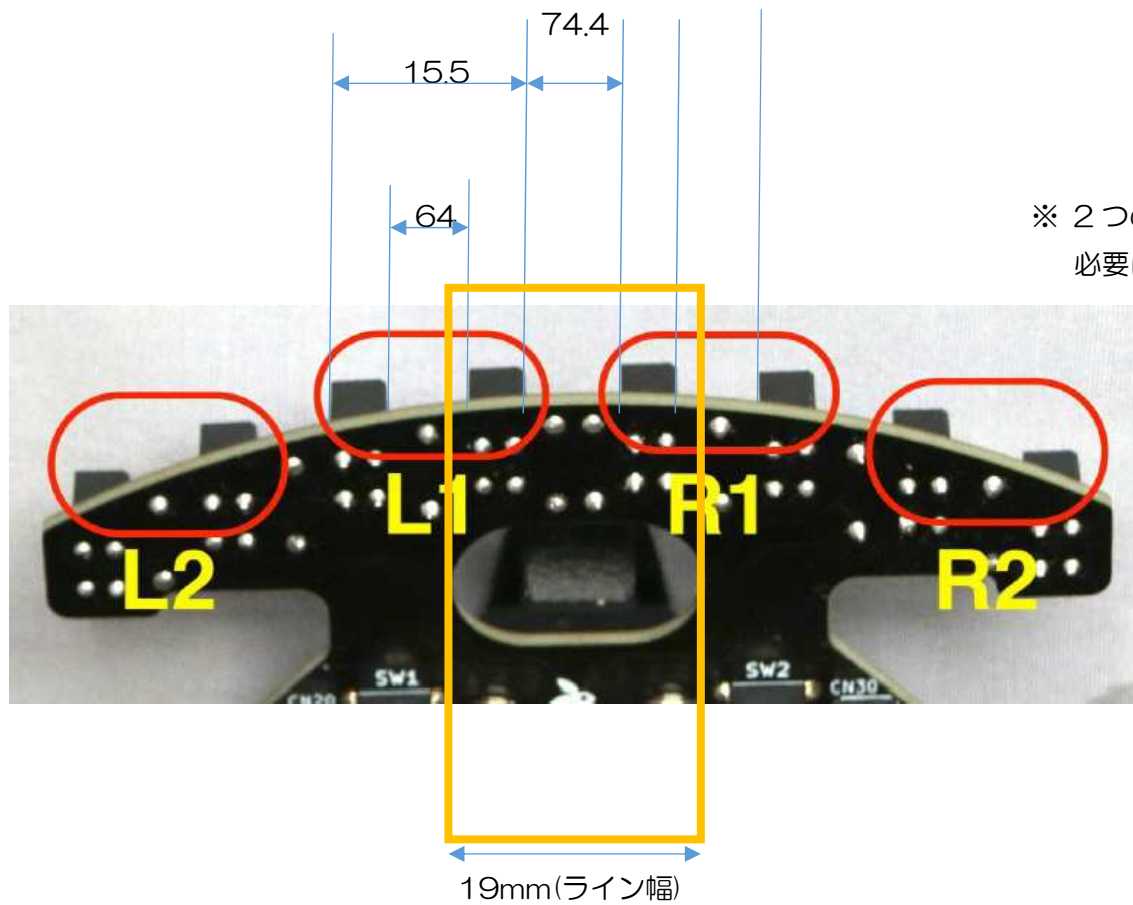


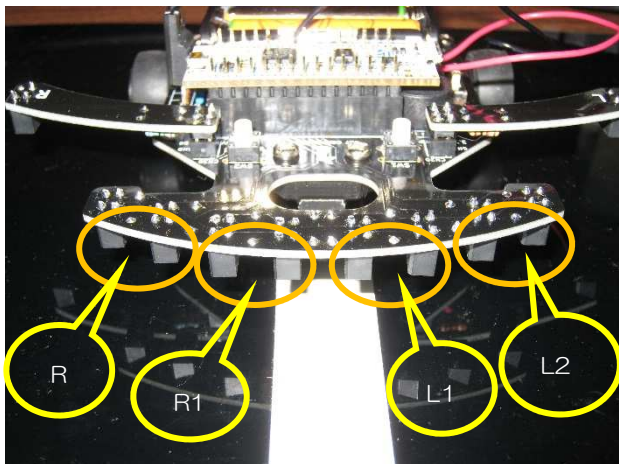
復習「センサーについてしっかり理解しよう」

1. センサ形状



※ 2つのセンサで1つのセンサ値を取得している。
必要に応じて寸法を測って下さい。

2. センサーの値を見て考察する。(典型的なパターンについて)



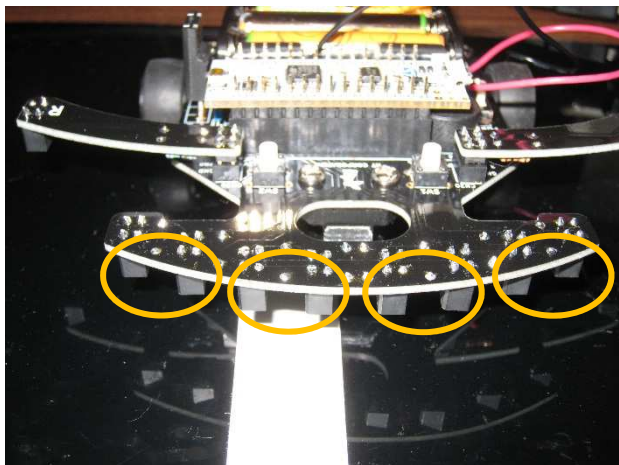
```
COM4
LL2=86 LL1=303 LR1=327 LR2=82 inside_offset=-22 outside_offset=4 ML=9 MR=10
LL2=86 LL1=304 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=10 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=304 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=10 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=10 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=10 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=6 ML=9 MR=10
```

