Park Park Go

最佳Park檔

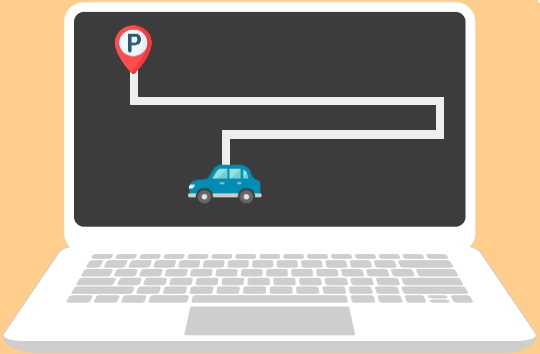
製作動機

- 全臺灣共有**8,178,242** 台汽車登記，全台灣車位僅有**5,446,977**格
- 尋找工作場所車位平均需要**6.4**分鐘
  尋找居家車位時需要**8.9**分鐘
- 停車場通常不會指定停車位給民眾
- **SPA**論文沒提供停車位的導引
- 多個出入口易造成混亂

智慧停車場導航與自走車模擬系統之功能

1 **感測器**辨識有無車位

2 利用**專家系統**分配最小成本停車格及規劃路線



3 利用**機器學習**提升室內定位精準度

4 結合**電腦視覺**及**PID演算法**建立道路循線系統

建立自走車模擬停車場導航系統

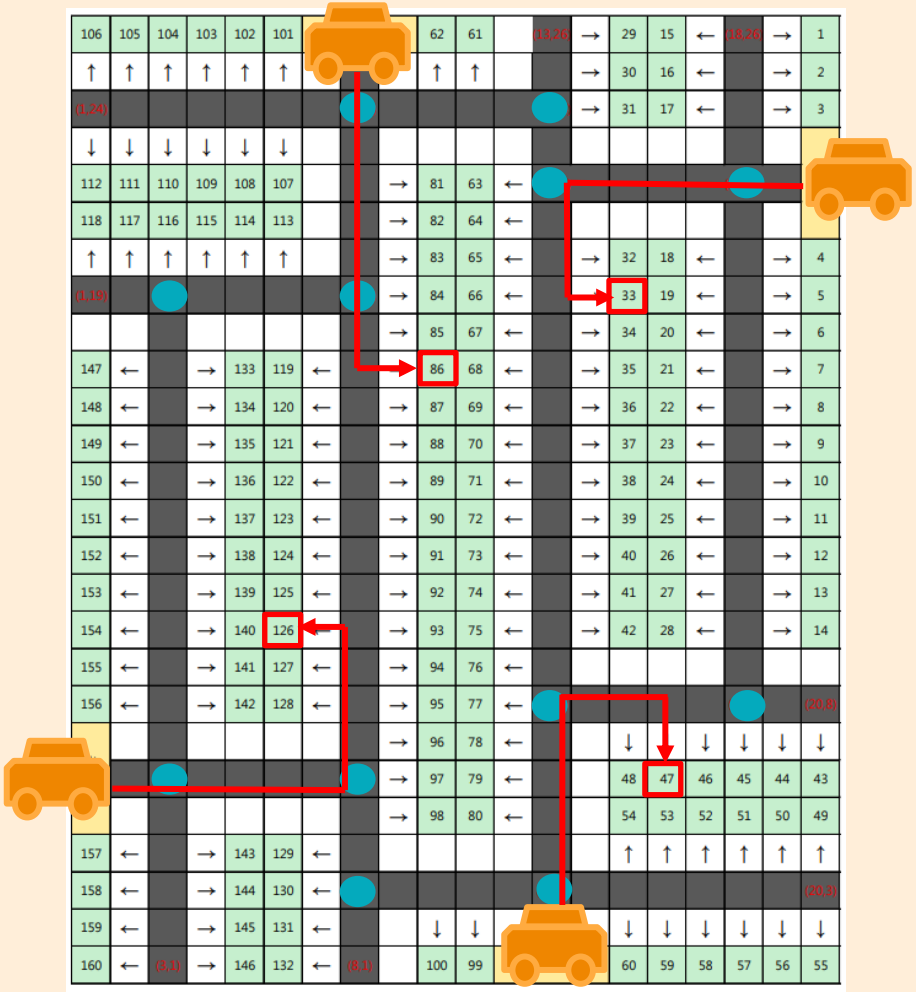
伺服器功能

1.管理停車場內停車格狀況

2.提供停車位

3.規劃路線

4.室內定位



自走車功能

1.給予自身訊息

2. 道路循線系統

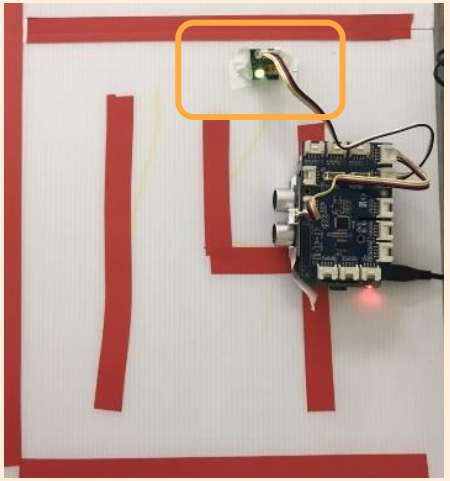
3. 接收Beacon的訊號

4.讀取伺服器給的定位

(一)利用感測器辨識車位是否為空位

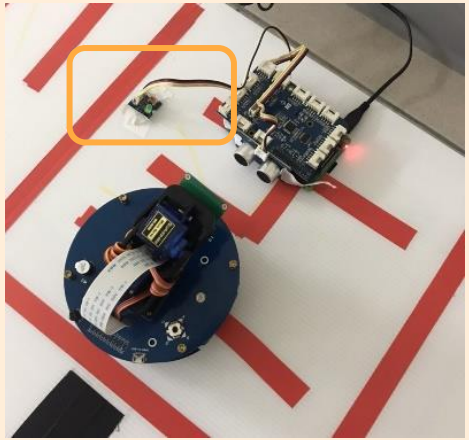
車位為空

亮著LED燈



車位有車

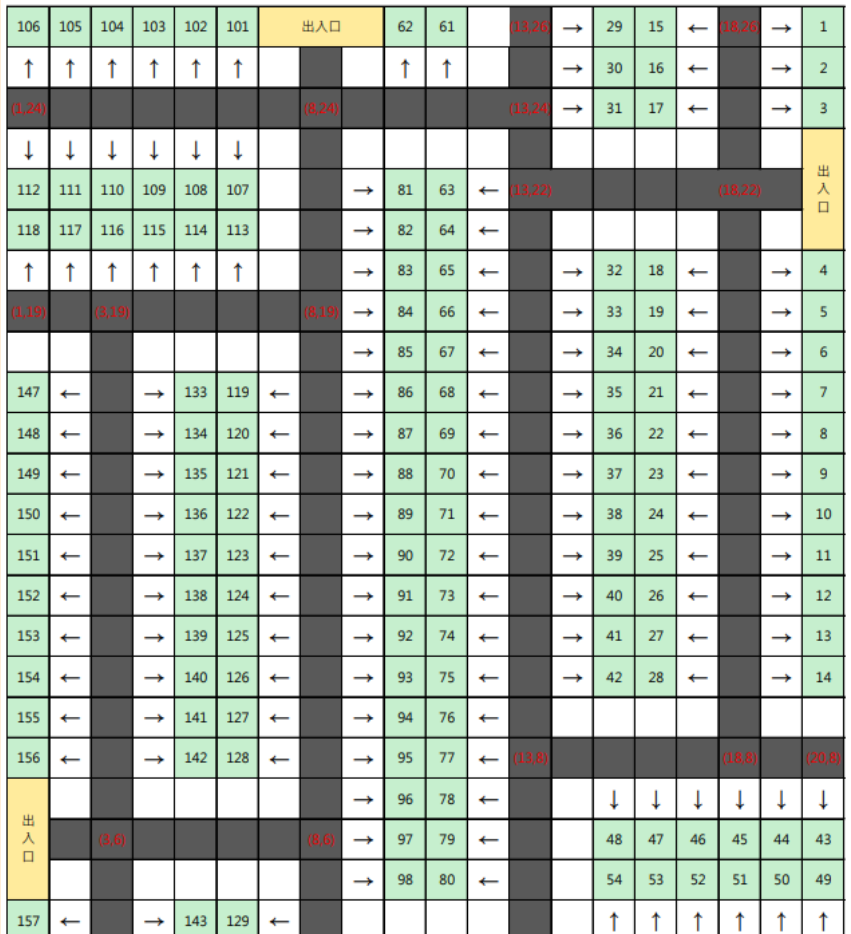
LED燈熄滅



(二)利用專家系統進行停車格分配及路線規劃

輸入Working Memory的Facts

