The Autonomous Lawnmower User Guide

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# Hardware Installation

**Wiring from Arduino Uno Wifi Rev 2 to RoboteQ HDC2450**

**Arduino RoboteQ**

PWM\_R -> D6 -> PIN 16

PWM\_L -> D3 -> PIN 15

LEFT\_FWD -> D1 -> PIN 10

RIGHT\_FWD -> D7 -> PIN 21

LEFT\_REV -> D2 -> PIN 23

RIGHT\_REV -> D5 -> PIN 22

**Wiring from Arduino Uno Wifi Rev 2 to Magnetometer**

**Arduino Magnetometer**

3.3V -> 3.3V

GND -> GND

SDA -> SDA

SLC -> SCL

**Wiring from GPS rover to the radio transmitter**

**GPS rover Radio transmitter**

5V -> 5V

GND -> GND

Rx -> Tx/MISO

Tx -> Rx/MOSI

**Wiring from GPS base to the radio transmitter**

**GPS base Radio transmitter**

5V -> 5V

GND -> GND

Rx -> Tx/MISO

Tx -> Rx/MOSI

# Software Installation

**Note: Assuming both client and server computer are running Ubuntu 18.04 LTS on the bare metal, not in a virtual box, and the user has administrator privilege!**

**Client**:

* Follow the link below to install ROS Melodic:

<http://wiki.ros.org/melodic/Installation/Ubuntu>

* Follow the link below to install ROS Joystick:

<http://wiki.ros.org/joy/Tutorials/ConfiguringALinuxJoystick>

* Issue the following commands in the terminal:

sudo apt-get install ros-melodic-rosserial

sudo apt-get install ros-melodic-teleop-twist-joy

sudo apt-get install libusb-dev

sudo apt-get install libspnav-dev

sudo apt-get install libbluetooth-dev

sudo apt-get install libcwiid-dev

cd ~

git clone <https://bitbucket.org/jdolds09/senior-design-project>

cd ~/senior-design-project/

catkin\_make

* Edit the .**bashrc** file. Note that this step will execute the below codes everytime a terminal is open. The codes below will change the behavior of the ROS environment.

cd ~

gedit .bash

Please replace **127.0.0.1** with the IP address of the server computer on the lawn mower and add the following line codes to the end of the .bashrc file:

export ROS\_IP=**127.0.0.1**

export ROS\_MASTER\_URI=http://**127.0.0.1**:11311

source ~/senior-design-project/catkin\_ws/devel/setup.bash

Save and close the text editor

**Server**:

* Follow the link below to install ROS Melodic:

<http://wiki.ros.org/melodic/Installation/Ubuntu>

* Follow the link below to install ROS Joystick:

<http://wiki.ros.org/joy/Tutorials/ConfiguringALinuxJoystick>

* Issue the following commands in the terminal:

sudo apt-get install ros-melodic-rosserial-arduino

sudo apt-get install ros-melodic-rosserial

sudo apt-get install ros-melodic-teleop-twist-joy

cd ~/Arduino/libraries

rm -rf ros\_lib

rosrun rosserial\_arduino make\_libraries.py .

sudo apt-get install libusb-dev

sudo apt-get install libspnav-dev

sudo apt-get install libbluetooth-dev

sudo apt-get install libcwiid-dev

sudo apt install python3-pip

pip3 install opencv-python

pip3 install imutils

cd ~

git clone <https://bitbucket.org/jdolds09/senior-design-project>

cd ~/senior-design-project/

catkin\_make

* Edit the .**bashrc** file. Note that this step will execute the below codes everytime a terminal is open. The codes below will change the behavior of the ROS environment.

cd ~

gedit .bash

Please replace **127.0.0.1** with the IP address of the server computer on the lawn mower and add the following line codes to the end of the .bashrc file:

export ROS\_IP=**127.0.0.1**

export ROS\_MASTER\_URI=http://**127.0.0.1**:11311

source ~/senior-design-project/catkin\_ws/devel/setup.bash

Save and close the text editor

* Need to make one adjustment to the header file path:

Open the header file with the following path:

~/Arduino/libraries/ros\_lib/ArduinoHardware.h

line 61, add **api/** in front of **HardwareSerial.h** to make it look like below:

**#include <api/HardwareSerial.h> // Arduino AVR**

save the file and close the text editor

* The Arduino code is in **/senior-design-project/serial\_joy/serial\_joy.ino**
* The Arduino IDE can be downloaded from <https://www.arduino.cc/en/Main/Software>
* After the Arduino IDE has been installed, the following libraries are required to be install

in the IDE (Sketch -> Include Library -> Manage Libraries)

* arduino-timer by Michael Contreras Version 1.0.0
* atmel atmega328pb Xplained mini board (might be automatically popup a message to install this library when the board is plugged into PC)

The base and the rover GPS can be configured using the **u-center** on **Windows** application. U-center can be downloaded from the link below:

<https://www.u-blox.com/en/product/u-center>

After the downloaded and installed the u-center, follow the instructions from **page 21-28** of the **ZED-F9P\_Integration\_Manual.pdf**. The pdf can be found at the link below

<https://cdn.sparkfun.com/assets/learn_tutorials/8/5/6/ZED-F9P_Integration_Manual.pdf>

The radio transmitter/receiver can be configured using the **Ardupilot - Mission Planner (Windows only)**

* Download and install Mission Planner using the link below:

<https://ardupilot.org/planner/docs/mission-planner-installation.html>

* Connect the radios to the PC via USB
* Click initial setup
* Click sick radio
* Change the COM port to the bigger radio
* Click load setting (might need to click several times)
* Change baud rate of radios to 115200
* Click copy required items to remote

The Ricoh Theta V can be configured as a client using the link below:

<https://community.theta360.guide/t/theta-v-client-mode-configuration-guide/2565>

After successfully connecting to a router,

* go to /senior-design-project/CameraFeed/webstreaming.py and replace **10.0.0.10** (at/near line 30) to the IP address of the Ricoh Theta V obtained from the router.
* go to /senior-design-project/Server.bash and replace **10.0.0.9** (at/near line 31) to the IP address of the server computer on the lawn mower.

# Execution

**Note: The server’s software must running before the client’s software can run!**

To run the software, please issue the following commands in the terminal:

**Server**:

cd ~

cd senior-design-project/

sudo ./Server.bash

**Client**:

cd ~

cd senior-design-project/

sudo ./Client.bash

Please replace **10.0.0.9** with the IP address of the server computer on the lawn mower and open Google Chrome browser and type in

https://**10.0.0.9**:8000/video\_feed

# Troubleshooting

**Note:**

* **“username” is the name of the user who logged into Ubuntu, it appears before the ampersand sign in the terminal.**
* **1.8.10 is the version of the Arduino IDE used when writing this guide. Please replace it with the version you downloaded.**

Below are possibles fix for “permission denied” error:

sudo usermod -a -G dialout username

sudo chmod 666 /dev/ttyACM0

Log out and log in Ubuntu

cd arduino-1.8.10

./arduino-linux-setup.sh username

Restart Ubuntu PC