自動スクロール タイムスタンプを表示

読み取れる値は
 LL2: 86
 LL1: 303
 LR1: 326
 LR2: 81

確認 床(黒)の上では小さい値、白線上では大きい値が得られる。

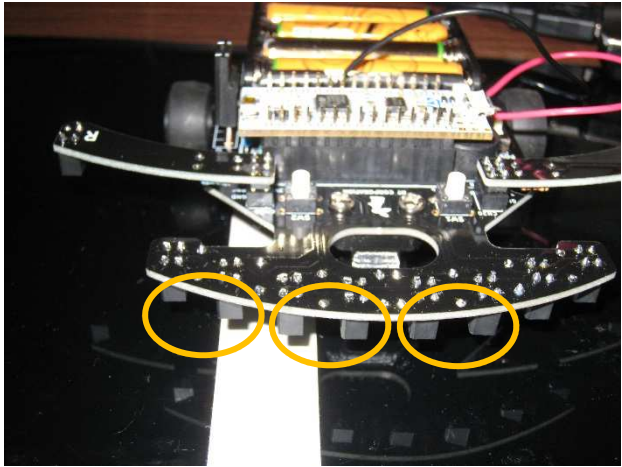
inside_offset,outside_offset とは? $LL1-LR1=303-326=-23$, $LL2-LR2=86-81=5$ (表示と同じ)



```
COM4
LL2=84 LL1=113 LR1=603 LR2=89 inside_offset=-490 outside_offset=-5 ML=10 MR=11
LL2=84 LL1=113 LR1=603 LR2=89 inside_offset=-489 outside_offset=-4 ML=11 MR=11
LL2=84 LL1=112 LR1=602 LR2=89 inside_offset=-489 outside_offset=-4 ML=11 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-489 outside_offset=-4 ML=10 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-489 outside_offset=-5 ML=10 MR=11
LL2=84 LL1=112 LR1=602 LR2=89 inside_offset=-488 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-490 outside_offset=-5 ML=10 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-489 outside_offset=-5 ML=10 MR=11
LL2=84 LL1=112 LR1=602 LR2=89 inside_offset=-488 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=601 LR2=89 inside_offset=-488 outside_offset=-4 ML=10 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-489 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=602 LR2=89 inside_offset=-488 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=113 LR1=601 LR2=89 inside_offset=-488 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=600 LR2=89 inside_offset=-489 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=601 LR2=89 inside_offset=-490 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=601 LR2=89 inside_offset=-489 outside_offset=-5 ML=10 MR=11
```

自動スクロール タイムスタンプを表示

読み取れる値は
 LL2: 84
 LL1: 112
 LR1: 602
 LR2: 89



COM4

```

LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-289 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-193 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=10 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=113 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=113 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-289 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=113 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=113 LR1=402 LR2=287 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=287 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=401 LR2=287 inside_offset=-288 outside_offset=-193 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=287 inside_offset=-288 outside_offset=-193 ML=10 MR=11
LL2=94 LL1=114 LR1=402 LR2=287 inside_offset=-288 outside_offset=-193 ML=9 MR=11

```

読み取れる値は

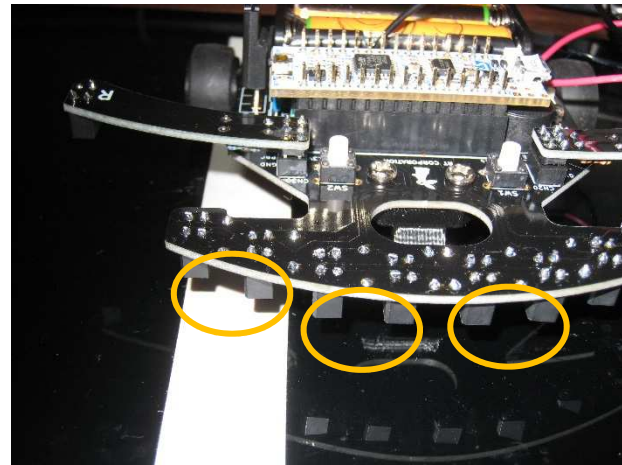
LL2: 94

LL1: 114

LR1: 402

LR2: 286

自動スクロール タイムスタンプを表示



COM4

```

LL2=98 LL1=121 LR1=149 LR2=585 inside_offset=-28 outside_offset=-486 ML=11 MR=12
LL2=97 LL1=121 LR1=150 LR2=584 inside_offset=-28 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=149 LR2=584 inside_offset=-28 outside_offset=-486 ML=10 MR=11
LL2=98 LL1=121 LR1=150 LR2=585 inside_offset=-28 outside_offset=-487 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=584 inside_offset=-29 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=585 inside_offset=-29 outside_offset=-486 ML=11 MR=12
LL2=98 LL1=121 LR1=150 LR2=585 inside_offset=-29 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=586 inside_offset=-28 outside_offset=-487 ML=11 MR=12
LL2=98 LL1=121 LR1=150 LR2=584 inside_offset=-28 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=149 LR2=584 inside_offset=-28 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=584 inside_offset=-29 outside_offset=-487 ML=11 MR=11
LL2=98 LL1=121 LR1=149 LR2=584 inside_offset=-28 outside_offset=-486 ML=11 MR=12
LL2=98 LL1=121 LR1=149 LR2=584 inside_offset=-29 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=585 inside_offset=-29 outside_offset=-487 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=585 inside_offset=-29 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=149 LR2=583 inside_offset=-29 outside_offset=-486 ML=11 MR=12

