

# Yogurt machine



# Objectives and motivation

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Manager



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Mechanic

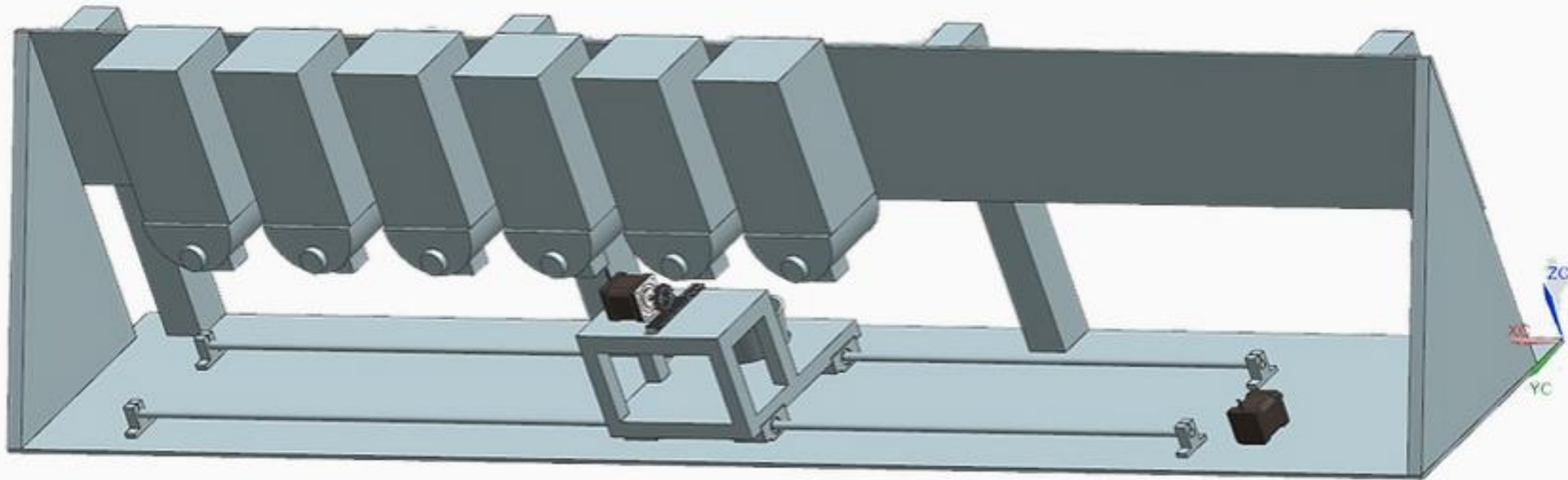


Jordi Guimerà  
Electronic

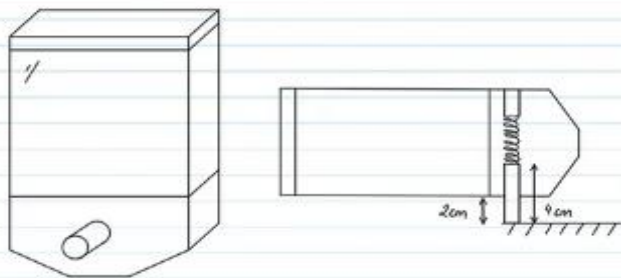


Denise Bermeo  
Programmer

# Specifications for the device you are designing







$$4 \text{ cm} \rightarrow 100\%$$

$$2 \text{ cm} \rightarrow 50\%$$

2cm missing for 50% → The weight of the deposit is 700g

$$\begin{array}{ccc} 700 & + & 700 \\ \downarrow & & \downarrow \\ 50\% & & 50\% \end{array} = 1400 \quad \downarrow \quad 100\%$$

We know that the formula for the elastic potential energy is :

$$E_{pe} = \frac{1}{2} K x^2 \rightarrow k = \frac{2 E_{pe}}{x^2}$$

and the formula for gravitational potential energy is :

$$E_{pg} = m g x = 700 \cdot 9.8 \cdot 2 \text{ cm} = 1373 \text{ J}$$

therefore we can say :

$$E_{pe} = E_{pg}$$

$$\frac{1}{2} K x^2 = 1373$$

$$k = \frac{2 \cdot 1373}{2^2} = 61865$$

$$F = k x = 61865 \cdot 2 = 123730 \text{ N cm}$$

$$F = 123730 / 9.81 = 12612.6 \text{ kg cm}$$

If our motor has a  $F = 3.2 \text{ kg cm}$  :

$$3.2 \rightarrow 100\%$$

$$12612.6 \rightarrow x \rightarrow 43173\%$$

**MOTOR 2**

water density →  $997 \text{ kg/m}^3$   
yogurt density →  $1044.68 \text{ kg/m}^3$

this means :

