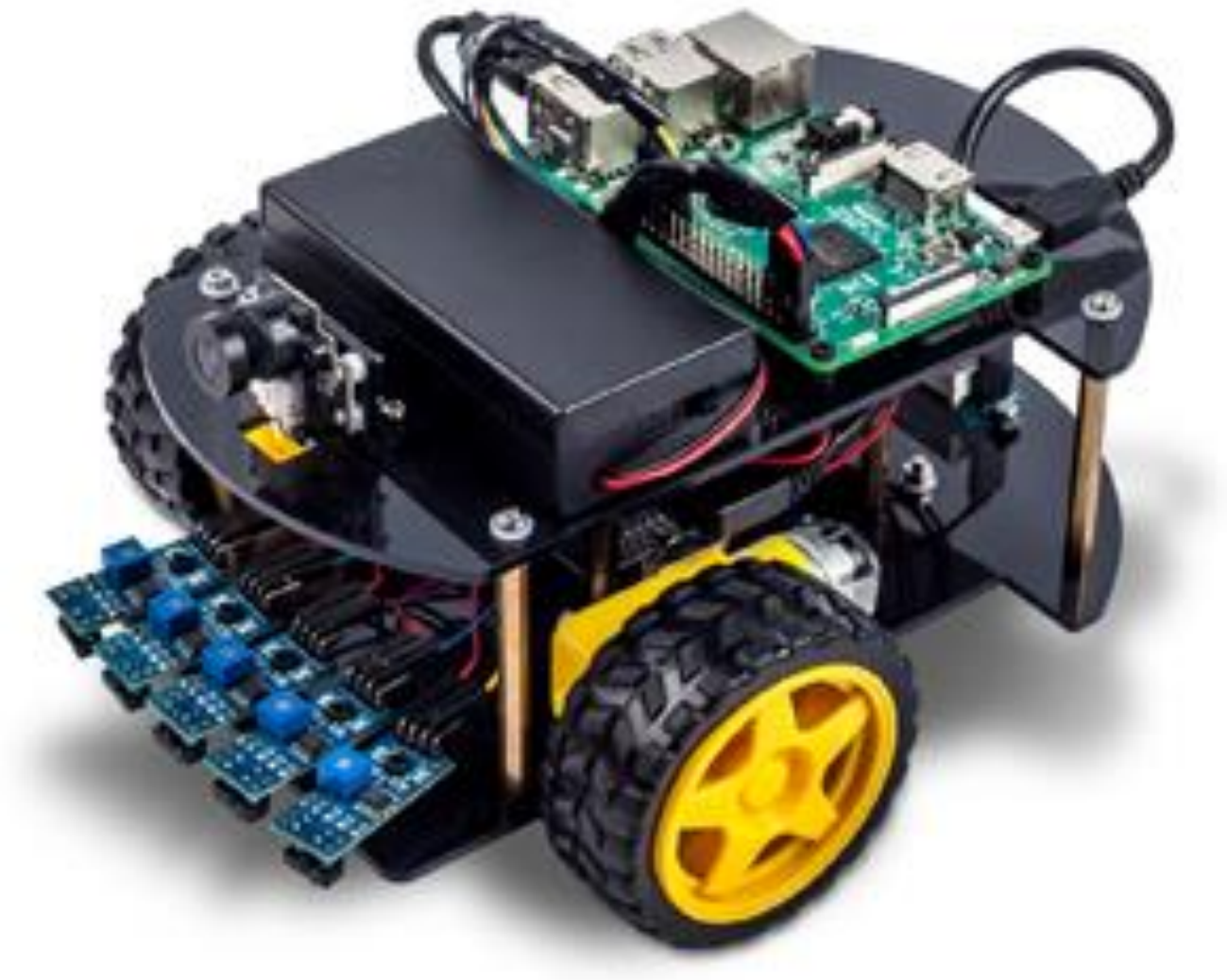
Raspberry Pi Robot Car



Manual Download: www.osoyoo.com/?=16259

CONTENT

Introduction

There are many entry level Robot Car Kits in the market, most of them are controlled by Arduino Boards. You can check our tutorial blog for such Arduino Robot kit in https://osoyoo.com/2017/08/06/osoyoo-robot-car-diy-introduction .

The advantage of Arduino Robot Car kit is that Arduino has no Operation System and programming is simple and easily. For some basic robot application which needs only simply logic to handle sensor data and control actuators, Arduino-controlled robot car is a good choice.

However, for some more complex robot applications which need more complex functions such as computer vision(CV), Internet of Things (IoT), web server control etc, Arduino board's ability is too weak to reach the target.

In order to help intermediate students to complete some complex Robotic project. We developed a more advanced Raspberry Pi Robot Car learning Kit.

Why Raspberry Pi is so important to the Robot Car DIY learning kit?

Because Raspberry Pi is a real computer which has Linux OS(Raspbian) and therefore much powerful than Arduino Board which is simply a micro-controller(MCU).

With Raspbian OS and its huge open-source software community , people can make much complicated Robot projects, i.e web application, database, A.I, machine learning, IoT, Computer Vision etc.

Unlike Arduino board, Raspberry Pi programming environment is much more complex and flexible. It supports almost all programming language as long as the language is supported by Rasbian Open Source community. The most commonly used languages for access Raspberry Pi GPIO pins are C and Python. If you want to learn some Raspberry Pi hardware GPIO programming, you can read our tutorial in following links:

https://osoyoo.com/2017/10/09/raspberry-pi-starter-kit-v1-introduction/

https://osoyoo.com/2016/06/13/internet-of-thingsiot-starter-kit-on-raspberry-pi/

Since Raspberry Pi programming is different from Arduino, we suggest user should get some basic Linux knowledge before practice Raspberry Pi Robot project.

If you want to learn Linux Robot by doing, you can buy this kit as learning kit. We provide some basic lessons in the kit to show you how to set up Rasbian Linux environment, how to use Linux shell to control car movement and how to use web browser to monitor and control car movement through the camera.

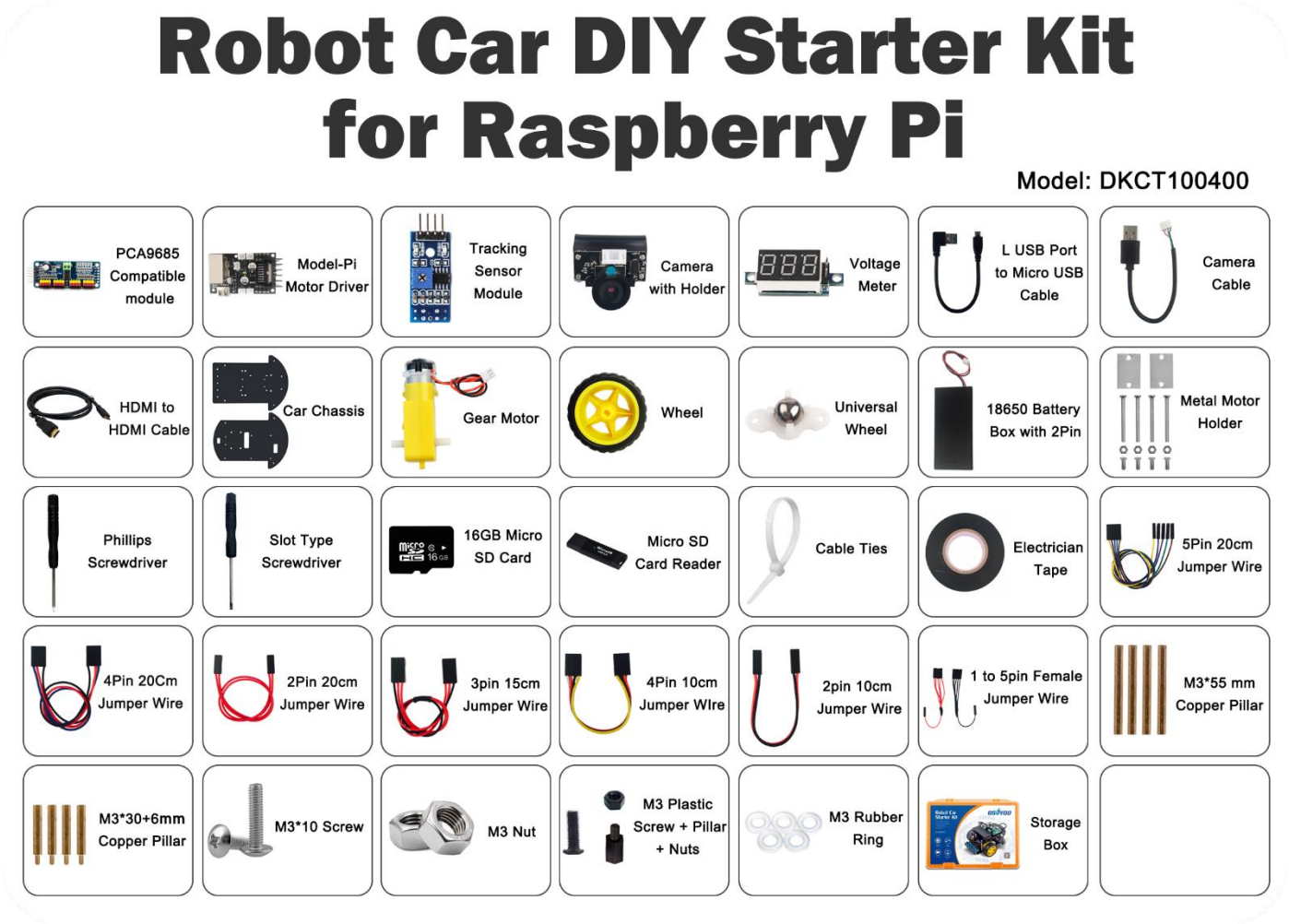
These basic projects in our tutorial have step by step instruction with sample code, circuit graph and installation video. These lessons all have been tested, so if you strictly follow our instruction, they will work without any problem. We also write detailed comments in our python sample code which can help you to understand the code and customize for your own application. However, you must have some linux and python background knowledge otherwise please do not change the code.

We also provide an optional Open-CV sample project for use to practice Robotic Computer Vision procedure. However, as OPENCV and machine learning open source community is evolving everyday, we can not guarantee that the opencv project will work properly. You might do your due diligence to follow up the opencv community's updates and make your project work.

If you have any interesting application to use our Robot kit, you are more than welcome to share your

excellent ideas in our comments section.

Package Listing



AUTHORIZED ONLINE RETAILERS

Raspberry Pi Robot Car Kit (without Raspberry Pi board and 18650 batteries)

Buy from US	Buy from UK	Buy from DE	Buy from IT	Buy from FR	Buy from ES
BUY NOW	BUY NOW	BUY NOW	BUY NOW	BUY NOW	BUY NOW

18650 Batteries and Charger

Lesson 1: Basic Framework Installation

OBJECTIVE

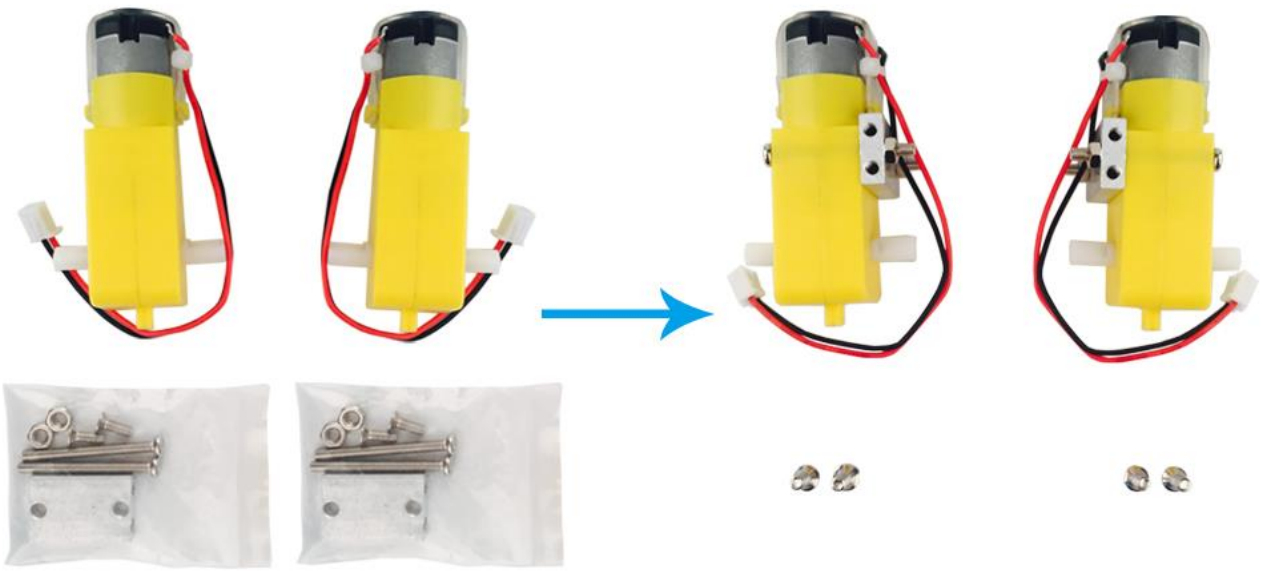
In this lesson, we will install the most important framework in the smart car and make car to do some simple movements as per our python sample code. If you have passed the test movement of this lesson, that means Arduino, voltage meter, motor drive module(Model-PI), motors, batteries ,chassis and wire connections between these parts are all functioning well.

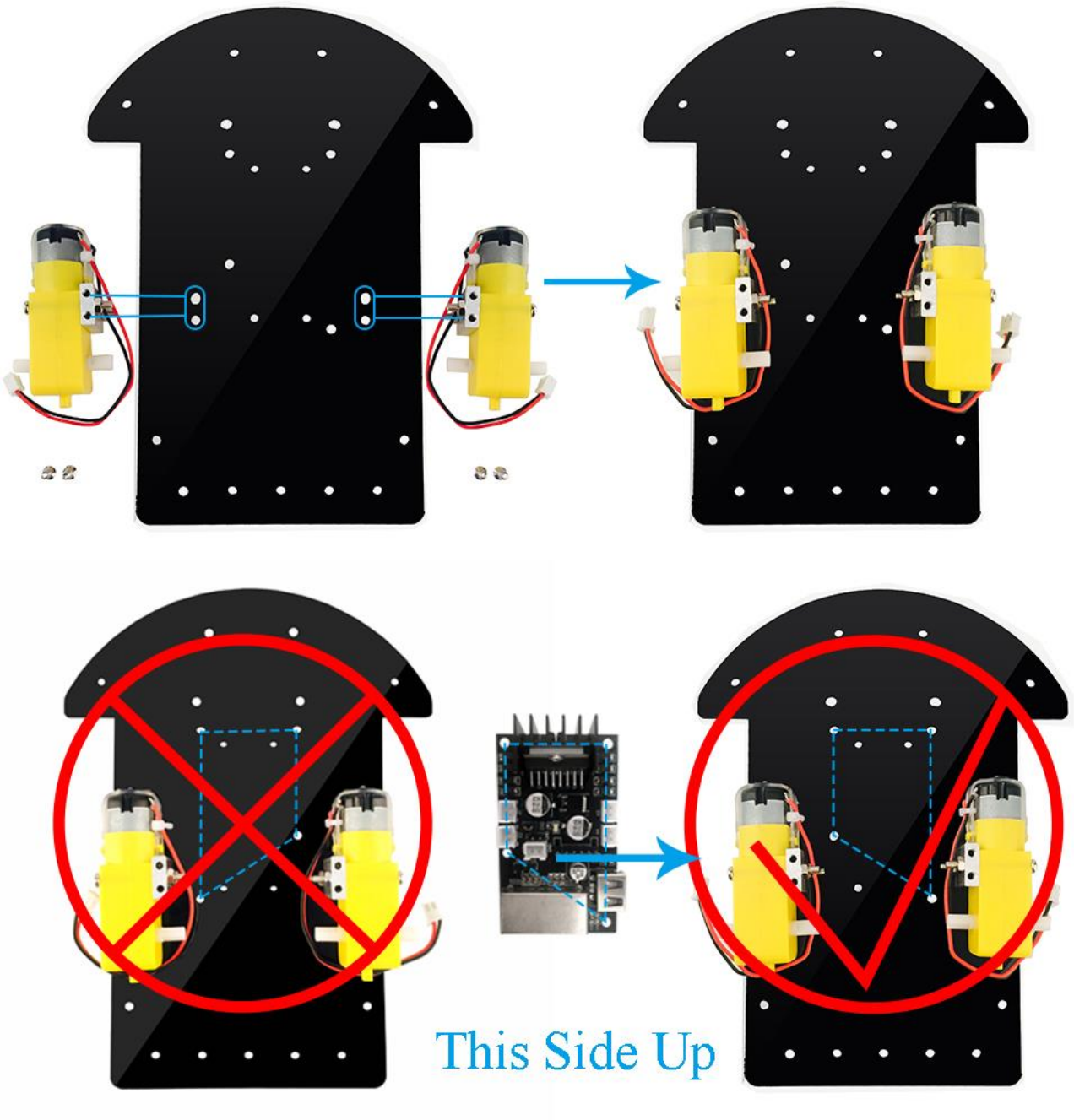
As your experiments in future lessons are all based on frame work of Lesson One, it is very important to test the installation and sample code in this Lesson properly.

HARDWARE INSTALLATION

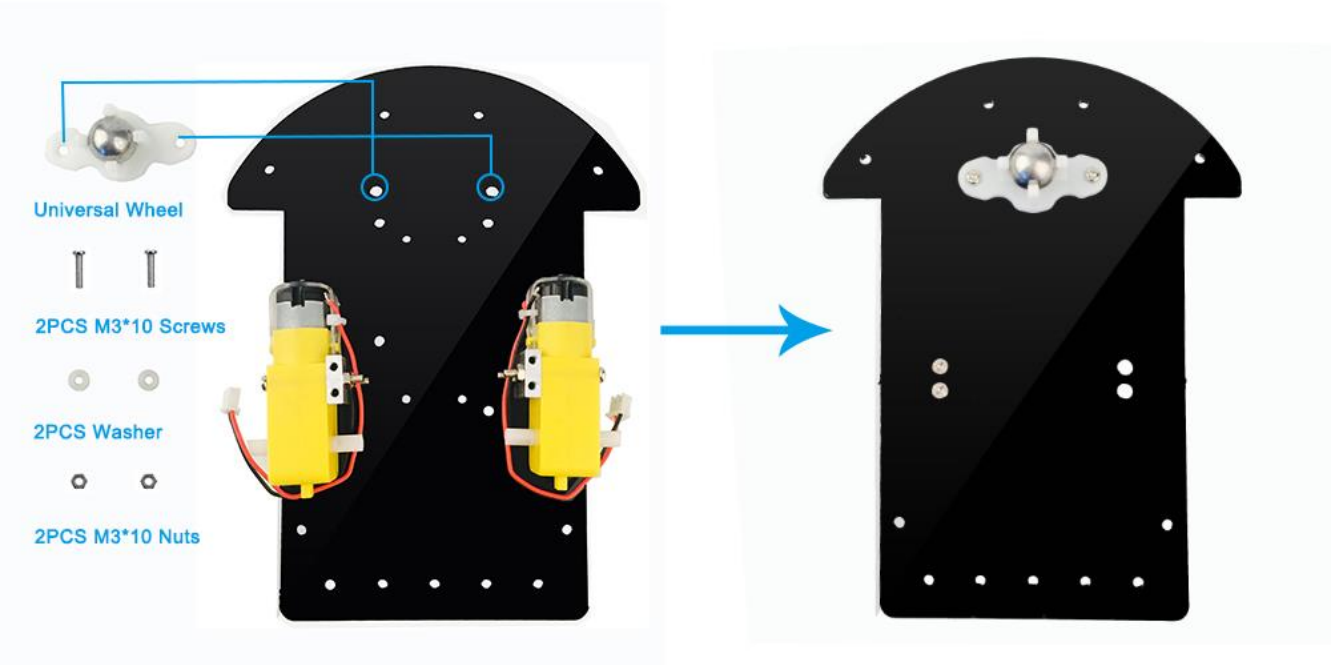
Lesson1 Youtube Video Link: https://youtu.be/I4e7SvpNccM

STEP1. Install driving wheels as follows.

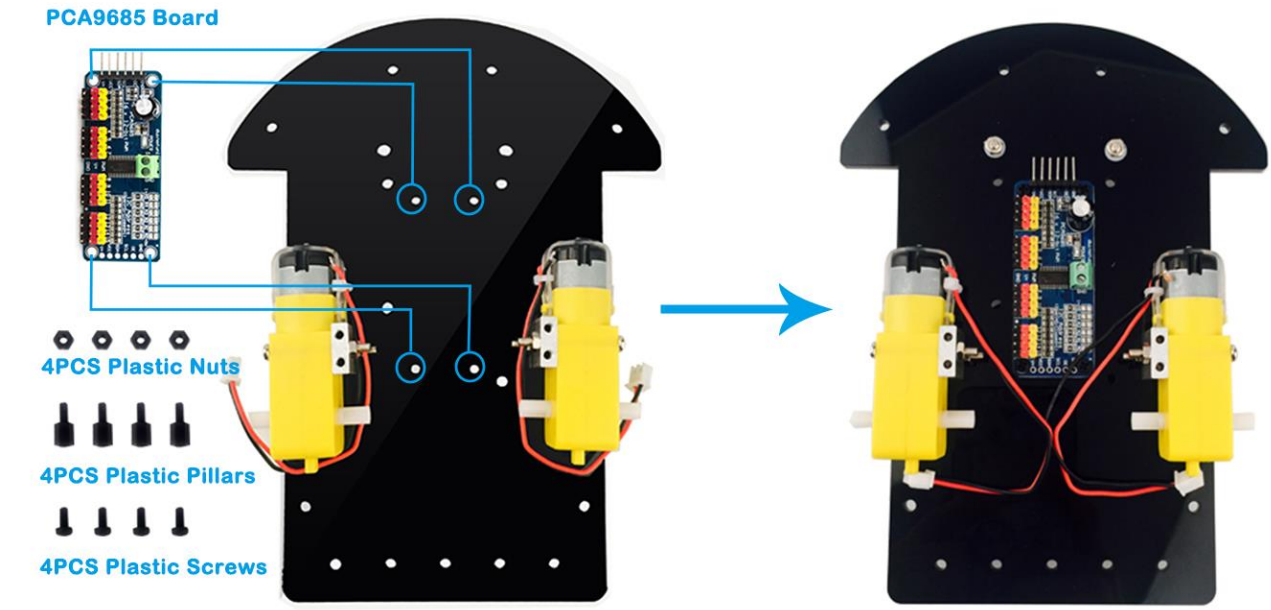




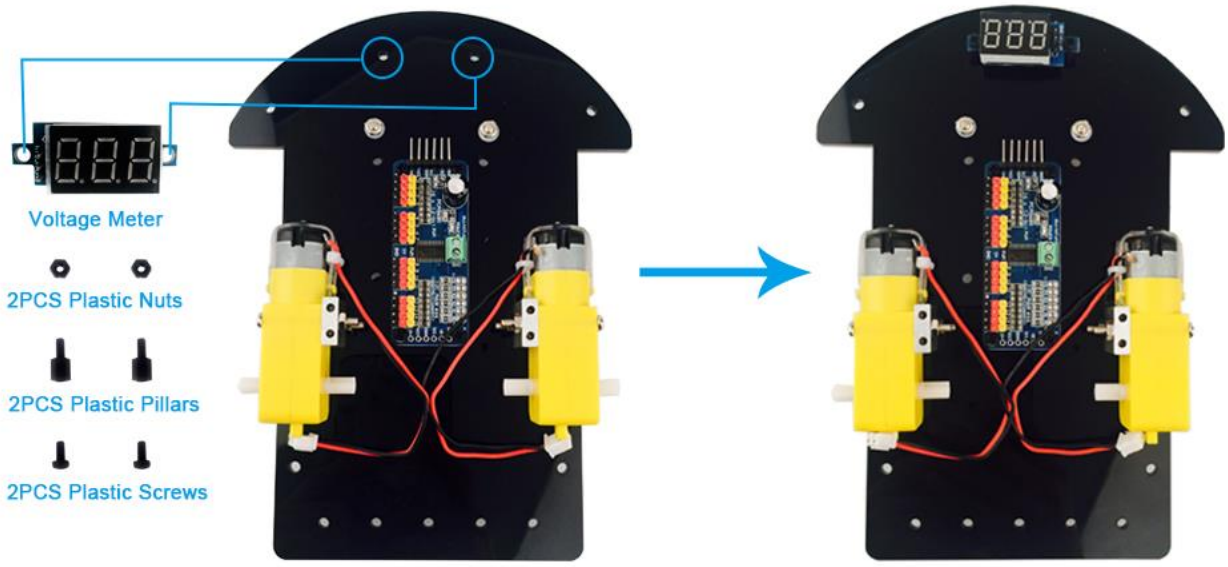
STEP2. Install universal wheel as follows.



