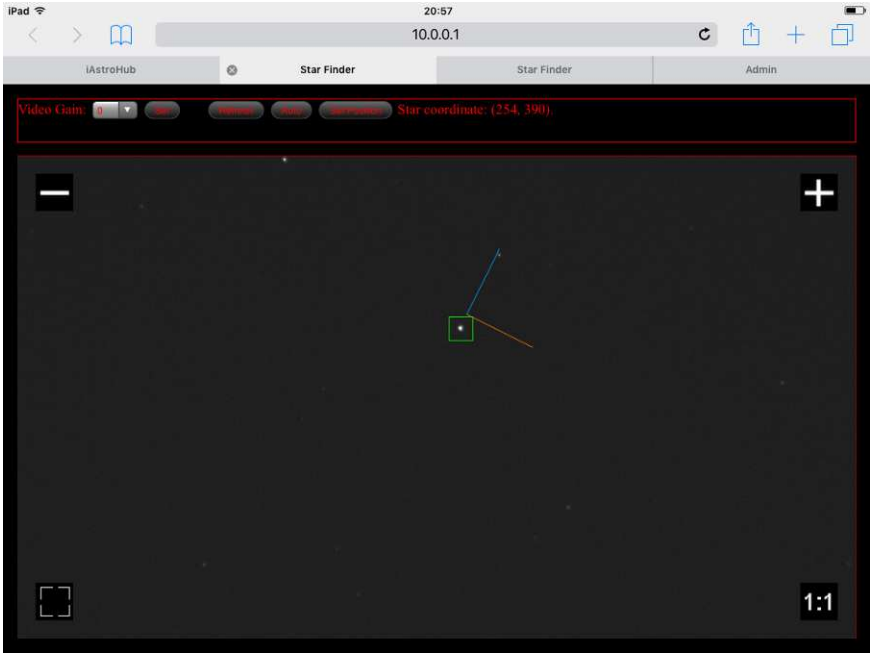
4.8 Autoguiding using

From the main page, autoguider control menu - star finder

- Tap on Manual to display the camera and tap on Auto to select the star.
- From the main page, tap on Calibrate to start the autoguiding alignement axes. It can takes some times. Done +++++ is displayed at the bottom when the calibration is done.



- Tap on Manual to see the new axes directions.



- Tap on guide to start the guiding

4.9 EQmod alignement

- The polar alignement is already done
- The mount is in a init position with a bubble and the telescope is pointed to the polar.
- Do a Go To to your aim with Skysafari. The mount move and arrive close to the aim.
- From the main page :
  - Take a 30 secondes picture to see some stars. If you use a Ha filter, increase temporary the ISO
  - Tap on 

to see the result
  - Tap on 

to start the plate solving
  - See the infos, don't touch any thing during the solving and wait the end

```
Reading input file 1 of 1: "/home/pi/www/image.jpg"...
Extracting sources...
Downsampling by 2...
simplexy: found 2411 sources.
Solving...
Reading file "/home/pi/www/image.axy"...
Field 1 did not solve (index index-4110.fits, field objects 1-10).
Field 1 did not solve (index index-4109.fits, field objects 1-10).
Field 1 did not solve (index index-4108.fits, field objects 1-10).
Field 1 did not solve (index index-4107.fits, field objects 1-10).
  log-odds ratio 451.923 (1.85296e+196), 60 match, 0 conflict, 70 distractors, 65 index.
  RA,Dec = (98.2611,5.00152), pixel scale 2.70448 arcsec/pix.
  Hit/miss:   Hit/miss: ++++++++++++++++++++-+++++-+-+-+++++-+-+-+-+-+-+-+---++-+-----+---+-+-++-+-+-+-+-----+++-+-------++
Field 1: solved with index index-4110.fits.
Field 1 solved: writing to file /home/pi/www/image.solved to indicate this.
Field: /home/pi/www/image.jpg
Field center: (RA,Dec) = (98.26, 5.001) deg.
Field center: (RA H:M:S, Dec D:M:S) = (06:33:02.316, +05:00:01.909).
Field size: 3.20994 x 2.14293 degrees
Field rotation angle: up is -173.734 degrees E of N
Creating new FITS file "/home/pi/www/image.new"...

Done in 32 sec
Mount can be aligned now.
Result is ready for SkySafari.
```

  - When it's finished, tap on 

to align
  - EQmod is now aligned to the sky and can Go To with accuracy in this area

4.10 Picture framing

The interst of this procedure is to frame a nebulae before to see it.