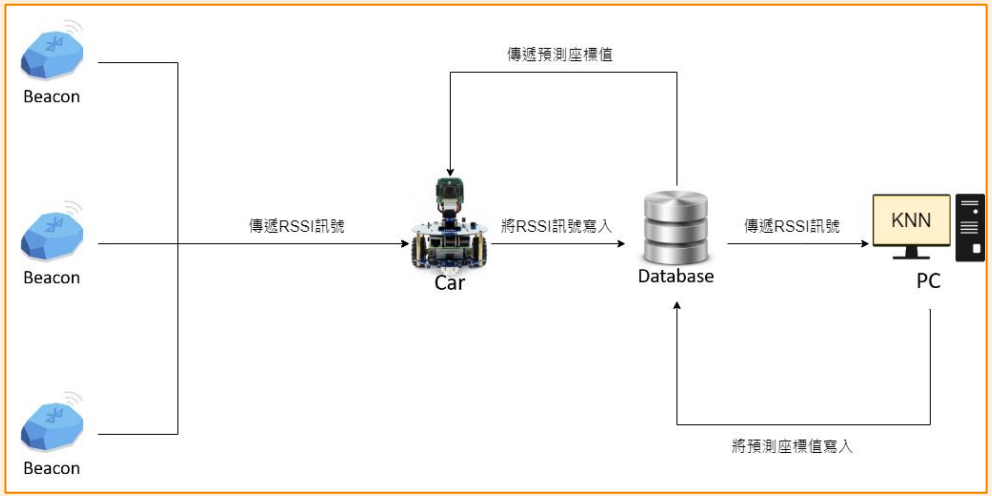
160個停車位
24個端點
26個車道路段



```
(space (ID 157) (x 3) (y 4) (turn W) (occupied 0))
(space (ID 158) (x 3) (y 3) (turn W) (occupied 1))
(space (ID 159) (x 3) (y 2) (turn W) (occupied 0))
(space (ID 160) (x 3) (y 1) (turn W) (occupied 0))
(point (x 3) (y 1))
(point (x 3) (y 6))
(point (x 3) (y 19))
(point (x 8) (y 1))
(point (x 8) (y 3))
(point (x 8) (y 6))
(point (x 8) (y 19))
(point (x 8) (y 24))
(point (x 8) (y 26))
(point (x 13) (y 1))
(point (x 13) (y 3))
(point (x 13) (y 8))
(point (x 13) (y 22))
(point (x 13) (y 24))
(point (x 13) (y 26))
(point (x 18) (y 8))
(point (x 18) (y 22))
(point (x 18) (y 26))
(point (x 20) (y 3))
(point (x 20) (y 8))
(point (x 20) (y 22))
(point (x 1) (y 6))
(point (x 1) (y 19))
(point (x 1) (y 24))
(line (x1 3) (y1 1) (x2 3) (y2 6) (distance 5))
(line (x1 3) (y1 6) (x2 3) (y2 19) (distance 13))
(line (x1 8) (y1 1) (x2 8) (y2 3) (distance 2))
(line (x1 8) (y1 3) (x2 8) (y2 6) (distance 3))
(line (x1 8) (y1 6) (x2 8) (y2 19) (distance 13))
(line (x1 8) (y1 19) (x2 8) (y2 24) (distance 5))
(line (x1 13) (y1 3) (x2 13) (y2 8) (distance 5))
(line (x1 13) (y1 8) (x2 13) (y2 22) (distance 14))
(line (x1 13) (y1 22) (x2 13) (y2 24) (distance 2))
(line (x1 13) (y1 24) (x2 13) (y2 26) (distance 2))
(line (x1 18) (y1 8) (x2 18) (y2 22) (distance 14))
(line (x1 18) (y1 22) (x2 18) (y2 26) (distance 4))
(line (x1 8) (y1 24) (x2 8) (y2 26) (distance 2))
```