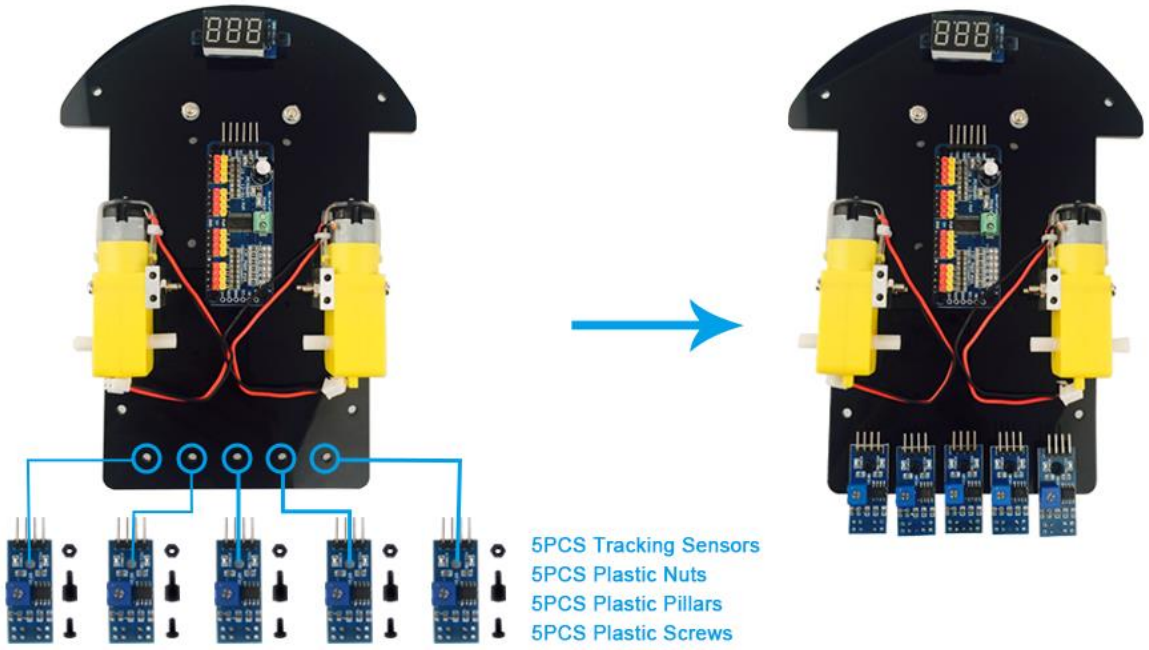
STEP3. Install PCA9685 compatible module.



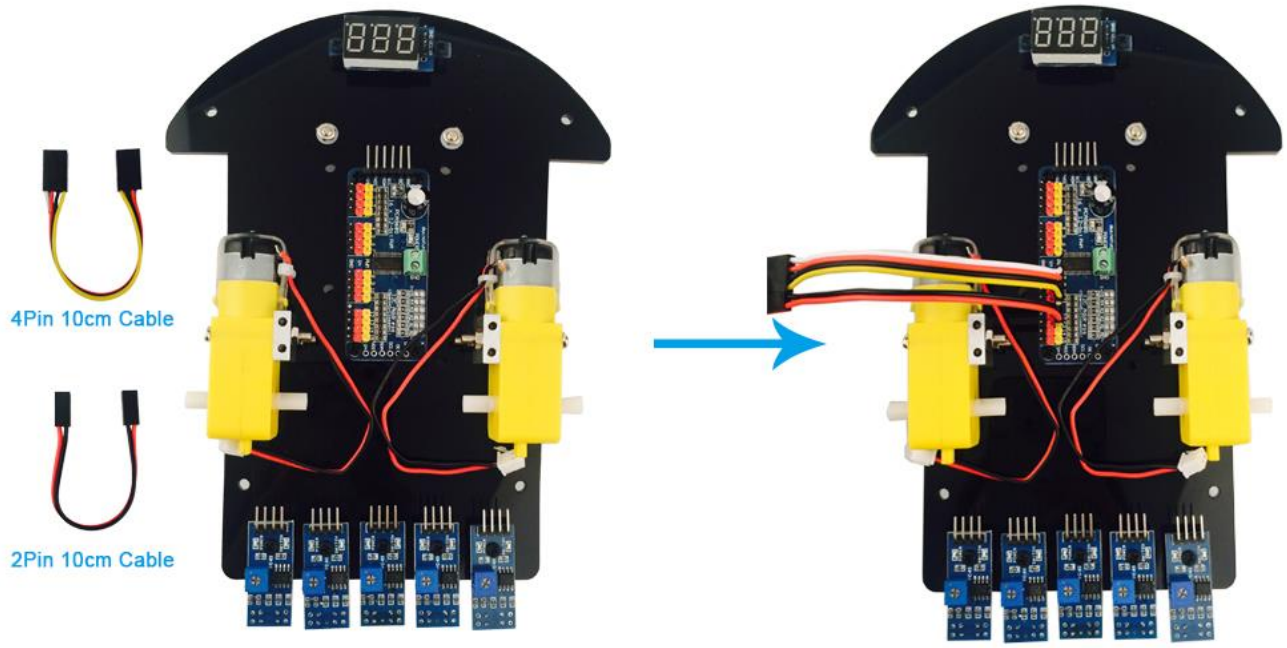
STEP4. Install voltage meter as follows.



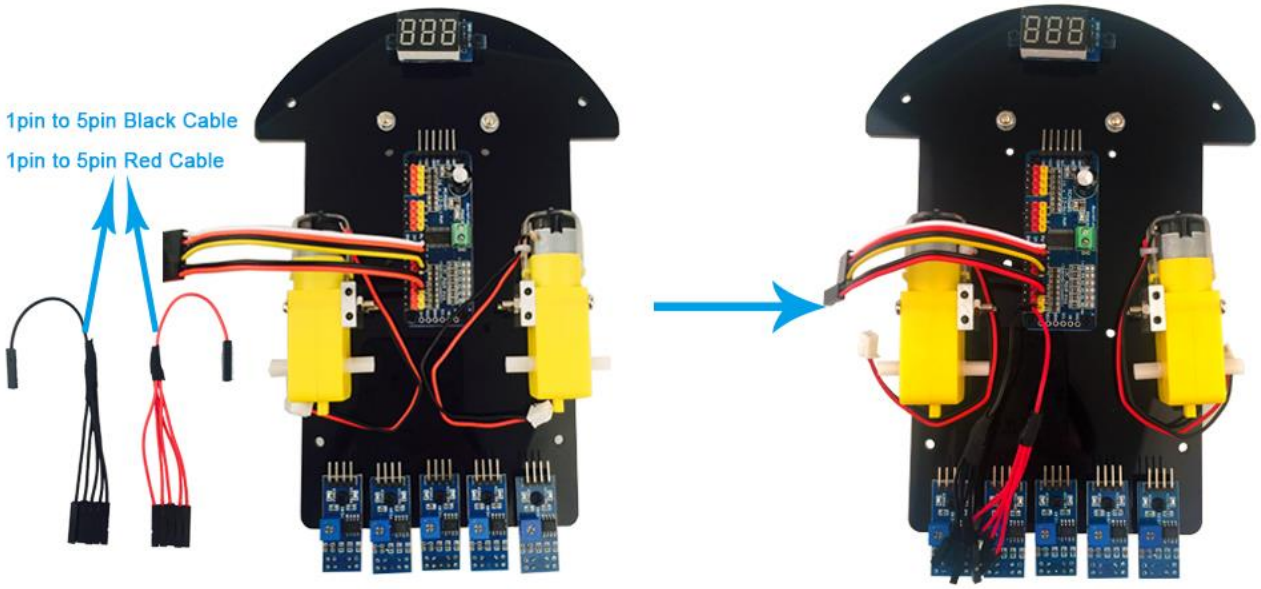
STEP5. Install 5 pcs tracking sensor as follows.

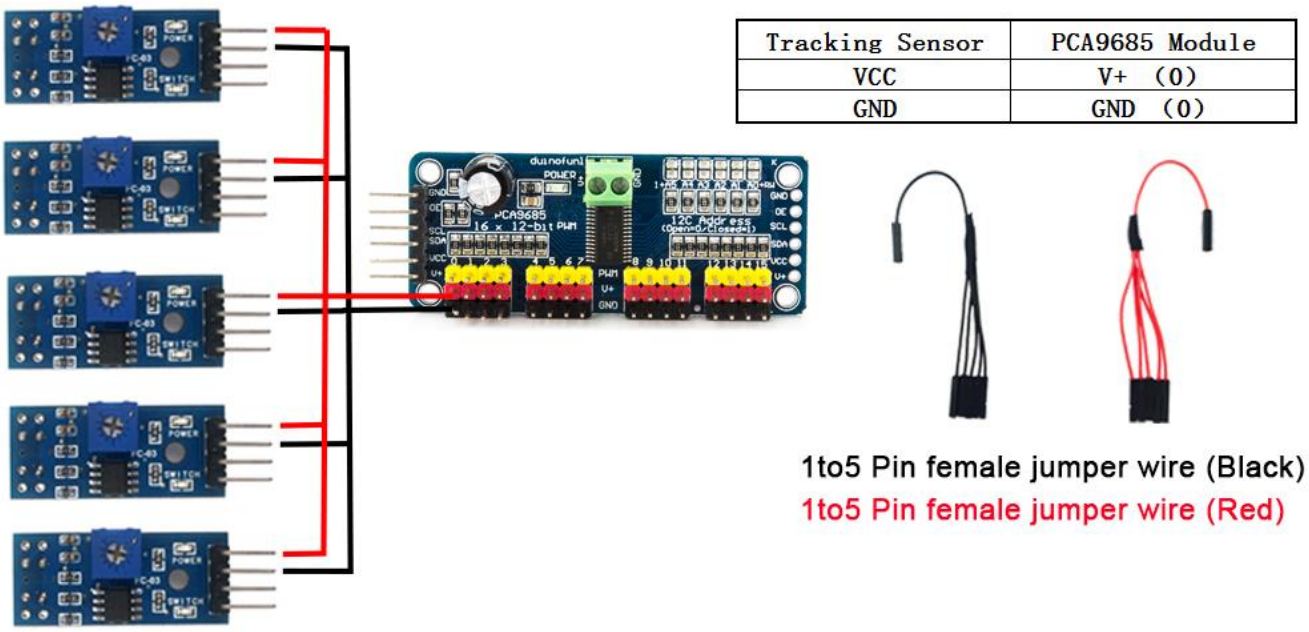


STEP6. Plug the 4 pin female to female cable (white, red, black, yellow) and 2 pin female to female cable (black, red) into PCA9685 compatible board as follows.

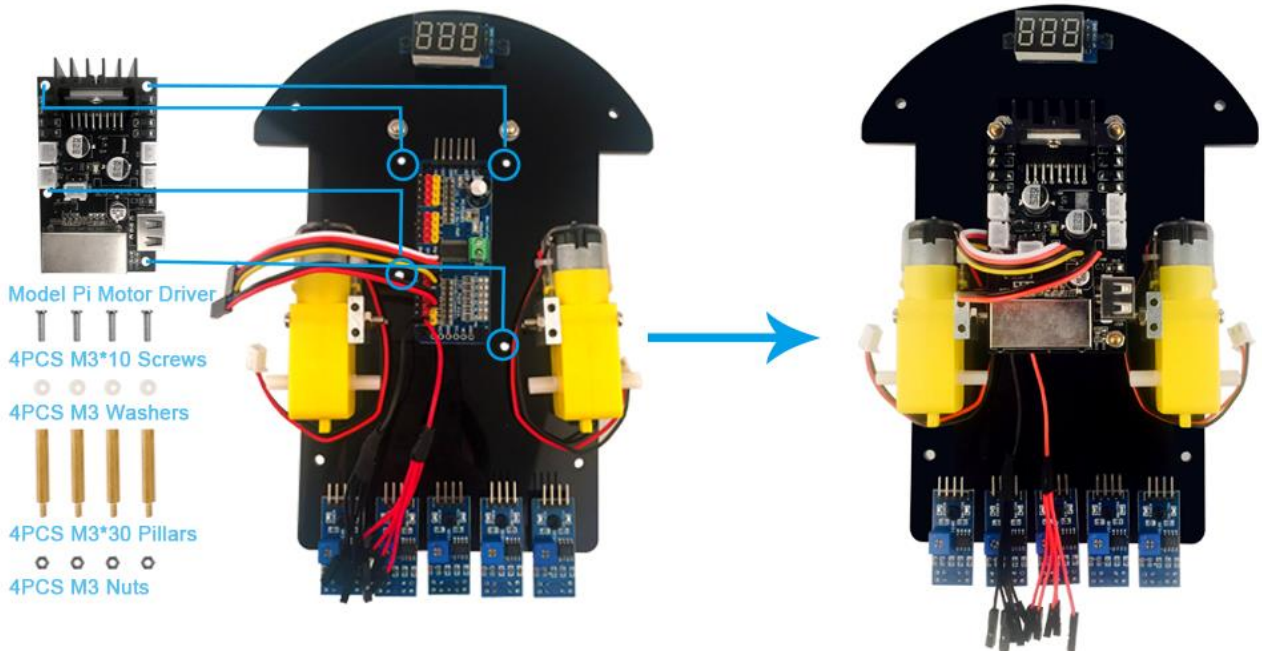


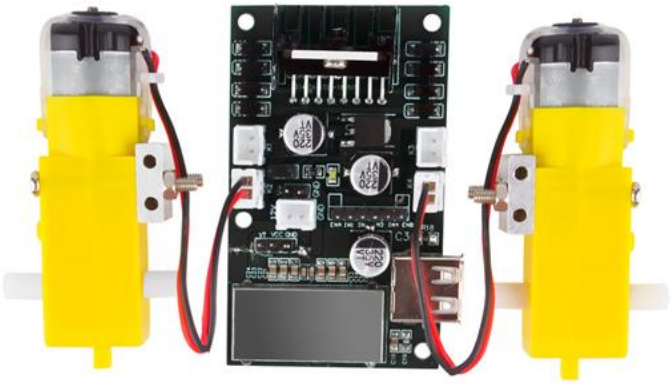
STEP7. Plug the 2 PCS 1 pin to 5 pin female to female cable (Black and Red) into PCA9685 compatible board as follows.

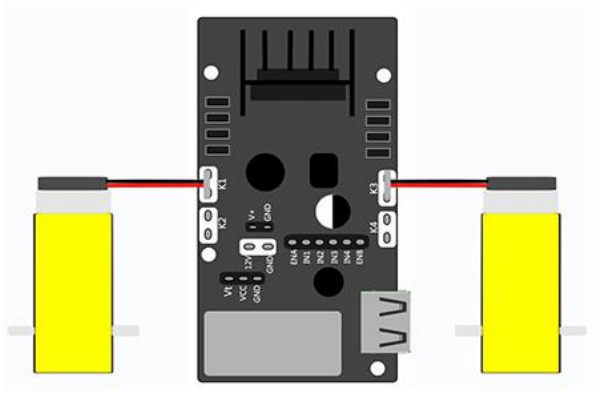




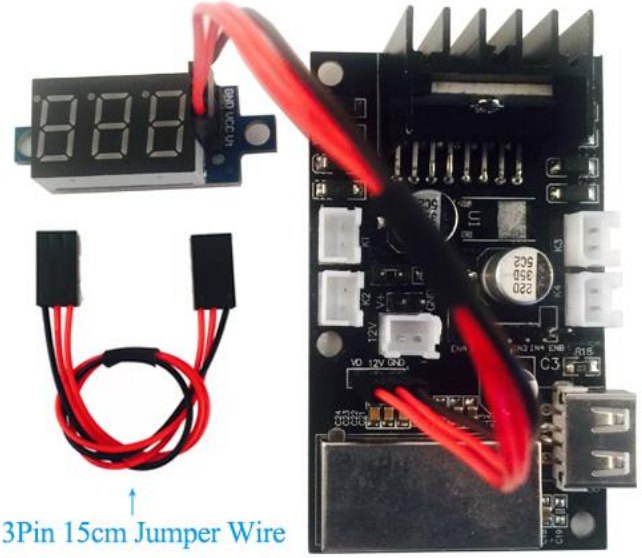
STEP8. Install the model pi motor driver board as follows. Then connect PCA9685 compatible module to motor driver board via 4pin and 2 pin cable. Meanwhile, connect the voltage meter to motor driver board via 3pin cable.