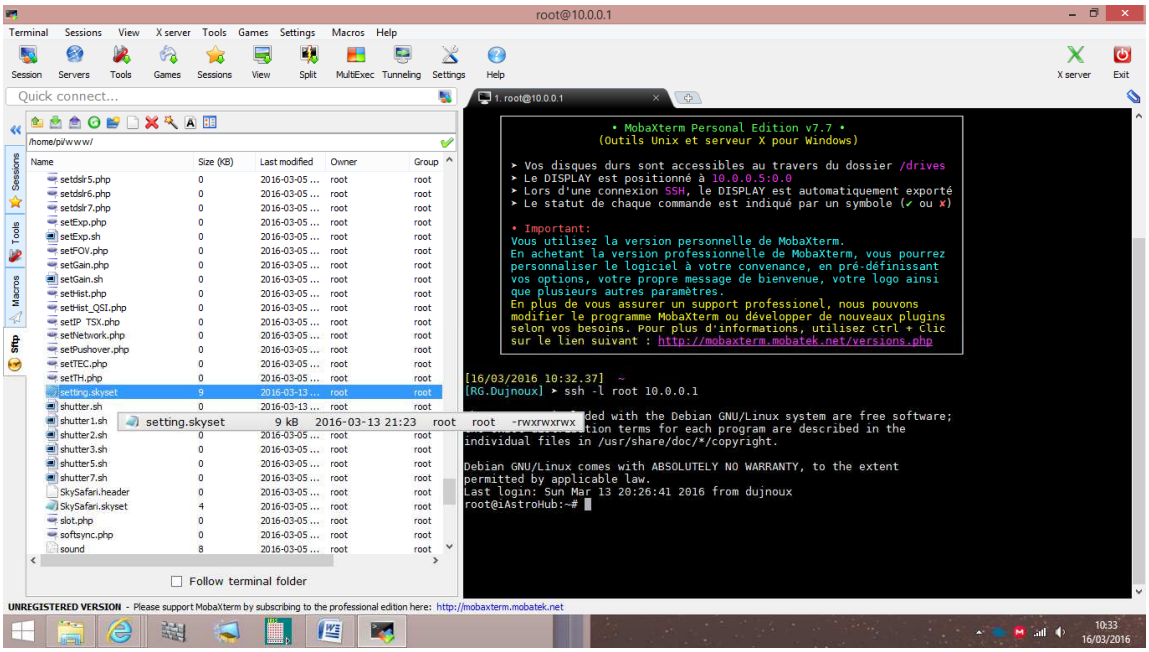
The previous chapter have explained how to center an object with accuracy.

The following chapters explains how to display **the angular position** of the sensor in Skysafari. You must configure iAH first.

4.11 Configuration d'iAH

- First you must configure Skysafari, enter the instrument infos and so on
- Save the settings **in Skysafari** and send it by email to your own email adress
- From a Windows PC
  - Download the setting file and rename it like this : **setting.skyset**
  - From the MobaXterm's SSH terminal

- Enter : ssh -l root 10.0.0.1
- User : **root** - password : **raspberry**
- The ligne is displaying : root@iAstroHub:~# (root connected)
- Drag and drop the file **setting.skyset** to **home/pi/www**

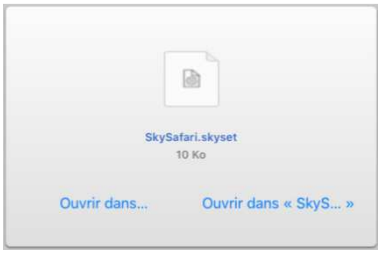


4.12 Display the plate solving result in Skysafari

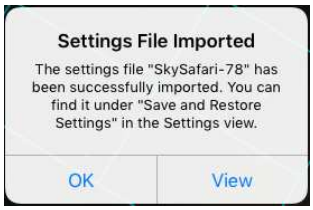
EQmod is already aligned to the sky. The following steps consists to **send the angular position** of the sensor to Skysafari.