(三)利用機器學習建立iBeacon室內定位系統

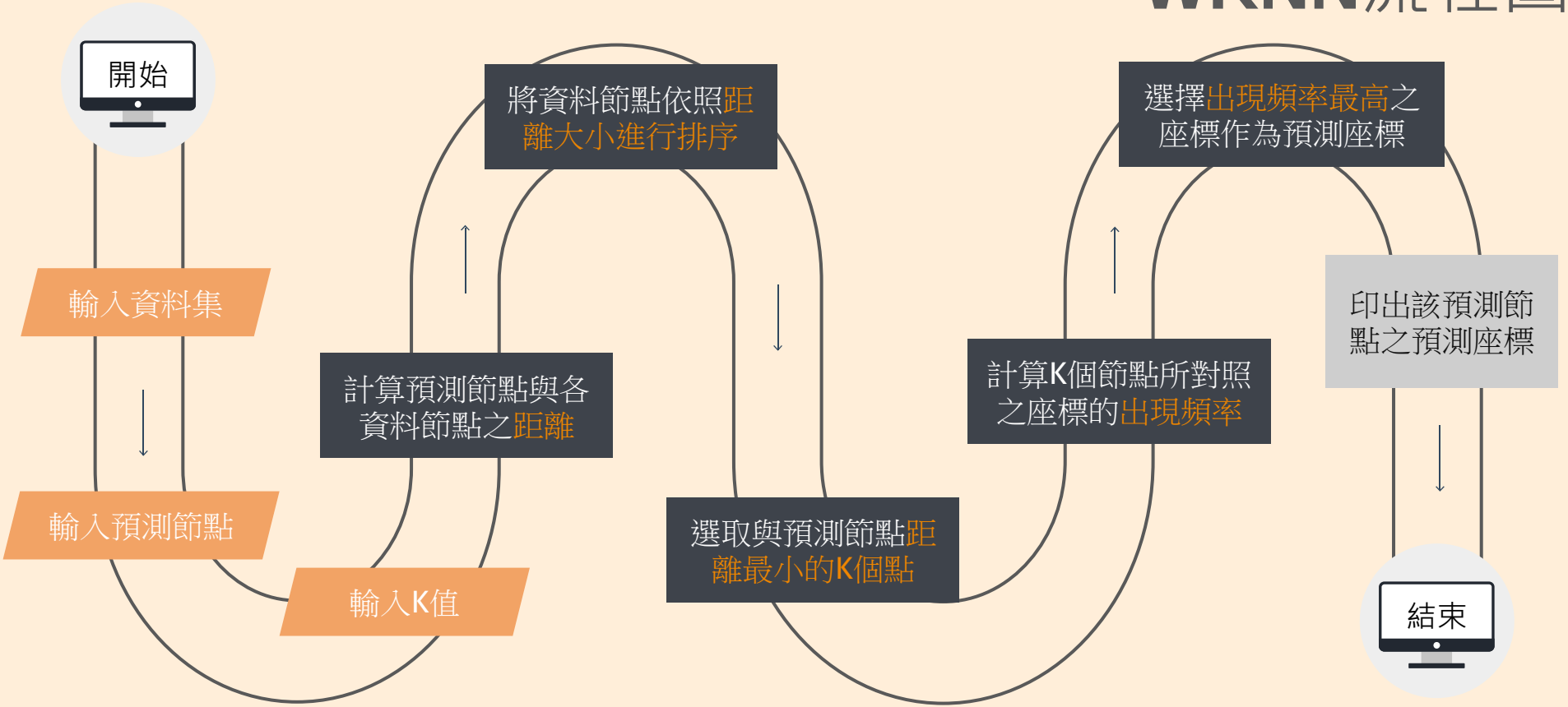
iBeacon室內定位



id	RSSI_A	RSSI_B	RSSI_C	RSSI_D	RSSI_E	RSSI_F	RSSI_G	RSSI_H	RSSI_I
1	-52	-79	-99	-78	-78	-76	-99	-85	-66
2	-99	-79	-76	-99	-65	-76	-73	-88	-99
3	-52	-66	-99	-68	-81	-76	-91	-83	-92
4	-54	-77	-61	-99	-72	-71	-81	-87	-99
5	-53	-78	-99	-77	-76	-83	-73	-99	-90
6	-53	-79	-96	-78	-82	-70	-99	-82	-99
7	-99	-79	-73	-78	-81	-76	-99	-84	-99
8	-99	-81	-76	-79	-68	-76	-89	-83	-81
9	-54	-78	-76	-80	-69	-61	-99	-88	-89
10	-35	-77	-99	-99	-81	-76	-99	-71	-99
11	-52	-77	-87	-78	-80	-77	-80	-82	-90

