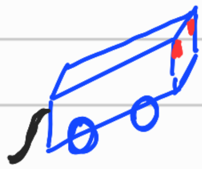
Map building (PRM)

png image

↓

Convert it to nodelist

"Create a YMAL file"

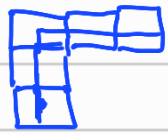


Specifications for Hardware

1. Chassis (1)
2. Motor Servo (2)
3. IR Sensor (2)/Ultrasonic sensors (3)
4. Caster Wheel
5. Wheels
6. Battery
7. Arduino Nano

May be before this to fill map we need flood fill but as we know the obstacles from start we can use

1. A* Algorithm (Global path planning).
   {You don't need local path planning}
2. Particle Filter for localization.
3. Controller

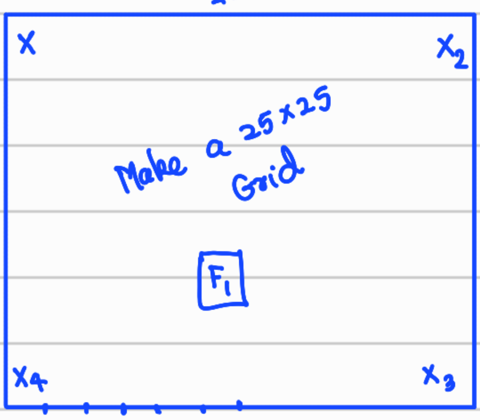


" 4 corners the robot is kept "

Per grid $= \frac{670.56}{26.8} = 25.02 \simeq 25$ cm

670.56 cm = 22 Feet

22 Feet = 670.56 cm



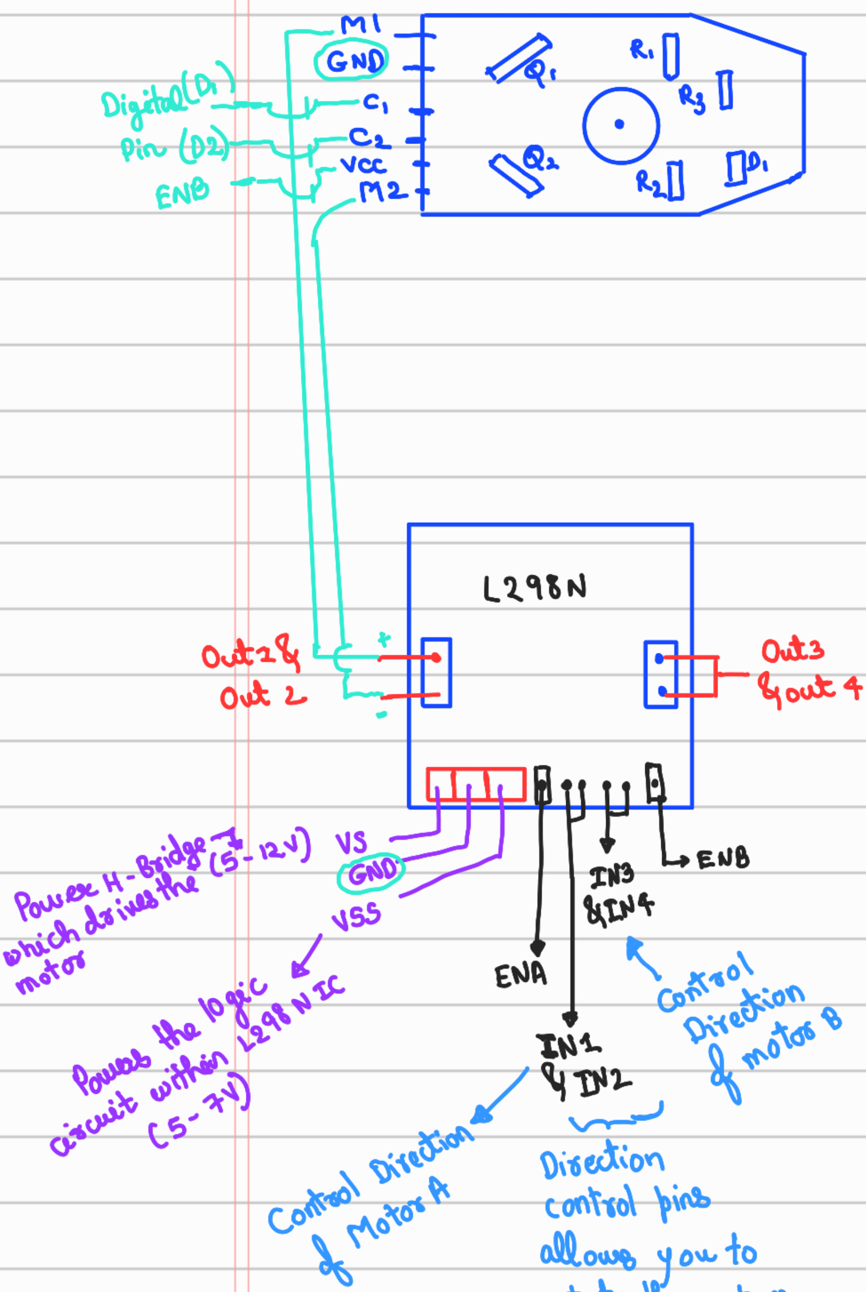
Micro Controller (Arduino) | Motor Driver (L298N) | Motors (DC with encoder) N20

