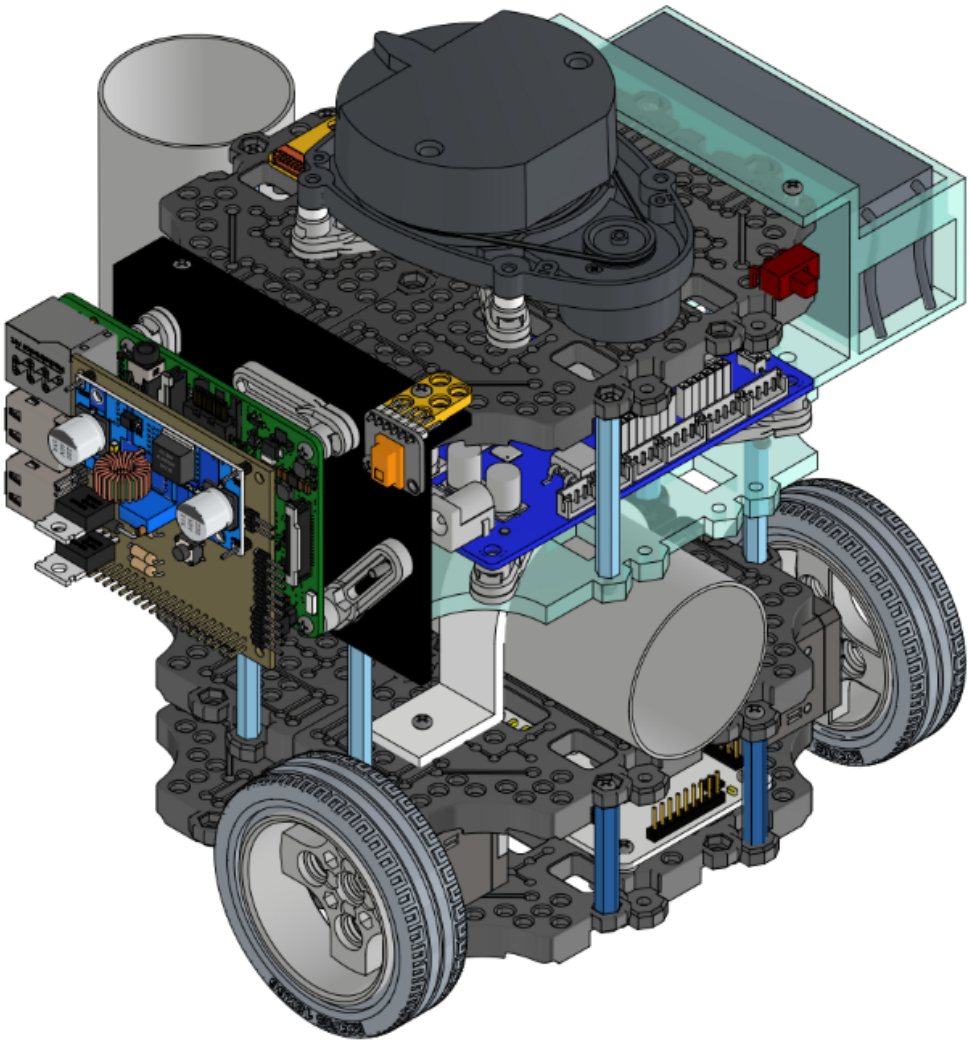