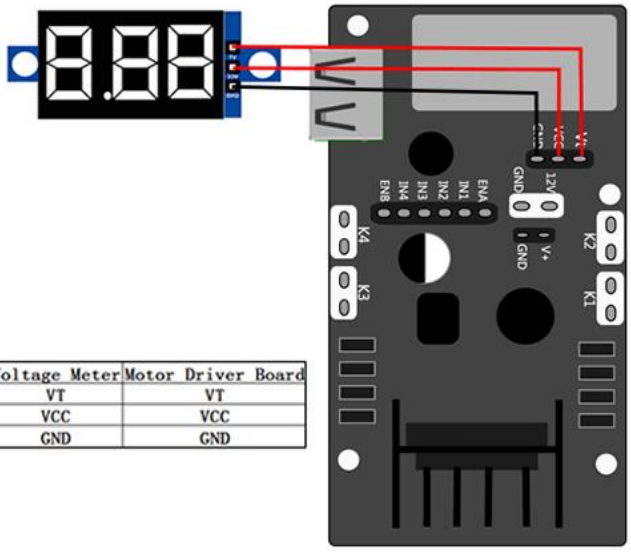




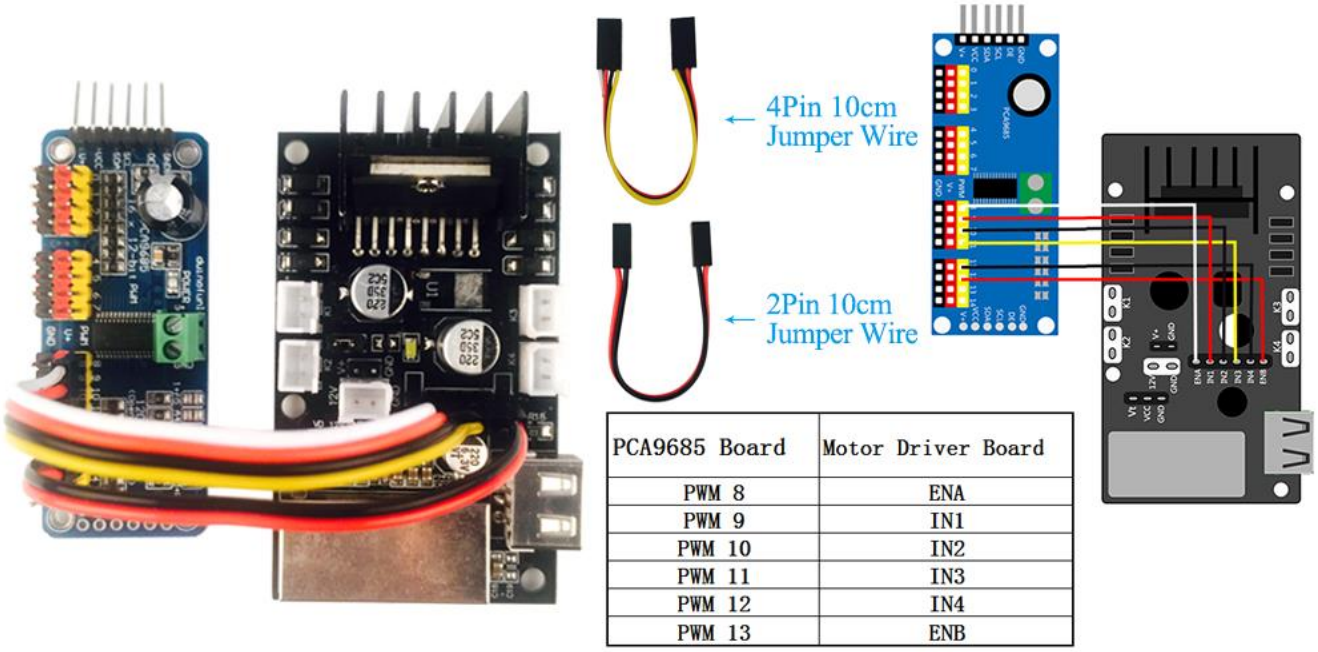


Car Motor	Motor DriverModule
Left Motor	K1 or K2
Right Motor	K3 or K4



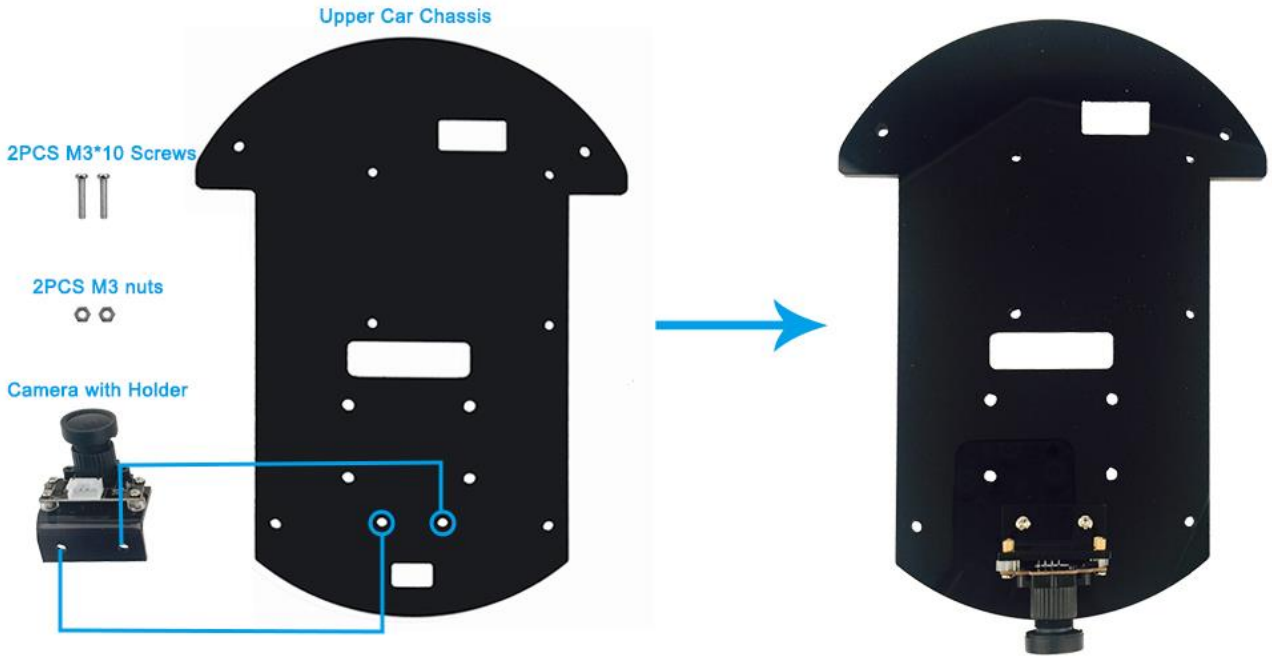


Voltage Meter	Motor Driver Board
VT	VT
VCC	VCC
GND	GND

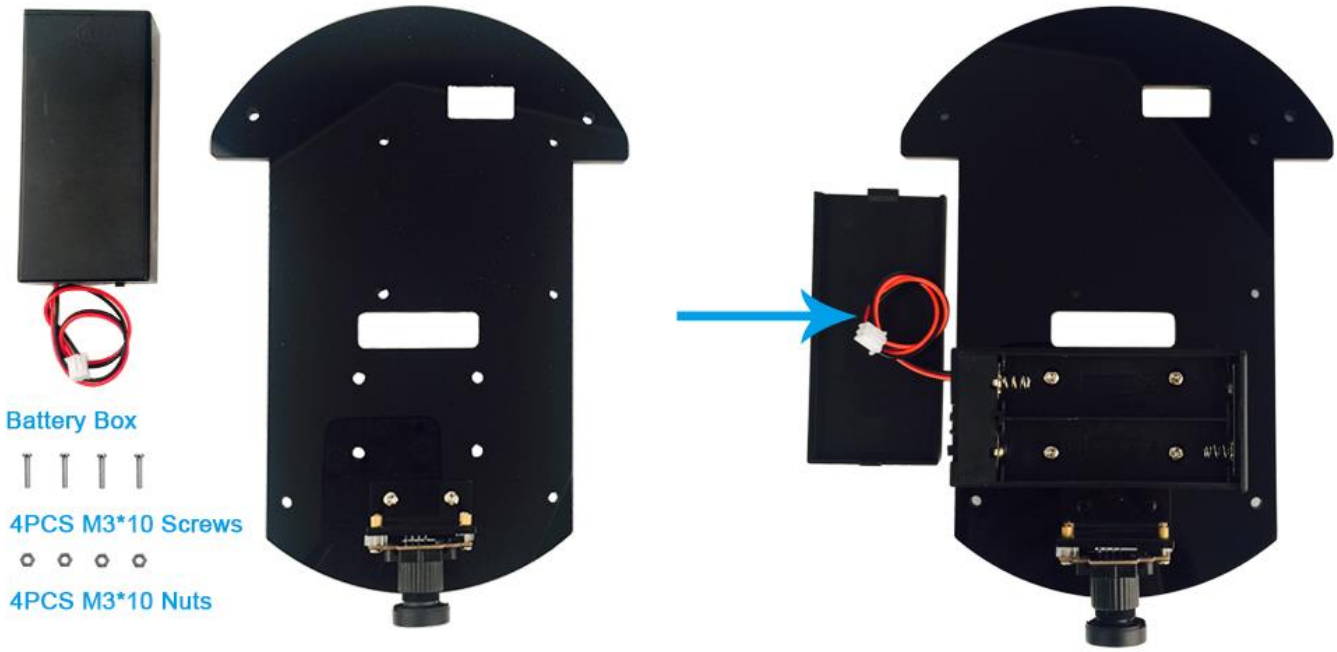


PCA9685 Board	Motor Driver Board
PWM 8	ENA
PWM 9	IN1
PWM 10	IN2
PWM 11	IN3
PWM 12	IN4
PWM 13	ENB

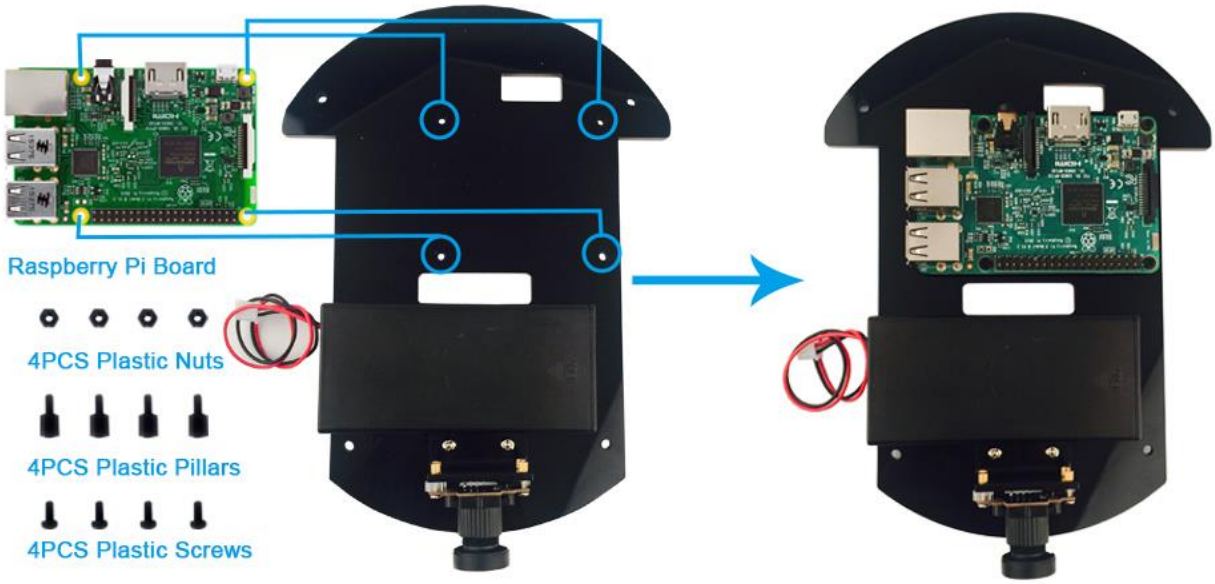
STEP9. Install camera module on the top car chassis as follows.



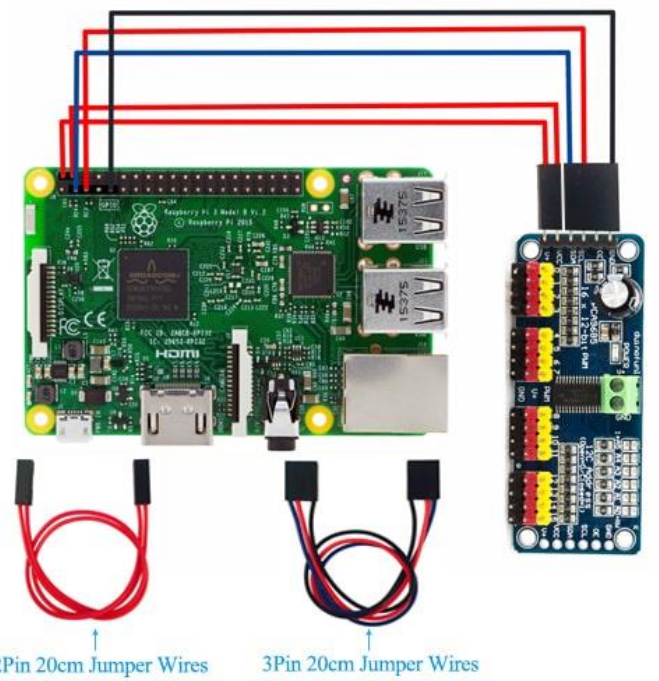
STEP10. Install battery box on the top car chassis as follows.



STEP11. Install raspberry pi on the top car chassis as follows.

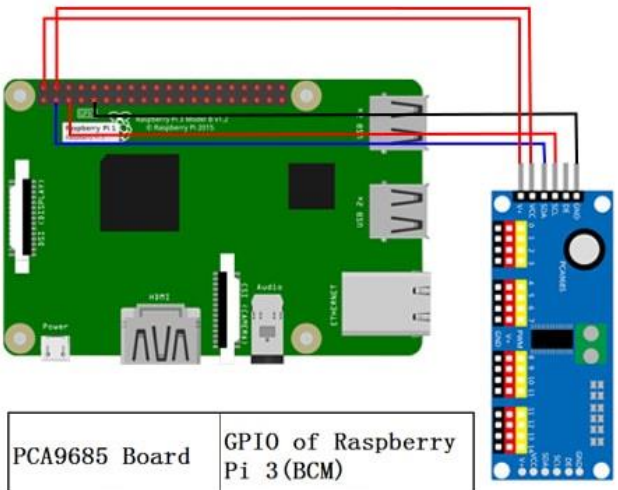


STEP12. Before install the top chassis as follows, you need to plug the battery box into model pi motor driver, then connect the Raspberry Pi board to PCA9685 compatible module and model Pi motor driver board, Lastly, connect 5 pcs tracking sensors to raspberry pi as follows.

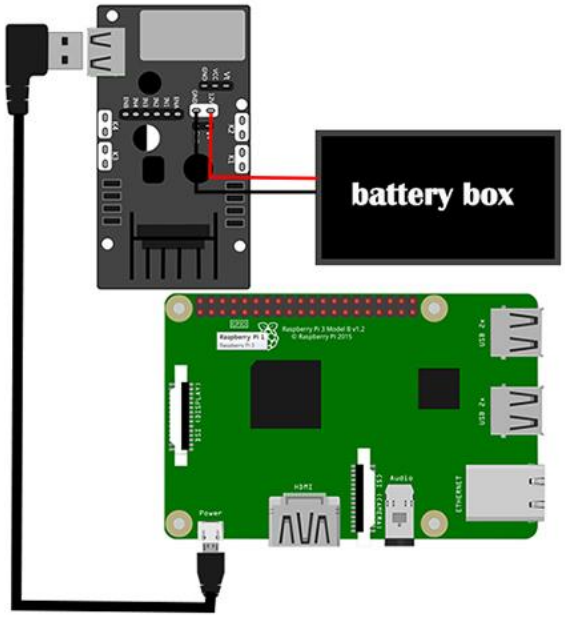


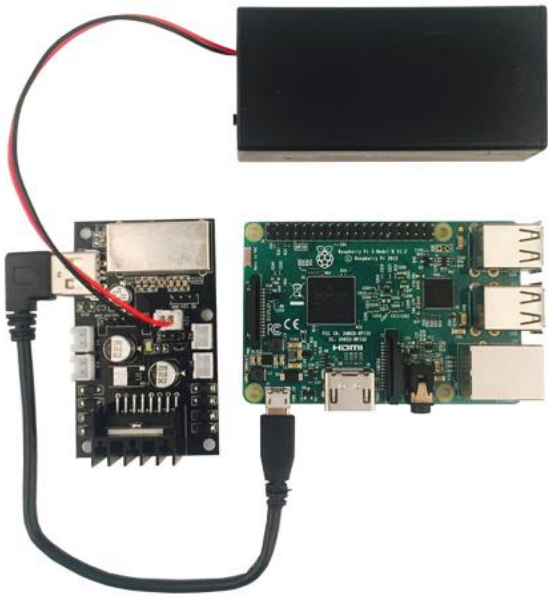
2Pin 20cm Jumper Wires

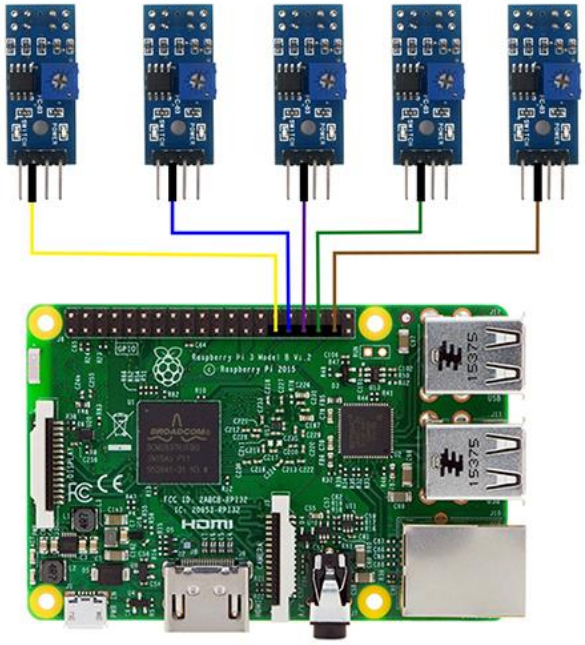
3Pin 20cm Jumper Wires



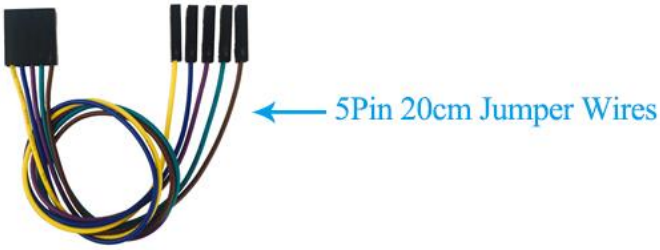
PCA9685 Board	GPIO of Raspberry Pi 3(BCM)
V+	5V
VCC	5V
SDA	SDA (GPIO 2)
SCL	SCL (GPIO 3)
/	/
GND	GND



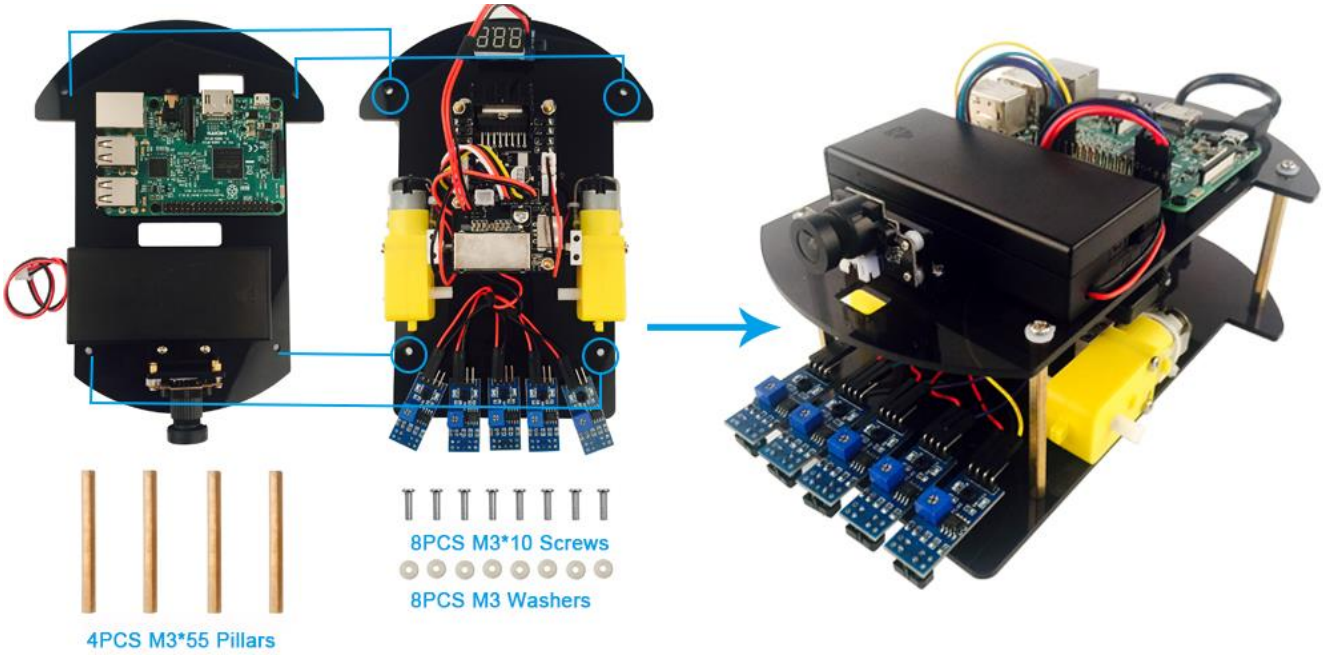




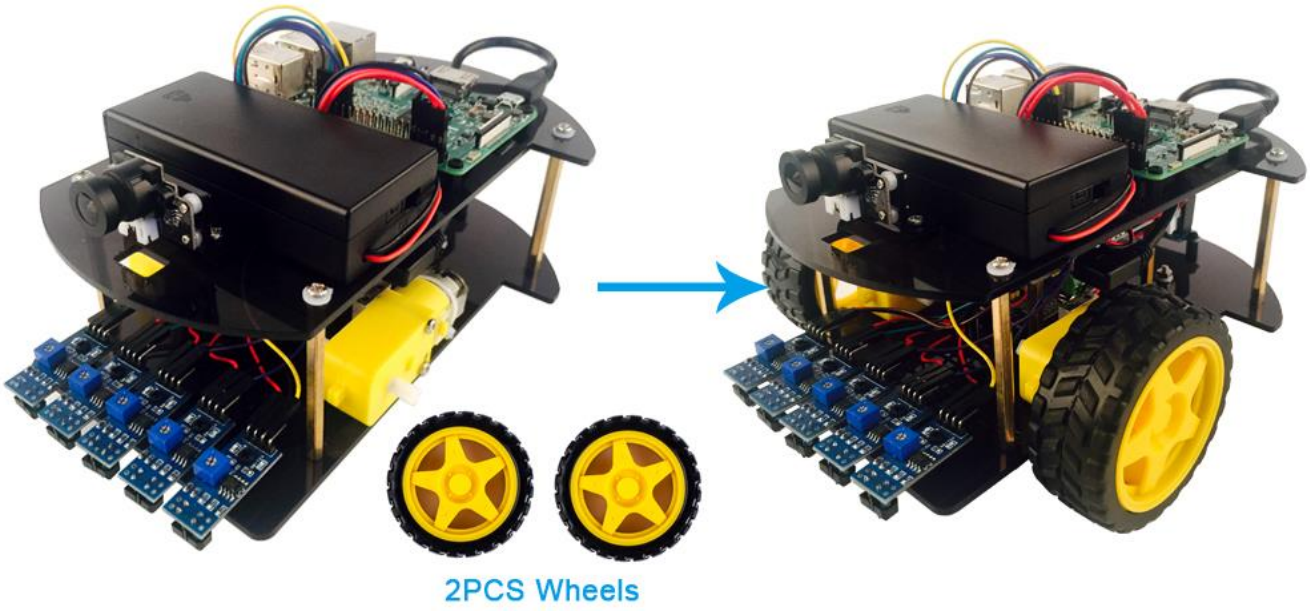
GPIO of Raspberry Pi3(BCM)	Tracking Sensor
(Left1)DO	GPIO5
(Left2)DO	GPIO6
(Left3)DO	GPIO13
(Left4)DO	GPIO19
(Left5)DO	GPIO26



STEP13. Install the top chassis as follows.



STEP14. Install the left and right wheels.



SOFTWARE INSTALLATION

Youtube Video for SD Card Pre-installed OSOYOO Image: https://youtu.be/dkv7dbz0i7Y

Youtube Video for Your SD Card: https://youtu.be/uVKoF83AIas

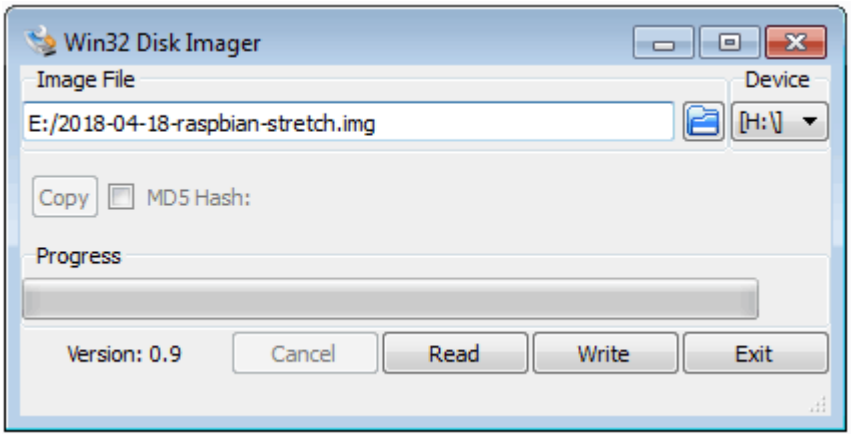
Software Preparation:
Imager utility: Win32DiskImager utility

OS: Raspbian (Use OS Raspbian 2018-04-18 in the subsequent tutorials,Please **download OS Raspbian Version before 2018-10-11**)

Format Tool: SDFormatter (Optional)

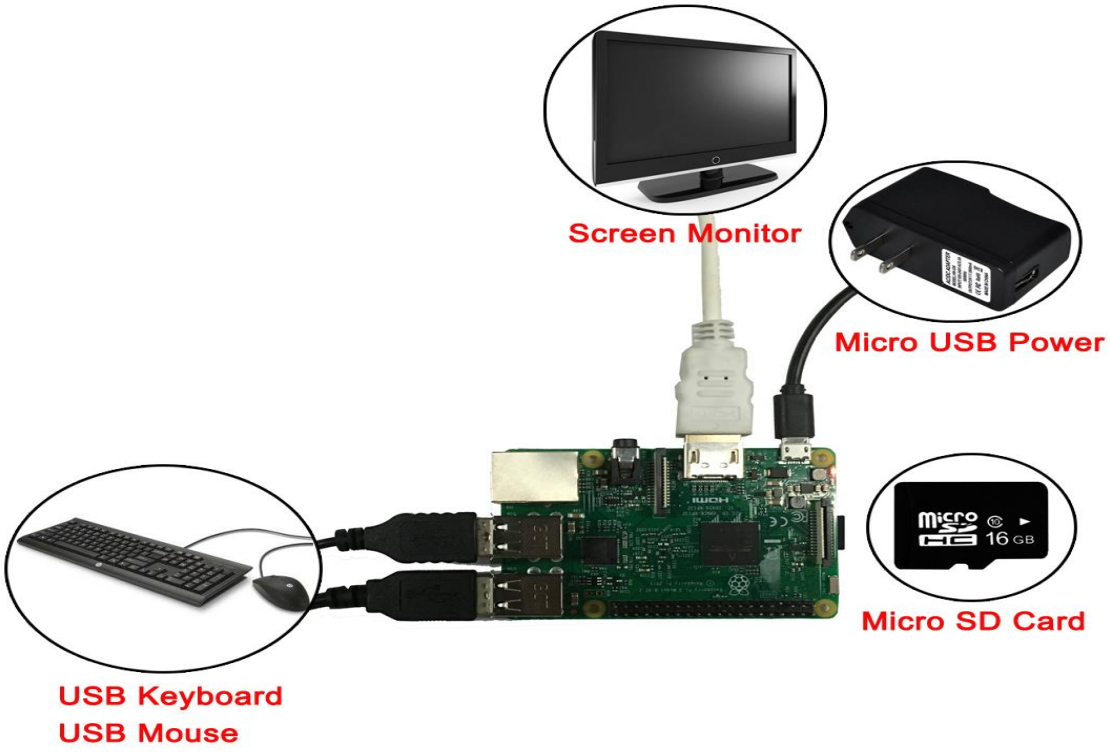
SSH Tool: PuTTY (for Windows users)

Step 1: Before connect to Raspberry Pi, you need to install Raspbian Operation System (OS) onto SD card(skip this step if your SD card has pre-installed Osoyoo Robot Image).You can select the latest version of RASPBIAN system on the official website: https://downloads.raspberrypi.org/raspbian/images/. Write the image via Win32DiskImager utility into your micro SD/TF card (minimum 16G), then plug the card into the slot on your Raspberry Pi.