N20 micro gear motor encoder

Q_1 & Q_2 → CC6101 hall effect sensor

R_1, R_2, R_3 → 3.3KΩ resistor

D1 → LED



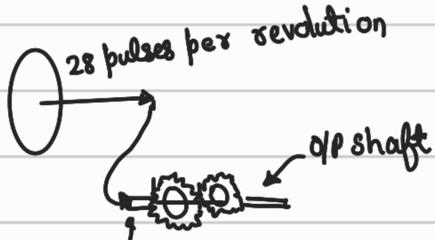
Direction control pins allows you to rotate the motors forward/Backward

[Power by 5V or GND logic]

Note:- ENA & ENB

(When the jumper is in place the jumper is in full speed. If we want to control the speeds the we can connect to PWM pins of arduino & program)

Encoder to gear pulse ratio



i/p shaft
(For 28 pulses the i/p shaft rung 100 times for every single turn of the o/p shaft)

$28 \times 100 = 2800$ pulses will turn 1 revolution of o/p shaft.

28 pulses per revolution

100 times

28 pulses = 100 revol

#

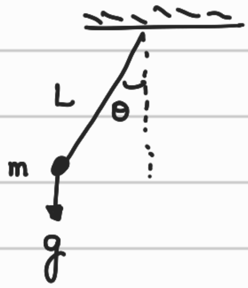
$$150 \text{ rpm} \times \pi d \quad (d = 4.2 \text{ cm}) = 155 \times \pi \times 4.2$$

$$= 1978 \text{ cm/min}$$

$$= 19.78 \text{ m/min}$$

$F = ma$

$$\ddot{\theta} = -\frac{g}{L}\sin(\theta) - \delta\dot{\theta}$$



$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} \theta \\ \dot{\theta} \end{bmatrix}$$

$$\frac{d}{dt}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} x_2 \\ -\frac{g}{L}\sin(x_1) - \delta x_2 \end{bmatrix}$$

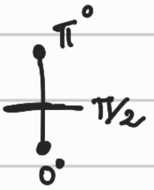
Assume, $\frac{g}{L} = \frac{9.81 \text{ m/s}^2}{0.09 \text{ m}}$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} x_2 \\ -\sin(x_1) - \delta x_2 \end{bmatrix}$$

$\delta = 0.1$

saddle point.

1. Fixed points (F.P.)



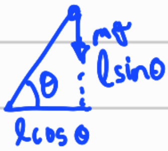
$$\bar{x} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \pi \\ 0 \end{bmatrix}$$

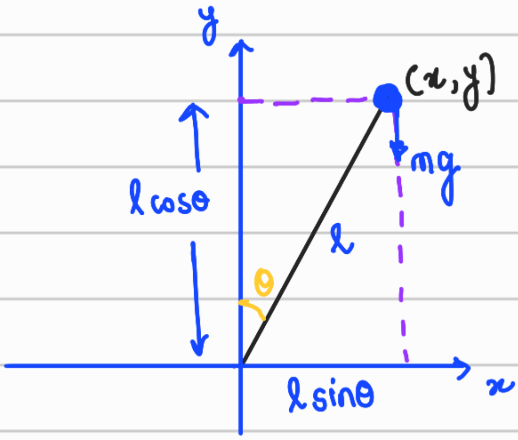
2. Linearization

$$\frac{Df}{Dx} = \begin{bmatrix} 0 & 1 \\ -\cos(x_1) & -\delta \end{bmatrix}$$

$$A_D = \begin{bmatrix} 0 & 1 \\ -1 & -\delta \end{bmatrix} \qquad A_U = \begin{bmatrix} 0 & 1 \\ 1 & -\delta \end{bmatrix}$$