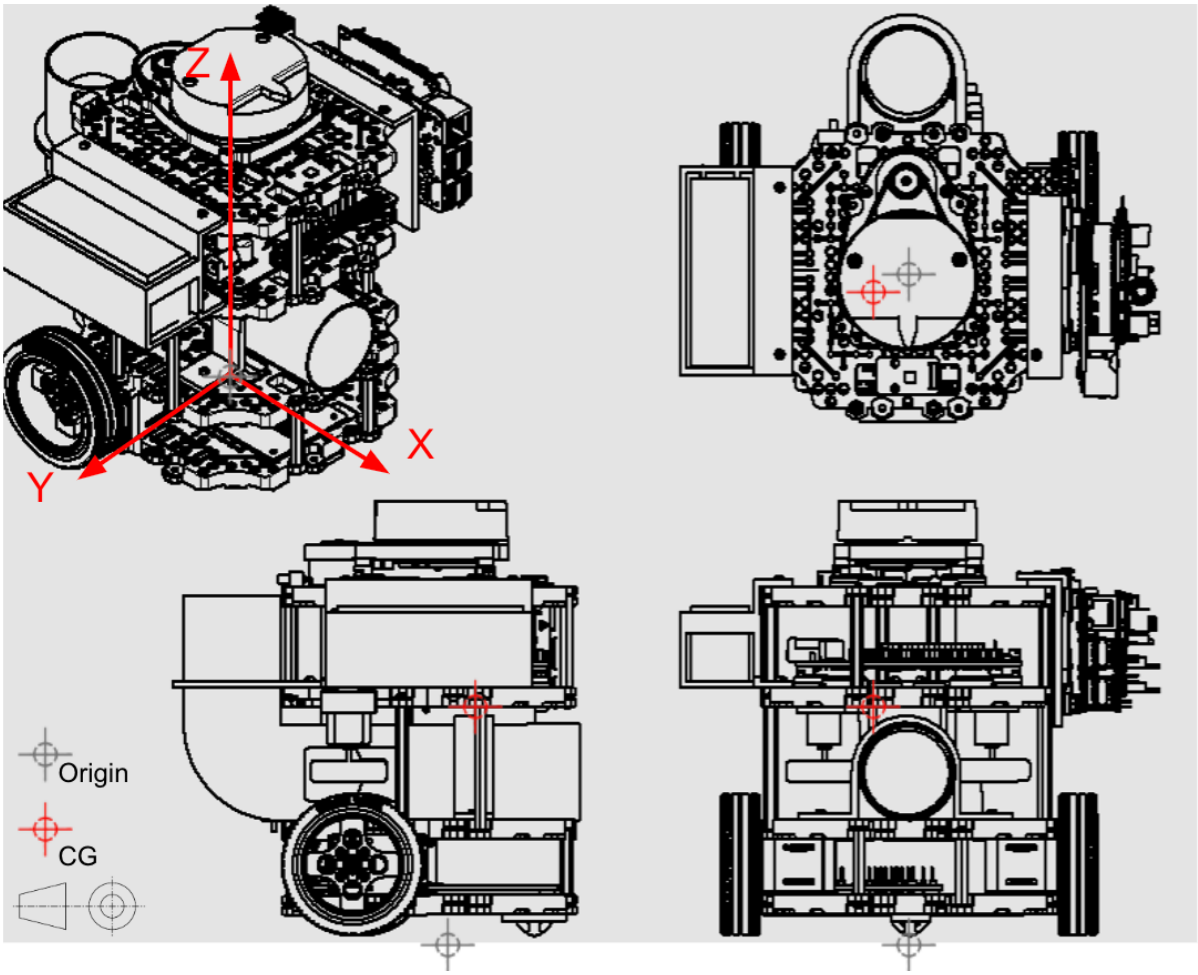
EG2310 AY 21/22
Studio 2 Group 2