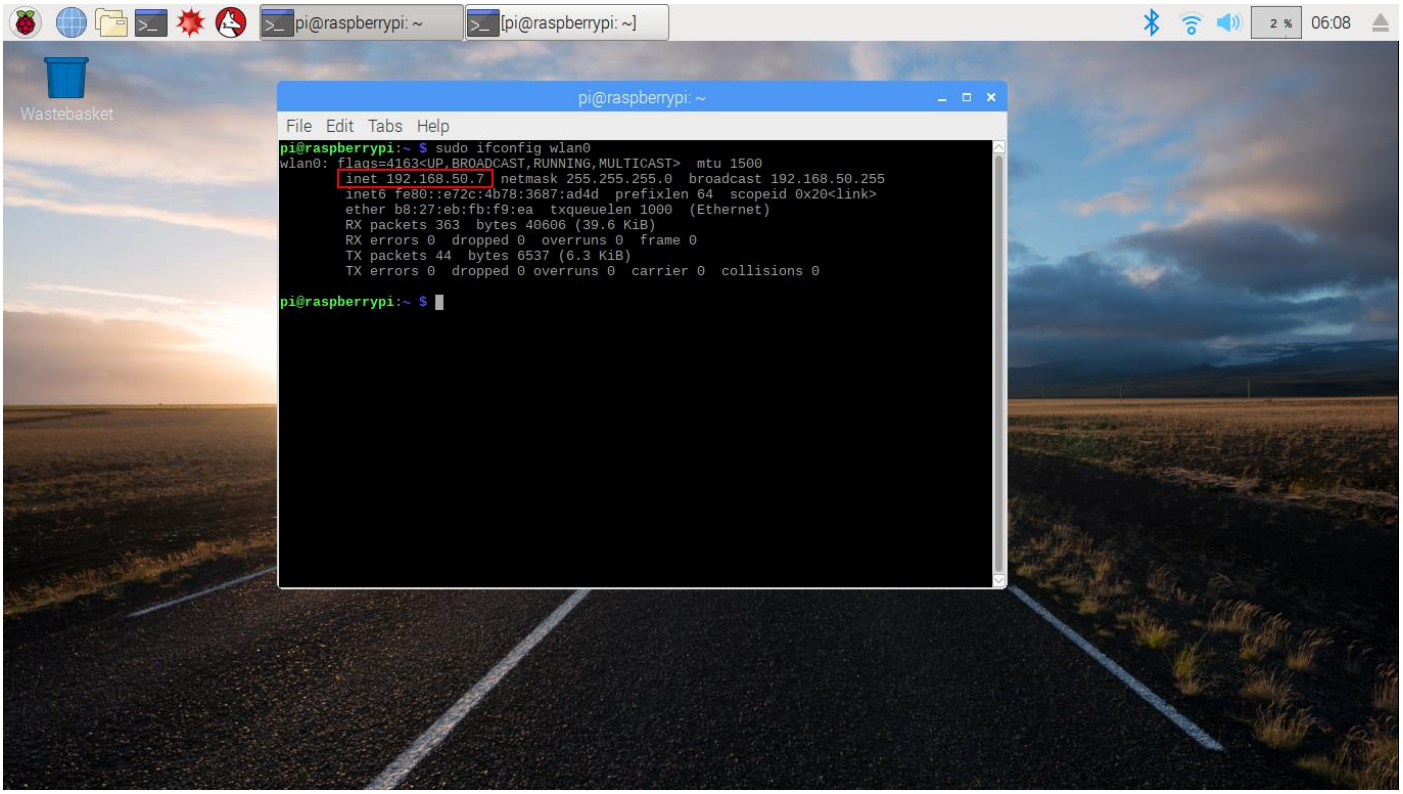
Step 1: Connect Wifi
Firstly, Connect Raspberry Pi to your HDMI monitor or TV. Put a keyboard and mouse into

Raspberry Pi USB ports. Insert SD card into the slot on your Raspberry Pi.Click on the wireless icon top right on desktop, should give a list of access points, select your wifi ssid and connect it. Once your Pi is connect to Wifi, you can hover your mouse to the wifi icon to see the your IP address.



Or your can type *sudo ifconfig wlan0* command in terminal. Your local ip address will show in wlan0 block(right side of the word *inet addr:*). It will look like 192.168……

Please remember above IP address, it will be used in our next steps.



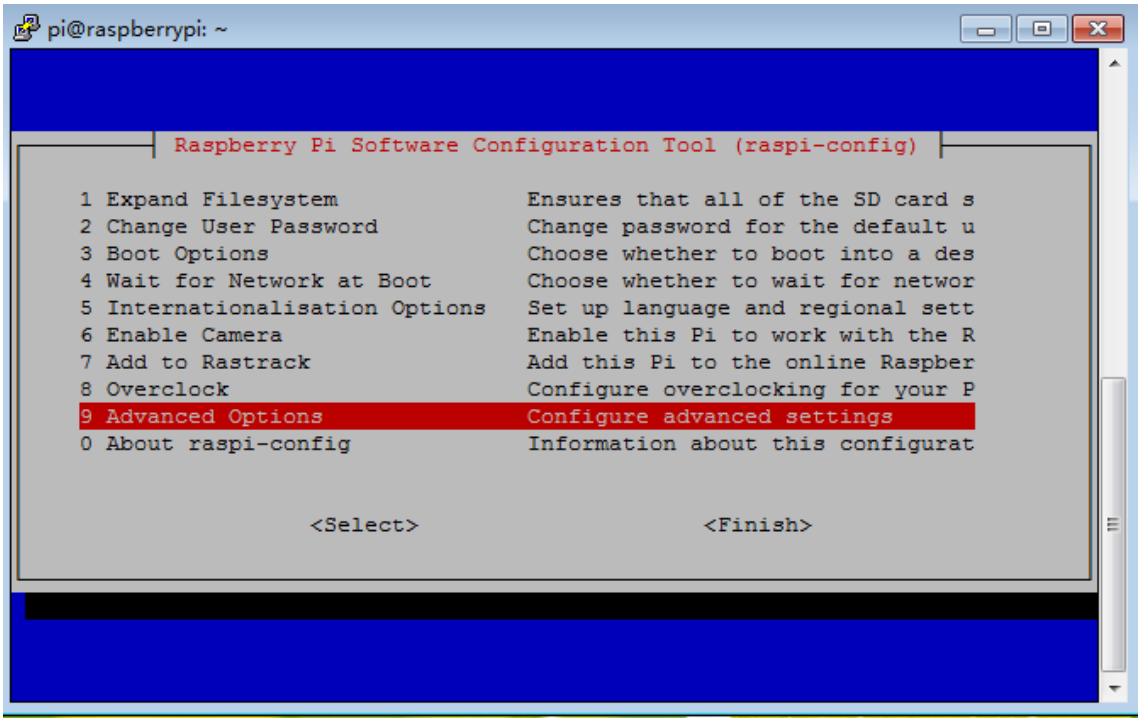
Important Note:As the raspberry pi robot car image was written into SD Card, you just need to follow the step 1 to connect wifi and skip Step 2 to Step 5, directly run the Testing Python code.

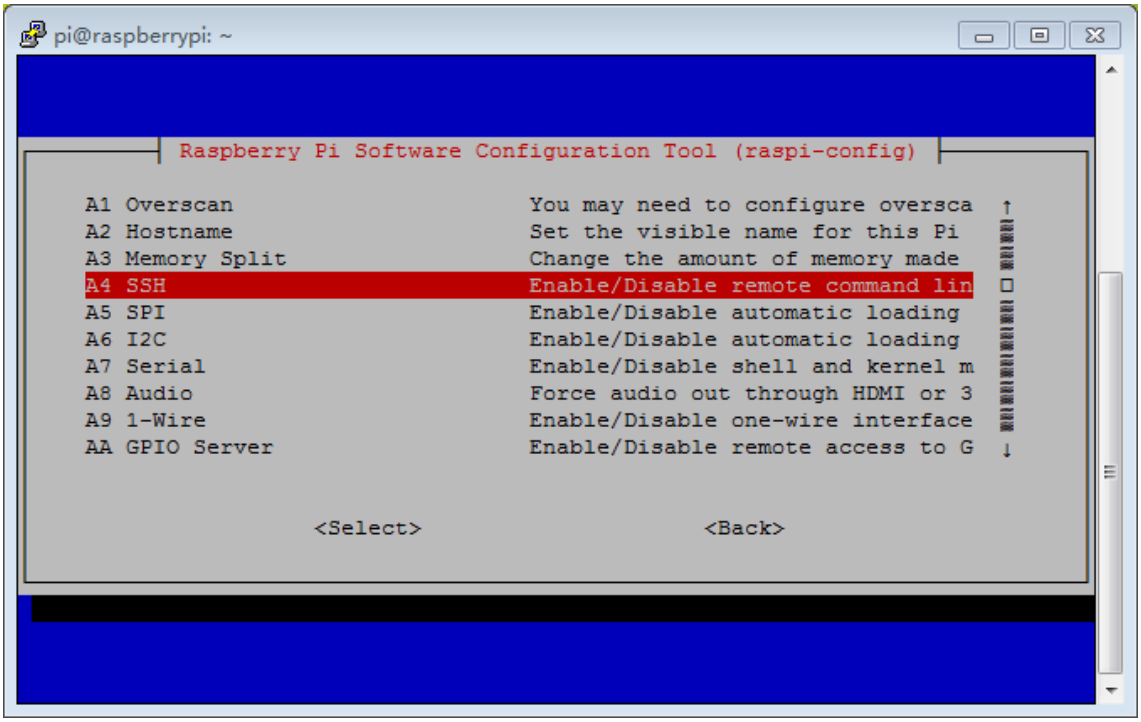
Step 2: Open SSH connection

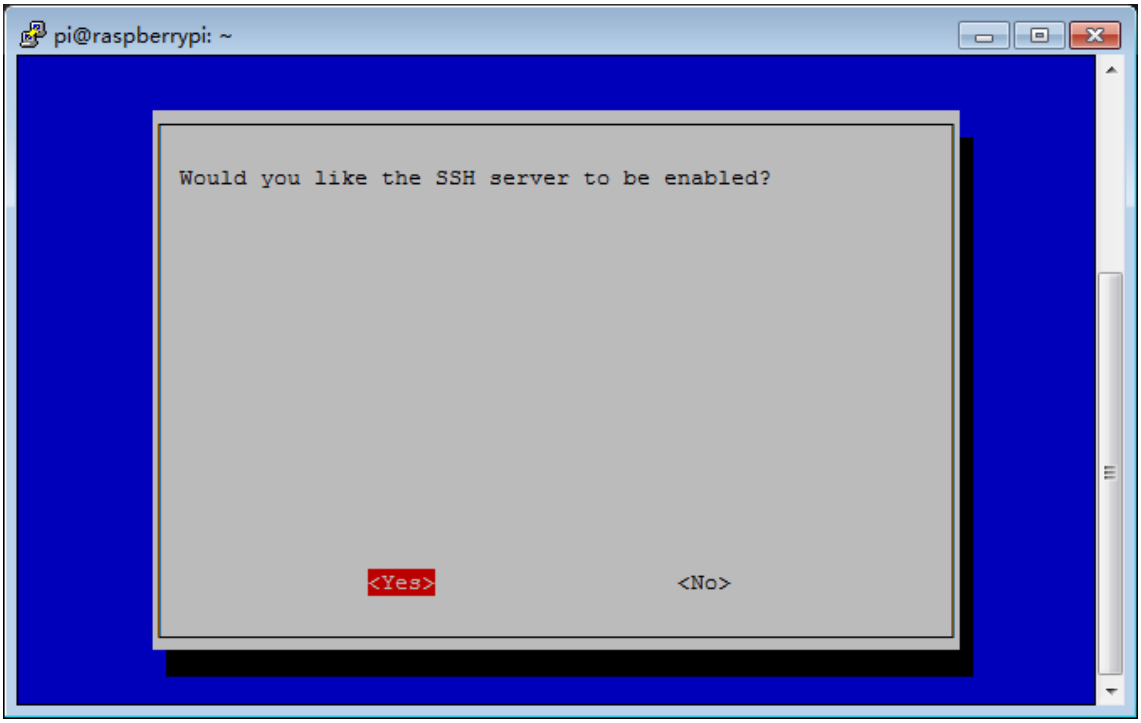
SSH enable user to type shell command remotely from internet so that we can control the car through wifi.In order to enable SSH function, we need type following command from terminal:

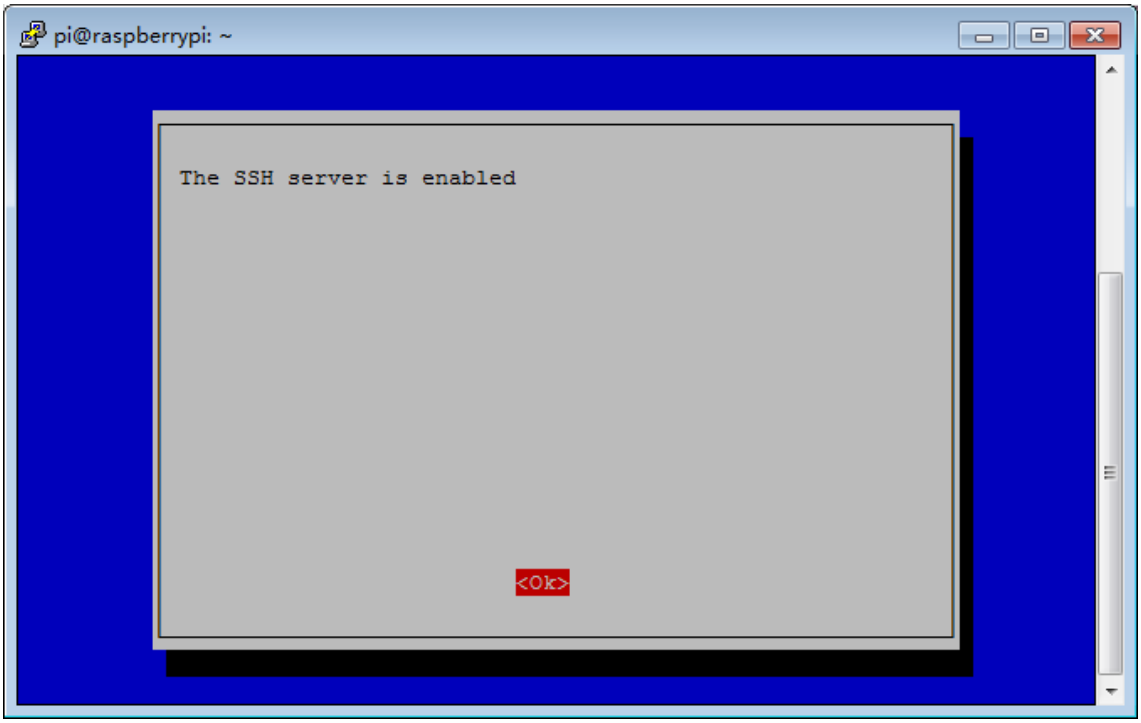
sudo raspi-config

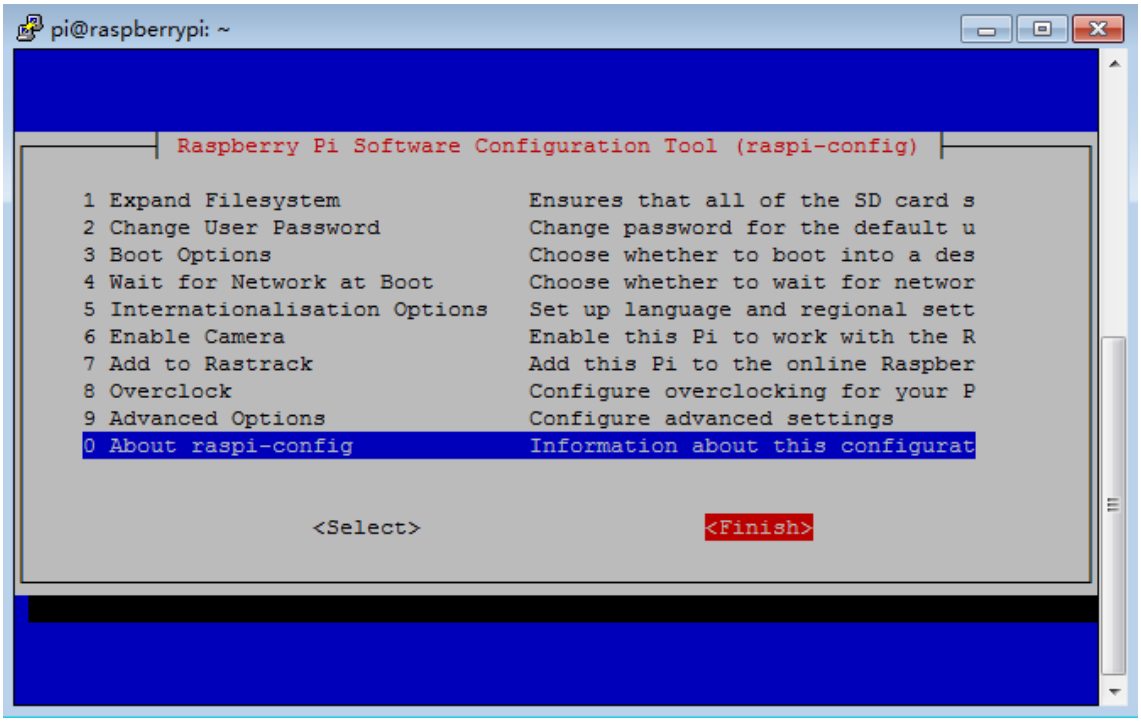
Then select Interfacing Options->SSH->Yes->Ok->Finish






pi@raspberrypi: ~
Would you like the SSH server to be enabled?
<Yes>
<No>

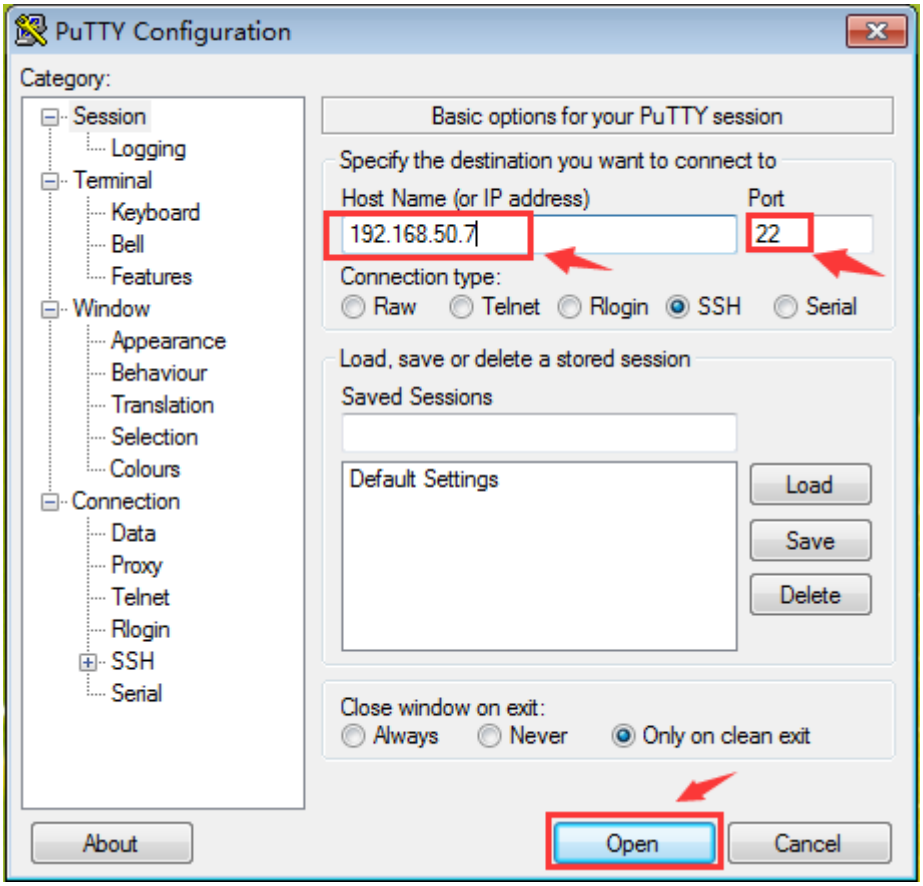




Step 3: Use SSH to connect Raspberry Pi terminal remotely

In order to make the car moving freely, we need disconnect Raspberry Pi from monitor, keyboard/mouse and use SSH to send command to Raspberry Pi terminal remotely.

If you are using Windows to send ssh command. you need download a free software called PuTTy to connect the Raspberry Pi local IP(you got from STEP 1).