Derivation of inverted pendulum



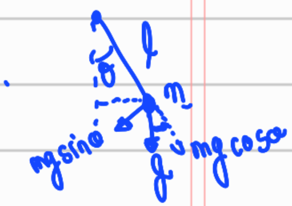


$\cos\theta = \frac{y}{l}$

$y = l\cos\theta$

$\sin\theta = \frac{x}{l}$

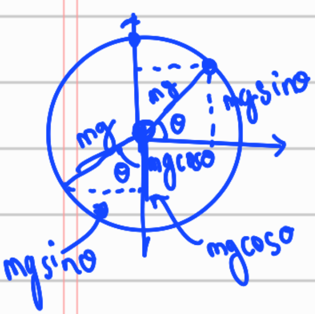
$x = l\sin\theta$



$x = l\sin\theta \qquad \dot{x} = l\cos\theta\,\dot{\theta}$

$y = l\cos\theta \qquad \dot{y} = -l\sin\theta\,\dot{\theta}$

$T = l\,mg\sin\theta$

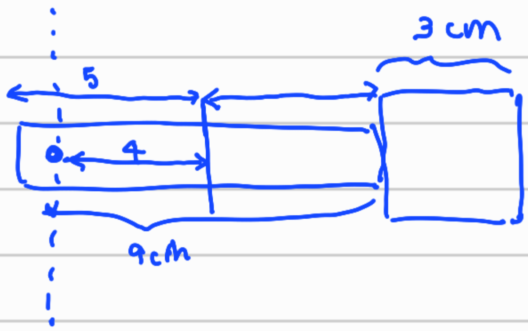


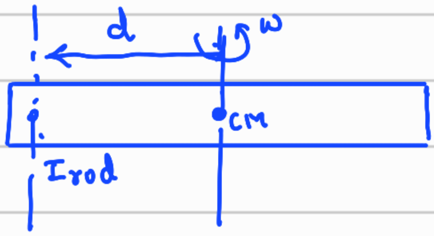
$M = I\,\ddot{\theta}(t)$

Net torque = Motor torque − Gravitational torque

$I\ddot{\theta} = \tau - mgL\sin(\theta)$

Assembly weight → 24.979 g





$I_s = I_{cm} + md^2$

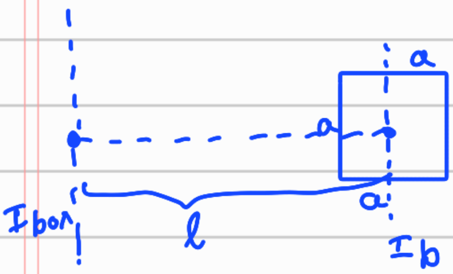
$I_{cm\,rod} = \frac{1}{12} m L^2$ (This is the measure of how mass is distributed about the axis)

Rod weight → 3.64 g

$d = \frac{L}{2}$

$= \frac{1}{12} mL^2 + m\left(\frac{L}{2}\right)^2 = \frac{1}{3} mL^2$

$= \frac{1}{12}(0.00364)(0.1)^2 + m(0.04)^2 = 5.835 \times 10^{-6}$ kgm^2



a $I_{box} = \frac{1}{6} ma^2 + ml^2$

$= \frac{1}{6}(0.02133)(0.03)^2 + (0.02133)(0.105)^2$

$= 2.383 \times 10^{-4}$ kgm^2

6.928×10^{-4} kgm^2 (10 coins)

Weight

Plate → 10.56 g

Box → 10.77 g + (4.10)×10 = 51.77

21.33g → 0.02133 kg   62.33g → 0.062 kg

$I_{new} = I_{rod} + I_{box}$

$= 5.835 \times 10^{-6} + 2.383 \times 10^{-4}$

$= 2.441 \times 10^{-4}$ kgm^2

6.986×10^{-4} kgm^2 (10 coins)

$I_{new}\ddot{\theta} = T_{rated} - mgL\sin(\theta) - (\text{friction})$

$(2.441 \times 10^{-4})\ \ddot{\theta} = 0.07 - (0.02133)(9.81)(0.105)\sin(\pi/2)$

$\ddot{\theta} = \frac{0.07 - 0.021}{2.441 \times 10^{-4}}$ ~ 10 coins → 0.0638

89 rad/s²

$\ddot{\theta} = 196.96$ rad/s² (0.07)

$$\tau = Nm = \left(\frac{kg\,m}{s^2}\right)m = \frac{kg\,m^2}{s^2}$$

$$I = kgm^2 \qquad \therefore \frac{\tau}{I} = \frac{\cancel{kg\,m^2}}{s^2} \times \frac{1}{\cancel{kgm^2}} = \frac{1}{s^2}$$