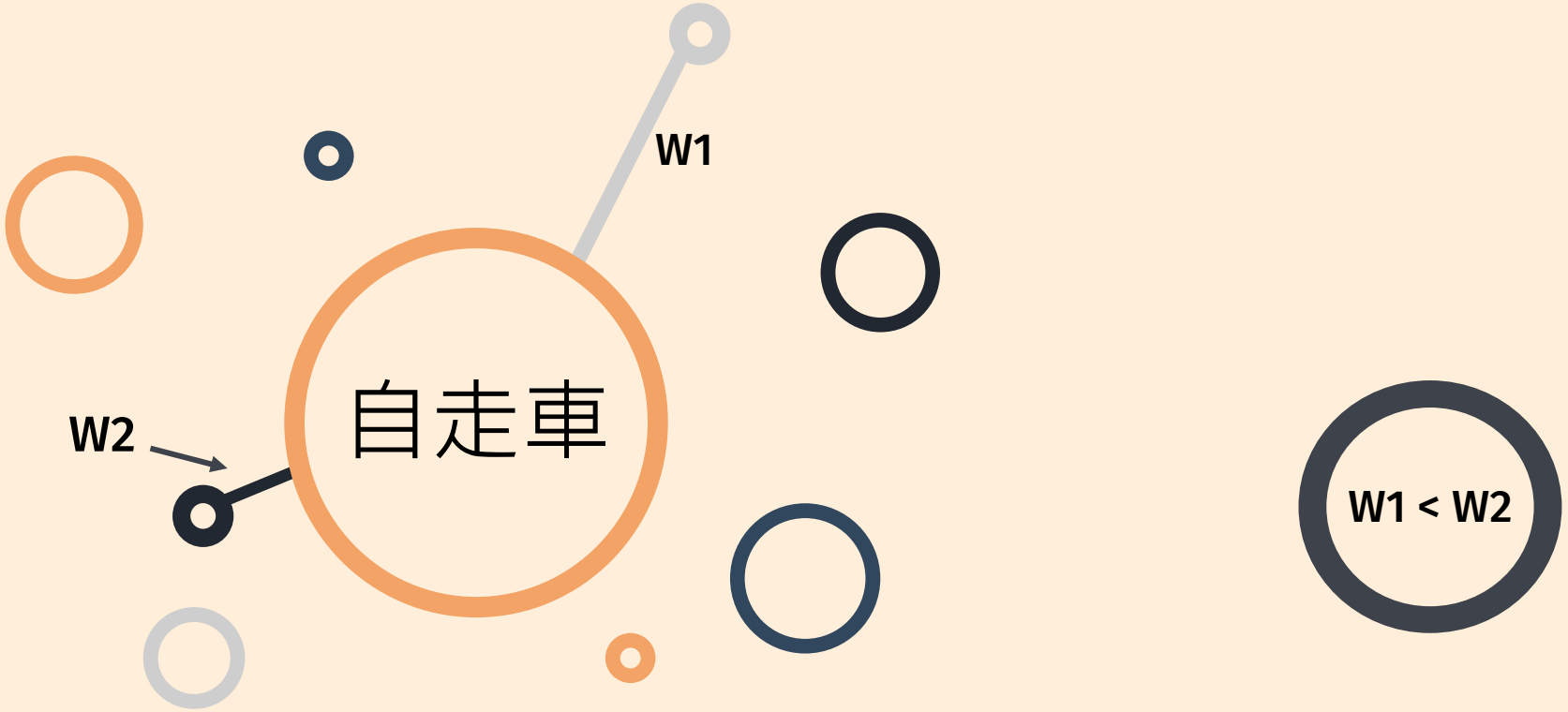
(三)利用機器學習建立iBeacon室內定位系統

WKNN流程圖



(三)利用機器學習建立iBeacon室內定位系統

運行WKNN



(三)利用機器學習建立iBeacon室內定位系統

實驗精確度的結果

ID	First in group	Second in group	Training dataset	Test dataset	K value	Accuracy
1	(13,24)	(3,6)	1080	120	6	94.2%
2	(13,3)	(13,24)	1080	120	6	96.7%
3	(8,24)	(8,6)	1080	120	6	87.5%
4	(13,24)	(8,24)	1080	120	6	92.5%
5	(13,3)	(18,8)	1080	120	6	94.2%
6	(13,24)	(3,19)	1080	120	6	93.3%
7	(8,6)	(18,8)	1080	120	6	92.5%
8	(8,3)	(13,3)	1080	120	6	87.5%
9	(8,19)	(13,3)	1080	120	6	90.8%
10	(13,24)	(8,3)	1080	120	6	93.3%

