智慧機器人

使用手冊

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註：6、7、8項操作為基本使用方法
進階操作或相關課程
請洽創客萊吧 Makerlab
電話：07 – 5564686
官網：https://www.makerlab.tw/

1.智慧機器人組件

無線通訊
擁有wifi與藍芽

搭載ROS系統
使用強大的機器人
操作系統

語音辨識
內建語音控制
功能

影像辨識
能夠於線道中
自動駕駛

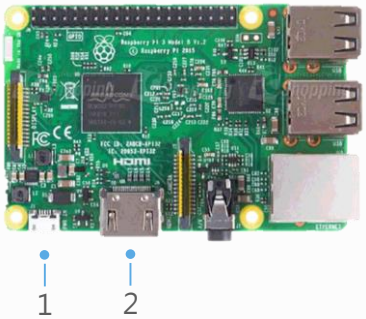
2.智慧機器人系統資訊

作業系統、帳號名稱與密碼

- 作業系統：Raspbian Stretch with desktop
  - 映像檔網址：https://www.raspberrypi.org/downloads/raspbian/
- 預設帳號與主機名稱
  - pi@raspberrypi
- 預設密碼
  - 創客萊吧之電話號碼：5564686

3.注意事項

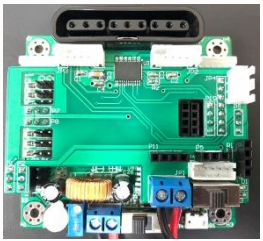
良好的使用方法有助於延長使用時間



單板電腦 – 樹梅派

常插拔的兩個地方需要小心謹慎

1. Micro USB 電源供應孔
2. HDMI 螢幕孔



馬達控制器

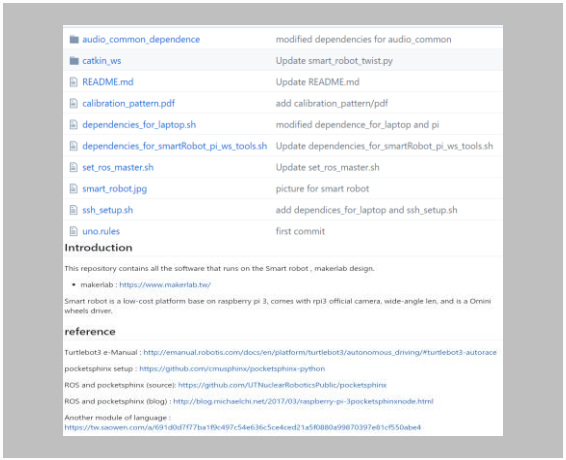
未使用智慧機器人時，請記得將所有電源關閉(確保未有指示燈亮起)，以延長鋰電池使用期限

鋰電池與充電器

充電時需有人在現場檢視，充電完畢需即時停止充電禁止於夜晚充電至隔天早上

4.技術資源

創客萊吧 Makerlab 已於 github 開放原始碼 ：https://github.com/kjoelovelife/smart_robot



audio_common_dependence	modified dependencies for audio_common
catkin_ws	Update smart_robot_twist.py
README.md	Update README.md
calibration_pattern.pdf	add calibration_pattern/pdf
dependencies_for_laptop.sh	modified dependence_for_laptop and pi
dependencies_for_smartRobot_pi_ws_tools.sh	Update dependencies_for_smartRobot_pi_ws_tools.sh
set_ros_master.sh	Update set_ros_master.sh
smart_robot.jpg	picture for smart robot
ssh_setup.sh	add dependices_for_laptop and ssh_setup.sh
uno.rules	first commit

Introduction

This repository contains all the software that runs on the Smart robot , makerlab design.