$$997 \rightarrow 100\%$$

$$1044.68 \rightarrow x \rightarrow 104.78\%$$

Terrine  
150ml

Pump  
400 ml/s

The pump can move 400 ml/s

The terrine needs 150 ml

The difference in densities is about 5%

$$100\% \rightarrow 150$$

$$105\% \rightarrow x \rightarrow 157.5 \text{ ml}$$

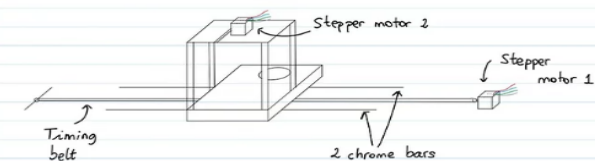
So we need about **160 ml**.

$$\text{If } 400 \text{ ml} \rightarrow 160 \text{ s}$$

$$160 \text{ ml} \rightarrow x \rightarrow 64 \text{ s}$$

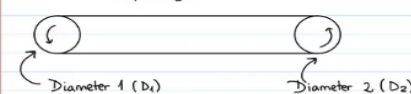
If we use a safety margin of 5s, we can say that the terrine will be filled in **~70s**.

**PUMP**



We neglect the friction of the belt due its symmetry, since the friction is very low and the friction of the chrome bars is reduced with sliding liquid.

$$D_1 = D_2$$



$$\begin{array}{l} V_1 = \omega_1 R_1 \\ V_2 = \omega_2 R_2 \end{array} \quad \left\{ \begin{array}{l} \omega_1 R_1 = \omega_2 R_2 \end{array} \right.$$

$$\begin{array}{l} 3.2 \text{ kg} \rightarrow 100\% \\ 2.4 \text{ kg} \rightarrow x \rightarrow 75\% \end{array}$$

We have a margin of 25% of the total motor power

The stepper motor operates at a speed between 60-80 mm/s, so :

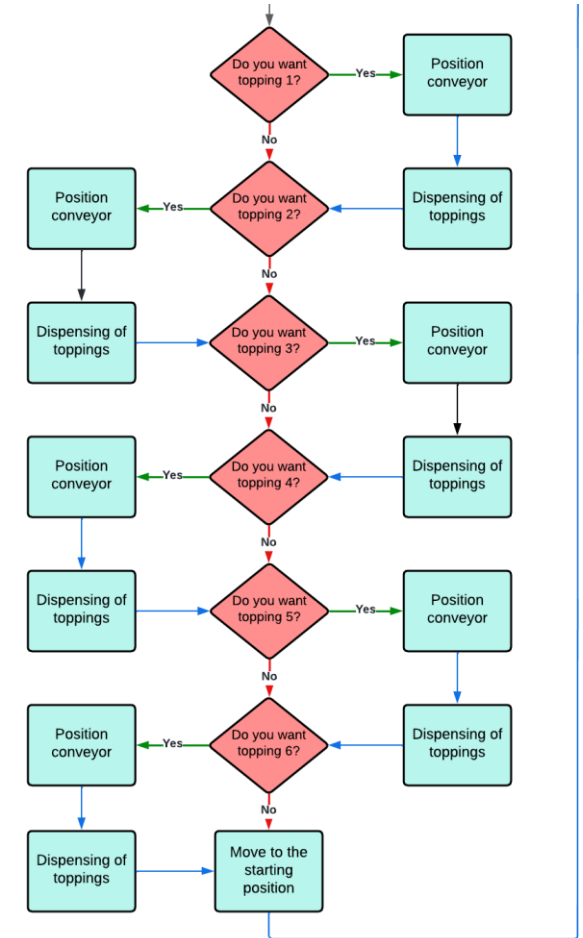
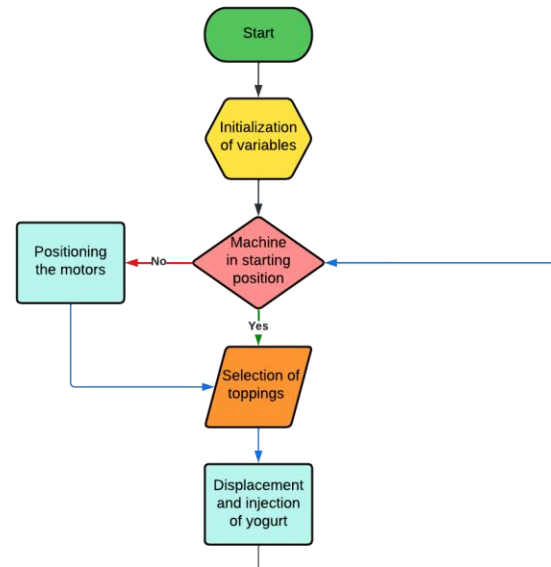
$$\omega_1 = \frac{V_1}{R_1} = \frac{60}{15 \cdot 10^{-3}} = 4000 \text{ rad/s} \cdot \frac{2\pi}{60} = 418.88 \text{ rpm}$$