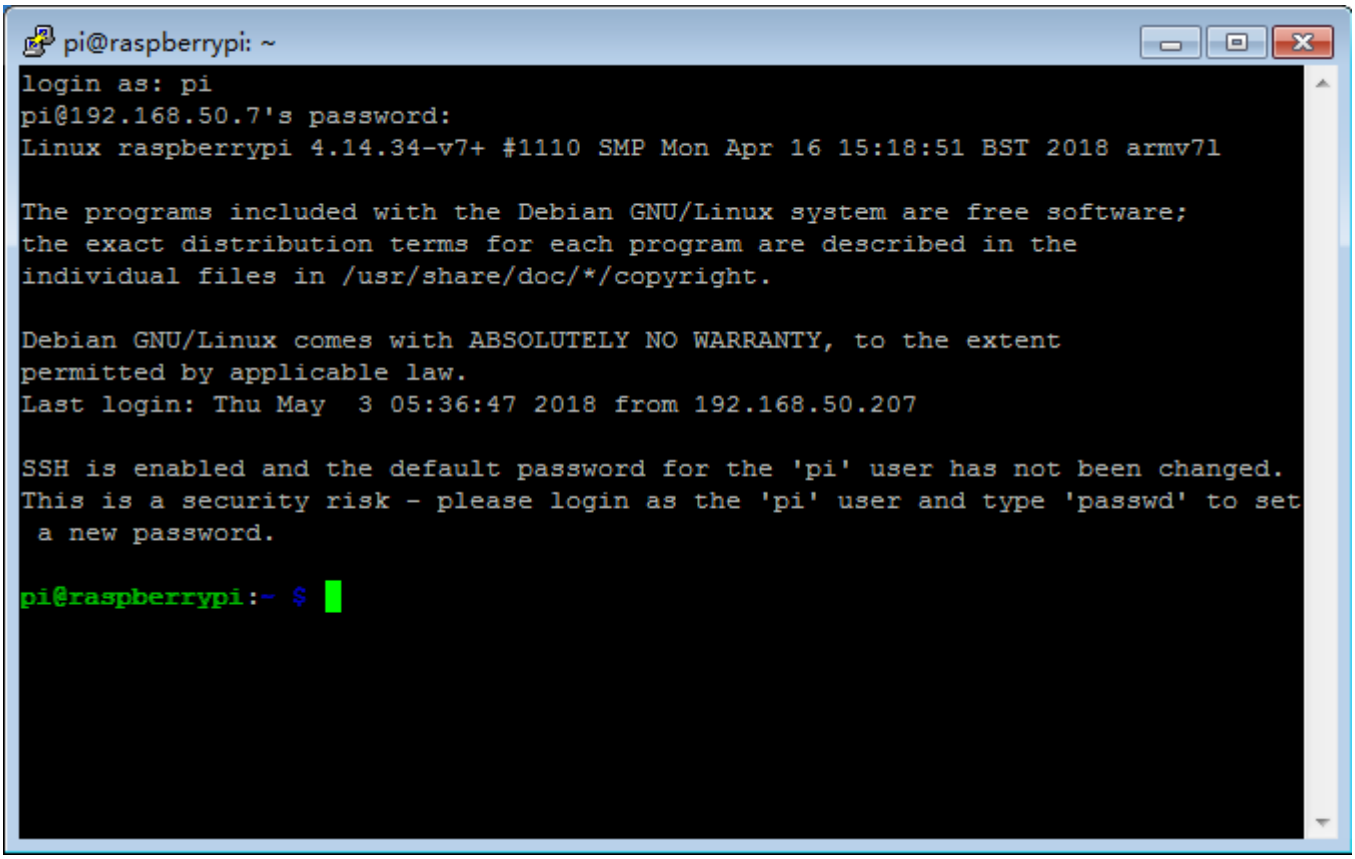


If you are using MacBook or other linux computer, please type: ssh pi@192.168.50.7

ssh *your_raspberry_pi_local_ip_address*

**your_raspberry_pi_local_ip_address means the wifi IP address you got from STEP 1*

When connecting ssh, you need use default user name *pi* and default password *raspberry* to login to Raspberry Pi.

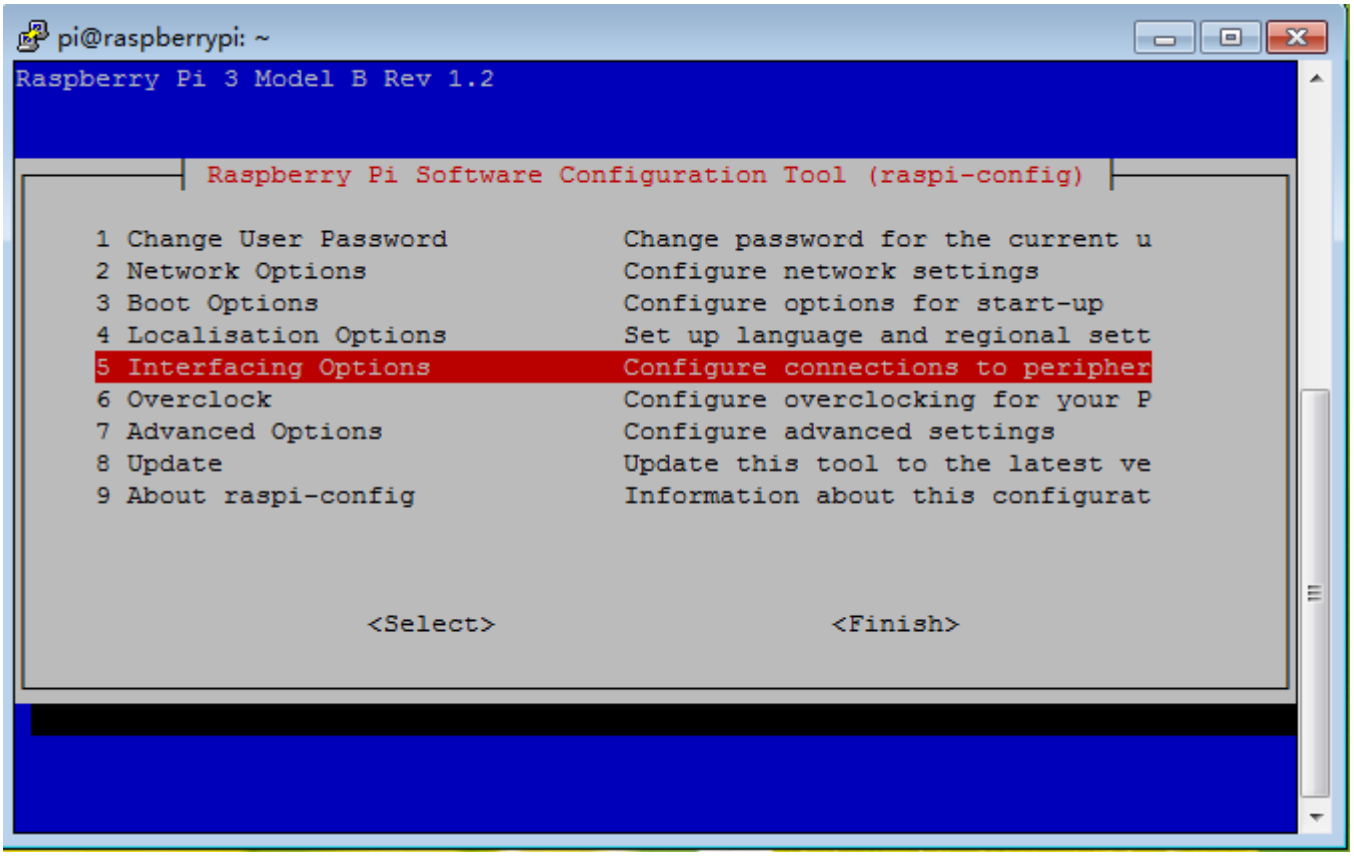


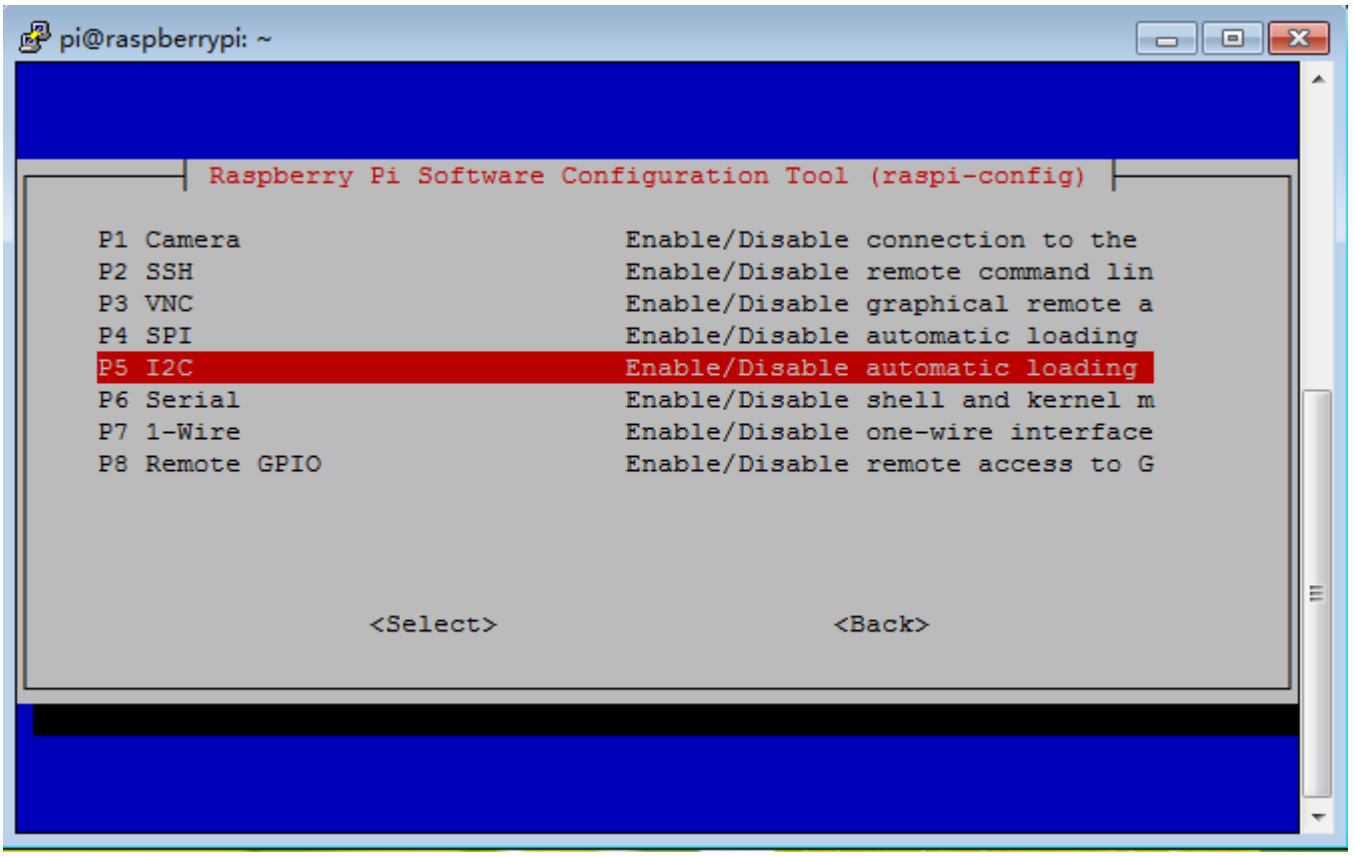
Step 4: Open I2C function(skip this step if your SD card has pre-installed Osoyoo Robot Image)

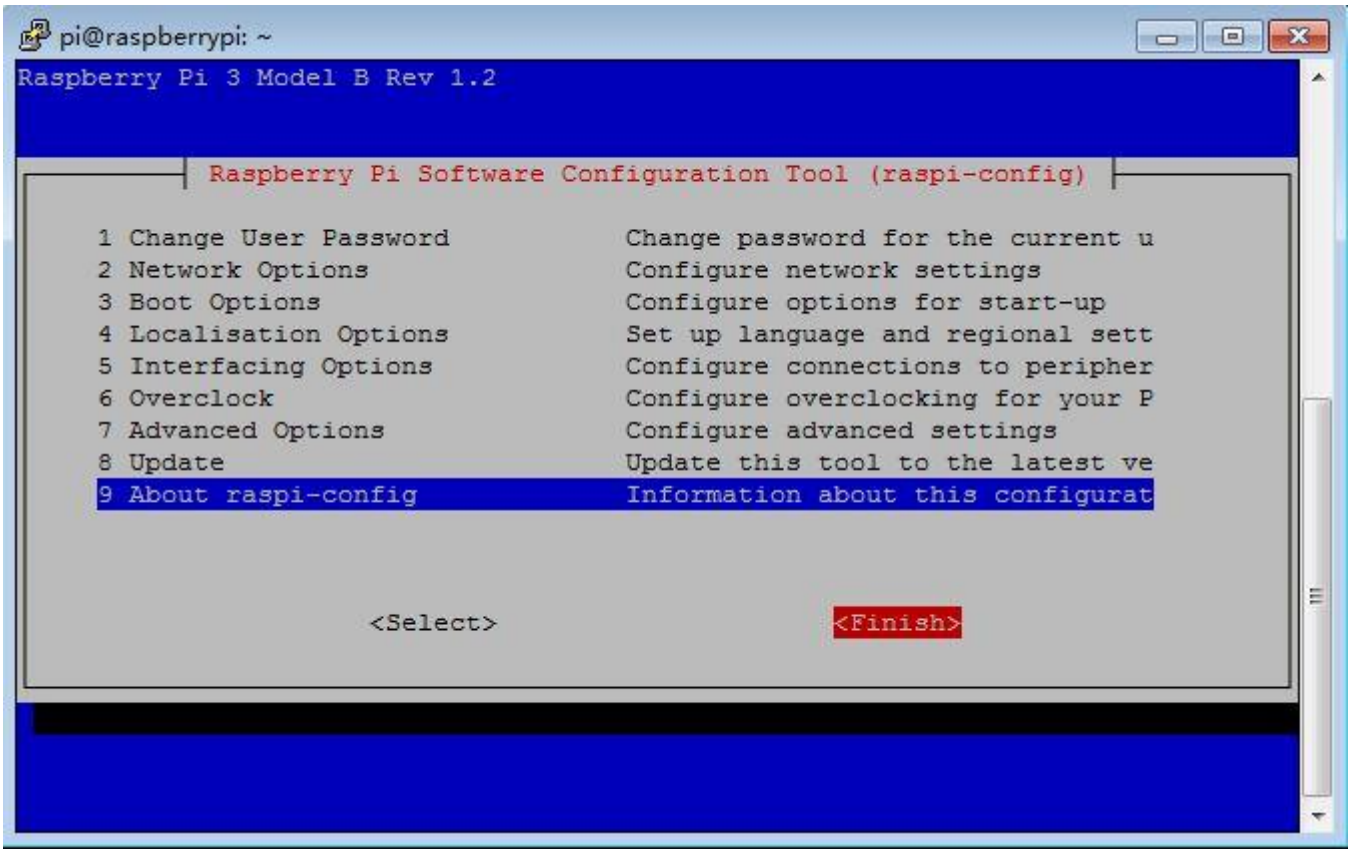
I2C is a protocol which will be used to exchange data with I2C device. In our project, I2C device is PCA9685 module.In order to use I2C function, we need type following command from terminal:

sudo raspi-config

Then select Interfacing Options->I2C->Yes->Ok->Finish


pi@raspberrypi: ~
Raspberry Pi 3 Model B Rev 1.2
Raspberry Pi Software Configuration Tool (raspi-config)
1 Change User Password Change password for the current u
2 Network Options Configure network settings
3 Boot Options Configure options for start-up
4 Localisation Options Set up language and regional sett
5 Interfacing Options Configure connections to peripher
6 Overclock Configure overclocking for your P
7 Advanced Options Configure advanced settings
8 Update Update this tool to the latest ve
9 About raspi-config Information about this configurat
<Select>
<Finish>


pi@raspberrypi: ~
Raspberry Pi Software Configuration Tool (raspi-config)
P1 Camera Enable/Disable connection to the
P2 SSH Enable/Disable remote command lin
P3 VNC Enable/Disable graphical remote a
P4 SPI Enable/Disable automatic loading
P5 I2C Enable/Disable automatic loading
P6 Serial Enable/Disable shell and kernel m
P7 1-Wire Enable/Disable one-wire interface
P8 Remote GPIO Enable/Disable remote access to G
<Select>
<Back>



Step 5: Install GPIO Library(skip this step if your SD card has pre-installed Osoyoo Robot Image)

(1)Update Rasbian Repository by typing following terminal command

cd ~

sudo apt-get update

(2)Install python-pip , python-sumbus and github

sudo apt-get install build-essential python-pip python-dev python-smbus git

(3)Install GPIO Library by typing following terminal command

git clone https://github.com/adafruit/Adafruit_Python_GPIO.git

cd Adafruit_Python_GPIO

sudo python setup.py install

(4)Typing following terminal command to remove installation files and save disk space

cd ~

sudo rm -fr Adafruit_Python_GPIO

Testing Previous Installation (skip this step if your SD card has pre-installed Osoyoo Robot Image)

(5)Download testing python code by typing following commands:

cd ~

mkdir osoyoo-robot/

cd osoyoo-robot/

wget http://osoyoo.com/driver/motor-test.tar.gz

tar -zxvf motor-test.tar.gz

(6) Run Testing Python code

cd ~/osoyoo-robot/motor-test

python motor-test.py

Important Note:As the raspberry pi robot car image was written into SD Card, you just need to follow the step 1 to connect wifi and skip others steps, directly run the Testing Python code.

After running above python sample code, your car should move forward for 2 seconds, then move backward for 2 seconds , then turn left for 2 seconds and finally turn right for 2 seconds.

If your car does not move as per above scenario, the installation should have some problem. You need double check the wire connection and software installation as per our previous steps.

Lesson 2: Line Follower

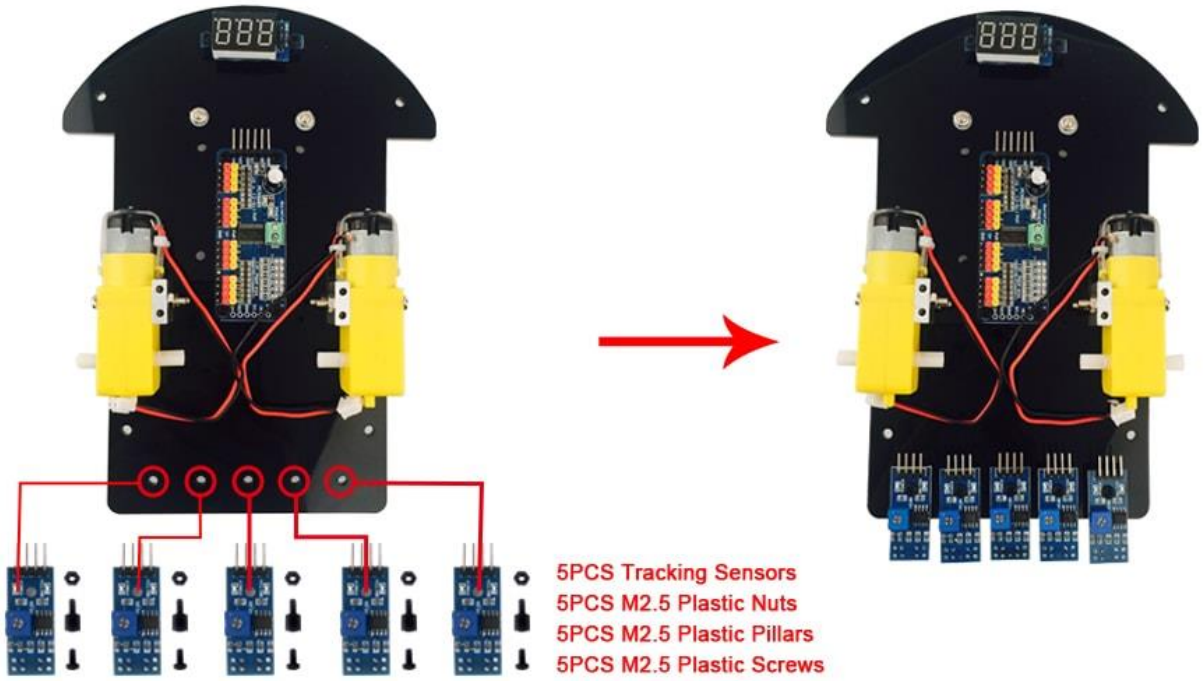
OBJECTIVE

In this lesson, we will use black/white tracking sensors to guide robot car to trace a black track in the white ground. If you have not completed installation in Lesson 1, please review Lesson 1.

(Note: in lesson 1, 5 black/white tracking sensors have been installed and connected to Raspberry Pi to prepare for lesson 2)

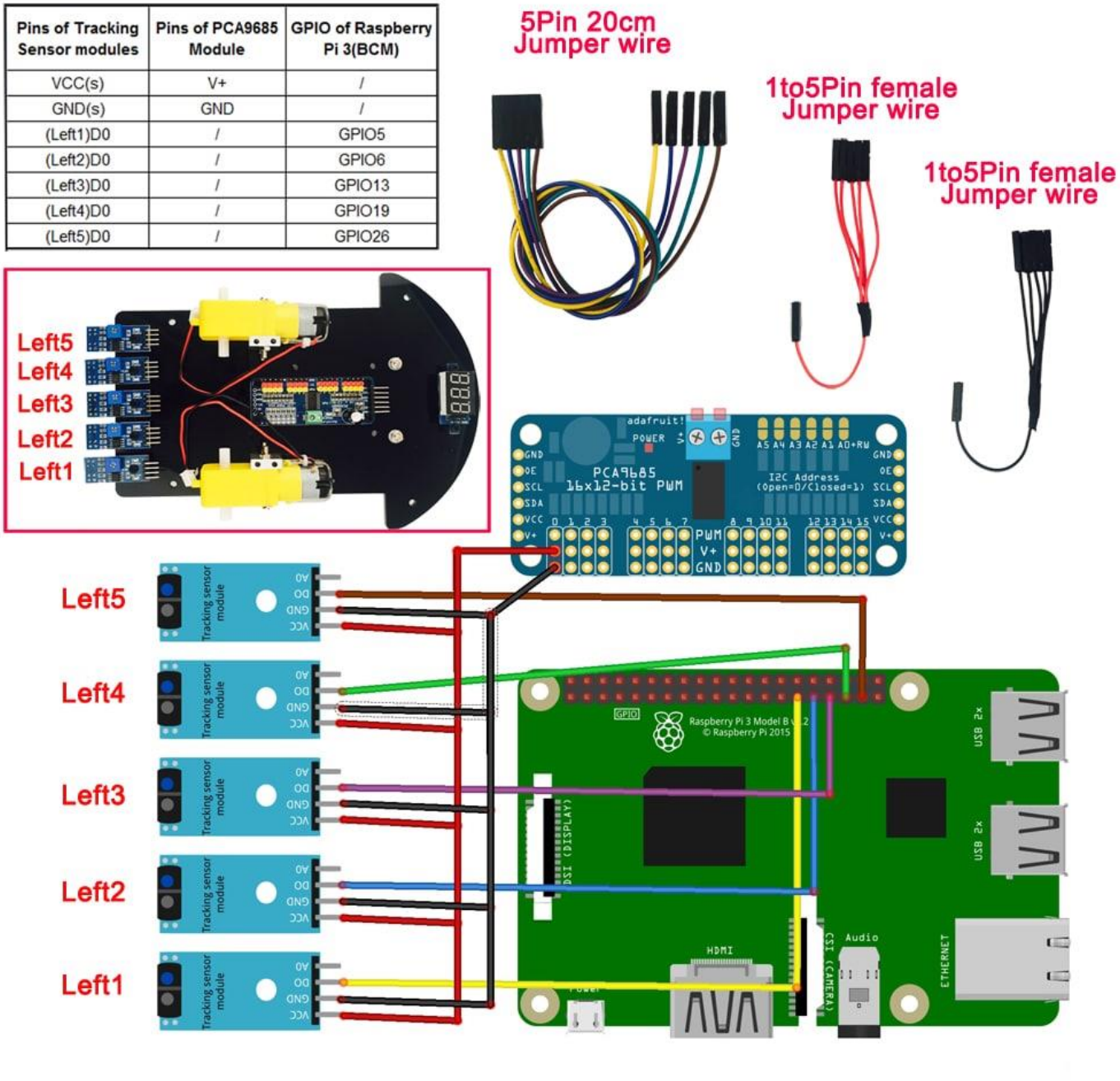
HARDWARE INSTALLATION

If you don't install 5 tracking sensor modules in lesson1, please install and connect these modules as following pictures. If you have already installed and connected these, please skip this step.



