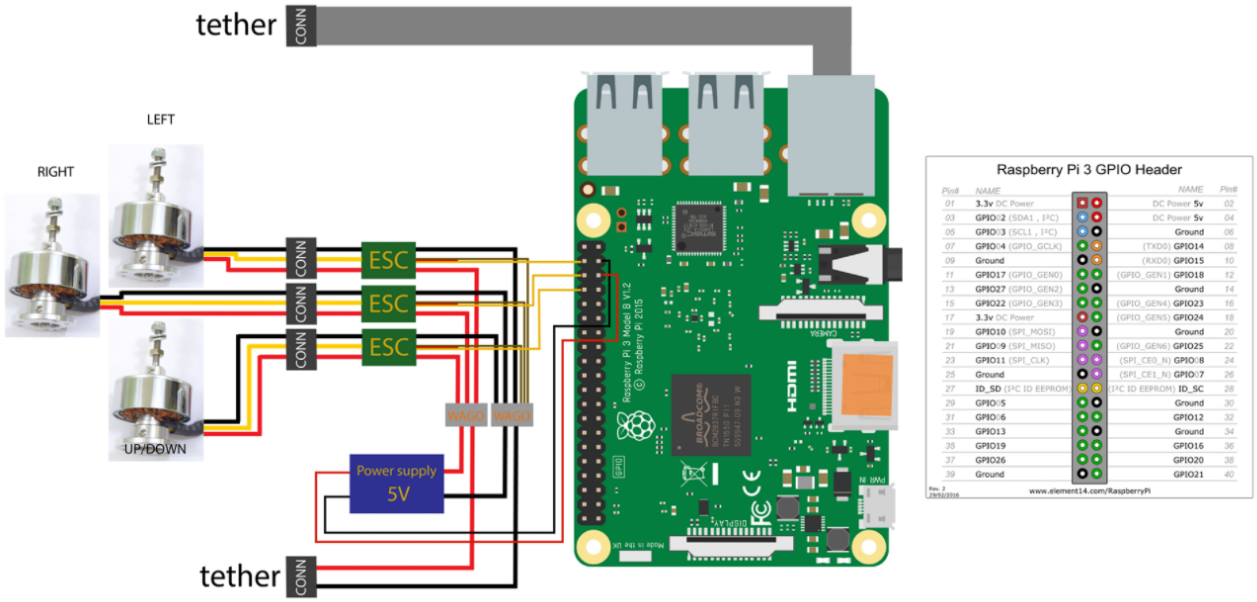
Hardware build guide



General

The ROV consists of a control unit that is Raspberry Pi, power supply and ESCs are a part of power unit and propulsion unit that is represented by thrusters. The schematic shows the connections between individual parts. Each thruster is characterized by the side of ROV it is supposed to be mounted on but that can still be changed in the code. Wires from motors then go through waterproof connectors to ESCs that are driving the motors. ESCs then have their own power wires for powering the motors as well as signal wires that are used for controlling the speed of the motors.
Raspberry Pi is powered using 5V power supply. The power supply that we used has adjustable output voltage and therefore it has to be adjusted to 5V ± 0,1V using a screwdriver and a multimeter. Then the output voltage of the power supply is guided to power pins of raspberry pi as shown in the schematic. For 12V power input to the ROV, we use 2 pin waterproof connector that connects 12V power supply on the surface with the rest of ROV. Power nodes are connected using WAGO terminals
All data between ROV and PC is transmitted through Ethernet cable that is connected to Raspberry Pi and again connected to tether using a waterproof connector. The last part is camera that is connected to CAMERA socket on the Raspberry Pi itself.

Connectors (CONN)

For this ROV we have decided to use Buccaneer 400 Series connectors in 2-3 types. For power, we used 2 pin connectors since they allow more current to flow through the connector, but for all other connectors we used 3 or 4 pin solutions. For Ethernet, we used 4 wire cable so 4 pin connector makes sense. For thrusters, we recommend using 3 pin connectors. These connectors have to be sealed and glued with epoxy to prevent any sort of leakage.