Tap on 

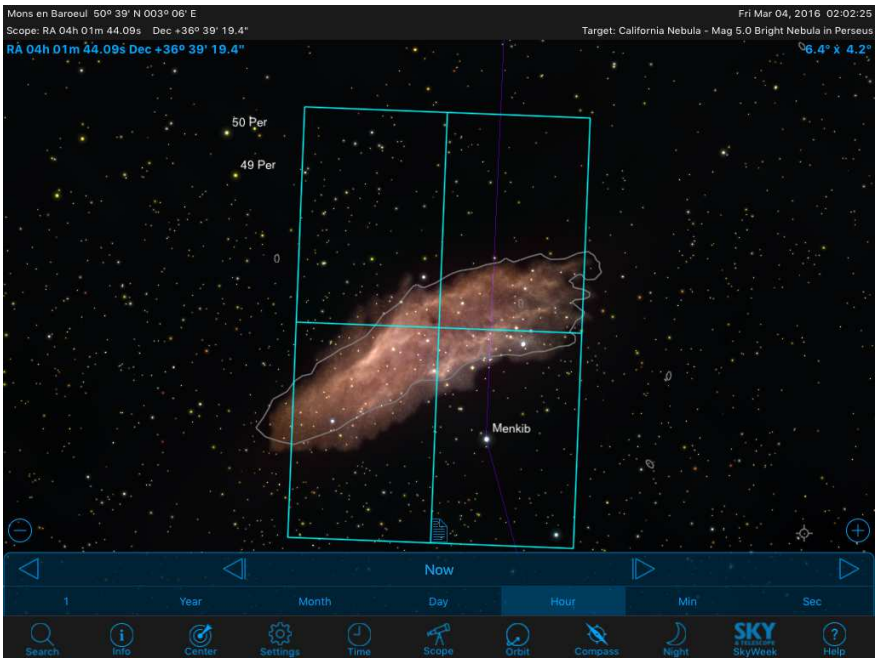
- If this kind of windows appear, tap on Open in Skysafari



- Tap **OK** pour acknoledge this new setting file



- From SkySafari,
  - **Setting** menu, apply the last file received
  - The **sensor** display is now **oriented** and located are according to the plate solving result.
  - Connect the mount and center if necessary
  - Don't tap on skysafari's **Align** button
  - Move the mount with the N E W S arrows if necessary



This result shows that it will be necessary to rotate the sensor to frame the nebulae properly

4.13 Plate-solving duration optimisation

The astrometry engine compare the last image viewed with its own stars data bases. Each data base is a file which correspond a FOV.

Anat let few differents files in iHA in order to be compliant with a lot of instruments, so Astrometry scan all the files during the plate-solving. It should be better to use only one file which correspond to your FOV.

You can download new files from Astrometry.net and change it with MobaXterm in order to optimise the duration of theplate-solving.

