Fifth week task

Mathematical Model

smart methods

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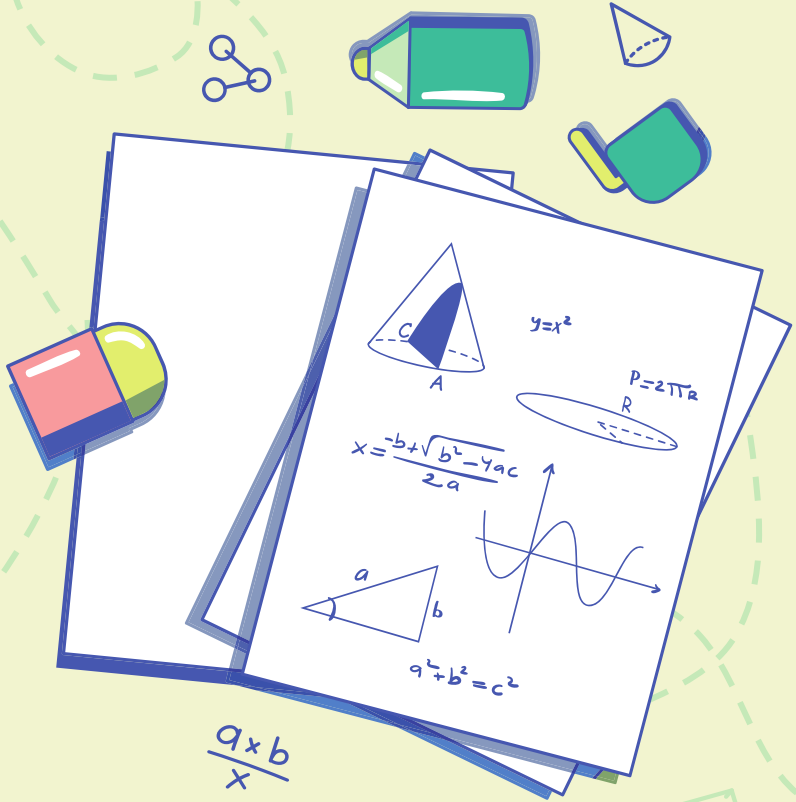
First Step

Defining the problem:

In this mathematical model, I will work to determine the safe and risk-free space in which Robert can move his hand, using some mathematical equations.

Also, through the mathematical equations, I will determine the appropriate place to install the object sensor on the robot to ensure that the robot remains within the safe space for it.



Determine the influencing elements (equation variables):

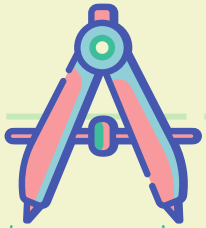
Second Step

If the robot arm works on 2D, the coordinates will be x and y, but if it works on 3D, the coordinates will be x, y and z.

I will solve mathematical equations for both cases, so we will have variables in the equation:

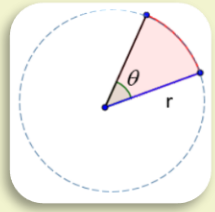
- A — The area of the circular sector.
- V — Circle volume.
- r — Radius of the circle.

Determine the appropriate mathematical process:



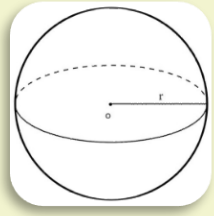
- *If the robot arm works on 2D we use the circular sector area law:*

$$A = \frac{\theta}{360^0} * (\pi r^2)$$



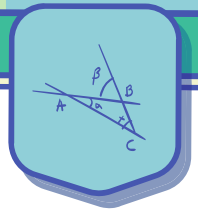
- *If the robot arm works on 3D we use the circle volume law:*

$$V = \frac{4}{3}\pi r^3$$



Fourth Step

Applying the process



Area of circular sector

$$A = \frac{\theta}{360^0} * (\pi r^2)$$

$$= \frac{90^0}{360^0} * \pi(42.5^2)$$

$$= \frac{1806.25\pi}{4} = 1418.6254cm^2$$

Circle volume

Diameter = 85cm
→ r = 42.5cm

$$V = \frac{4}{3}\pi r^3$$

$$= \frac{4}{3}\pi * (42.5)^3$$

$$= 321555.0981cm^3$$

Quarter volume of circle:

$$v = 321555.0981 * \frac{1}{4} = 80388.7745cm^3$$

Fourth Step

Defining the outputs:

- **Area of circular sector used in 2D:**

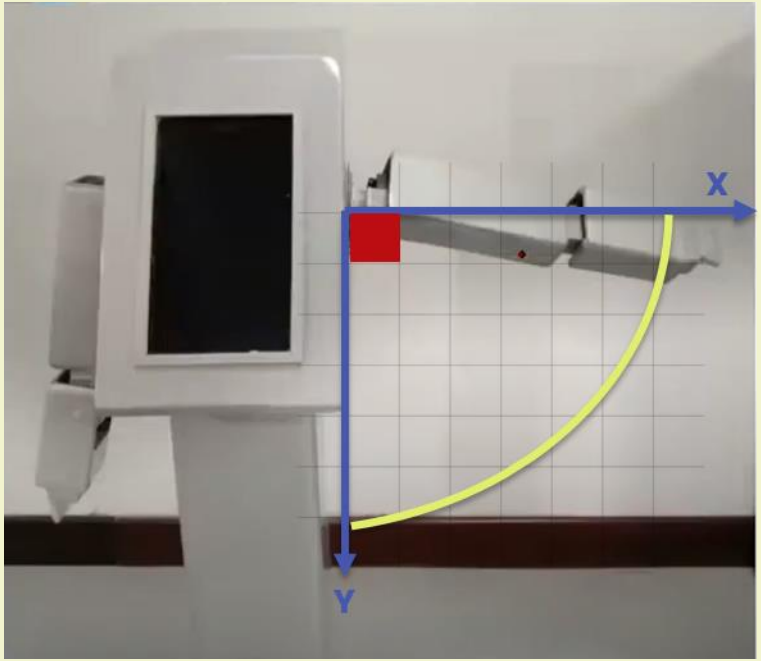
A= 1418.6254 cm^2

- **Circle volume used in 3D:**

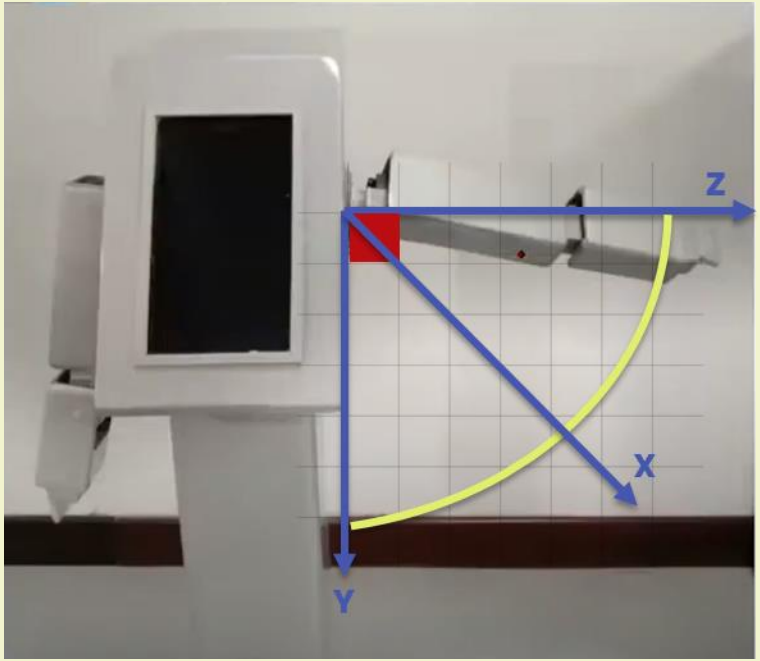
V= 80388.7745 cm^3

Graph execution:

- Area of circular sector used in 2D:



- Circle volume used in 3D:



Sixth Step

Where on the robot should the object sensor be installed?

I see that the object sensor should be installed in the center of the imaginary circle as in the picture...

To ensure that the robot will stop working as soon as any object enters the fake safety circuit.