Connection for 5PCS Tracking Sensor Modules

Pins of Tracking Sensor modules	Pins of PCA9685 Module	GPIO of Raspberry Pi 3(BCM)
VCC(s)	V+	/
GND(s)	GND	/
(Left1)D0	/	GPIO5
(Left2)D0	/	GPIO6
(Left3)D0	/	GPIO13
(Left4)D0	/	GPIO19
(Left5)D0	/	GPIO26



SOFTWARE INSTALLATION

Note:

1. if you use our image as OS system as lesson1, please skip Software Installation and go to Step2 to adjust the sensitivity of tracking sensor module or the step “test tracking line”

2. Please keep the raspberry Pi on power when using SSH to send command to Raspberry Pi terminal remotely.

Step 1: Download line-tracking sample code with following terminal command(skip this step if your micro SD card has pre-installed Osoyoo Robot Image):

cd ~/osoyoo-robot/
wget http://osoyoo.com/driver/lf.tar.gz

tar -zxvf lf.tar.gz

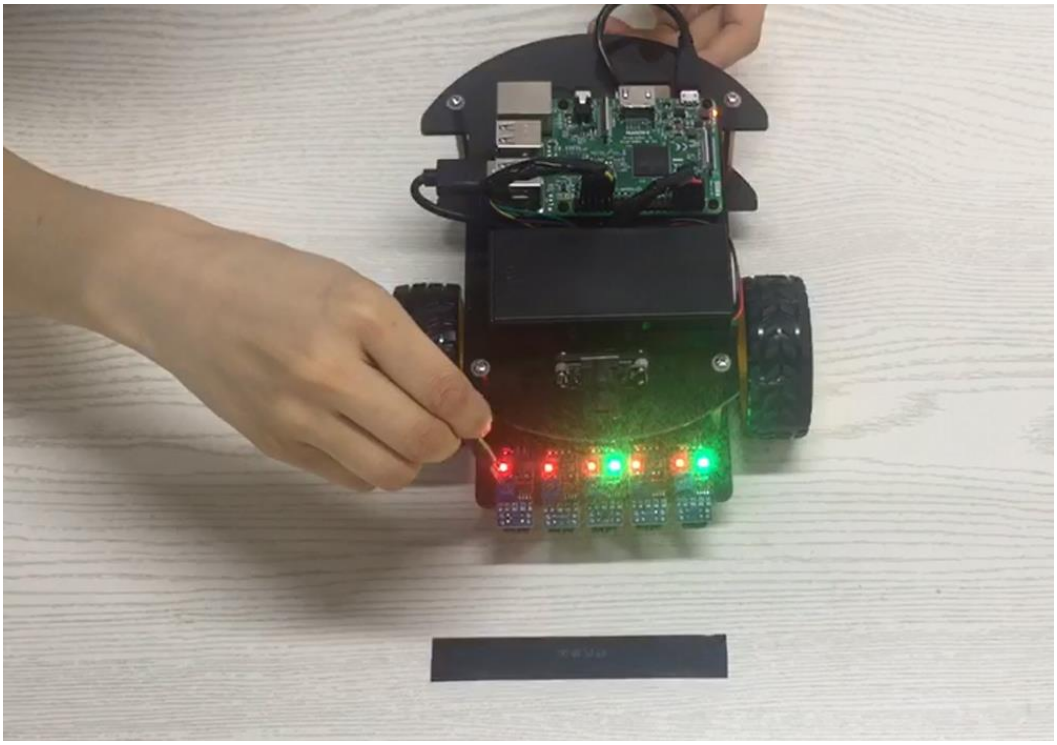
```
pi@raspberrypi:~ $ cd ~/osoyoo-robot/
pi@raspberrypi:~/osoyoo-robot $ wget http://osoyoo.com/driver/lf.tar.gz
--2018-05-02 09:41:33--  http://osoyoo.com/driver/lf.tar.gz
Resolving osoyoo.com (osoyoo.com)... 142.44.137.157
Connecting to osoyoo.com (osoyoo.com)|142.44.137.157|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 3775 (3.7K) [application/x-gzip]
Saving to: 'lf.tar.gz'

lf.tar.gz           100%[===================>]   3.69K  --.-KB/s    in 0.001s

2018-05-02 09:41:34 (4.25 MB/s) - 'lf.tar.gz' saved [3775/3775]

pi@raspberrypi:~/osoyoo-robot $ tar -zxvf lf.tar.gz
lf/
lf/lf.tar.gz
lf/test.py
lf/osoyoo_PCA9685.py
lf/osoyoo_PCA9685.pyc
lf/line_follow.py
```

Note: Above commands will download sample code file to osoyoo-robot/lf directory

Step 2: Test Black/White Tracking sensors

There are 5 black/white tracking sensors in the forehead of the car. Each sensor has two LED lights . The red LED indicates power. The green LED indicates black/white. When black is detected, Green LED will turn off and a "1" will be sent to Raspberry Pi GPIO pin, otherwise LED will ON and a "0" will be sent.

* To make sensors working properly, you need use a screw driver to adjust the sensitivity screw on each sensor and make sure Green LED will ON when it is over White and Off when it is over Black.

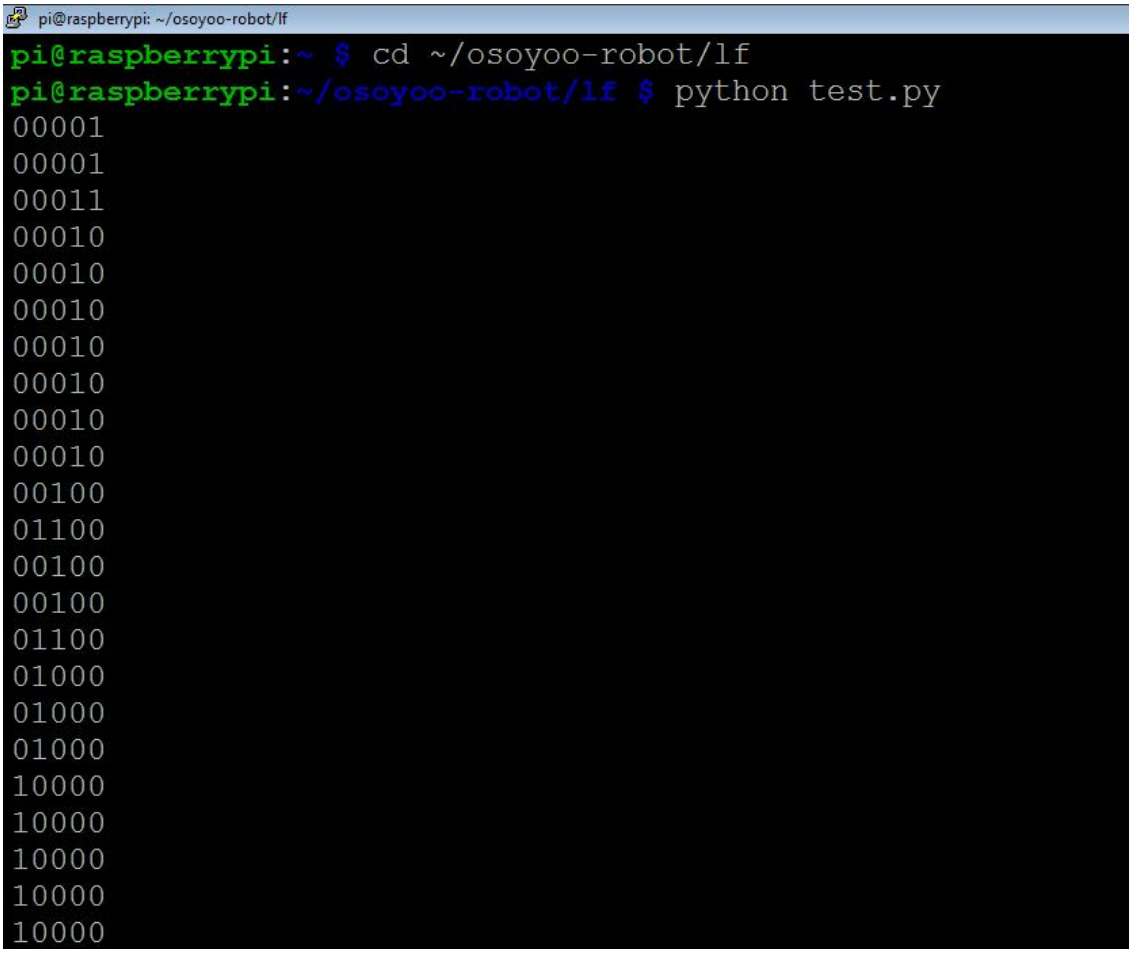


If you want to learn more about adjust tracking module, please follow the next youtube vedio:

https://youtu.be/H1RuMCsZz4k

Following python code and experiment will tell you if the sensors are installed correctly.
First, put a 2 cm black track on white ground, then put your car over the track and turn on battery.
Next, use SSH to connect your Raspberry Pi remotely from your PC(use Putty if you are using Windows), and type following terminal command:
cd ~/osoyoo-robot/lf
python test.py

When your put the first sensor(from right) on the black track, the green LED will turn off and your will see Putty terminal window show 00001 as following:



This means Raspberry Pi detected WHITE(0) from 4 sensors in the left and Black(1) from the right edge sensor. You can change the position of the black track from right to left sensors one by one and make the result change from 00001 to 00010,00100,01000,10000.If your result is not showed as above, you might need to double check if the sensor sensitivity and connection to the Pi is correct.

Testing line tracking

First, make a black track on white ground. The track can be round or curve , but the turning angle of each curve should not be too sharp. We suggest user use 2cm width black tape sticking on white ceramic tile and make a nice track.

Next put your car over the track and turn on the power switch on battery box.

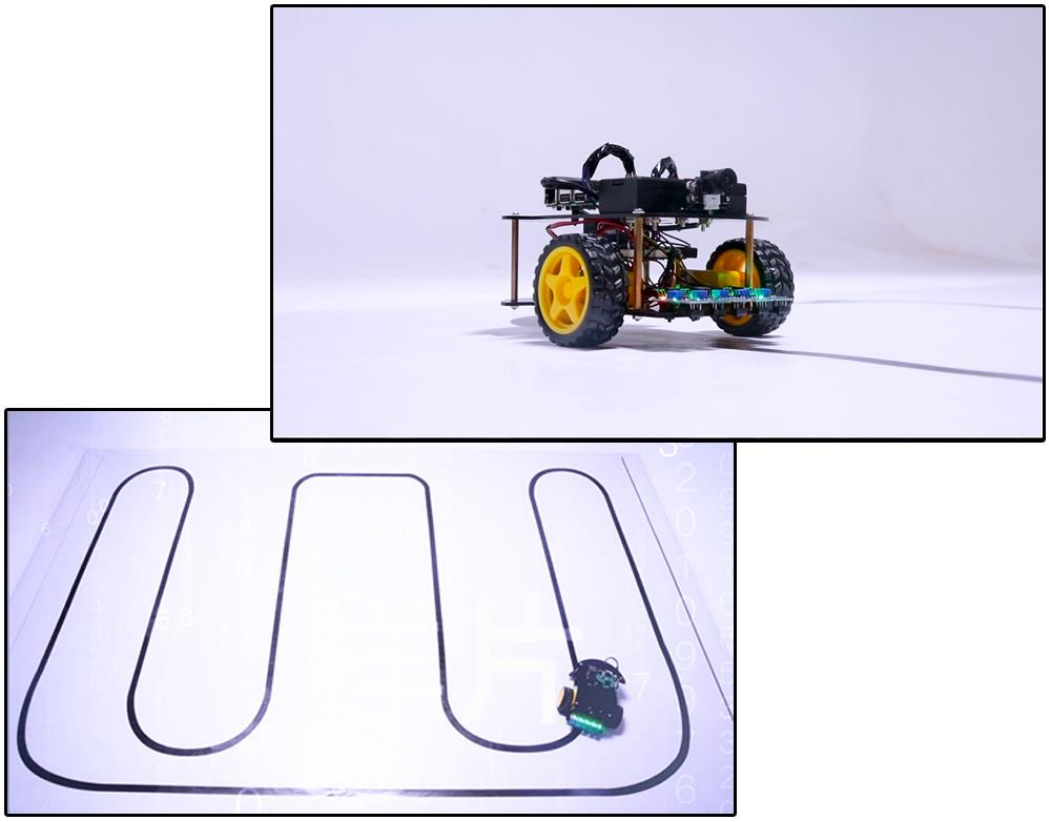
Last, use SSH to connect Raspberry Pi through your PC and typing following commands:

cd ~/osoyoo-robot/lf

python line_follow.py

```
pi@raspberrypi:~ $ cd ~/osoyoo-robot/lf
pi@raspberrypi:~/osoyoo-robot/lf $ python line_follow.py
00100
00100
00100
00100
00100
00100
00100
```

After above command is sent to raspberry Pi, your car will start moving along the black track automatically.



Youbute link : https://youtu.be/KP8Di5RUFZA

Lesson 3: Simple Installation – Web Control Camera

OBJECTIVE

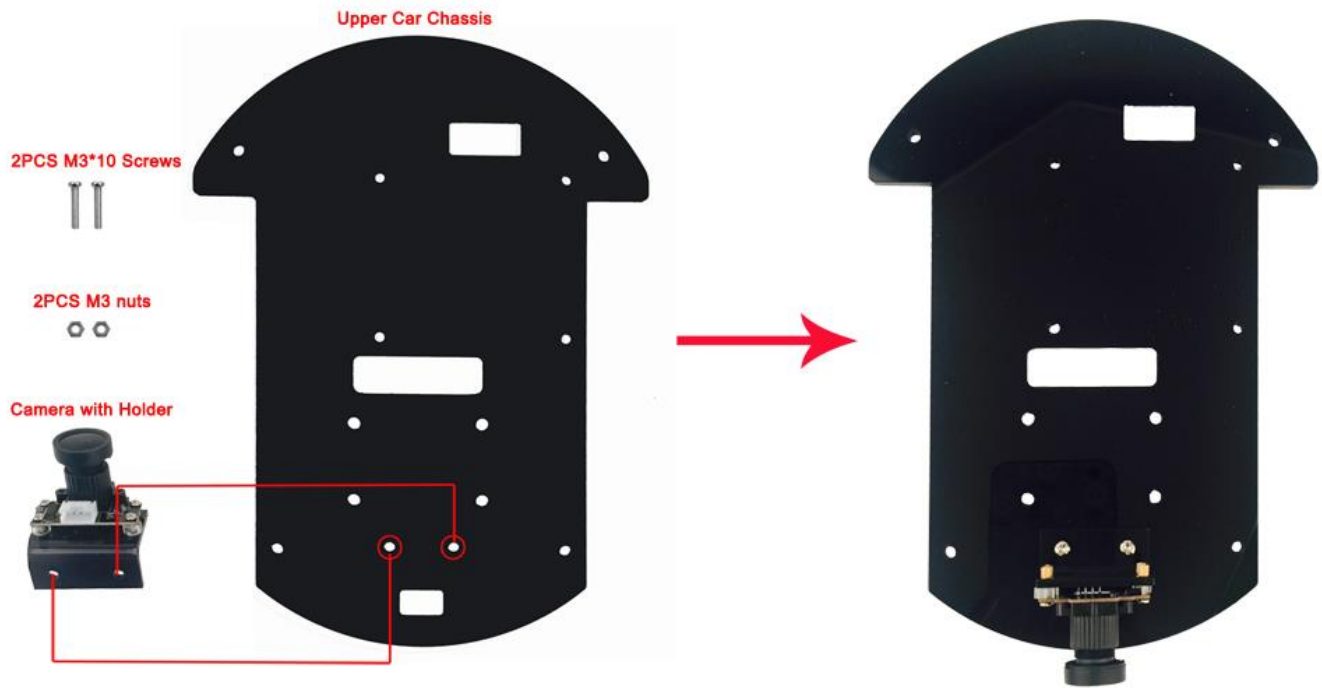
In this lesson, we will learn how to let the robot car has vision to see front environment and how to control the robot car through web browser or mobile APP.

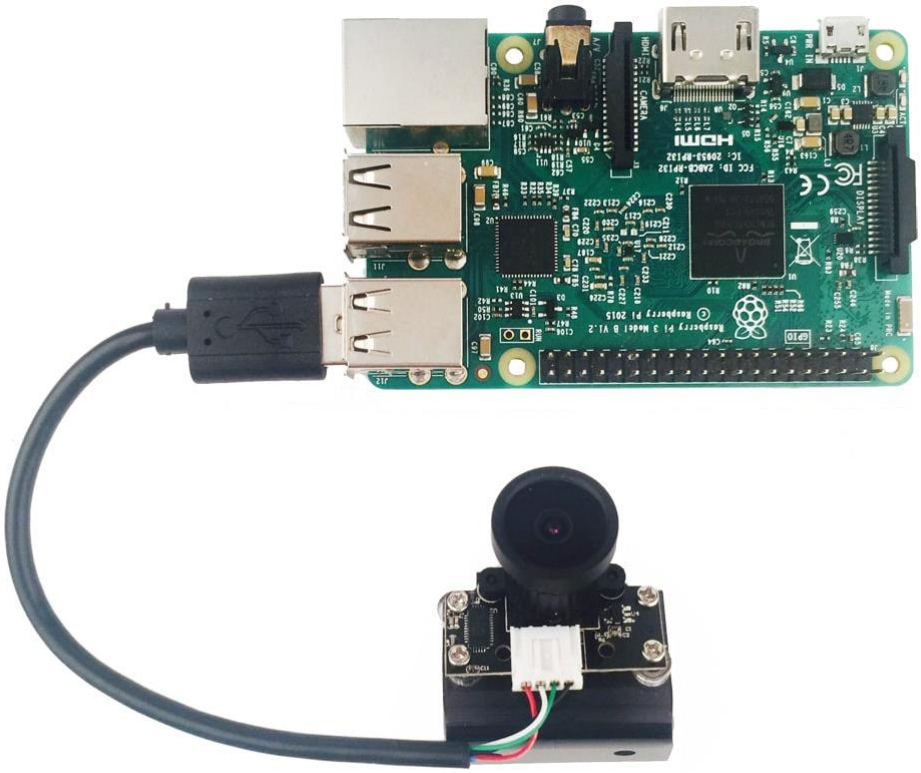
To complete this task, we need install a web server software called “mjpg-streamer” in Raspberry Pi, this software will catch video from Robot Car camera and send the video to a web page.

We also need to install another web server software called “WebIOPi” in Raspberry Pi. This software will allow user to use browser to remotely control Raspberry Pi GPIO input/output and therefore control the movement of our robot motor.

HARDWARE INSTALLATION

If you don’t install camera in lesson1, please install and connect camera as following pictures. If you have already installed and connected these, please skip this step.



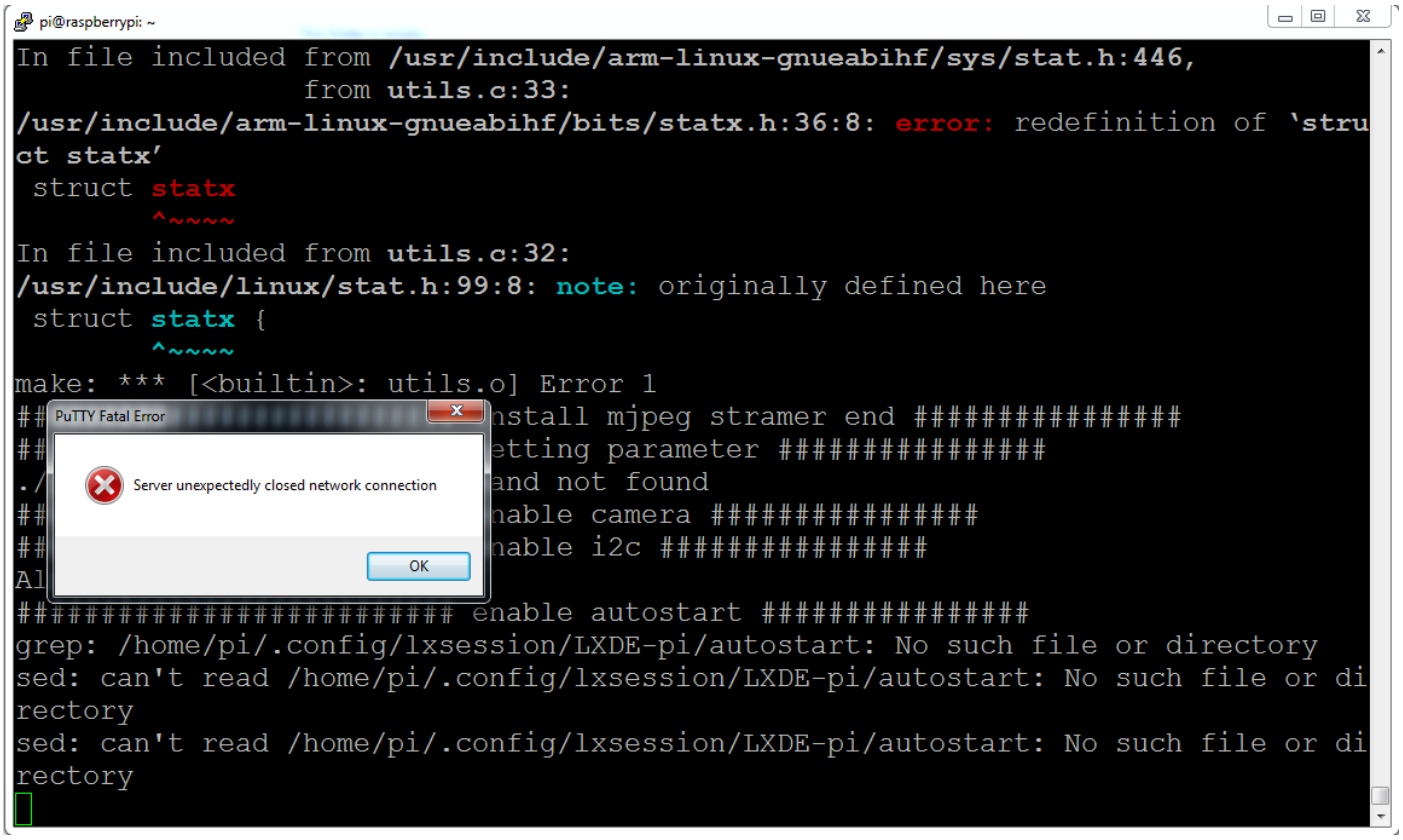


SOFTWARE INSTALLATION

In Shell Terminal, type following commands:
wget http://osoyoo.com/driver/picar/pirobot.sh
chmod 777 pirobot.sh
sudo ./pirobot.sh

Above shell script command will automatically download installation file from remote software repository,configure and install the webiopi and mjpg-streamer server onto your Raspberry Pi.

Once the script file command finishes running, raspberry pi will restart automatically. You will see the Pop-up window “Server unexpectedly closed network connection”, click “Confirm” button.



Now you go to Test Step or Apple/Android APP test and run the car.

Testing Server Installation

Now you can put your car on the ground and turn on the power-switch in battery box. We need to use SSH to control the car. So you must enable SSH with raspi-config command before testing. If you are using windows, please use download Putty to ssh your Pi, if you are using MacBook, please directly use ssh command in terminal.

In shell terminal, run following command to run the webiopi and mjpg-stream server :

/home/pi/superscript

Your webiopi and web stream server will start and your can use browser or APP to control the car now!