- makerlab : https://www.makerlab.tw/

Smart robot is a low-cost platform base on raspberry pi 3, comes with rpi3 official camera, wide-angle len, and is a Omini wheels driver.

reference

Turtlebot3 e-Manual : http://emanual.robotis.com/docs/en/platform/turtlebot3/autonomous_driving/#turtlebot3-autorace

pocketsphinx setup : https://github.com/cmusphinx/pocketsphinx-python

ROS and pocketsphinx (source): https://github.com/UTNuclearRoboticsPublic/pocketsphinx

ROS and pocketsphinx (blog) : http://blog.michaelchi.net/2017/03/raspberry-pi-3pocketsphinxnode.html

Another module of language :
https://tw.saowen.com/a/691d0d7f77ba1f0c497c54e636c5ce4ced21a5f0880a99870397e81cf550abe4

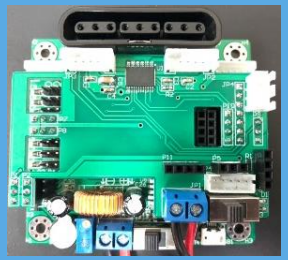
讓你能夠更方便地使用智慧機器人

IcShop 將需要使用到的知識與技術，
通通幫你整合在開放的 github上，
讓你使用起來更加方便

5.智慧機器人電源啟動順序

使用智慧機器人前的預備動作

1. 樹莓派接入 HDMI螢幕線與螢幕連線



2. 使用鋰電池啟動馬達控制器

3. 使用行動電源啟動樹梅派

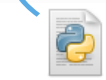
6、鍵盤遙控智慧機器人

6-1 利用筆電註冊 Master

指令： roscore

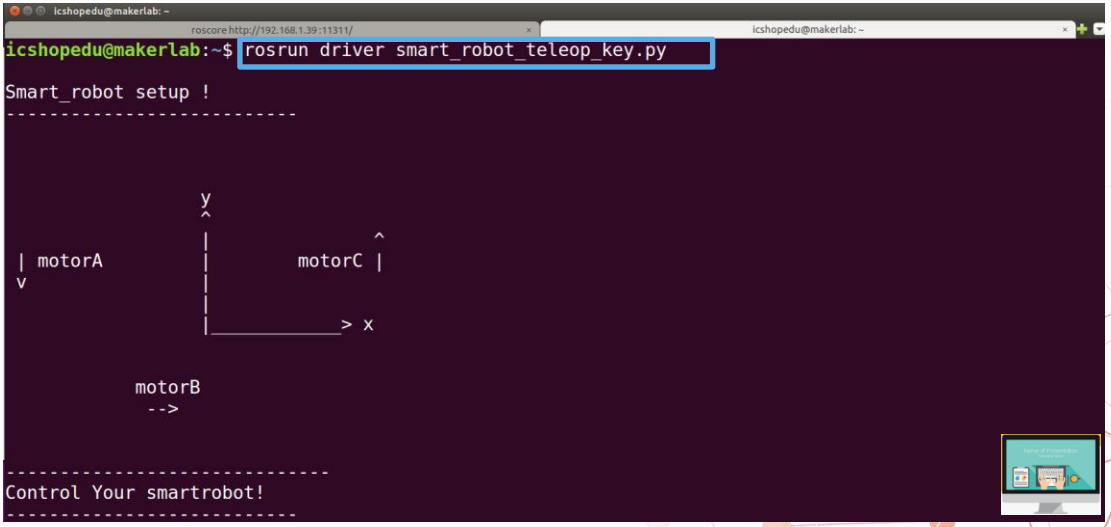
```
roscore http://192.168.1.39 :11311/
icshopedu@makerlab:~$ roscore
... logging to /home/icshopedu/.ros/log/bb9ac28c-34b8-11e9-8492-080027b7a30b/ros
launch-makerlab-19689.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://192.168.1.39 :33483/
ros_comm version 1.12.14


SUMMARY
========

PARAMETERS
 * /rosdistro: kinetic
 * /rosversion: 1.12.14
```