```

読み取れる値は

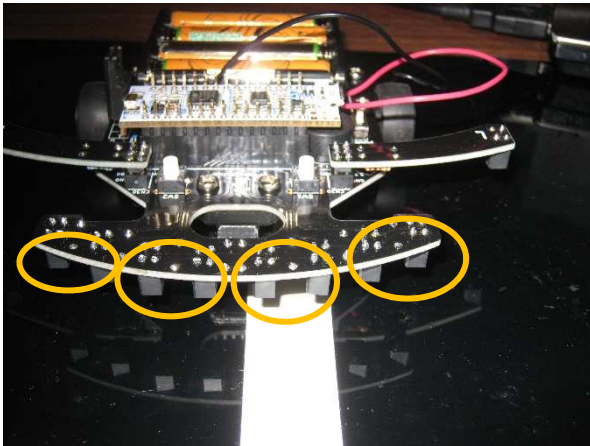
LL2: 98

LL1: 121

LR1: 150

LR2: 585

自動スクロール タイムスタンプを表示



```
COM4
LL2=92 LL1=536 LR1=114 LR2=82 inside_offset=422 outside_offset=11 ML=9 MR=9
LL2=93 LL1=535 LR1=114 LR2=82 inside_offset=423 outside_offset=10 ML=9 MR=9
LL2=92 LL1=535 LR1=114 LR2=82 inside_offset=421 outside_offset=11 ML=8 MR=8
LL2=92 LL1=535 LR1=114 LR2=82 inside_offset=421 outside_offset=11 ML=9 MR=8
LL2=92 LL1=536 LR1=114 LR2=83 inside_offset=422 outside_offset=9 ML=9 MR=8
LL2=92 LL1=537 LR1=113 LR2=83 inside_offset=424 outside_offset=10 ML=9 MR=9
LL2=92 LL1=538 LR1=113 LR2=84 inside_offset=425 outside_offset=9 ML=9 MR=9
LL2=93 LL1=538 LR1=113 LR2=84 inside_offset=425 outside_offset=9 ML=9 MR=9
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=426 outside_offset=9 ML=9 MR=8
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=427 outside_offset=9 ML=9 MR=9
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=427 outside_offset=9 ML=8 MR=8
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=427 outside_offset=9 ML=9 MR=8
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=427 outside_offset=9 ML=9 MR=8
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=427 outside_offset=9 ML=9 MR=8
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=427 outside_offset=9 ML=9 MR=8
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=427 outside_offset=9 ML=9 MR=8
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=427 outside_offset=9 ML=9 MR=8
LL2=93 LL1=540 LR1=113 LR2=84 inside_offset=427 outside_offset=9 ML=9 MR=8
```

自動スクロール タイムスタンプを表示

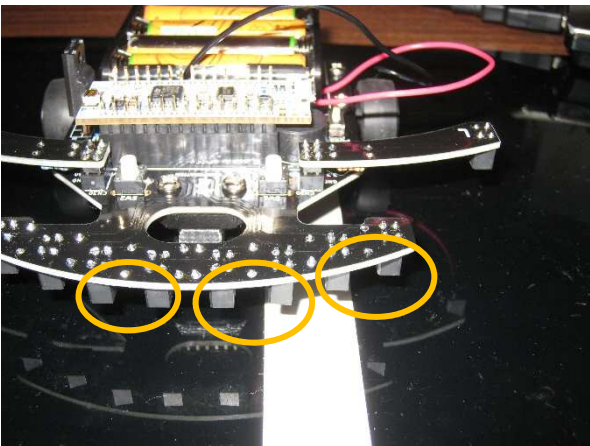
読み取れる値は

LL2: 93

LL1: 540

LR1: 113

Lr2: 84



```
COM4
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=7
LL2=308 LL1=383 LR1=119 LR2=84 inside_offset=262 outside_offset=223 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=225 ML=8 MR=7
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=307 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=223 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=223 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=263 outside_offset=224 ML=8 MR=7
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=223 ML=8 MR=7
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=223 ML=8 MR=7
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=263 outside_offset=224 ML=8 MR=7
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=308 LL1=383 LR1=120 LR2=84 inside_offset=263 outside_offset=224 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=8 MR=8
```

自動スクロール タイムスタンプを表示

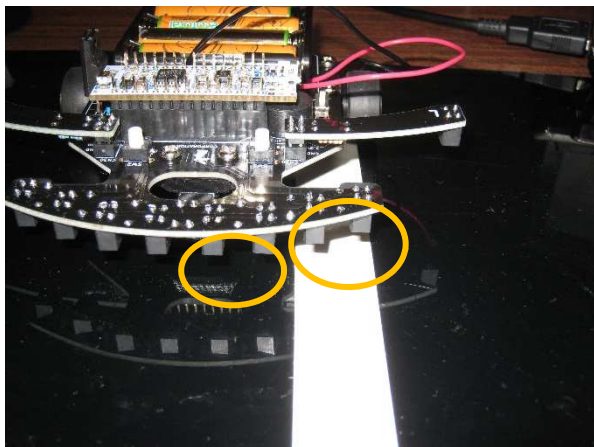
読み取れる値は

LL2: 308

LL1: 382

LR1: 120

LR2: 84



COM4

```
LL2=570 LL1=132 LR1=120 LR2=87 inside_offset=13 outside_offset=481 ML=9 MR=5
LL2=570 LL1=132 LR1=120 LR2=87 inside_offset=12 outside_offset=483 ML=8 MR=5
LL2=569 LL1=132 LR1=120 LR2=86 inside_offset=12 outside_offset=483 ML=8 MR=6
LL2=568 LL1=132 LR1=120 LR2=85 inside_offset=12 outside_offset=484 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=84 inside_offset=11 outside_offset=483 ML=8 MR=6
LL2=566 LL1=132 LR1=120 LR2=84 inside_offset=12 outside_offset=484 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=84 inside_offset=11 outside_offset=484 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=84 inside_offset=12 outside_offset=484 ML=8 MR=7
LL2=567 LL1=131 LR1=120 LR2=84 inside_offset=11 outside_offset=483 ML=8 MR=7
LL2=567 LL1=132 LR1=120 LR2=84 inside_offset=11 outside_offset=484 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=83 inside_offset=12 outside_offset=483 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=83 inside_offset=11 outside_offset=483 ML=8 MR=6
LL2=567 LL1=131 LR1=120 LR2=83 inside_offset=11 outside_offset=483 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=83 inside_offset=12 outside_offset=483 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=83 inside_offset=11 outside_offset=484 ML=8 MR=7
LL2=567 LL1=131 LR1=120 LR2=84 inside_offset=11 outside_offset=484 ML=8 MR=6
```