4.14 Take care

- **Don't forget to tap** 

before disconnect supply
- When all is configured, save your own SD image with Win32 Disk drive imager

5 Annexes

5.1 Web sites

My web site

http://thx59.free.fr

iAstroHub sources

https://github.com/aruangra/iAstroHub

IAstroHub forum

http://www.cloudynights.com/topic/551998-iastrohub-30-iot-for-astrophotography/page-9#entry7675472

7-ZIP
http://www.7-zip.org/

Win32 drive Imager
http://sourceforge.net/projects/win32diskimager/

MobaXterm

http://mobaxterm.mobatek.net/download-home-edition.html

Astrometry

http://data.astrometry.net/4200/

http://astrometry.net/doc/readme.html

Applications

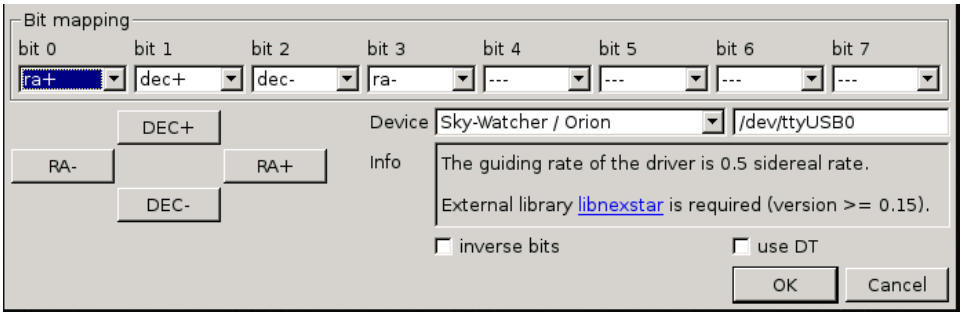
http://QDSLRdashboard.info/

http://SkySafariastronomy.com/products/SkySafari/

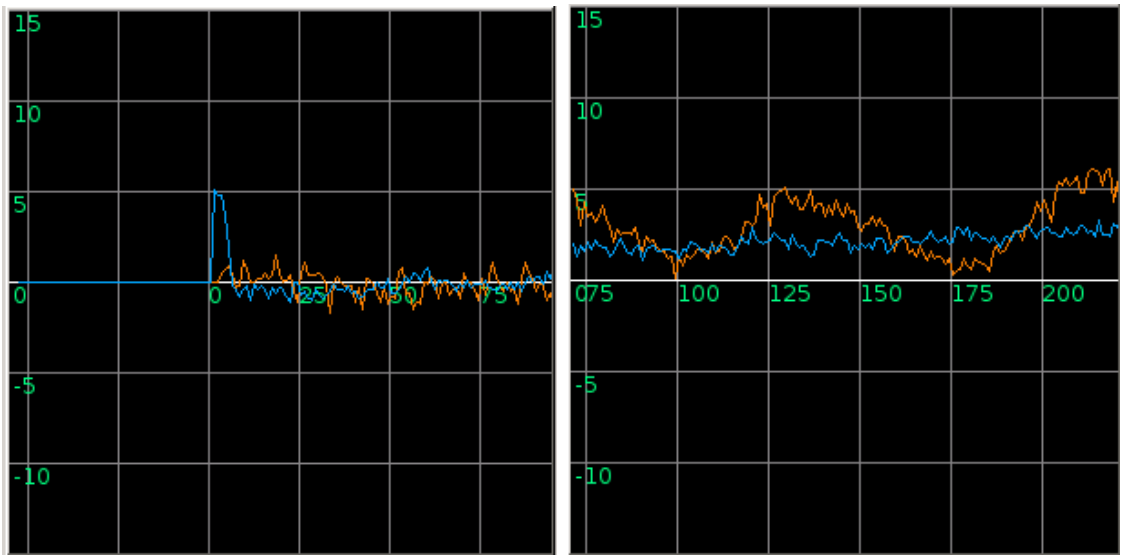
5.2 EQdirect autoguiding

It's possible to guide directly throught EQmod (without ST4 link).