6、鍵盤遙控智慧機器人

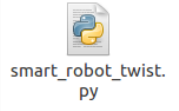
6-2 利用筆電開啟新的 Terminal ，執行 

節點

指令： rosrun driver smart_robot_teleop_key.py



6、鍵盤遙控智慧機器人

6-3 利用智慧機器人執行  節點

指令：`rosrun driver smart_robot_twist.py`

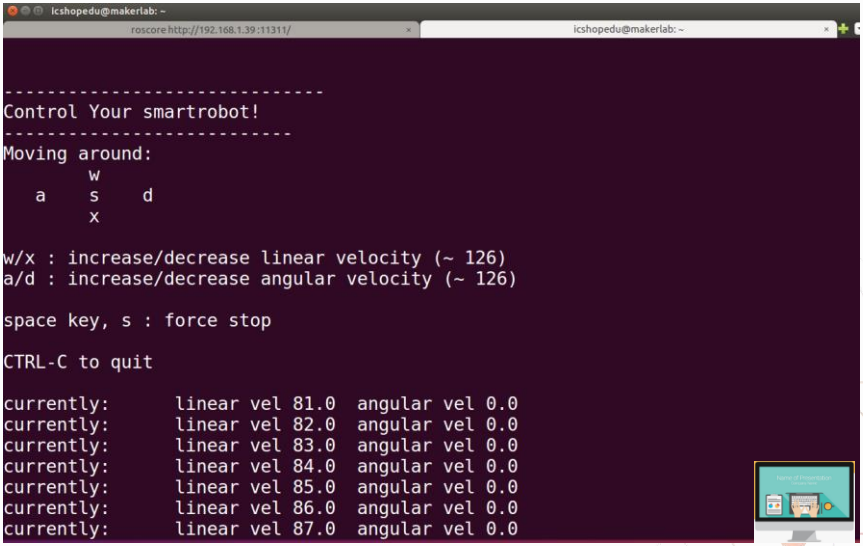
```
pi@raspberrypi: ~
pi@raspberrypi:~ $ rosrun driver smart_robot_twist.py


Control Smart Robot !
---------------------------


                y
                ^
                |                ^
 | motorA       |        motorC |
 v              |
                |
                |
                |_____________> x


           motorB
            -->
```

6、鍵盤遙控智慧機器人

6-4 在筆電執行 

節點的 Terminal，按下 w/x/s/a/d

即可移動智慧機器人



按鍵	移動方向
W	前進
X	後退
A	逆時針旋轉
D	順時針旋轉
S	停止

7、語音控制智慧機器人

7-1 利用筆電註冊 Master

指令： roscore

```
roscore http://192.168.1.39:11311/
icshopedu@makerlab:~$ roscore
... logging to /home/icshopedu/.ros/log/bb9ac28c-34b8-11e9-8492-080027b7a30b/ros
launch-makerlab-19689.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://192.168.1.39 :33483/
ros_comm version 1.12.14


SUMMARY
========

PARAMETERS
 * /rosdistro: kinetic
 * /rosversion: 1.12.14
```

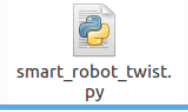
7、語音控制智慧機器人

7-2 利用智慧機器人執行 pocketsphinx.launch 文件

指令：roslaunch pocketsphinx pocketsphinx.launch

```
/home/pi/smart_robot/catkin_ws/src/pocketsphinx/launch/pocketsphinx.launch http://makerlab.local:11311/
pi@raspberrypi:~ $ roslaunch pocketsphinx pocketsphinx.launch
... logging to /home/pi/.ros/log/bb9ac28c-34b8-11e9-8492-080027b7a30b/roslaunch-raspberrypi-1954.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://192.168.1.25 :36557/

SUMMARY
========

PARAMETERS
 * /rosdistro: kinetic
 * /rosversion: 1.12.14

NODES
  /
    pocketsphinx_recognizer (pocketsphinx/recognizer.py)
    voice_control (pocketsphinx/voice_control.py)

ROS_MASTER_URI=http://makerlab.local:11311/

process[pocketsphinx_recognizer-1]: started with pid [1963]
```

7、語音控制智慧機器人

7-3 利用智慧機器人執行 

節點，開始移動

指令： rosrun driver smart_robot_twist.py

```
pi@raspberrypi: ~
pi@raspberrypi:~ $ rosrun driver smart_robot_twist.py


Control Smart Robot !
---------------------------


                y
                ^
                |                ^
 | motorA       |        motorC  |
 v              |
                |
                |
                |_____________> x


           motorB
            -->
```