(TIP: If you want to automatically start the server each time when you restart the pi without typing above command, please run following commands:

sudo crontab –e
you will see a menu list of editor choices, select nano as your editor, then you will see crontab file edit window. In the bottom of the window, add a line as following:

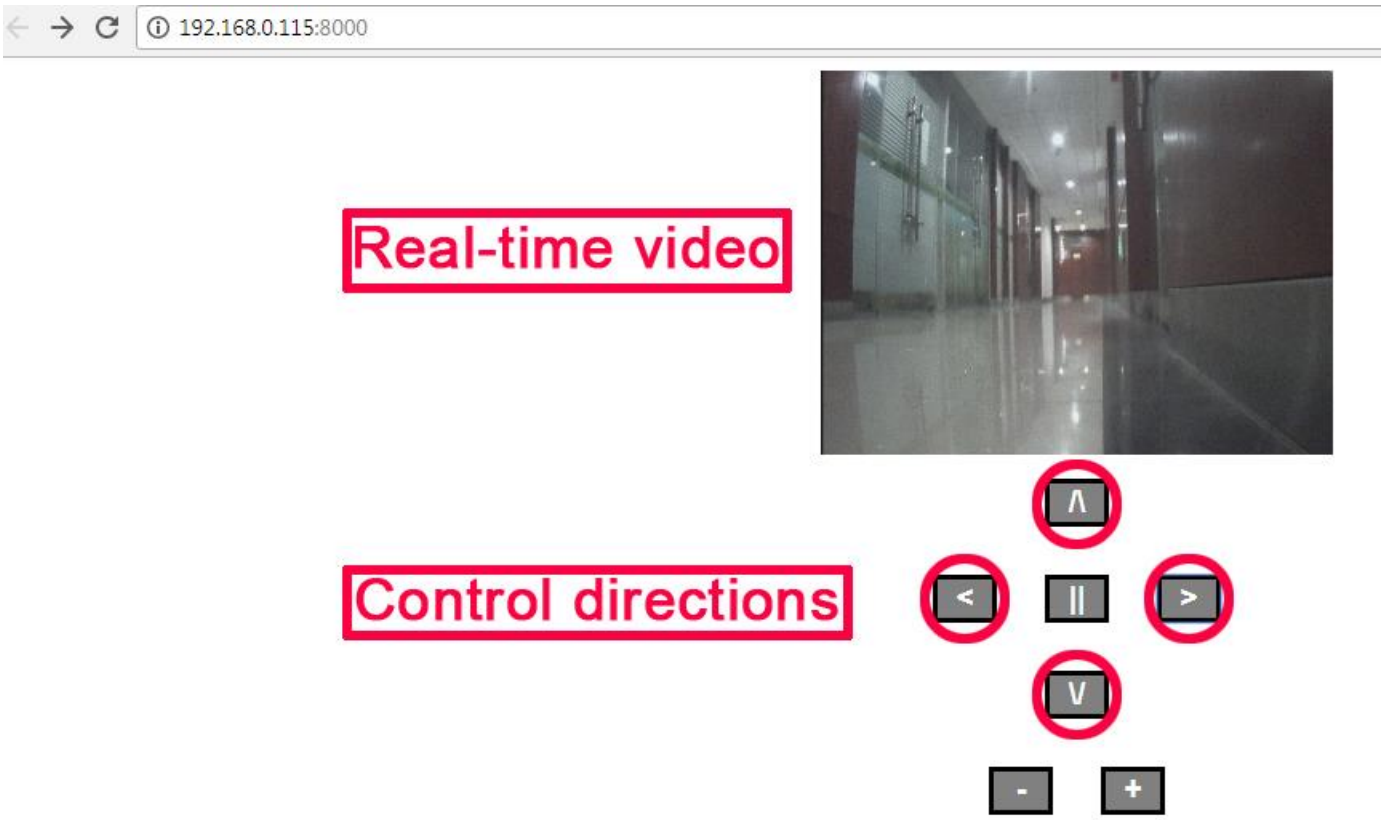
@reboot /home/pi/superscript

press Ctrl-X save and exit crontab editor.
now reboot your Raspberry Pi, your server will automatically started
)

Control the car with browser

Now you can use your browse to acess Raspberry IP with port 8000(i.e, if your Pi IP address is 192.168.0.115, please visit http://192.168.0.115:8000, you will see following picture in your browser, click arrow buttons, you can make car moving to your desired directions.

User Name: webiopi
Password: raspberry



Android and iOS App

You can also use our free Android App or Apple App instead of browser to control the car.

Download the Android app fromhttps://osoyoo.com/driver/osoyoo-robot.apk

For Apple iOS user, please search Osoyoo raspberry Pi Robot Car in Apple APP store ,download and install it.

Run the App, click set up and enter config page set the fields as following:

Robot IP:
your raspberrr pi ip Port: 8000
Video URL: http://your_raspberry_pi_ip:8899/?action=stream(please use IP such as 192.168.0.16 to replace your_raspberry_pi_ip)
User Name: webiopi
Password: raspberry

Click Save button and exit config page.

Now you can use the arrow buttons in App to control the car.

Lesson 3: Complex Installation – Web Control Camera

OBJECTIVE

In this lesson, we will learn how to let the robot car has vision to see front environment and how to control the robot car through web browser or mobile APP.

To complete this task, we need install a web server software called “mjpg-streamer” in Raspberry Pi, this software will catch video from Robot Car camera and send the video to a web page.

We also need to install another web server software called “WebIOPi” in Raspberry Pi. This software will allow user to use browser to remotely control Raspberry Pi GPIO input/output and therefore control the movement of our robot motor.

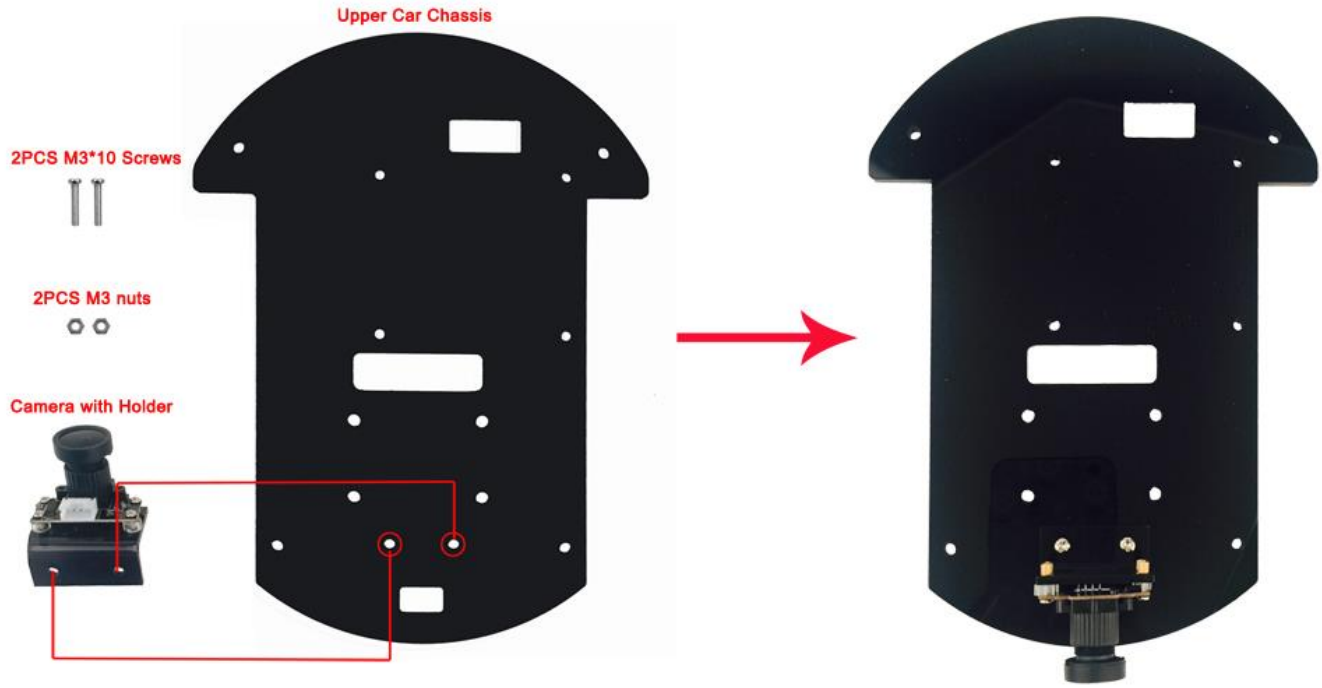
HARDWARE INSTALLATION

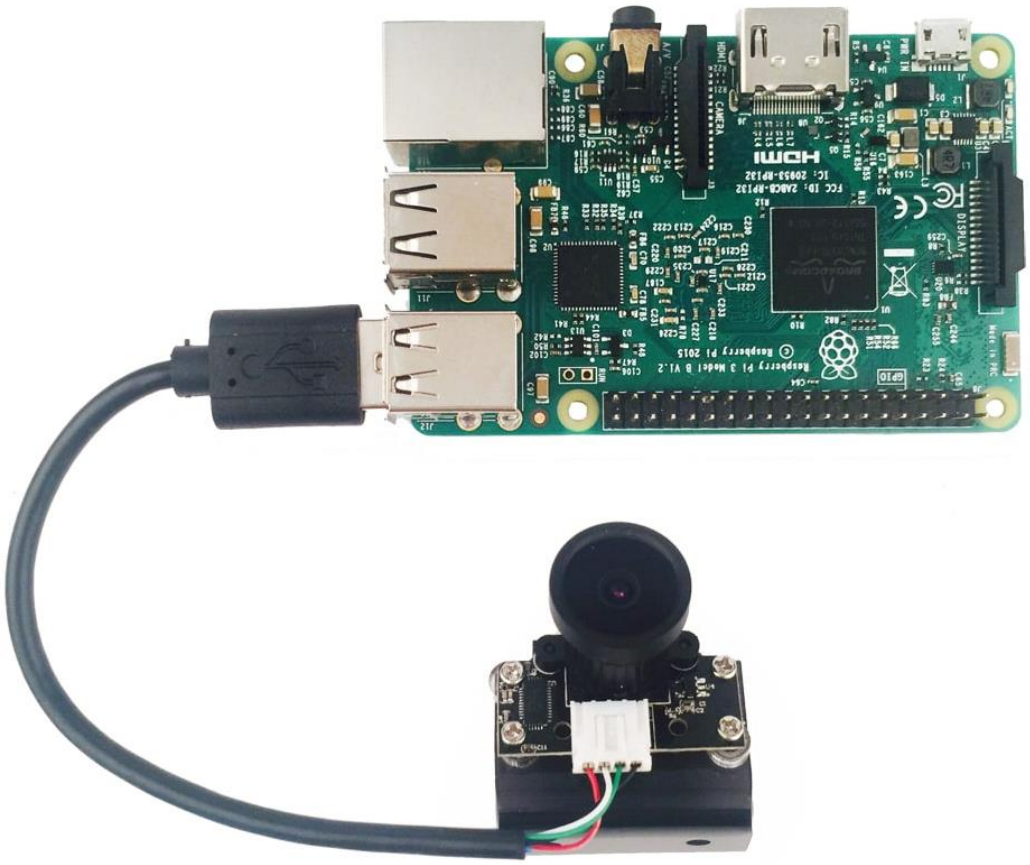
Youtube video link:

https://youtu.be/-KavLp6SI7s

https://youtu.be/L__7hzbfDeI

If you don’t install camera in lesson1, please install and connect camera as following pictures. If you have already installed and connected these, please skip this step.





SOFTWARE INSTALLATION

Complex Installation Guide

If you are advanced user, you might want to install webiopi and mjpg-streamer by yourself in order to customize some feature such as port number etc. If this is the case, you can take following steps 1 to 8 to install and config webiopi and mjpeg-streamer separately. If you are a beginner, please avoid use this advanced guide. Just take simple guide which will make installation much easier for you.

Note:
1. If your micro SD card has pre-installed Osoyoo Robot Image,please skip Step 1 to Step 8 and direct Run Step 9: Testing
2. Please keep the Raspberry Pi on battery power when using SSH to send command to Raspberry Pi terminal remotely.

Step 1: Download WebIOPi/mjpg-streamer installation package by running following terminal commands (skip this step if your micro SD card has pre-installed Osoyoo Robot Image)

```
cd ~
sudo apt-get install rpi.gpio -y
mkdir osoyoo-robot
mkdir osoyoo-robot/cam-robot
cd osoyoo-robot/cam-robot
wget http://osoyoo.com/driver/WebIOPi-0.7.1.tar.gz
wget http://osoyoo.com/driver/mjpg-streamer.tar.gz
wget http://osoyoo.com/driver/robot.tar.gz
tar -xzvf WebIOPi-0.7.1.tar.gz
tar -xzvf mjpg-streamer.tar.gz
```

tar -xzvf robot.tar.gz

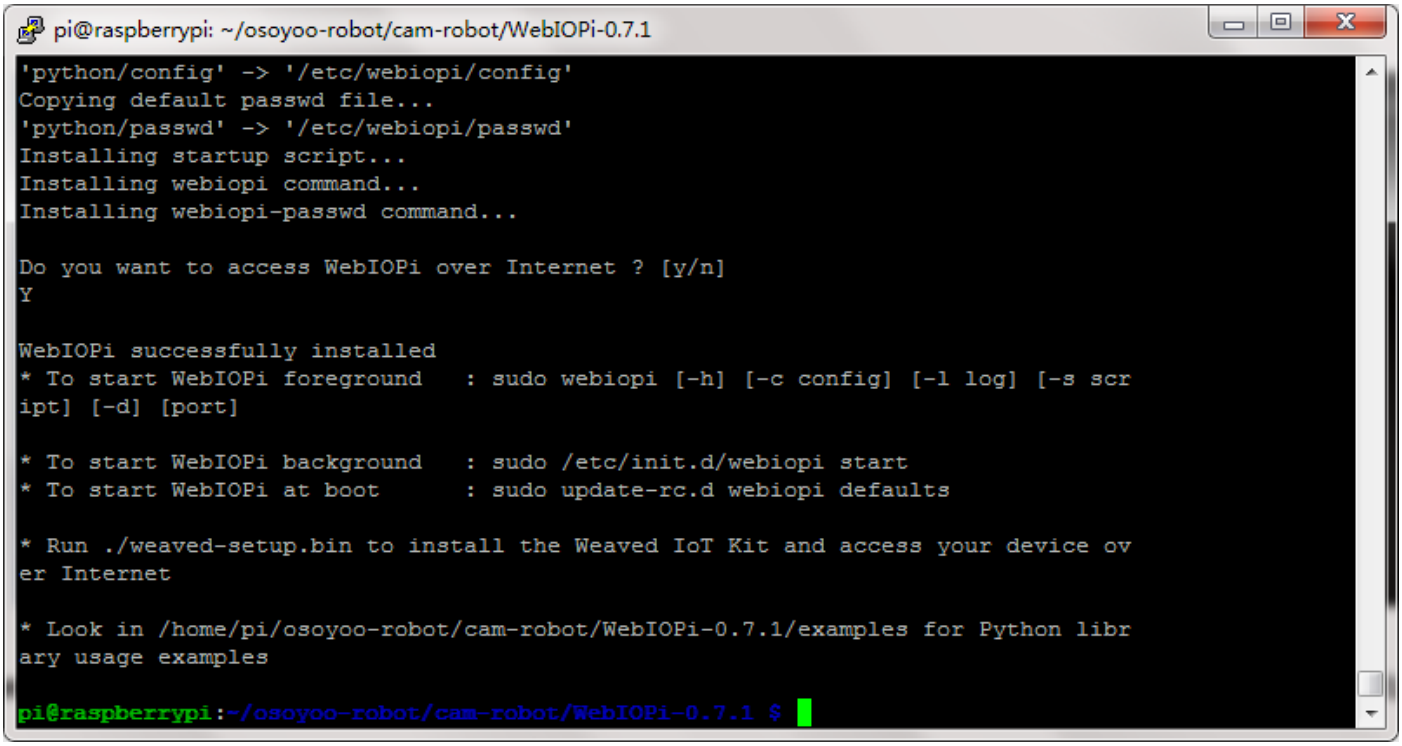
Following Step 2 to 4 are for WebIOPI server Installation

Step 2: Download and install WebIOPi patch by running following terminal command (skip this step if your micro SD card has pre-installed Osoyoo Robot Image)

```
cd ~/osoyoo-robot/cam-robot/WebIOPi-0.7.1/
wget http://osoyoo.com/driver/webiopi-pi2bplus.patch
patch -p1 -i webiopi-pi2bplus.patch
```

Step 3: Install WebIOPi by running following terminal command(skip this step if your micro SD card has pre-installed Osoyoo Robot Image)

```
sudo ./setup.sh
```



You need verify the installation by typing following command

webiopi -h

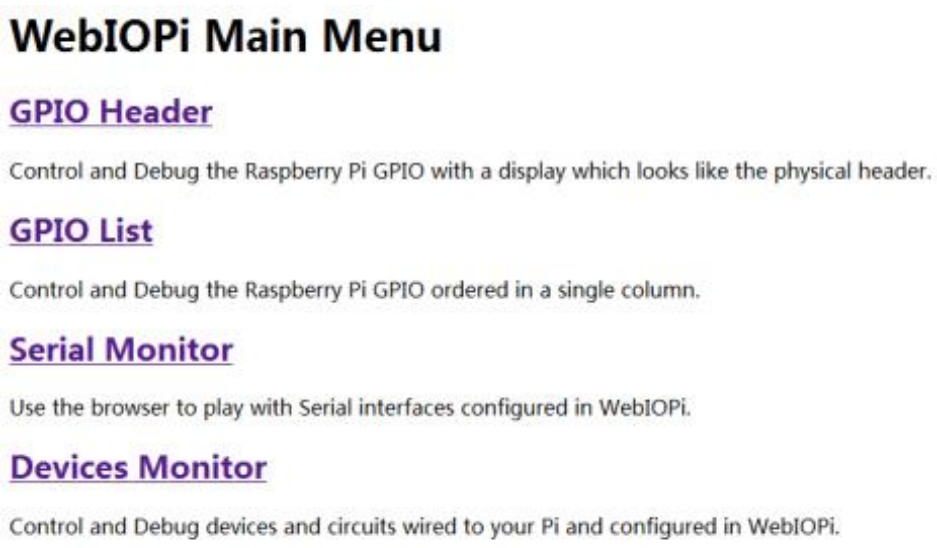
If WebIOPi is installed successfully, you will see following message in terminal, otherwise you might need redo the download and installation.

```
pi@raspberrypi:~/osoyoo-robot/cam-robot/WebIOPi-0.7.1 $ webiopi  -h
WebIOPi command-line usage
webiopi [-h] [-c config] [-l log] [-s script] [-d] [port]

Options:
  -h, --help            Display this help
  -c, --config file     Load config from file
  -l, --log file        Log to file
  -s, --script file     Load script from file
  -d, --debug           Enable DEBUG

Arguments:
  port                  Port to bind the HTTP Server
```

Step 4: Run webiopi by typing following command:(skip this step if your micro SD card has pre-installed Osoyoo Robot Image)

sudo webiopi -d -c /etc/webiopi/config

Use a browser in another computer (your computer/PAD/Phone in same LAN of your Pi) to visit your Pi's IP address with port **"8000"** (i.e http://192.168.0.115:8000, please replace 192.168.0.115 with your Pi's local IP address), your browser will show WebIOPi login page. You need use default WebIOPi user name **"webiopi"** and default password **"raspberry"** to login to the server. Once you are logged into WebIOPi page, you will see WebIOPI Main Menu as following. If you can not see this page , you need to reinstall the WebIOPI software.



Please press "Ctrl" + "C" then "Ctrl" + "Z" in your terminal to end WebIOPi running.

Note: If you don't know your raspberry pi IP address, type following command in your terminal, *ifconfig wlan0*

Your raspberry Pi IP address is in the right side of the word inet addr:

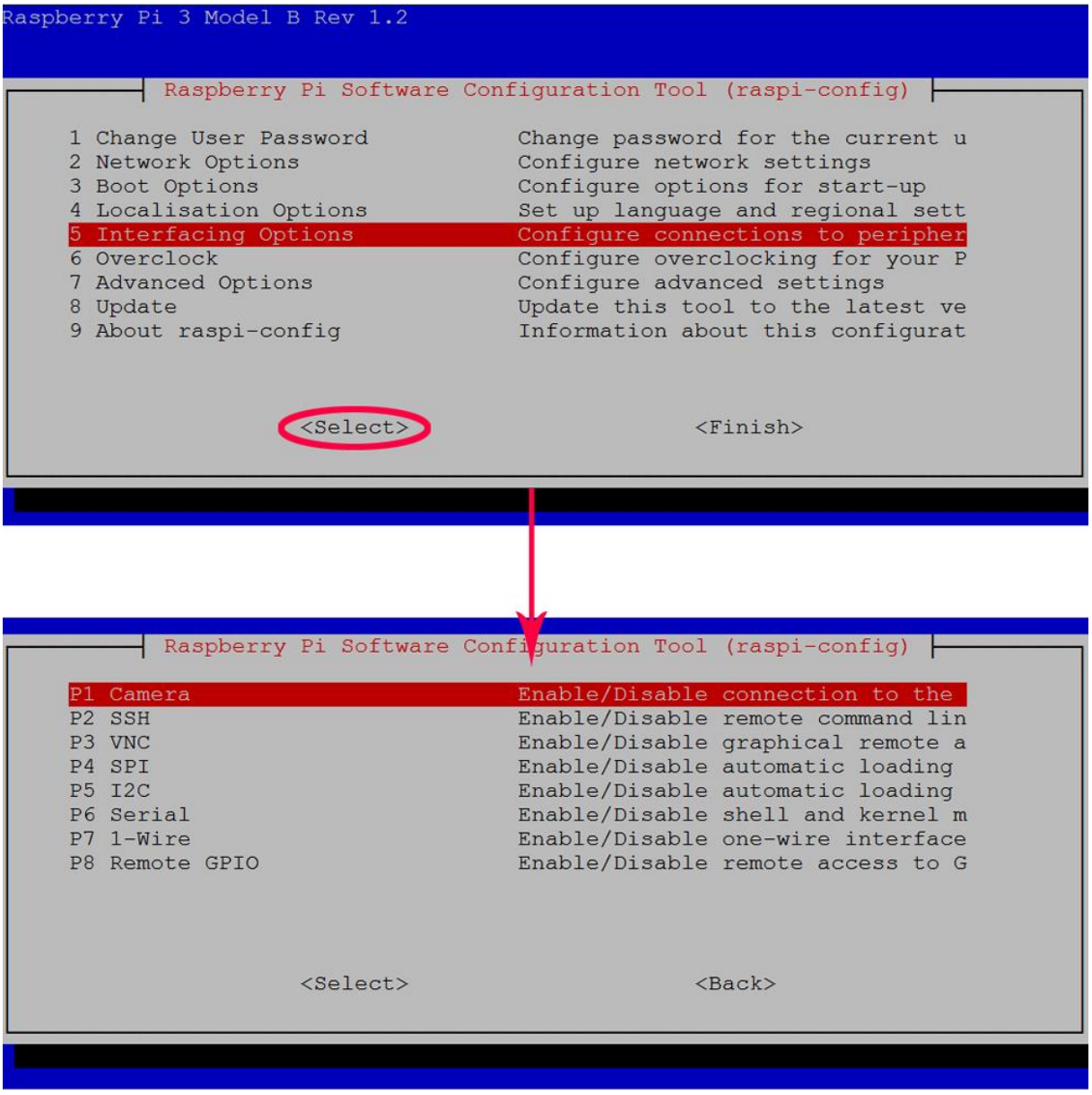
```
pi@raspberrypi:~/osoyoo-robot/cam-robot/WebIOPi-0.7.1 $ ifconfig wlan0
wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.0.115  netmask 255.255.255.0  broadcast 192.168.0.255
        inet6 fe80::f957:5b0f:bc9:d6e5  prefixlen 64  scopeid 0x20<link>
        ether b8:27:eb:fb:f9:ea  txqueuelen 1000  (Ethernet)
        RX packets 3226  bytes 1041847 (1017.4 KiB)
        RX errors 0  dropped 1556  overruns 0  frame 0
        TX packets 1949  bytes 403165 (393.7 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Following Step 5 to 7 is for mjpg-streamer server Installation

Step 5: If you are using CSI camera , please take following action as per step A and B. (If you are using USB camera which comes with the car, please skip this step)(skip this step if your micro SD card has pre-installed Osoyoo Robot Image)

A. enable camera in Raspberry Pi

sudo raspi-config



B. edit “/etc/modules” file by typing following command (otherwise /dev has no camera device node)

sudo nano /etc/modules

Please add the following line in the bottom of the “/etc/modules” file, and then press “ctrl” + “x” and then “y” to save the file and press “enter” exist nano editor

bcm2835-v4l2