自動スクロール タイムスタンプを表示

読み取れる値は

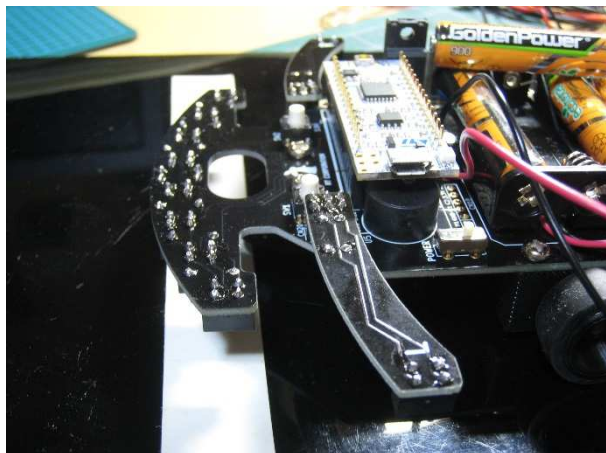
LL2: 570

LL1: 131

LR1: 120

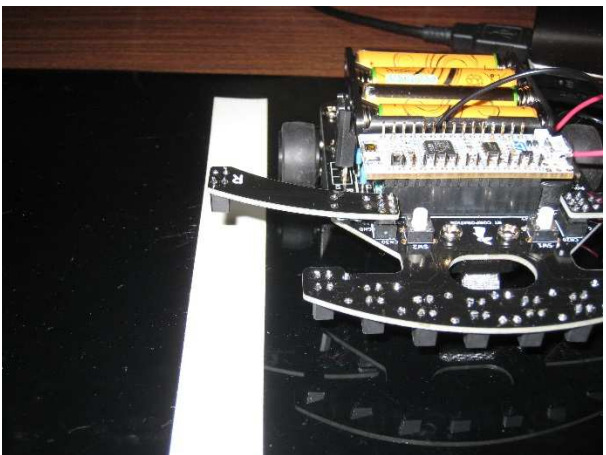
LR2: 84

交差点の識別



4つのセンサいずれも大きい値

スタート・ゴールマーカ識別



COM4

```

LL2=672 LL1=652 LR1=729 LR2=643 inside_offset=-78 outside_offset=29 ML=11 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-78 outside_offset=27 ML=10 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-78 outside_offset=28 ML=11 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-78 outside_offset=28 ML=10 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-78 outside_offset=28 ML=11 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-78 outside_offset=28 ML=10 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-78 outside_offset=28 ML=11 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-78 outside_offset=28 ML=10 MR=7
LL2=672 LL1=652 LR1=729 LR2=644 inside_offset=-78 outside_offset=28 ML=11 MR=7
LL2=672 LL1=652 LR1=730 LR2=645 inside_offset=-77 outside_offset=28 ML=10 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-77 outside_offset=29 ML=11 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-78 outside_offset=28 ML=10 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-77 outside_offset=28 ML=10 MR=7
LL2=672 LL1=652 LR1=730 LR2=644 inside_offset=-78 outside_offset=28 ML=10 MR=7

```

自動スクロール タイムスタンプを表示

読み取れる値は

LL2: 672

LL1: 652

LR1: 730

LR2: 644

COM4

```

LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=9 MR=78
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=8 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=8 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=8 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=9 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=8 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=8 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=5 ML=8 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=8 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=9 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=8 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=8 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=9 MR=79
LL2=84 LL1=100 LR1=113 LR2=78 inside_offset=-12 outside_offset=6 ML=9 MR=79
LL2=84 LL1=100 LR1=112 LR2=78 inside_offset=-12 outside_offset=6 ML=8 MR=79

```

自動スクロール タイムスタンプを表示

読み取れる値

LL2: 84

LL1: 100

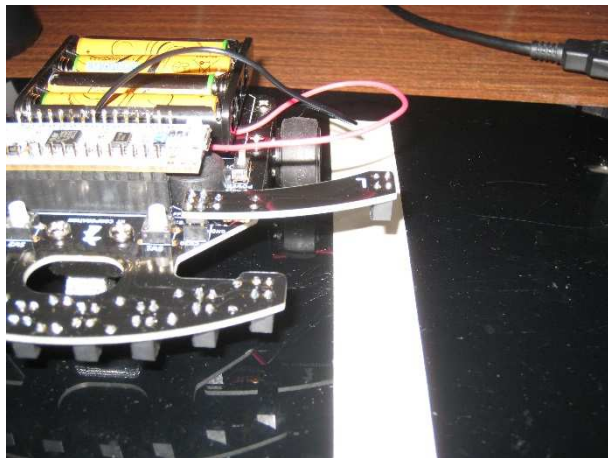
LR1: 112

LR2: 78

ML: 8

MR: 79

コーナーマーカ識別



COM4

```
LL2=94 LL1=103 LR1=110 LR2=84 inside_offset=-7 outside_offset=10 ML=114 MR=7
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-7 outside_offset=9 ML=114 MR=7
LL2=94 LL1=103 LR1=110 LR2=84 inside_offset=-7 outside_offset=10 ML=115 MR=6
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-7 outside_offset=9 ML=114 MR=7
LL2=94 LL1=104 LR1=110 LR2=85 inside_offset=-7 outside_offset=9 ML=114 MR=6
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-6 outside_offset=9 ML=115 MR=6
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-7 outside_offset=9 ML=114 MR=6
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-7 outside_offset=10 ML=114 MR=6
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-7 outside_offset=9 ML=114 MR=7
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-7 outside_offset=9 ML=115 MR=7
LL2=94 LL1=104 LR1=110 LR2=85 inside_offset=-6 outside_offset=9 ML=114 MR=7
LL2=94 LL1=103 LR1=110 LR2=84 inside_offset=-6 outside_offset=10 ML=114 MR=6
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-6 outside_offset=9 ML=114 MR=6
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-7 outside_offset=10 ML=115 MR=6
LL2=94 LL1=103 LR1=110 LR2=85 inside_offset=-7 outside_offset=9 ML=114 MR=6
LL2=94 LL1=104 LR1=110 LR2=85 inside_offset=-7 outside_offset=9 ML=115 MR=6
```