使用語音控制智慧機器人行動順序

1. 靠近語音模組
2. 說出關鍵字指令，如
   go ：前進
   Stop：停止

更多關鍵字指令：請查閱 7-4 步驟

7、語音控制智慧機器人

7-4 可至 smart_robot | catkin_ws | src | pocketsphinx | vocab | hub4wsj_sc_8k

找尋  voice_cmd.kwlist，查看已可辨認出的關鍵字，例如 "GO"

voice_cmd.kwlist (~/smart_robot/catkin_ws/src/pocketsphinx/vocab/hub4wsj_sc_8k) - gedit

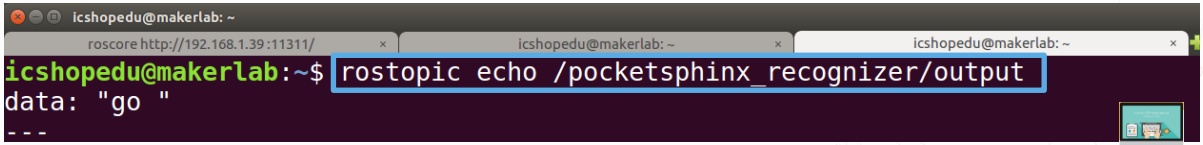
Open Save

```
CLOSE HAND /1e-1/
CONSIDER ROTATION /1e-1/
FREE DIRECTIONS /1e-1/
IGNORE ROTATION /1e-1/
INVERTED CONTROL MODE /1e-1/
LIMIT DIRECTIONS /1e-1/
MANIPULATION /1e-1/
NATURAL CONTROL MODE /1e-1/
NAVIGATION /1e-1/
OPEN HAND /1e-1/
ROBOT PLAN AND GO /1e-1/
ROBOT PLAN HOME /1e-1/
ROBOT PLEASE EXECUTE /1e-1/
ROBOT PLEASE PLAN /1e-1/
ROBOT PLEASE GO HOME /1e-1/
ROBOT PLAN HOME /1e-1/
TURN HANDLE CLOCKWISE /1e-1/
TURN HANDLE COUNTERCLOCKWISE /1e-1/
STOP /1e-1/
FORWARD /1e-1/
BACKWARD /1e-1/
GO /1e-1/
BACK /1e-1/
```

7、語音控制智慧機器人

7-5 利用筆電開啟新的 Terminal，執行指令查看語音控制指令辨識結果

指令： rostopic echo /pocketsphinx_recognizer/output



7、語音控制智慧機器人

7-6 可至 smart_robot | catkin_ws | src | pocketsphinx | vocab | hub4wsj_sc_8k

找尋 

，查看內建可使用的字庫

voice_cmd.dic (~/smart_robot/catkin_ws/src/pocketsphinx/vocab/hub4wsj_sc_8k) - gedit