Lin Guider must be configured as above



The result will be worst. The followin curves compares the results

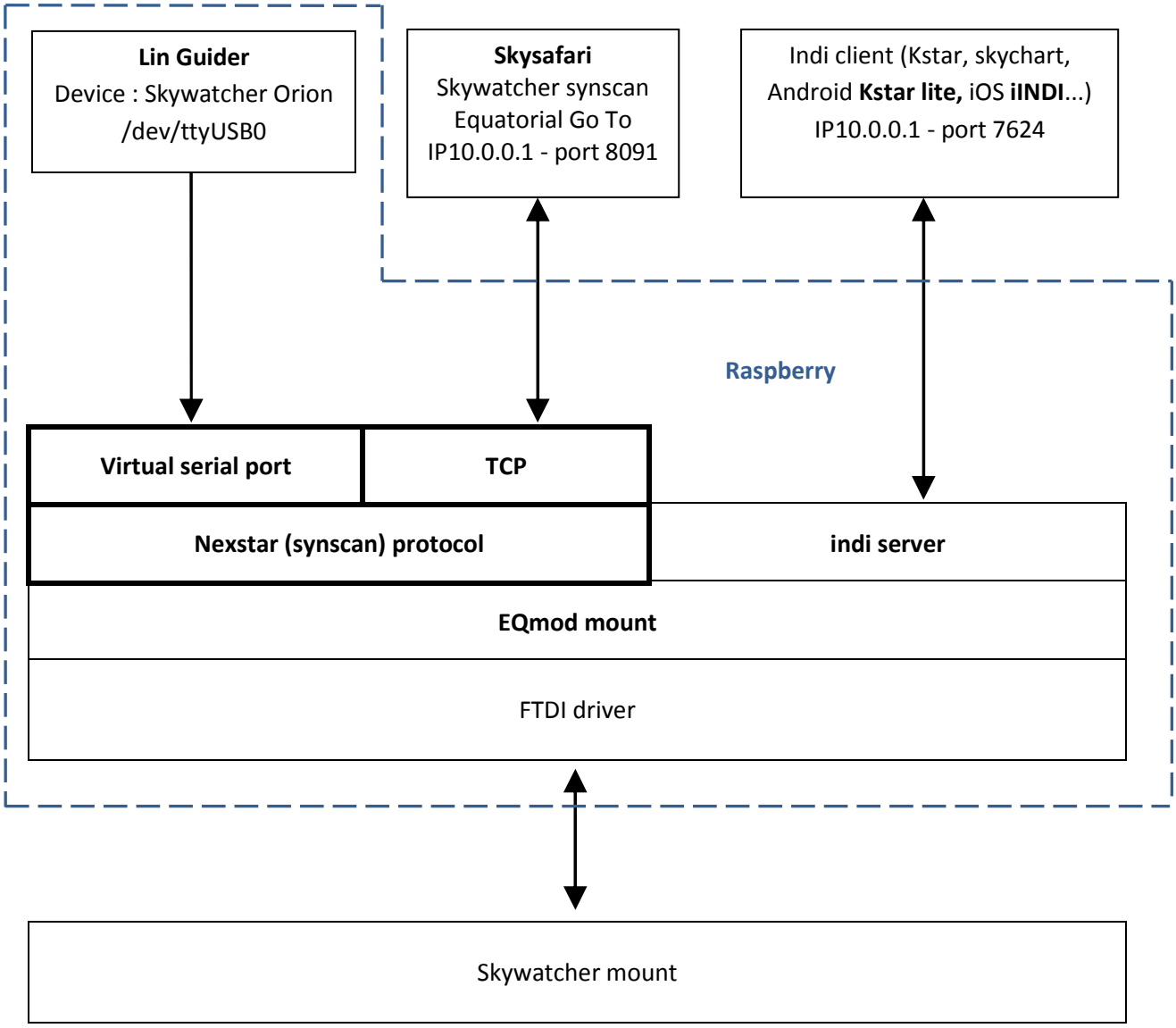


ST4 *EQdirect*

5.3 EQmod

A specific program have been added to EQmod in order to talk with clients using Nexstar protocol (RS232 port of the handset).