自動スクロール タイムスタンプを表示

読み取れる値

LL2: 94

LL1: 103

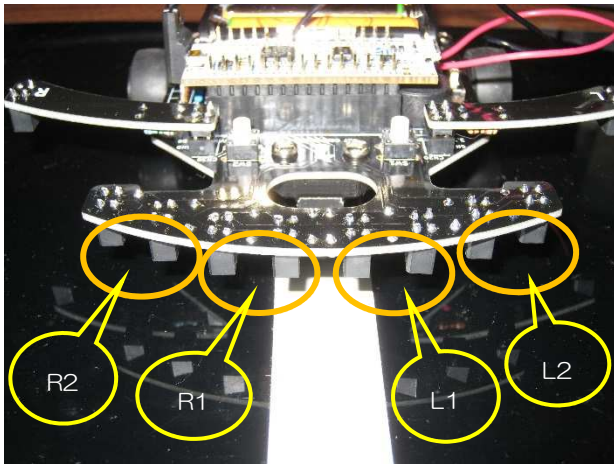
LR1: 110

LR2: 85

ML: 114

MR: 6

3.フィードバック制御(P制御)を理解する



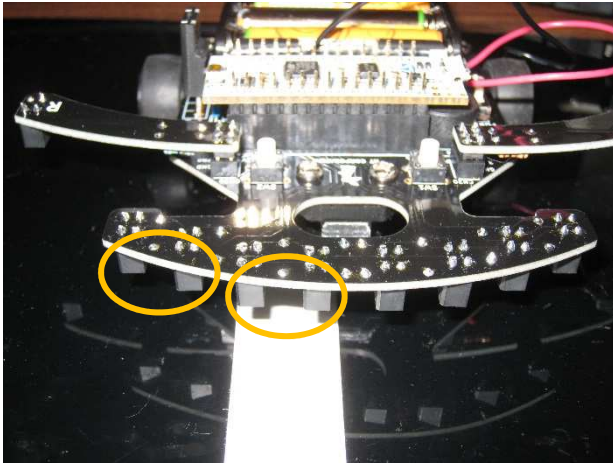
```
COM4
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-22 outside_offset=4 ML=9 MR=10
LL2=86 LL1=304 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=10 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=304 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=10 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=10 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=10 MR=10
LL2=86 LL1=302 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=9
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=10 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-24 outside_offset=5 ML=10 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=5 ML=9 MR=10
LL2=86 LL1=303 LR1=326 LR2=81 inside_offset=-23 outside_offset=6 ML=9 MR=10
自動スクロール タイムスタンプを表示
```

LL2: 86
LL1: 303
LR1: 326
 LR2: 81

正常データから inside_offset= 303-326=-23, outside_offset=86-81=5 とする

//ラインセンサの値から制御量を算出する

$$\begin{aligned} \text{Line_Controll} &= (\text{analogRead}(\text{LINE_L1_Pin}) - \text{analogRead}(\text{LINE_R1_Pin}) - \text{inside_offset}) \\ &\quad 303 \quad - \quad 326 \quad - \quad (-23) \\ &+ 2 * (\text{analogRead}(\text{LINE_L2_Pin}) - \text{analogRead}(\text{LINE_R2_Pin}) - \text{outside_offset}) \\ &+ 2 * (\quad 86 \quad - \quad 81 \quad - \quad 5 \quad) \\ \text{Line_controll} &= 303 - 326 - (-23) + 2 * (86 - 81 - 5) = -23 + 23 + 2 * 0 = 0 \\ \text{PWM_L_Value} &= 80 - \text{Line_signed} * \text{Line_Controll} / 10 = 80 - 1 * 0 / 10 = 80 \\ \text{PWM_R_Value} &= 80 + \text{Line_signed} * \text{Line_Controll} / 10 = 80 + 1 * 0 / 10 = 80 \end{aligned}$$



```

COM4
LL2=84 LL1=113 LR1=603 LR2=89 inside_offset=-490 outside_offset=-5 ML=10 MR=11
LL2=84 LL1=113 LR1=603 LR2=89 inside_offset=-489 outside_offset=-4 ML=11 MR=11
LL2=84 LL1=112 LR1=602 LR2=89 inside_offset=-489 outside_offset=-4 ML=11 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-489 outside_offset=-4 ML=10 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-489 outside_offset=-5 ML=10 MR=11
LL2=84 LL1=112 LR1=602 LR2=89 inside_offset=-488 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-490 outside_offset=-5 ML=10 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-489 outside_offset=-5 ML=10 MR=11
LL2=84 LL1=112 LR1=602 LR2=89 inside_offset=-488 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=601 LR2=89 inside_offset=-488 outside_offset=-4 ML=10 MR=11
LL2=84 LL1=113 LR1=602 LR2=89 inside_offset=-489 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=602 LR2=89 inside_offset=-488 outside_offset=-4 ML=11 MR=11
LL2=84 LL1=113 LR1=601 LR2=89 inside_offset=-488 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=600 LR2=89 inside_offset=-489 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=601 LR2=89 inside_offset=-490 outside_offset=-5 ML=11 MR=11
LL2=84 LL1=112 LR1=601 LR2=89 inside_offset=-489 outside_offset=-5 ML=10 MR=11

```

自動スクロール タイムスタンプを表示

読み取れる値は

LL2: 84

LL1: 112

LR1: 602

LR2: 89

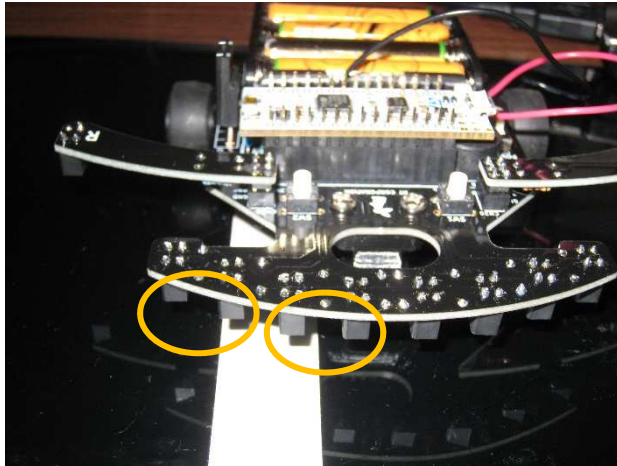
//ラインセンサの値から制御量を算出する

$$\text{Line_Control} = (\text{analogRead}(\text{LINE_L1_Pin}) - \text{analogRead}(\text{LINE_R1_Pin}) - \text{inside_offset}) + 2 * (\text{analogRead}(\text{LINE_L2_Pin}) - \text{analogRead}(\text{LINE_R2_Pin}) - \text{outside_offset});$$

$$\text{Line_control} = 112 - 602 - (-23) + 2 * (84 - 89 - 5) = -487$$

$$\text{PWM_L_Value} = 80 - \text{Line_signed} * \text{Line_Control} / 10 = 128.7$$

$$\text{PWM_R_Value} = 80 + \text{Line_signed} * \text{Line_Control} / 10 = 31.3$$