```
  GNU nano 2.7.4                        File: /etc/modules

# /etc/modules: kernel modules to load at boot time.
#
# This file contains the names of kernel modules that should be loaded
# at boot time, one per line. Lines beginning with "#" are ignored.

i2c-dev
bcm2835-v4l2
```

Step 6: download and install mjpg-streamer support library by typing following command(skip this step if your micro SD card has pre-installed Osoyoo Robot Image)

cd ~
sudo apt-get update
sudo apt-get install libv4l-dev libjpeg8-dev -y
sudo apt-get install subversion -y

Step 7: Compile mjpg-streamer(skip this step if your micro SD card has pre-installed Osoyoo Robot Image)

Firstly, edit the configuration file “input_uvc.c” by typing following command

cd ~/osoyoo-robot/cam-robot/mjpg-streamer/plugins/input_uvc
sudo nano input uvc.c

Find following line(you can use “ctrl” + “W” to search the line when you enter nano editor)

int width=640, height=480, fps=5, format=V4L2_PIX_FMT_MJPEG

Replace the string **V4L2_PIX_FMT_MJPEG** with new string **V4L2_PIX_FMT_YUYV**

Then press “ctrl” + “x” and then “y” to save the file and press “enter” exist nano editor

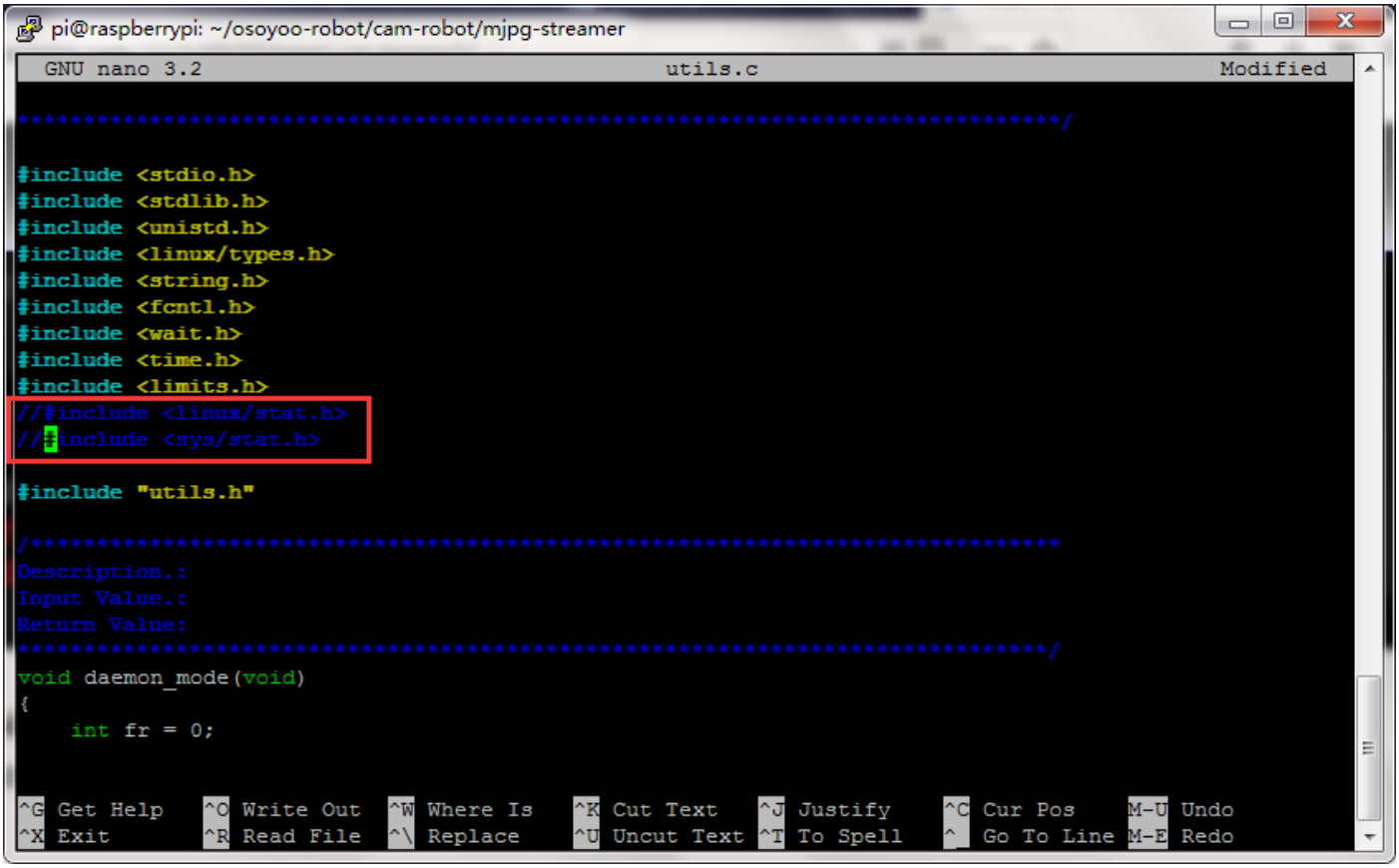
```
             parameter and stores the default and parsed values in the
             appropriate variables.
Input Value.: param contains among others the command-line string
Return Value: 0 if everything is fine
             1 if "--help" was triggered, in this case the calling programm
             should stop running and leave.
*******************************************************************************/
int input_init(input_parameter *param, int id)
{
    char *dev = "/dev/video0", *s;
    int width = 640, height = 480, fps = 5, format = V4L2_PIX_FMT_YUYV, i;
    /* initialize the mutes variable */
    if(pthread_mutex_init(&cams[id].controls_mutex, NULL) != 0) {
        IPRINT("could not initialize mutex variable\n");
        exit(EXIT_FAILURE);
    }
```

Secondly, we need compile the source code with following commands:

cd ~/osoyoo-robot/cam-robot/mjpg-streamer
sudo nano utils.c

comment the concerned includes in mjpg-streamer/utils.c line 32 & 33 :

//#include < linux/stat.h >
//#include < sys/stat.h >



Then press “ctrl” + “x” and then “y” to save the file and press “enter” exist nano editor

Thirdly, Run command as following:

make all

Fourthly, test camera installation: Plug your camera into Raspberry Pi, then type following command:

*ls /dev/video**

You should see following result in your terminal, “/dev/video0” is the camera installed in Pi.

```
pi@raspberrypi:~/osoyoo-robot/cam-robot/mjpg-streamer $ ls   /dev/video*
/dev/video0  /dev/video1  /dev/video10  /dev/video11  /dev/video12
```

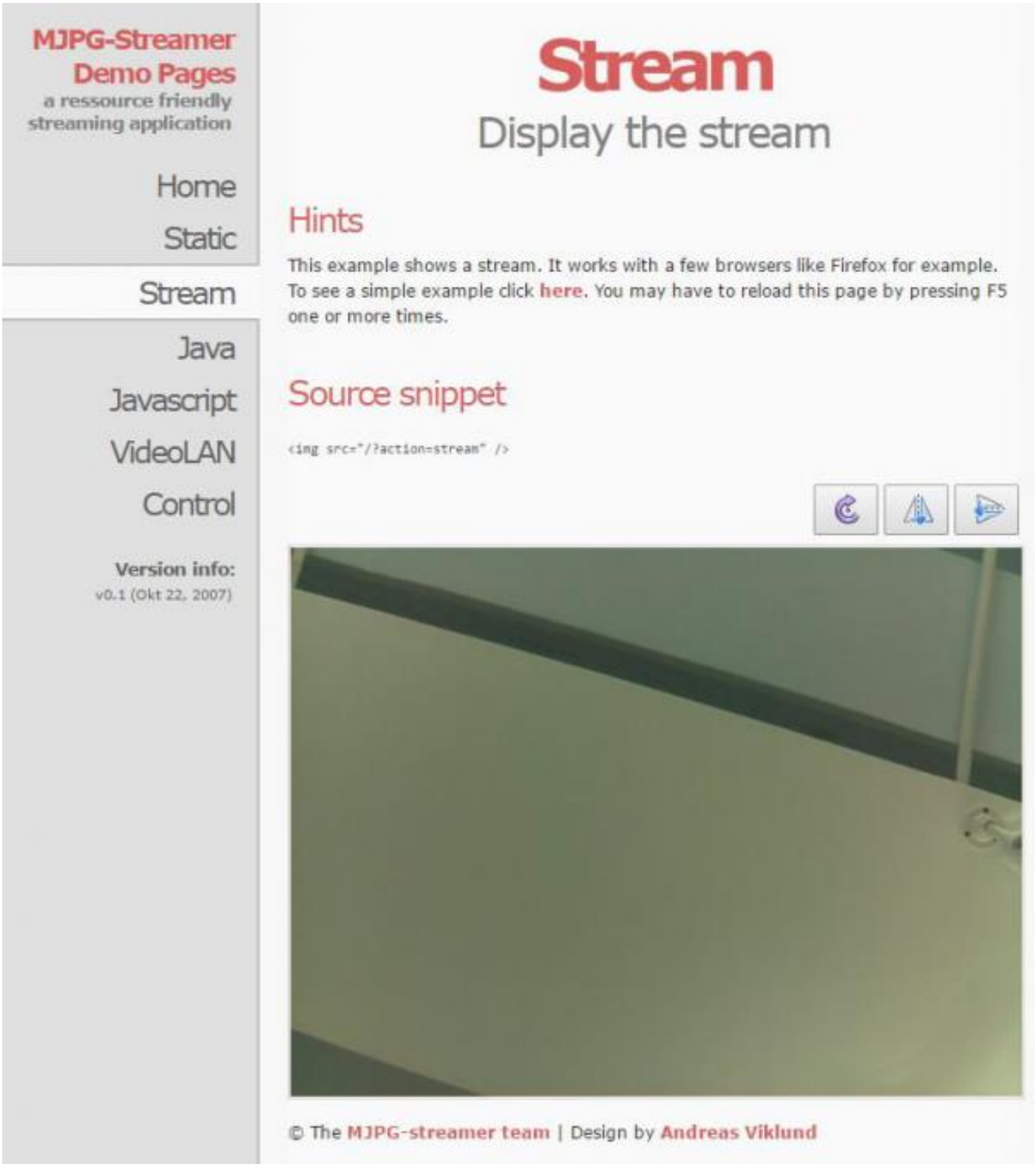
At last, Run mjpg-streamer Server by typing following command in terminal:

cd ~/osoyoo-robot/cam-robot/mjpg-streamer

sudo ./start.sh

```
pi@raspberrypi:~/osoyoo-robot/cam-robot/mjpg-streamer $ cd ~/osoyoo-robot/cam-robot/mjpg-stream
er
pi@raspberrypi:~/osoyoo-robot/cam-robot/mjpg-streamer $ sudo ./start.sh
MJPG Streamer Version: svn rev: Unversioned directory
 i: Using V4L2 device.: /dev/video0
 i: Desired Resolution: 640 x 480
 i: Frames Per Second.: 30
 i: Format............: YUV
 i: JPEG Quality......: 80
 o: www-folder-path...: www/
 o: HTTP TCP port.....: 8899
 o: username:password.: disabled
 o: commands.........: enabled
```

Now use browser in another computer to access your Raspberry Pi IP address with port 8899 (i.e, if your Pi IP address is 192.168.0.115, visit http://192.168.0.115:8899 in your browser), you will see following image. Click Stream button in left menu, you will see the real time video captched by the camera in your Raspberry Pi.



You can use Ctrl C command in terminal to end the mjpg-streamer server

Step 8: To combine webiopi and mjpg-streamer into same webpage which allows we “see” video from camera and control Robot Car with brower, we need change some default setting of WebIOPi and MJPG-streamer. To do so, we need to edit config file by typing following command and modify this file as Modification A, Modification B, Modification C: (skip this step if your micro SD card has pre-installed

Osoyoo Robot Image)

sudo nano /etc/webiopi/config

Modification A: replace webiopi default script python file which allow us to send control signal to Pi from Browser, please add following pink line into "/etc/webiopi/config" file

[SCRIPTS]

Load custom scripts syntax :

name = sourcefile

#each sourcefile may have setup, loop and destroy functions and macros

#myscript = /home/pi/WebIOPi-0.7.1/examples/scripts/macros/script.py

myscript = /home/pi/osoyoo-robot/cam-robot/robot/script.py

Modification B. change webiopi default html file path by adding following pink line:

Use doc-root to change default HTML and resource files location

#doc-root = /home/pi/WebIOPi-0.7.1/examples/servo-control

doc-root = /home/pi/osoyoo-robot/cam-robot/robot

Modification C. Add PCA9685 address into config by addling following pink line

[DEVICES]]

Device configuration syntax:

name = device [args...]

name : used in the URL mapping

#device : device name

#args : (optional) see device driver doc

#If enabled, devices configured here are mapped on REST API /device/name

#Devices are also accessible in custom scripts using deviceInstance(name)

#See device driver doc for methods and URI scheme available

Raspberry native UART on GPIO, uncomment to enable

Don't forget to remove console on ttyAMA0 in /boot/cmdline.txt

And also disable getty on ttyAMA0 in /etc/inittab

#serial0 = Serial device:ttyAMA0 baudrate:9600

USB serial adapters

#usb0 = Serial device:ttyUSB0 baudrate:9600

#usb1 = Serial device:ttyACM0 baudrate:9600

#temp0 = TMP102

#temp1 = TMP102 slave:0x49

#temp2 = DS18B20

#temp3 = DS18B20 slave:28-0000049bc218

#bmp = BMP085

#gpio0 = PCF8574

#gpio1 = PCF8574 slave:0x21

#light0 = TSL2561T

#light1 = TSL2561T slave:0b0101001

#gpio0 = MCP23017

#gpio1 = MCP23017 slave:0x21

#gpio2 = MCP23017 slave:0x22

pwm0 = PCA9685 slave:0x40

#pwm1 = PCA9685 slave:0x41

#adc0 = MCP3008

#adc1 = MCP3008 chip:1 vref:5

#dac1 = MCP4922 chip:1

Finally, press “ctrl” + “x” and then “y” to save the file and press “enter” exist nano editor.

Testing Server Installation

Now you can put your car on the ground and turn on the power-switch in battery box. We need to use SSH to control the car. So you must enable SSH with raspi-config command before testing. If you are using windows, please use download Putty to ssh your Pi, if you are using MacBook, please directly use ssh command in terminal.

Step 1. To start mjpg-streamer, in ssh terminal, please type followinig command:
cd ~/osoyoo-robot/cam-robot/mjpg-streamer

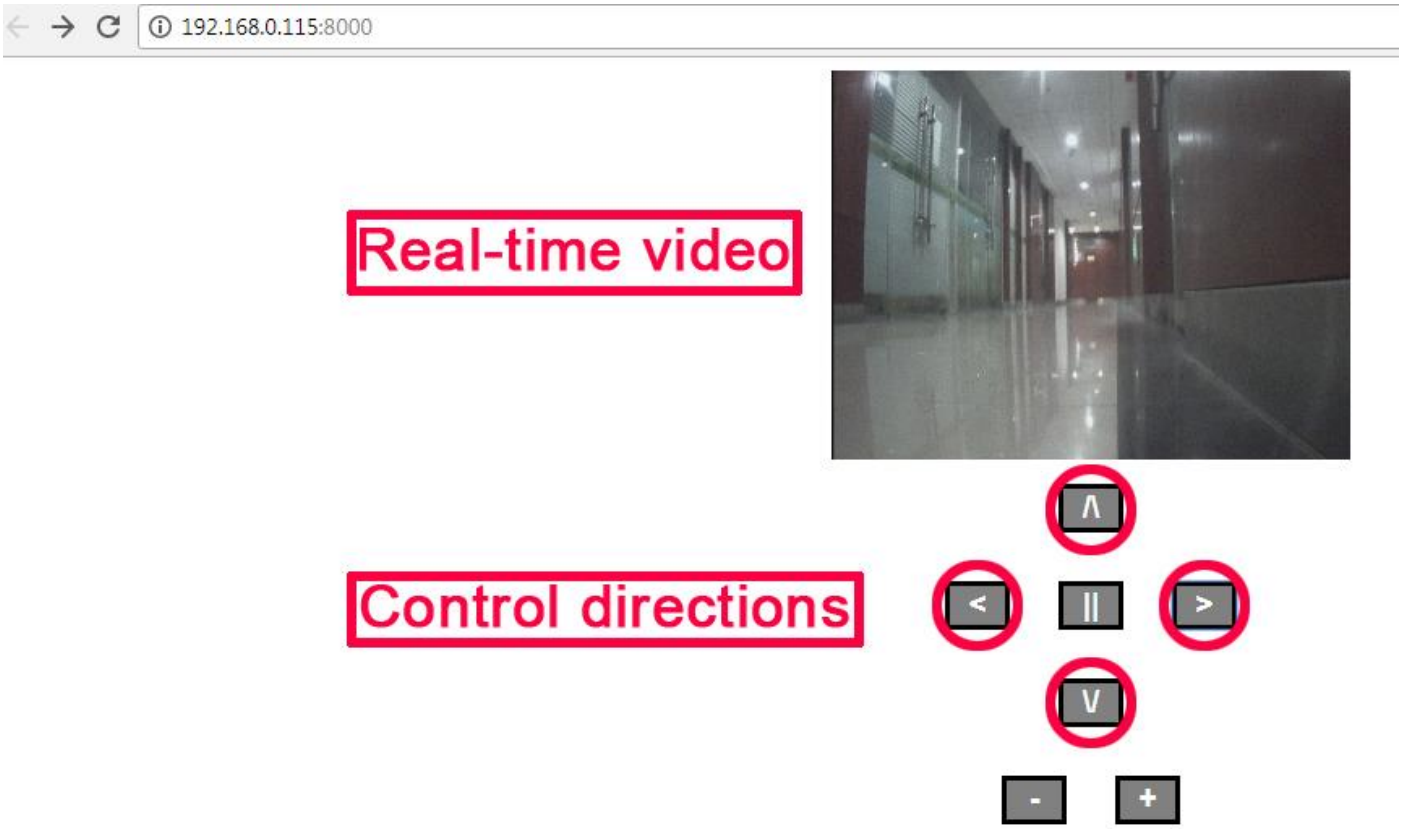
sudo ./start.sh

```
pi@raspberrypi:~ $ cd ~/osoyoo-robot/cam-robot/mjpg-streamer
pi@raspberrypi:~/osoyoo-robot/cam-robot/mjpg-streamer $ sudo ./start.sh
MJPG Streamer Version: svn rev:
 i: Using V4L2 device.: /dev/video0
 i: Desired Resolution: 640 x 480
 i: Frames Per Second.: 30
 i: Format............: YUV
 i: JPEG Quality......: 80
 o: www-folder-path...: www/
 o: HTTP TCP port.....: 8899
 o: username:password.: disabled
 o: commands.........: enabled
```

Step 2. To start webiopi, please open another ssh window and type following command:
sudo webiopi -d -c /etc/webiopi/config

Control the car with browser

Now you can use your browse to acess Raspberry IP with port 8000(i.e, if your Pi IP address is 192.168.0.115, please visit http://192.168.0.115:8000, you will see following picture in your browser, click arrow buttons, you can make car moving to your desired directions.



Android and iOS App

You can also use our free Android App or Apple App instead of browser to control the car.

Download the Android app fromhttps://osoyoo.com/driver/osoyoo-robot.apk

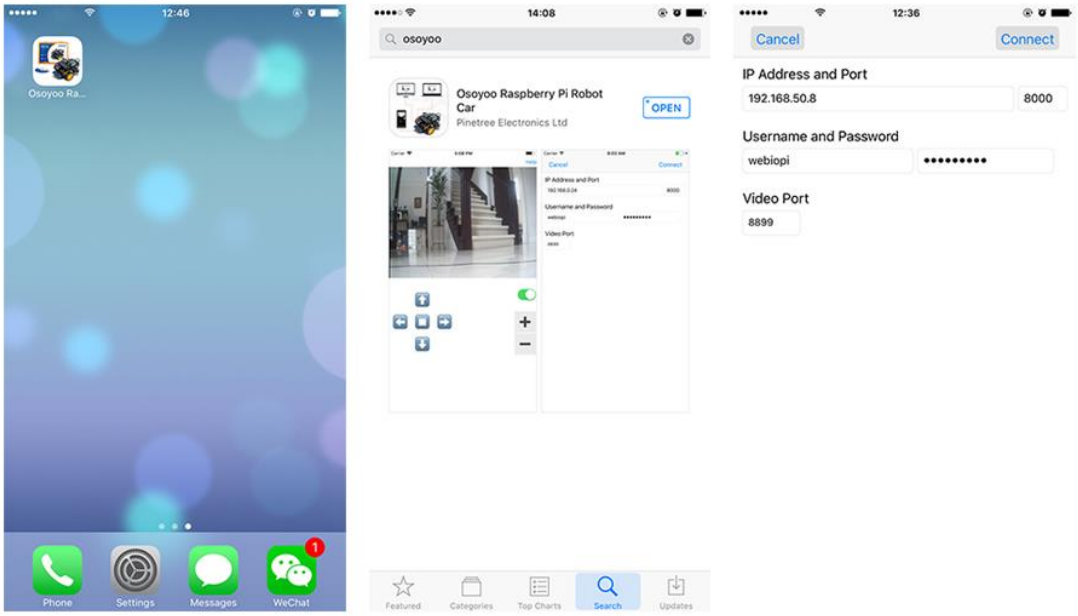
For Apple iOS user, please search Osoyoo raspberry Pi Robot Car in Apple APP store ,download and install it.

Run the App, click set up and enter config page set the fields as following:

Robot IP:
your raspberrr pi ip Port: 8000
Video URL: http://your_raspberry_pi_ip:8899/?action=stream(please use IP such as 192.168.0.16 to replace your_raspberry_pi_ip)
User Name: webiopi
Password: raspberry

Click Save button and exit config page.

OSOYOO Raspberry Pi Car Apple APP



Now you can use the arrow buttons in App to control the car.