Measurements

Brief

It is of interest to take measurements of the printed circuit boards provided to us.

- We want to determine the absolute center of the robot’s pivot circle so we can place a photodiode there
- We want to determine the angle required to correct a skew

Board Measurements

Measurements

14/08/23

Brief

We need to take some measurements on the robot to calculate correction angle.

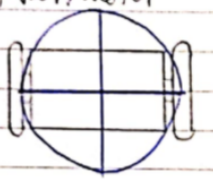
We need:

Wheel Diameter

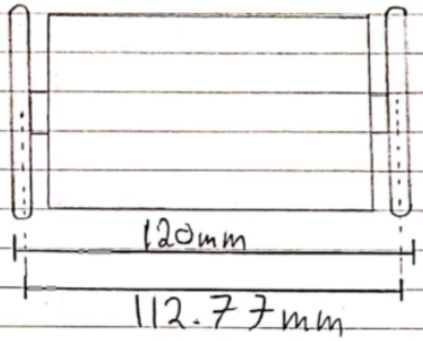
= 64.8mm d

32.4mm r

Pivot Perimeter



Width Between Wheels



$P = \pi d = \pi \cdot 112.77\,mm$

$P = 354.277\,mm$

Pulses per rotation: $3 \times 19 \times 4 = 228$

Wheel perimeter: $\pi \cdot 64.8 = 203.57\,mm$

∴ every 228 pulses on 4x accuracy, ie. 1 revolution, 203.57mm is traversed.

To traverse 1° of perimeter:

100.1° ~ 360° => 354.277/203.57 = 1.74 rev = 396.74 pulse
50.1° ~ 180° => 177.1385/203.57 = 0.87 rev. = 198.34 pulse
25.1° ~ 90° => 88.569/203.57 = 0.435 rev = 99.18 pulse

SUMMARY OF FINDINGS

This measurement document focused on the diameter and circumference of circles related to the device. The goal was to determine the correlation between wheel revolutions and pivot traversal.

Wheel diameter - 64.8mm

Distance between wheel contact points to ground - 112.77mm

Pivot circle circumference - 354.277mm

Pulses per revolution - 228 on 4x accuracy

Wheel circumference - 203.57mm

Pulses per FULL revolution - 396.79

Pulses per HALF revolution - 198.39

Pulses per QUARTER revolution - 99.198

Mount Reference Measurements (Important for Altium)

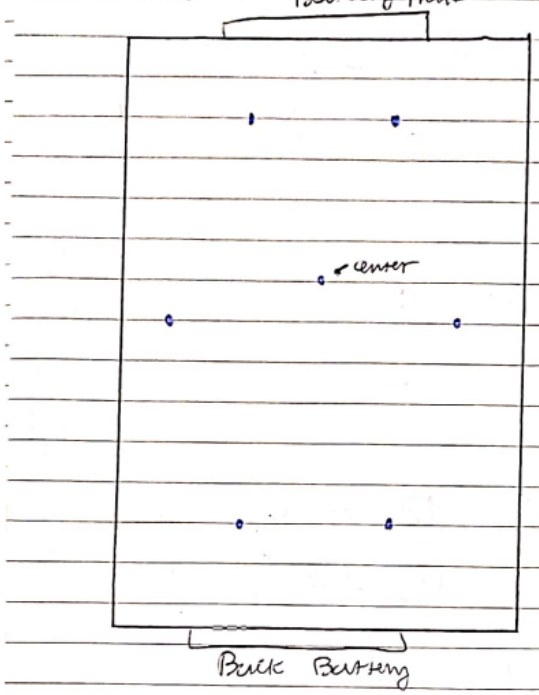
Measurements - Trigonometry

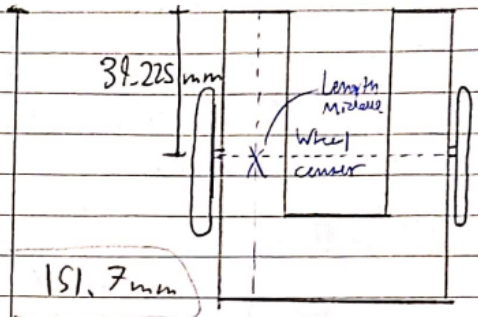
14, 08, 23

Brief

With the constant # pulses for turn ratio decided, we need to use the CAD layout of the sensors to dictate the correction angle.

CAD Layout

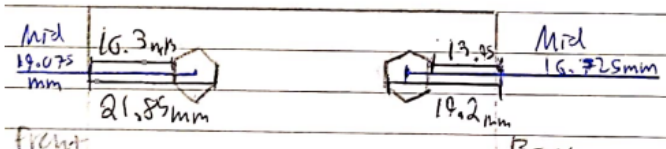




∴ Length middle = Wheel center ✓

Center = 39.225 mm along lengthwise the connector board

Now to measure Distance from each mount as ref for Altium



=> Distances from each Mount:

Front: From edge: 19.075 (middle)	From Center: 20.15 mm
Back: From edge: 16.725mm (middle)	From Center: 22.5mm

SUMMARY OF FINDINGS

This measurement document focused on determining the distance to place the photodiodes. For the algorithm to work correctly, we need the central photodiode to be in the geometric center of the robot’s pivot point.