平均正確率：
92.25%

(四)結合電腦視覺及PID演算法建立道路循線系統

影像處理

HSV
轉換

高斯
模糊

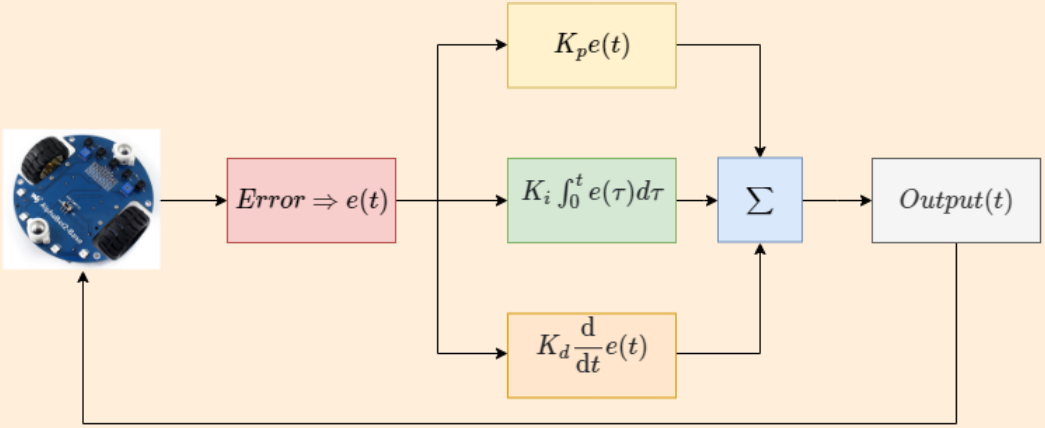
二值化

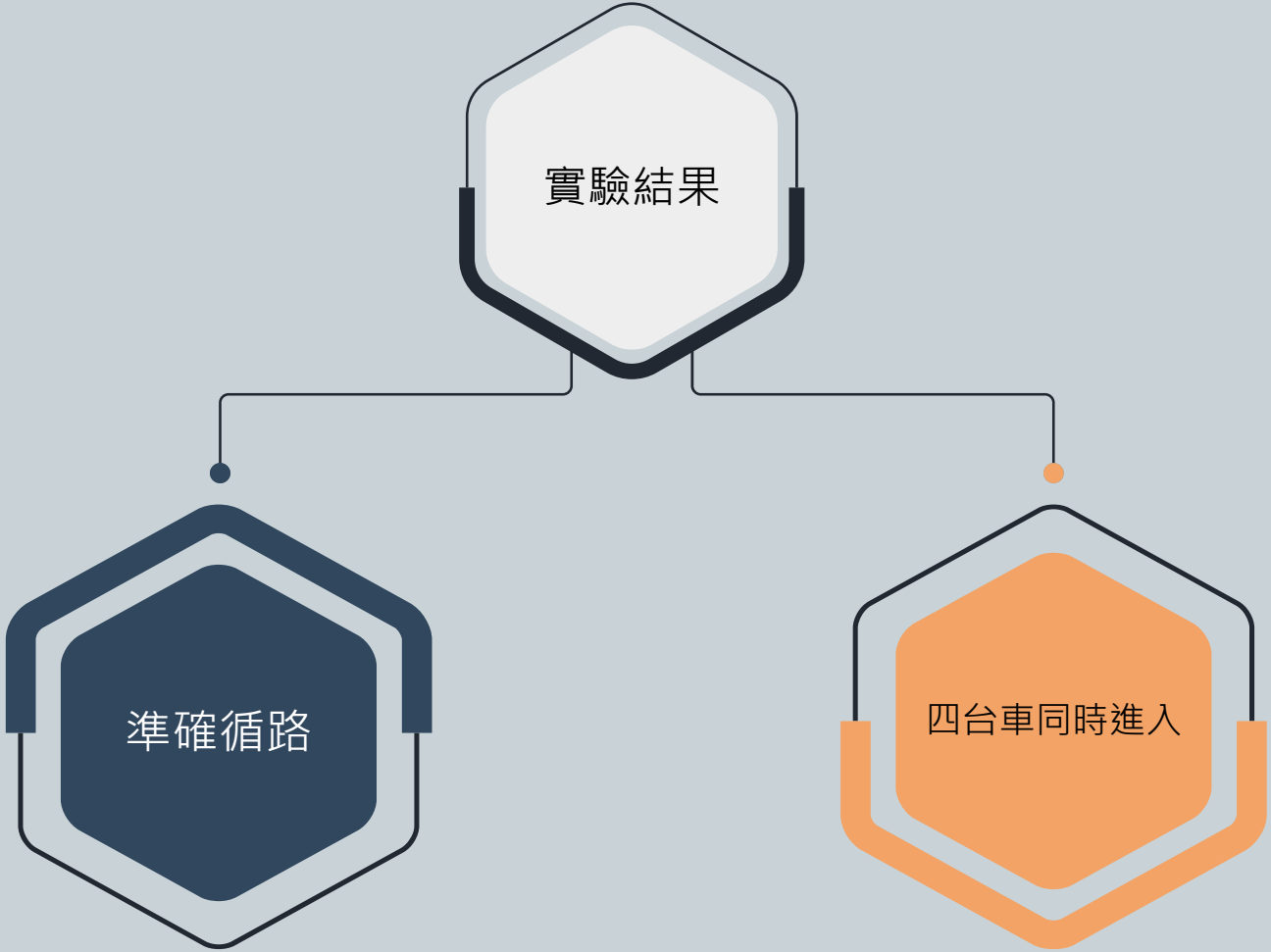
影像
膨脹

(四)結合電腦視覺及PID演算法建立道路循線系統

PID演算法

$$\text{Outout}(t) = K_p e(t) + K_i \int_0^t e(\tau)d\tau + K_d \frac{d}{dt} e(t)$$