Open Save

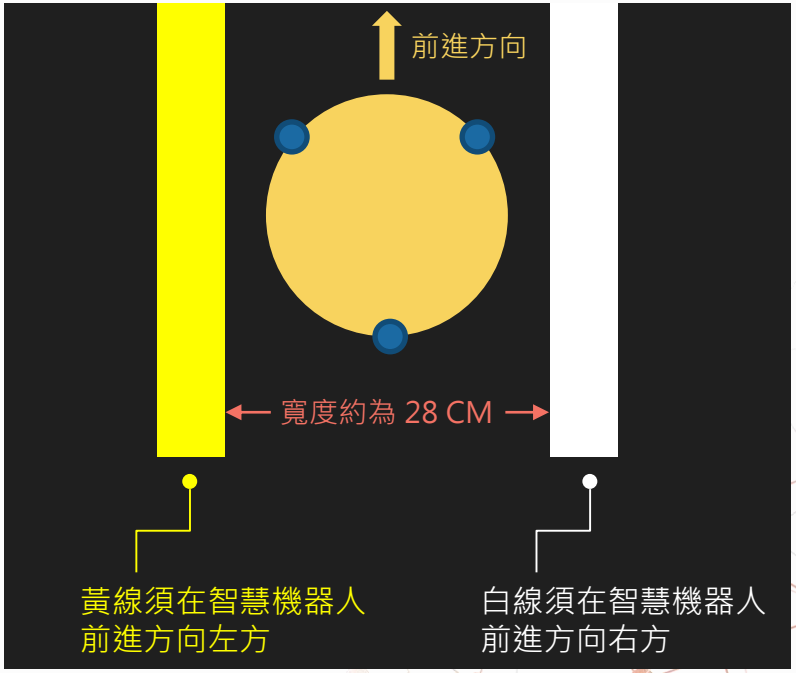
```
AND     AH N D
CLOCKWISE       K L AA K W AY Z
CLOSE   K L OW S
CONSIDER        K AH N S IH D ER
CONTROL K AH N T R OW L
COUNTERCLOCKWISE        K AW N T ER K L AO K W AY Z
DIRECTIONS      D ER EH K SH AH N Z
DIRECTIONS(2)   D IY R EH K SH IH N Z
DIRECTIONS(3)   D AY R EH K SH IH N Z
DIRECTIONS(4)   D IH R EH K SH IH N Z
EXECUTE EH K S AH K Y UW T
FREE    F R IY
GO      G OW
HAND    HH AE N D
HANDLE  HH AE N D AH L
HOME    HH OW M
IGNORE  IH G N AO R
INVERTED        IH N V ER T IH D
LIMIT   L IH M AH T
MANIPULATION    M AH N IH P Y AH L EY SH AH N
MODE    M OW D
NATURAL N AE CH ER AH L
NATURAL(2)      N AE CH R AH L
NAVIGATION      N AE V AH G EY SH AH N
OPEN    OW P AH N
```

Plain Text Tab Width: 8 Ln 1, Col 1 INS

8、智慧機器人影像辨識道路

8-1 準備好地圖與智慧機器人

地圖底色須為深色
(黑色最佳)



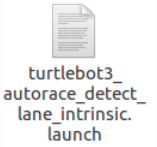
8、智慧機器人影像辨識道路

8-2 利用筆電註冊 Master

指令： roscore

```
roscore http://192.168.1.39 :11311/
icshopedu@makerlab:~$ roscore
... logging to /home/icshopedu/.ros/log/bb9ac28c-34b8-11e9-8492-080027b7a30b/ros
launch-makerlab-19689.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://192.168.1.39 :33483/
ros_comm version 1.12.14


SUMMARY
========

PARAMETERS
 * /rosdistro: kinetic
 * /rosversion: 1.12.14
```

8、智慧機器人影像辨識道路

8-3 利用智慧機器人執行 

文件

指令： roslaunch turtlebot3_autorace_camera turtlebot3_autorace_detect_lane_intrinsic.launch

```
pi@raspberrypi:~ $ roslaunch turtlebot3_autorace_camera turtlebot3_autorace_detect_lane_intrinsic.launch
... logging to /home/pi/.ros/log/bb9ac28c-34b8-11e9-8492-080027b7a30b/roslaunch-raspberrypi-2230.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://192.168.1.25 :33149/

SUMMARY
========

PARAMETERS
 * /camera/camera/ISO: 889
 * /camera/camera/awb_mode: tungsten
 * /camera/camera/brightness: 59
 * /camera/camera/contrast: 50
 * /camera/camera/exposureCompensation: 0
 * /camera/camera/exposure_mode: antishake
 * /camera/camera/hFlip: False
 * /camera/camera/saturation: 0
 * /camera/camera/sharpness: 0
 * /camera/camera/shutterSpeed: 25000
 * /camera/camera/vFlip: False
 * /camera/camera/videoStabilisation: False
```