- even through a virtual serial port to autoguide directly from Lin guider (as showed previouly)
- or throught a TCP port to use skysafari without handset



Linux command examples :

```
indi_getprop
indi_setprop "EQMod Mount.GEOGRAPHIC_COORD.LAT;LONG;ELEV=50:37:00;04:05:00;10"
indi_setprop "EQMod Mount.GEOGRAPHIC_COORD.LAT;LONG;ELEV=50.6;04.12;10.2"
EQMod Mount.TELESCOPE_MOTION_WE.MOTION_EAST=Off
EQMod Mount.TELESCOPE_ABORT_MOTION.ABORT=Off
```

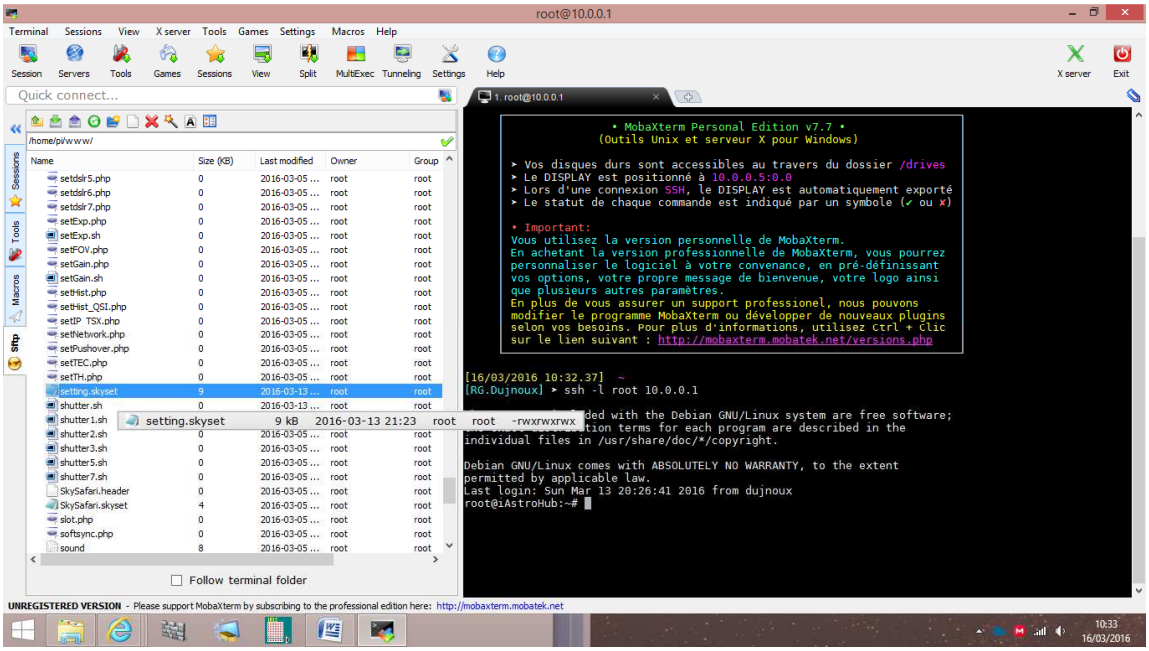
5.4 MobaXterm using

MobaXterm is a terminal with the following functions :

- SFTP : handle and edit the Linux Rasberry files from a Windows PC
- SSH : launch Linux commands
- X11 : display Linux GUI on a Windows PC

To connect SSH to iAH :

- Enter : **ssh -l root 10.0.0.1**
- ID: **root** - Password: **raspberry**
- Now SSH is displaing : **root@iAstroHub:~#** (root connected)