COM4

```

LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-289 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-193 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=10 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=113 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-289 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=113 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=113 LR1=402 LR2=287 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=287 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=286 inside_offset=-288 outside_offset=-192 ML=9 MR=11
LL2=94 LL1=114 LR1=401 LR2=287 inside_offset=-288 outside_offset=-193 ML=9 MR=11
LL2=94 LL1=114 LR1=402 LR2=287 inside_offset=-288 outside_offset=-193 ML=10 MR=11
LL2=94 LL1=114 LR1=402 LR2=287 inside_offset=-288 outside_offset=-193 ML=9 MR=11

```

読み取れる値は

LL2: 94

LL1: 114

LR1: 402

LR2: 286

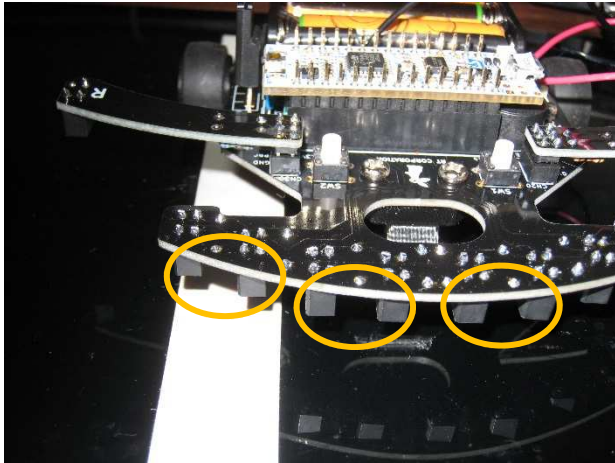
自動スクロール タイムスタンプを表示

//ラインセンサの値から制御量を算出する

$$\begin{aligned} \text{Line_Controll} &= (\text{analogRead}(\text{LINE_L1_Pin}) - \text{analogRead}(\text{LINE_R1_Pin}) - \text{inside_offset}) \\ &\quad + 2 * (\text{analogRead}(\text{LINE_L2_Pin}) - \text{analogRead}(\text{LINE_R2_Pin}) - \text{outside_offset}); \\ \text{Line_control} &= 114 - 402 - (-23) + 2 * (94 - 286 - 5) = -659 \end{aligned}$$

$$\text{PWM_L_Value} = 80 - \text{Line_signed} * \text{Line_Controll} / 10 = 145.9$$

$$\text{PWM_R_Value} = 80 + \text{Line_signed} * \text{Line_Controll} / 10 = 14.1$$



```
COM4
LL2=98 LL1=121 LR1=149 LR2=585 inside_offset=-28 outside_offset=-486 ML=11 MR=12
LL2=97 LL1=121 LR1=150 LR2=584 inside_offset=-28 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=149 LR2=584 inside_offset=-28 outside_offset=-486 ML=10 MR=11
LL2=98 LL1=121 LR1=150 LR2=585 inside_offset=-28 outside_offset=-487 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=584 inside_offset=-29 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=585 inside_offset=-29 outside_offset=-486 ML=11 MR=12
LL2=98 LL1=121 LR1=150 LR2=586 inside_offset=-28 outside_offset=-487 ML=11 MR=12
LL2=98 LL1=121 LR1=150 LR2=584 inside_offset=-28 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=149 LR2=584 inside_offset=-28 outside_offset=-486 ML=11 MR=12
LL2=98 LL1=121 LR1=150 LR2=584 inside_offset=-29 outside_offset=-487 ML=11 MR=11
LL2=98 LL1=121 LR1=149 LR2=584 inside_offset=-28 outside_offset=-486 ML=11 MR=12
LL2=98 LL1=121 LR1=149 LR2=584 inside_offset=-29 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=585 inside_offset=-29 outside_offset=-487 ML=11 MR=11
LL2=98 LL1=121 LR1=150 LR2=585 inside_offset=-29 outside_offset=-486 ML=11 MR=11
LL2=98 LL1=121 LR1=149 LR2=583 inside_offset=-29 outside_offset=-486 ML=11 MR=12
```

自動スクロール タイムスタンプを表示

読み取れる値は
 LL2: 98
 LL1: 121
 LR1: 150
 LR2: 585

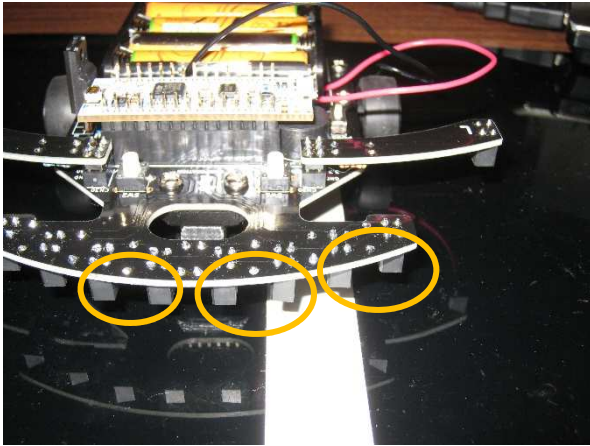
//ラインセンサの値から制御量を算出する

$$\text{Line_Controll} = (\text{analogRead}(\text{LINE_L1_Pin}) - \text{analogRead}(\text{LINE_R1_Pin}) - \text{inside_offset}) + 2 * (\text{analogRead}(\text{LINE_L2_Pin}) - \text{analogRead}(\text{LINE_R2_Pin}) - \text{outside_offset});$$

$$\text{Line_control} = 121 - 150 - (-23) + 2 * (98 - 585 - 5) = -990$$

$$\text{PWM_L_Value} = 80 - \text{Line_signed} * \text{Line_Controll} / 10 = 179$$

$$\text{PWM_R_Value} = 80 + \text{Line_signed} * \text{Line_Controll} / 10 = -19 \text{ (逆転 19)}$$



```
COM4
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=7
LL2=308 LL1=383 LR1=119 LR2=84 inside_offset=262 outside_offset=223 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=225 ML=8 MR=7
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=307 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=223 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=223 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=263 outside_offset=224 ML=8 MR=7
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=223 ML=8 MR=7
LL2=307 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=223 ML=8 MR=7
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=263 outside_offset=224 ML=8 MR=7
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=9 MR=8
LL2=308 LL1=383 LR1=120 LR2=84 inside_offset=263 outside_offset=224 ML=9 MR=8
LL2=308 LL1=382 LR1=120 LR2=84 inside_offset=262 outside_offset=224 ML=8 MR=8
```

