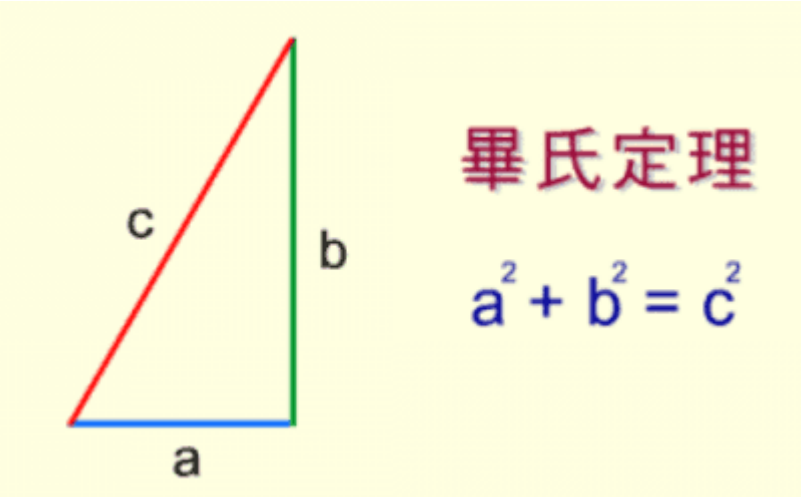
In homework 4 we implement PING, QTI, BBCar.

## (1) Implementation and Algorithm

For homework 4_1, we use PING and BBCar.

The main algorithm is that we Pythagorean theorem(畢氏定理).




Where we get distance of side B first, then try to find distance of side C. Since the object is a rectangular box, when we reach the corner of the box, it the measurement will rapidly drop since the ultrasound was not blocked by the object. Then we can get distance of side C. Then apply the theorem we can get distance of side a, which is half length of the box.

To do so, we use BBCar which will rotate and with one wheel move forward and the other move backward, which act like drawing a circle.

Then we can send the result through Xbee.

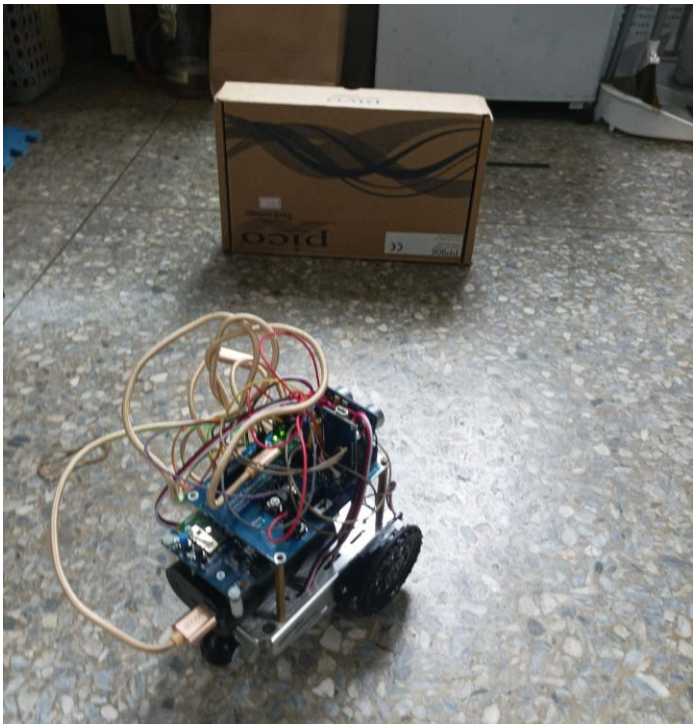
For homework 4_2, we use QTI and encoder.

The main task is to use QTI sensor to find the pattern (0b1111). The car will stop, send the distance it recorded, reset the data of encoder and move forward after a short period.

Then through XBee, we can get the distance it move.

## *(2) Validation and Result*

For Homework 4_1:




The car started at the middle line of the box, start to rotate clockwise, and stop when it detected there was a huge drop between two measurements. And the result send through XBEE.

```
Hello system on
System ready.
measure done
start is 43.896992, last is 47.242371
width is 17.461262
measure done
```

Where b is 43.896992(cm), c is 47.242371(cm) and we can use formula to get a, which is 17.461262(cm).

And the exactly half width of the box is 15(cm).

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For Homework 4_2

The car will start from left side and stop when QTI sensor get 0b1111. And the result we get from XBEE is

```
Hello system on
Distance = 0.000000
Distance = 16.583125
Distance = 13.394063
```

The ruler in the picture is 15(cm) and it is quite close to the measurement.

***(3) Encounter issue***

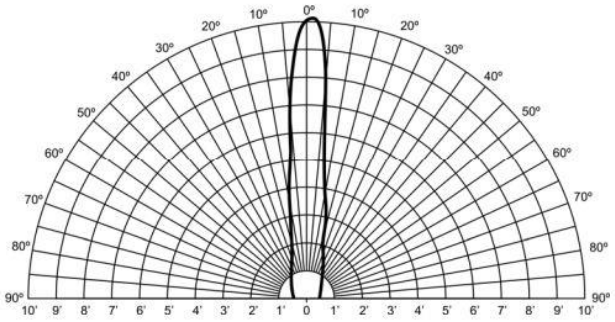
(a) USB cable is annoying:

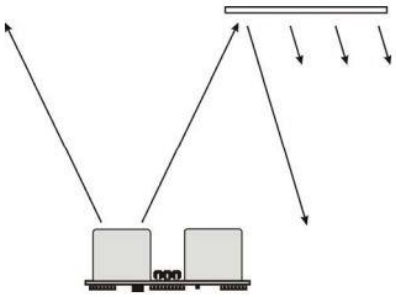
It is quite annoying to use USB cable to transmit data, so I use XBEE, Thanks to wireless communication.

(b) Ultrasound is not so accurately:

Since the sound is reflected by the surface, sometimes it is not so accurately, Sometimes, measurement will come out result like 20 cm. I think that it is because the soundwave is propagating at a direction. And usually we will use a straight line to measure the distance (like a ruler). And the wave will still get interfere by corner of box or others. But still, it can measure the distance and it is much more accurate than module(hc-sr04) I used in Arduino project,

Money talks ☺.



(c) Polar testing:

At first, I want to use angle and Trigonometric functions (cosine) to find width of the box. But I can't ensure that the degree the car rotated every time is accurate. And we are measure with a triangle. So why bothers myself ☺.

## *(4) Discussion*

I get familiar to BBCar in this homework, and I spend some time to figure out XBEE and UART implementation in mbed. Hope that I can finished final project as fast as possible for the next coming weeks filled with exams and homework QQ.