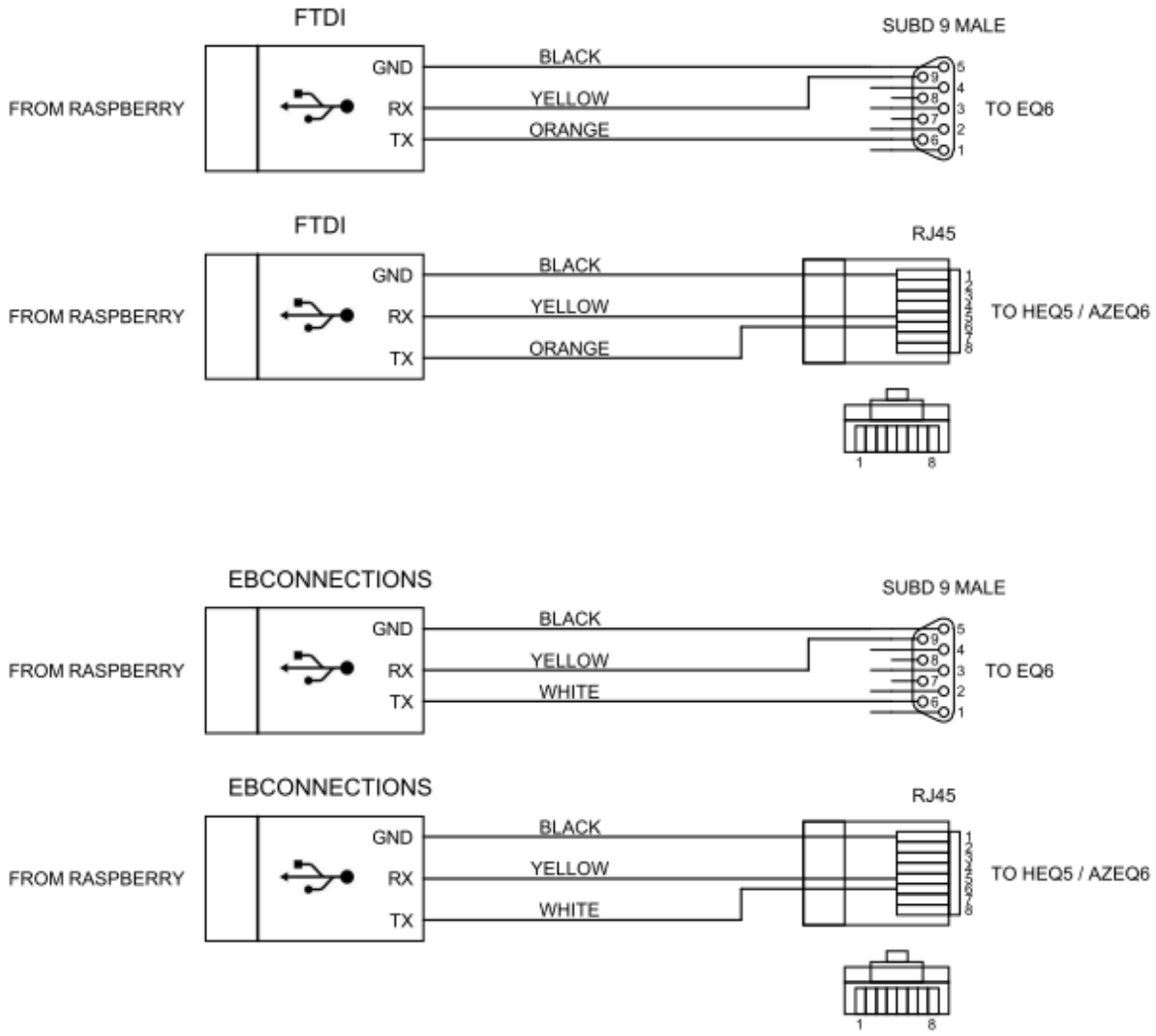
sftp *ssh*

The using is easy. It permit to :

- edit Raspberry's files
- handle Astrometry and Skysafari files
- use Linux commands

5.5 EQdirect interface wiring

The diagrams below show different wiring depending on the converter manufacturers and the mounts.



Notes :

The black GND wire must be longer than the others in order to be the last to be disconnected in case of extraction.

5.6 Gphoto2 Linux command example

```
gphoto2 --auto-detect
```

For Canon 1100d :

```
gphoto2 --set-config shutterspeed=bulb

gphoto2 --set-config eosremoterelease=Immediate --wait-event=3s --set-config
eosremoterelease=Off --wait-event-and-download=2s
```