8、智慧機器人影像辨識道路

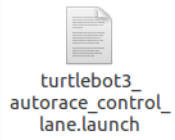
8-4 利用筆電執行  文件

turtlebot3_autorace_control_lane.launch

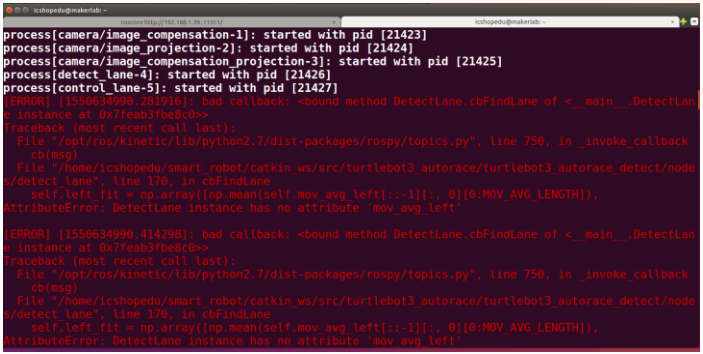
指令： roslaunch turtlebot3_autorace_control turtlebot3_autorace_control_lane.launch

```
icshopedu@makerlab: ~
roscore http://192.168.1.39:11311/
icshopedu@makerlab: ~
icshopedu@makerlab:~$ roslaunch turtlebot3_autorace_control turtlebot3_autorace_control_lane.launch
... logging to /home/icshopedu/.ros/log/bb9ac28c-34b8-11e9-8492-080027b7a30b/roslaunch-makerlab-21406
.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://192.168.1.39 :42389/

SUMMARY
========

PARAMETERS
 * /camera/image_compensation/camera/extrinsic_camera_calibration/clip_hist_percent: 1.0
 * /camera/image_compensation/is_extrinsic_camera_calibration_mode: False
 * /camera/image_compensation_projection/camera/extrinsic_camera_calibration/clip_hist_percent: 1.0
 * /camera/image_compensation_projection/is_extrinsic_camera_calibration_mode: False
 * /camera/image_projection/camera/extrinsic_camera_calibration/bottom_x: 165
 * /camera/image_projection/camera/extrinsic_camera_calibration/bottom_y: 120
 * /camera/image_projection/camera/extrinsic_camera_calibration/top_x: 75
 * /camera/image_projection/camera/extrinsic_camera_calibration/top_y: 35
 * /camera/image_projection/is_extrinsic_camera_calibration_mode: False
 * /desired_center: 200
 * /detect_lane/detect/lane/white/hue_h: 90
```

8、智慧機器人影像辨識道路

8-4-1 利用筆電執行 

文件出現紅字



若是出現紅色字體
表示智慧機器人不在正確的線道上
請回到 8-1 步驟
確認地圖與智慧機器人擺放位置是否正確
若擺放正確則紅色字體不會再被刷新

8、智慧機器人影像辨識道路

8-5 利用智慧機器人執行  節點，開始移動

smart_robot_twist.py

指令：rosrun driver smart_robot_twist.py

```
pi@raspberrypi: ~
pi@raspberrypi:~ $ rosrun driver smart_robot_twist.py


Control Smart Robot !
---------------------------


                y
                ^
                |                ^
 | motorA       |        motorC |
 v              |
                |
                |
                |_____________> x


           motorB
            -->
```

8、智慧機器人影像辨識道路

8-6 修改 

參數，調整影像辨識道路行進路線

位置：smart_robot | catkin_ws | src | turtlebot3_autorace | turtlebot3_autorace_control | param | **control_lane**

automove.yaml (~/smart_robot/catkin_ws/src/turtlebot3_auto...tlebot3_autorace_control/param/control_lane

Open Save

```
kp: 0.0001 # default:0.0001   , range 0.00001 ~ 0.0025
kd: 0.0007  # default:0.007   , range 0.001 ~ 0.0001
y_max_speed: 30 # default:30 , range 0 ~ 126
z_max_speed: 40 # default:40 , range 0 ~ 126
desired_center: 200 # default:500 , range: 0 ( yellow ) ~ 599 ( white )
```