0.013

$\ddot{\theta} = 53.27\ rad/s^2$

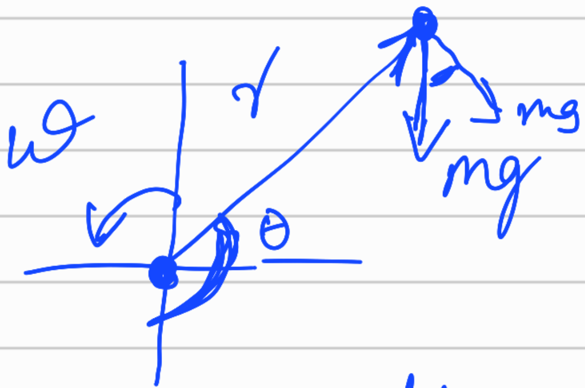
$$mgl\sin(\theta) = kg\,\frac{m}{s^2}\,m = \frac{kg\,m^2}{s^2} = Nm$$

Theoritical $\quad I\ddot{\theta} \doteq 0.04\ Nm$

$I = 6.75\times10^{-7} \qquad \ddot{\theta} = 86$

$\rightarrow (2.441\times10^{-4})(200) = 0.04\ Nm$

Exper $\rightarrow (2.441\times10^{-4})(89) = 0.01\ Nm$



$$mgr\cos\theta = \frac{dL}{dt} = I\alpha = I\ddot{\theta}$$

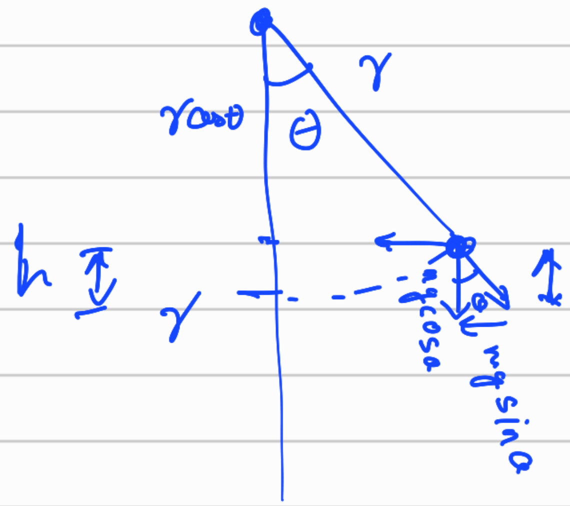
$$\cos\theta = \frac{I}{mgr}\ddot{\theta}$$

$$\theta = \cos^{-1}\left(\frac{I}{mgr}\ddot{\theta}\right)$$

$$y = f(x) \rightarrow \cos\theta = \frac{I}{mgr}\ddot{\theta}$$

$\bar{y}_r = \cancel{\ } - 1$

$$\begin{cases} y - y_r = 0 \\ \dot{y} - \dot{y}_r = 0 \end{cases} \qquad \frac{I(\ddot{\theta})}{mgr} + 1 = 0 \qquad + 1$$



$r - r\cos\theta = h$

$P = mgh \qquad K = \frac{1}{2} I \omega^2$

$= \frac{1}{2} I \omega^2$

$mgh + \frac{1}{2} I \omega^2 = \text{const}$

$\underline{I} \omega \dot{\omega} - rmg \sin\theta\, \omega = 0$

$\tau \rightarrow (\underline{I} \dot{\omega}) - mgr \sin\theta = 0$

$\cancel{\omega = x_1}$ $\qquad x_1 = \theta$

$\cancel{\dot{\omega} = x_2}$ $\qquad x_2 = \dot{\theta}$

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = \frac{mg \sin x_1}{I} + \frac{u}{I}$$

$$\ddot{\theta} = \frac{0.07 - 0.021}{2.441 \times 10^{-4}}$$

$$(2.44 \times 10^{-4})\,\ddot{\theta} = \tau - 0.021$$

Case 1 :- $\tau = 0.034$

$$(2.44 \times 10^{-4})\,\ddot{\theta} = 0.034 - 0.021$$
$$= 0.013$$

$$\ddot{\theta} = \frac{0.013}{2.44 \times 10^{-4}} = 53.27 \text{ rad/s}^2$$

Case 2 :- $\tau = 0.01$

$$\ddot{\theta} = \frac{-0.011}{2.44 \times 10^{-4}} = -45.08 \text{ rad/s}^2$$