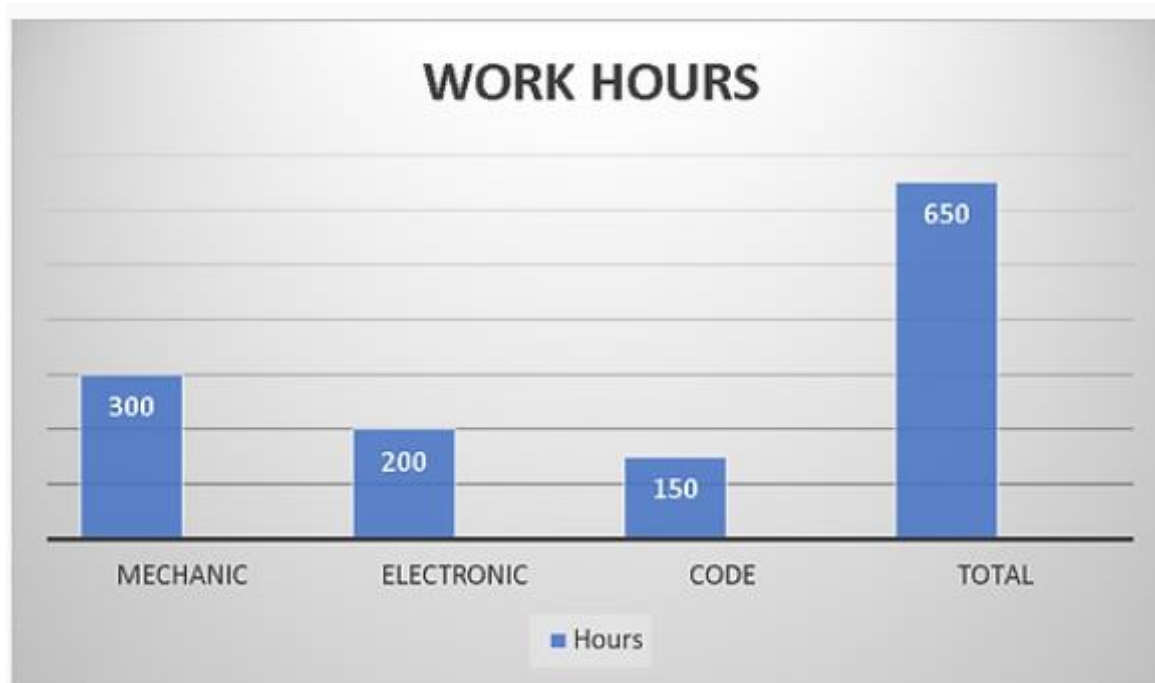
If the stepper motor reaches 2000rpm, the transport speed **complies** with the motor power

**MOTOR 1**

# Mechanical calculations

# Demonstrators





Material	Preu / Unitat	Quantitat	Total
Stepper motor NEMA 17	10,85 €	2,00	21,70 €
Pololu A4988 stepper driver	1,79 €	2,00	3,58 €
ESP32	7,88 €	1,00	7,88 €
MEC-SLU16-DQ-A	6,97 €	4,00	27,88 €
MEC-SHSUPV16-DT-A	3,18 €	4,00	12,72 €
Mega 2560	13,03 €	0,00	0,00 €
Endstop	0,59 €	2,00	1,18 €
DC-DC converter (12V to 5V)	9,49 €	1,00	9,49 €
AC power supply 12V	11,38 €	1,00	11,38 €
Micro water pump	2,95 €	1,00	2,95 €
T2 timing pulley 20 teeth 5mm bore	1,99 €	1,00	1,99 €
GT2 6mm wide timing belt	Price for meter-> 1,99 €	4,00	7,96 €
Synchro Toothed Pulley GT2	2,49 €	1,00	2,49 €
Dispenser Container	6,90 €	6,00	41,40 €
Corretja T5 10mm	Price for meter-> 12,10 €	4,00	48,40 €
Cadena portacables 06.16.018.0	29,35 €	1,00	29,35 €
Bomba Peristáltica 3x5	26,47 €	1,00	26,47 €
			256,82 €

Extra materials	Price
Wood	25,00 €
Metal Bars	33,00 €
Toppings	15,00 €
Price /h	15,00 €
Total work hours	650
Total price (work)	9750
Total price	9.823,00 €

# Budget



# Automatic Yogurt Machine

UNIVERSITAT CENTRAL DE CATALUNYA - UVIC UCC

## Website

<https://jguimera6.wixsite.com/my-site>

Any questions?