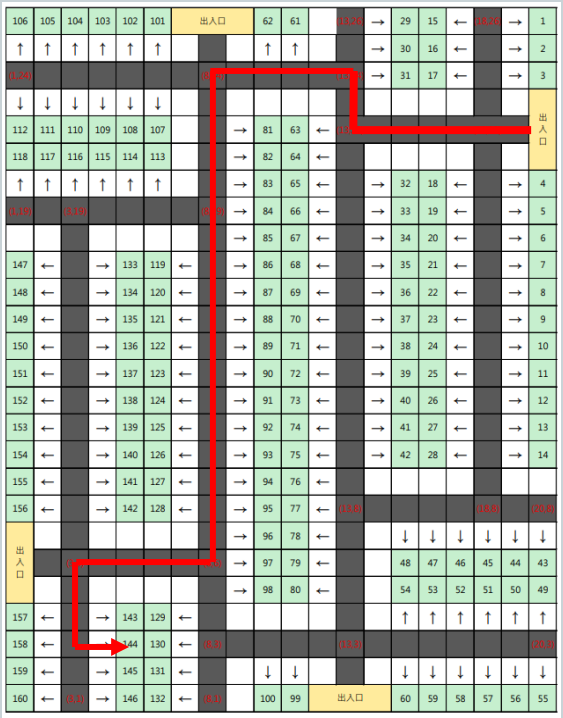


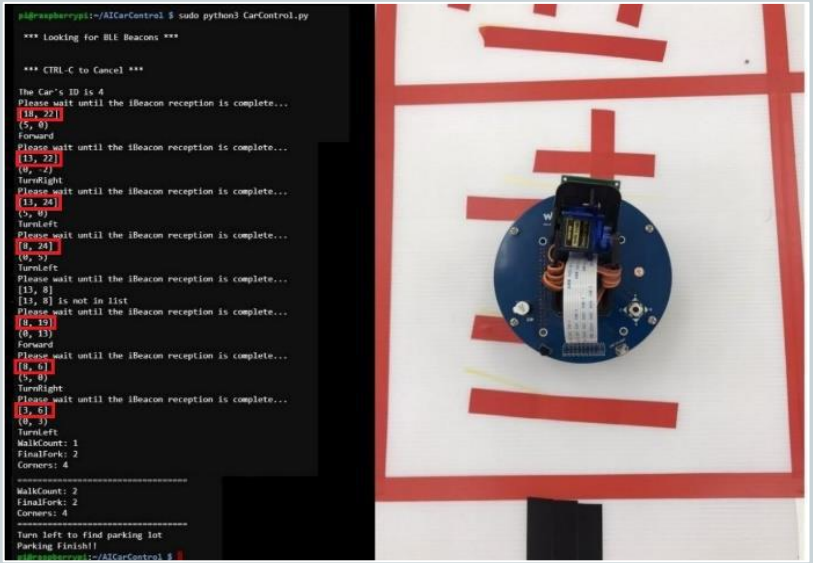

實驗結果
準確循路
四台車同時進入

實驗結果

準確循路

id	Car	Space	Route	Direction	FinalFork
4	Car4: (18,22)	Space: No.144 (3,3)	(18,22),(13,22),(13,24),(8,24),(8,19),(8,6),(3,6),(3,3)	E	2