Wiring

The wiring in this ROV is straightforward and most of it is described in the schematic. But there are some rules that has to be kept for ROV to function correctly. Firstly, the cables on thrusters has to be wired up correctly. Yellow should line up with yellow, red with red and black with black. This will decrease the change of the motor being polarized differently (it would turn on the other side). If there is a case of wrong moving motor swapping any two wires will fix it. Secondly, as the schematic says thin red wires coming out of ESCs should be cut down since they are not necessary for this application. Thin black/brown wires coming out of ESCs should be connected to the ground WAGO terminal or to any Ground pin of Raspberry Pi (use GPIO header pinout provided in the schematic). Last of the thin wires (yellow one) should be connected to GPIO pins. In the schematic, they are connected to GPIO2, GPIO3 and GPIO4. However, this is free to modify. The pins can be connected to any GPIO pin and this can be later modified in the code. By swapping these pins you can change the placement of the motor (you can swap left motor for the right one).

Power Supplies

There are two power supplies in this project. One that is on the surface and powers the whole ROV and one that is inside of the ROV and powers the Raspberry Pi. The power supply that is on the surface should be outputting 12V at around 12A. This is then connected to the ROV through the tether. The other power supply is used for converting 12V to 5V that is used in Raspberry Pi. The power supply we used needs to be adjusted to output 5V before connecting to Raspberry Pi to ensure that no electronics in Raspberry Pi are being burned by it. To adjust it used multimeter to measure output when powered by 12V power supply and by turning the trimming potentiometer using screwdriver to adjust the output voltage.

Raspberry pi setup

For this project we decided to use the **Raspberry Pi 3 Model B (latest version)** and compatible raspberry pi camera this product comes without a SD card (buy it from any electronics shop at least 4gb). To set up the raspberry pi we recommend using the NOOBS OS
(NOOBS is an easy operating system installer which contains Raspbian. It also provides a selection of alternative operating systems which are then downloaded from the internet and installed). NOOBS installation guide is available below. After you're done with the installation you can check IP address of the Raspberry Pi. To check the IP type *ifconfig* into the terminal. After the installation you should always consider updating the APT and installing any updates(see comands below). For the software to work we need to download and install the gstreamer as well as pigpio(see comands below).

Raspberry pi Noobs installation:

1. Download NOOBS.rar
2. Format SD card (FAT32)
3. Extract NOOBS files to the SD card
4. Eject SD card
5. Put the SD card into the raspberry
6. Boot up the Raspberry pi (connected to HDMI device and USB keyboard)
7. Choose NOOBS in the install option and install it

Raspberry pi setup commands (run these commands in terminal)

1. sudo apt-get update
2. sudo apt-get upgrade
3. sudo apt-get install gstreamer1.0

PIGPIO setup (run these commands in terminal)

1. sudo apt-get update
2. sudo apt-get install pigpio python-pigpio python3-pigpio
3. to test it use (sudo pigpiod)

main.py and superscript.sh setup

1. open terminal and type “git clone https://github.com/Rovmakercompetition/ROVMC.git”
2. move the *main.py* and *superscript.sh* to */home/pi* directory
3. create an executable out of *superscript.sh* (sudo chmod x+a superscript.sh)
4. make sure that the IPs in main.py and superscript are set up correctly
5. open .bashrc text file “sudo nano /home/pi/.bashrc
6. add line “sudo ./superscript.sh” at the end of the file

Now each time the Raspberry Pi boots up it will run the superscript that will run main.py and GStreamer instance to enable video stream this video stream can later be displayed on computer.

Ground Station setup

The Ground station was designed to run on Ubuntu but any other debian based distribution should be supported.
First you need to install Ubuntu on your computer. There are many guides that you can find on internet. After you installed Ubuntu you will need to install Qt framework that can be downloaded on www.qt.io. Just choose Start a free trial option then Desktop & Mobile applications and install the Open Source version of Qt.
When you installed Qt, update the APT (sudo apt-get update) and install the gstreamer same as for raspberry pi(see above).Then update the gstreamer library “sudo apt-get install gstreamer1.0-libav”.
As soon as the GStreamer is installed, download RMC_Controller project and put it in /home/pi folder and run *RMC_Controller.pro* in *Qt Creator*. After the project loades up choose compiler for desktop applications and then hit run button in the left corner to run the application.