Bill of Materials / CG derivation, Tánkyu 2310i



Ang Kai Jun	A0235198W
David Chong Joon Wei	A0236533H
Ha Zhe Li	A0236541J
Rayner Lim Fang Yuh	A0238285W
Wang Yanxiao Austin	A0240524R



To find the CG, we first measure the XYZ coordinates of each component with respect to an arbitrary point on the robot. In this case we will set the reference on the ground level directly beneath the center of the waffle plate. This point will be our Origin.

Assumptions made:

1. All screws, nuts, bolts and washers' CG are accounted for with the major component itself.
2. Parts symmetrical about the origin are assumed to have CG within the axis Z of the origin.

Table 1: Bill of Materials

Calculated to 3 Decimal Places.

S/n.	Component	Weight (Kg)	Component's CG from origin		
			X(m)	Y(m)	Z(m)
Level 1					
1.1	Waffle Plate lvl 1	0.079	0.000	0.000	0.015
1.2	Ball Caster	0.004	-0.005	0.000	0.000
1.3	Left Dynamixel Motor	0.055	0.040	-0.05	0.020
1.4	Right Dynamixel Motor	0.055	0.040	0.050	0.020
1.5	NFC reader	0.016	0.005	0.010	0.016
1.6	Posts x4	0.001	0.000	0.000	0.035
1.7	Left Wheel + Tire	0.029	0.040	0.080	0.030
1.8	Right Wheel + Tire	0.029	0.040	-0.080	0.030
Level 2					
2.1	Waffle Plate lvl 2	0.079	0.000	0.000	0.052
2.2	Pipe clamp	0.070	0.022	0.005	0.075
2.3	Pipe	0.120	0.090	0.005	0.100
2.4	Servo mount	0.002	-0.037	-0.050	0.063
2.5	Servo	0.010	-0.035	-0.030	0.065
2.6	Posts x4	0.010	0.000	0.000	0.082
Level 3					
3.1	Acrylic Waffle Plate lvl 3	0.079	0.010	0.000	0.112
3.2	OpenCR bracket x4	0.007	0.020	0.000	0.120
3.3	OpenCR	0.062	0.020	0.000	0.125

3.4	Motor mount x2	0.020	-0.015	0.000	0.107
3.5	Motor + wheel x2	0.034	-0.030	0.000	0.107
3.6	Posts x4	0.080	-0.028	0.000	0.140
Level 4					
4.1	Waffle Plate lvl 4	0.079	0.000	0.000	0.163
4.2	Lidar bracket x4	0.007	0.000	0.000	0.178
4.3	Lidar	0.110	-0.010	0.000	0.190
4.4	USB2LDS	0.002	-0.052	0.000	0.178
4.5	Rpi Bracket	0.070	0.000	0.070	0.135
4.6	Rpi support x4	0.007	0.015	0.085	0.127
4.7	Rpi	0.047	0.000	0.090	0.122
4.8	PCB	0.070	0.000	0.095	0.122
4.9	IR sensor	0.004	0.033	0.085	0.165
4.11	IR bracket	0.002	0.033	0.083	0.165
4.12	Battery bracket	0.070	0.000	-0.093	0.145
4.13	Battery	0.137	0.000	-0.095	0.137
TOTAL MASS:		1.384kg	-	-	-

Table 2: Moment of components

Calculated to 3 Significant Figures.

Component	**Xm(kgm)**	**Ym(kgm)**	**Zm(kgm)**
Level 1			
Waffle Plate lvl 1	0.000	0.000	0.00119
Ball Caster	-0.0000200	0.000	0.000
Left Dynamixel Motor	0.00220	-0.00275	0.00110
Right Dynamixel Motor	0.00220	0.00275	0.00110
NFC reader	0.0000800	0.000160	0.000256
Posts x4	0.000	0.000	0.0000350
Left Wheel + Tire	0.00116	0.00232	0.000870
Right Wheel + Tire	0.00116	-0.00232	0.000870
Level 2			
Waffle Plate lvl 2	0.000	0.000	0.00410
Pipe clamp	0.00154	0.000350	0.00525
Pipe	0.0108	0.000600	0.0120
Servo mount	0.0000740	0.0001000	0.000126
Servo	-0.00035	-0.000300	0.000650
Posts x4	0.000	0.000	0.00082
Level 3			
Acrylic Waffle Plate lvl 3	0.000790	0.000	0.00885
OpenCR bracket x4	0.000140	0.000	0.000840
OpenCR	0.00124	0.000	0.00775
Motor mount x2	0.000300	0.000	0.00214

Motor + wheel x2	-0.00102	0.000	0.00364
Posts x4	-0.00224	0.000	0.0112
Level 4			
Waffle Plate lvl 4	0.000	0.000	0.0129
Lidar bracket x4	0.000	0.000	0.00125
Lidar	-0.00110	0.000	0.0209
USB2LDS	-0.000104	0.000	0.000356
Rpi Bracket	0.000	0.00490	0.00945
Rpi support	0.000420	0.00238	0.00356
Rpi	0.00	0.00423	0.00573
PCB	0.00	0.00665	0.00854
IR sensor	0.000132	0.000340	0.000660
IR bracket	0.0000660	0.000166	0.000330
Battery bracket	0.000	0.00651	0.0102
Battery	0.000	0.0130	0.0188
TOTAL:	0.0175	0.0391	0.155

The overall CG position can therefore be calculated by summing the individual component moments in each axis and dividing that sum by the sum of mass of all the components.

Sum Xm(kgm)	Sum Ym(kgm)	Sum Zm(kgm)
0.0175	0.0391	0.155

Total mass = 1.384kg

CG coordinates:

X-distance(m)	Y distance(m)	Z distance (m)
0.0126	0.0283	0.112