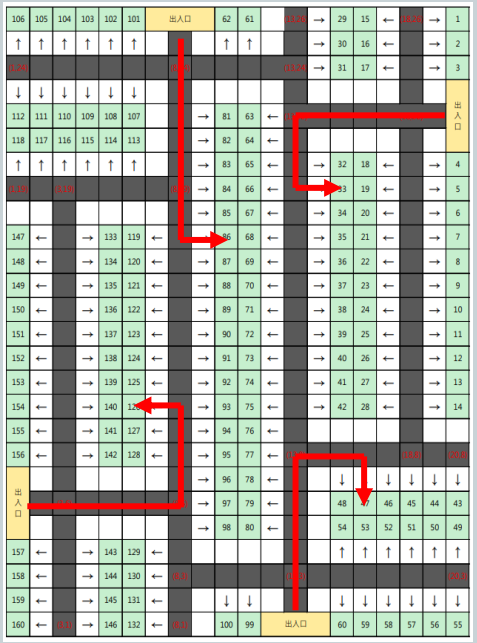




實驗結果

四台車同時進入

id	Car	Space	Route	Direction	FinalFork
1	Car1: (13,3)	Space: No.47 (16,8)	(13,3),(13,8),(16,8)	S	2
2	Car2: (3,6)	Space: No.126 (8,10)	(3,6),(8,6),(8,10)	W	3
3	Car3: (8,24)	Space: No.86 (8,17)	(8,24),(8,19),(8,17)	E	2
4	Car4: (18,22)	Space: No.33 (13,19)	(18,22),(13,22),(13,19)	E	2

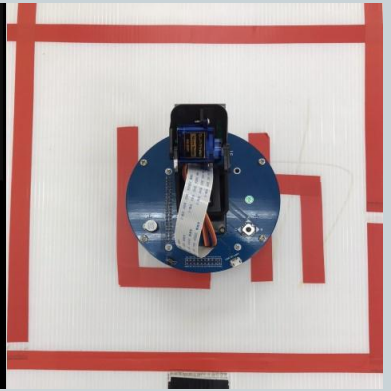



```
pi@raspberrypi:~/AICarControl $ sudo python3 CarControl.py

 *** Looking for BLE Beacons ***


 *** CTRL-C to Cancel ***

The Car's ID is 1
Please wait until the iBeacon reception is complete...
[13, 3]
(0, -5)
Forward
Please wait until the iBeacon reception is complete...
[13, 8]
(-3, 0)
TurnRight
WalkCount: 1
FinalFork: 2
Corners: 4
==================================
WalkCount: 2
FinalFork: 2
Corners: 4
==================================
Turn right to find parking lot
Parking Finish!!
pi@raspberrypi:~/AICarControl $
```

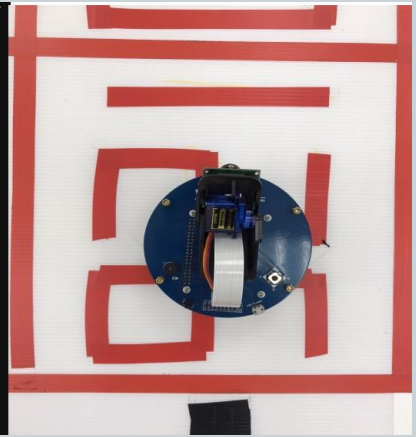


```
pi@raspberrypi:~/AICarControl $ sudo python3 CarControl.py

 *** Looking for BLE Beacons ***


 *** CTRL-C to Cancel ***

The Car's ID is 2
Please wait until the iBeacon reception is complete...
[3, 6]
(-5, 0)
Forward
Please wait until the iBeacon reception is complete...
[8, 6]
(0, -4)
TurnLeft
WalkCount: 1
FinalFork: 3
Corners: 4
==================================
WalkCount: 2
FinalFork: 3
Corners: 4
==================================
WalkCount: 3
FinalFork: 3
Corners: 4
==================================
Turn left to find parking lot
Parking Finish!!
pi@raspberrypi:~/AICarControl $
```



結論

1. 成本低
2. 提升室內定位精準度
3. 最小成本的分配及路線
4. 可移植性