Robot length - 151.7mm

Connector board length - 78.45mm

Connector board midpoint from edge - 39.225mm

Distance from edge to front mechanical mount - 19.075mm

Distance from center to front mechanical mount - 20.15mm

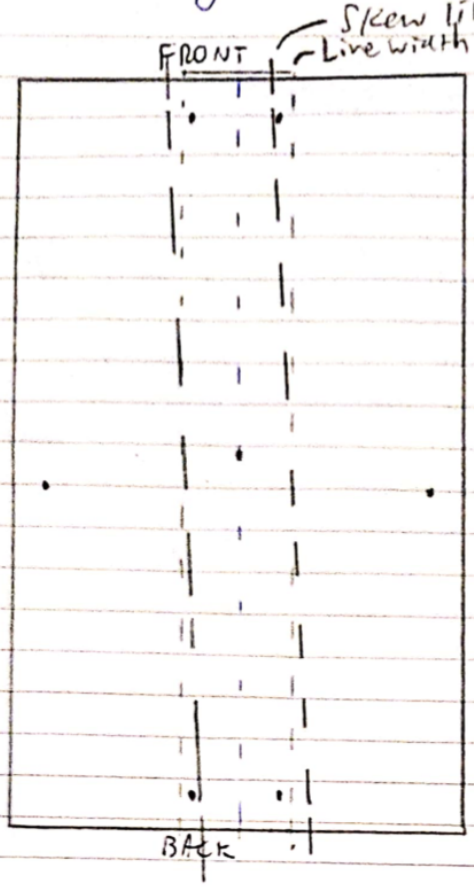
Distance from edge to back mechanical mount - 16.725mm

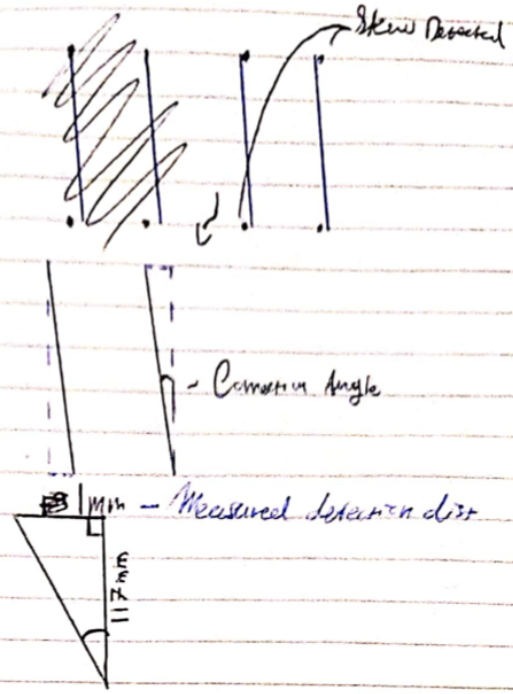
Distance from center to back mechanical mount - 22.5mm

Angle and Pulse Analysis

Trigonometry of Light sensors

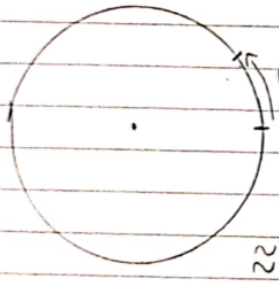
15/08/23





Δ Correction $= \operatorname{atan}\left(\frac{1}{117}\right) = 0.4895°$

Pivot Circle



0.4816° ; 0.008543 rad

- We Need to correct by 0.489° at a skew.
  - Calculate encoder pulses

$\approx 0.48° = \frac{1}{735.15}\ \text{rev} = \frac{1}{735.15} \cdot 354.277\ \text{mm about circumference}$

$= 0.4819\ \text{mm about circumference}$

$= \frac{1}{735.15} \cdot 228 = 0.31\ \text{pulses}$

∴ Turning one pulse to correct skew will overshoot the angle by

322.58°

SUMMARY OF FINDINGS

This measurement document focuses on determining the amount of encoder pulses required to count before the robot has corrected its skew.

Delta distance for photodiode to register the black line - 1mm

Distance between skew sensors - 127-5-5 = 117mm

Angle of correction = 0.4895 degrees

Fraction of circumference - $\frac{1}{735.15}$

Pulses required - 0.31

Continuation on Pulse Calculations…

It is apparent that the robot does not have the precision to rotate 0.5 degrees. At minimum, the robot will rotate one pulse and that overshoots the angle by 332.58%. The following calculations will provide the necessary length between the skew sensors to facilitate an accurate skew correction procedure.

Variables

x = Length between skew sensors

p = portion of circumference angle takes up

a = correction angle

Objective:

$$angle = atan(\frac{1}{x})$$

Working:

$$Pulse = 1$$

$$1 = 228 * p$$

$$p = 0.00438596$$

$$a = p * 360$$

$$a = 1.57894$$

$$1.57894 = atan(\frac{1}{x})$$

$$x = 36.278mm$$

Summary

Changing the length between the skew sensors will provide the robot enough room to correct its skew. The above length value will ensure that one pulse is perfect for correction.