自動スクロール タイムスタンプを表示

読み取れる値は

LL2: 308

LL1: 382

LR1: 120

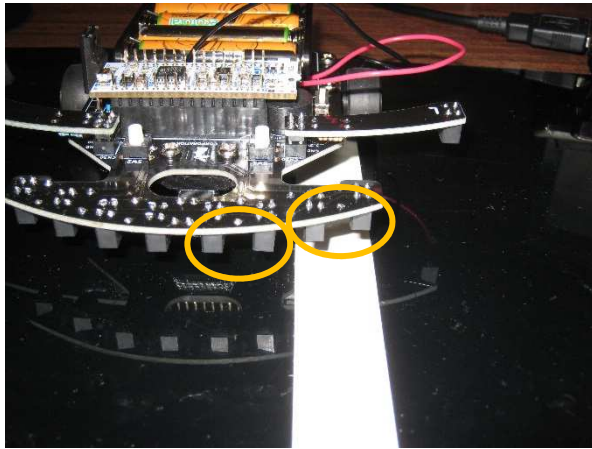
LR2: 84

//ラインセンサの値から制御量を算出する

$$\begin{aligned} \text{Line_Control} &= (\text{analogRead}(\text{LINE_L1_Pin}) - \text{analogRead}(\text{LINE_R1_Pin}) - \text{inside_offset}) \\ &\quad + 2 * (\text{analogRead}(\text{LINE_L2_Pin}) - \text{analogRead}(\text{LINE_R2_Pin}) - \text{outside_offset}); \\ \text{Line_control} &= 382 - 120 - (-23) + 2 * (308 - 84 - 5) = 881 \end{aligned}$$

$$\text{PWM_L_Value} = 80 - \text{Line_signed} * \text{Line_Control} / 10 = -8.1 \text{ (逆転 8.1)}$$

$$\text{PWM_R_Value} = 80 + \text{Line_signed} * \text{Line_Control} / 10 = 168.1$$



```
COM4
LL2=570 LL1=132 LR1=120 LR2=87 inside_offset=13 outside_offset=481 ML=9 MR=5
LL2=570 LL1=132 LR1=120 LR2=87 inside_offset=12 outside_offset=483 ML=8 MR=5
LL2=569 LL1=132 LR1=120 LR2=86 inside_offset=12 outside_offset=483 ML=8 MR=6
LL2=568 LL1=132 LR1=120 LR2=85 inside_offset=12 outside_offset=484 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=84 inside_offset=11 outside_offset=483 ML=8 MR=6
LL2=566 LL1=132 LR1=120 LR2=84 inside_offset=12 outside_offset=484 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=84 inside_offset=11 outside_offset=484 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=84 inside_offset=12 outside_offset=484 ML=8 MR=7
LL2=567 LL1=131 LR1=120 LR2=84 inside_offset=11 outside_offset=483 ML=8 MR=7
LL2=567 LL1=132 LR1=120 LR2=84 inside_offset=11 outside_offset=484 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=83 inside_offset=12 outside_offset=483 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=83 inside_offset=11 outside_offset=483 ML=8 MR=6
LL2=567 LL1=131 LR1=120 LR2=83 inside_offset=11 outside_offset=483 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=83 inside_offset=12 outside_offset=483 ML=8 MR=6
LL2=568 LL1=131 LR1=120 LR2=83 inside_offset=11 outside_offset=484 ML=8 MR=7
LL2=567 LL1=131 LR1=120 LR2=84 inside_offset=11 outside_offset=484 ML=8 MR=6
```

自動スクロール タイムスタンプを表示

読み取れる値は

LL2: 570

LL1: 131

LR1: 120

LR2: 84

//ラインセンサの値から制御量を算出する

```
Line_Control = (analogRead(LINE_L1_Pin) - analogRead(LINE_R1_Pin) - inside_offset)
               + 2 * (analogRead(LINE_L2_Pin) - analogRead(LINE_R2_Pin) - outside_offset);
```

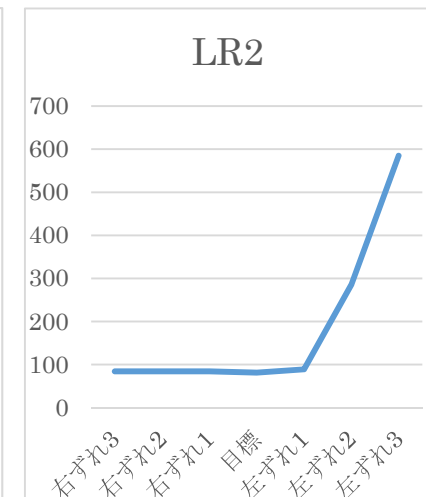
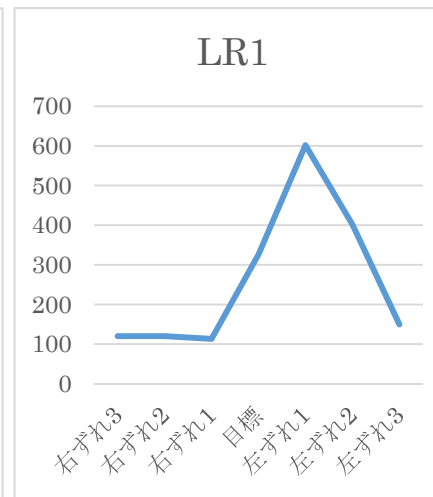
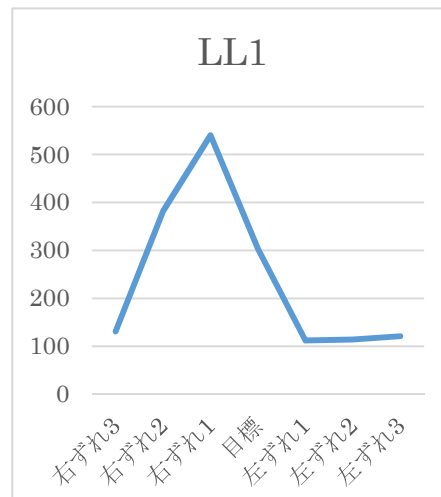
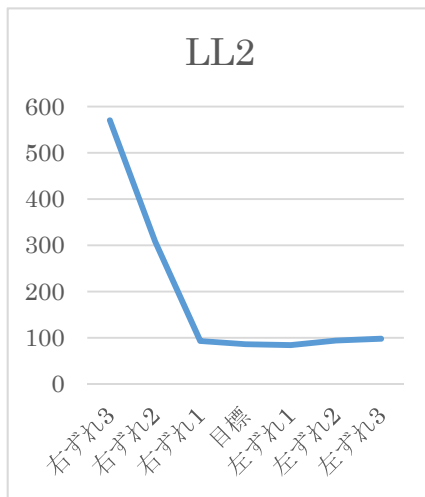
Line_control = 131 - 120 - (-23) + 2 * (570 - 84 - 5) = 996

PWM_L_Value = 80 - Line_signed * Line_Control / 10 = -19.6(逆転 19.6)

PWM_R_Value = 80 + Line_signed * Line_Control / 10 = 179.6

4.データのまとめ

	LL2	LL1	LR1	LR2
右ずれ3	570	131	120	84
右ずれ2	308	382	120	84
右ずれ1	93	540	113	84
目標	86	303	326	81
左ずれ1	84	112	602	89
左ずれ2	94	114	402	286
左ずれ3	98	121	150	585



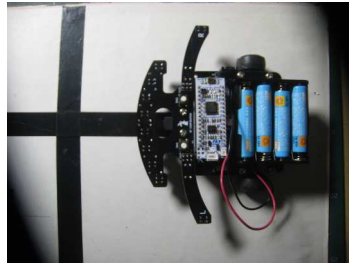
グラフから判断しても、センサ値の取得についてはますますであると判断できる。
同様に「白地に黒テープ」の場合も確認する必要がある。

5. 「交差点」と「ゴール区画に完全に入れる」処理の追加・修正

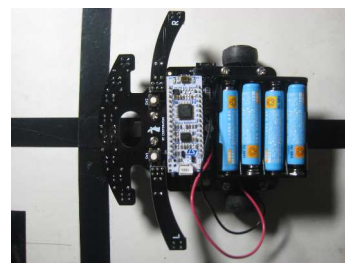
「ロボットレース大会出るレベル」確保

練習コースは「白地に黒テープ」なので、下の各場合のセンサー値を確認し、交差点(クロスライン)パス走行を確定して下さい。

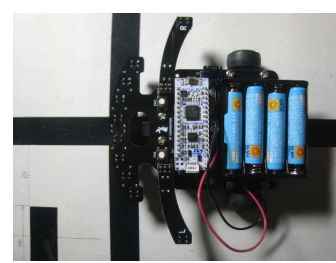
1



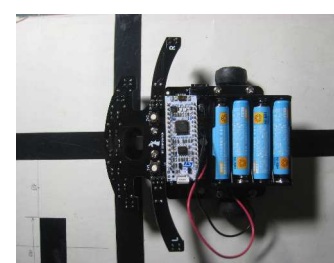
2



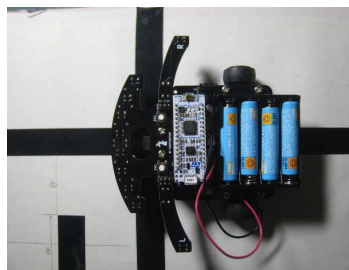
3



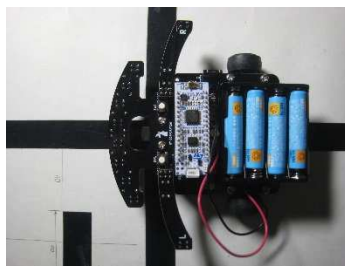
4



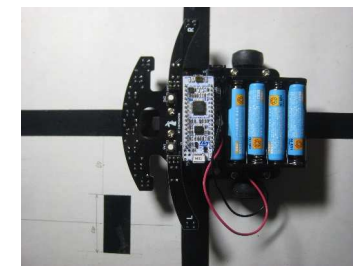
5



6



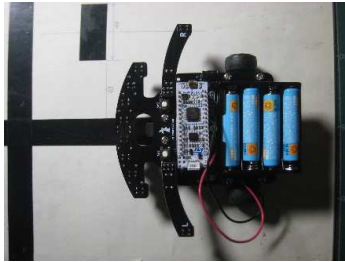
7



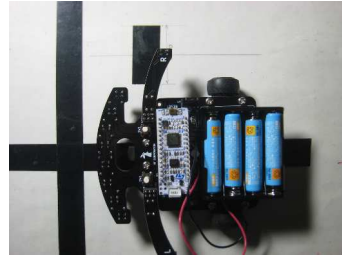
	1	2	3	4	5	6	7
LL2		726	260	81	260	685	685
LL1		360	397	150	397	451	349
LR1		507	481	156	481	592	663
LR2		693	163	93	163	656	671

サンプルプログラムでは 2 本目のマーカー通過後、ロボットは即停止します。ロボットレース競技ではスタート・ゴール区画にロボットを完全に入れ停止しなければなりません。マーカー認識, マーカー上走行そしてマーカーパスについてセンサ値がどうなっているか確認し、各自のプログラム修正をして下さい。

1



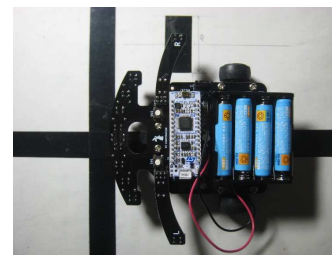
2



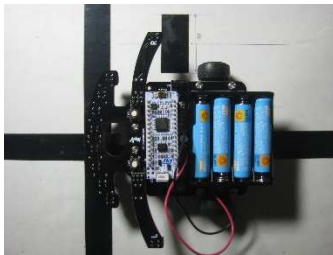
3



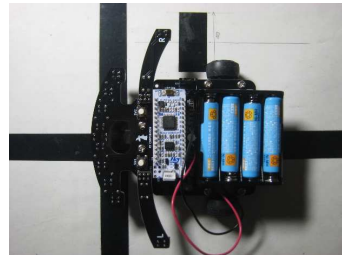
4



5



6



	1	2	3	4	5	6
MR	155	109	96	111	137	139

本番コース(黒地に白テープ)も同様にセンサ値を確認しよう。

本日で「とりあえず出場できるロボット」が完成しました。

ここからが本番です。四日目に続く