Diseño de un sistema hardware in the loop para un Robot manipulador serial RR

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MATERIALES

ESP32

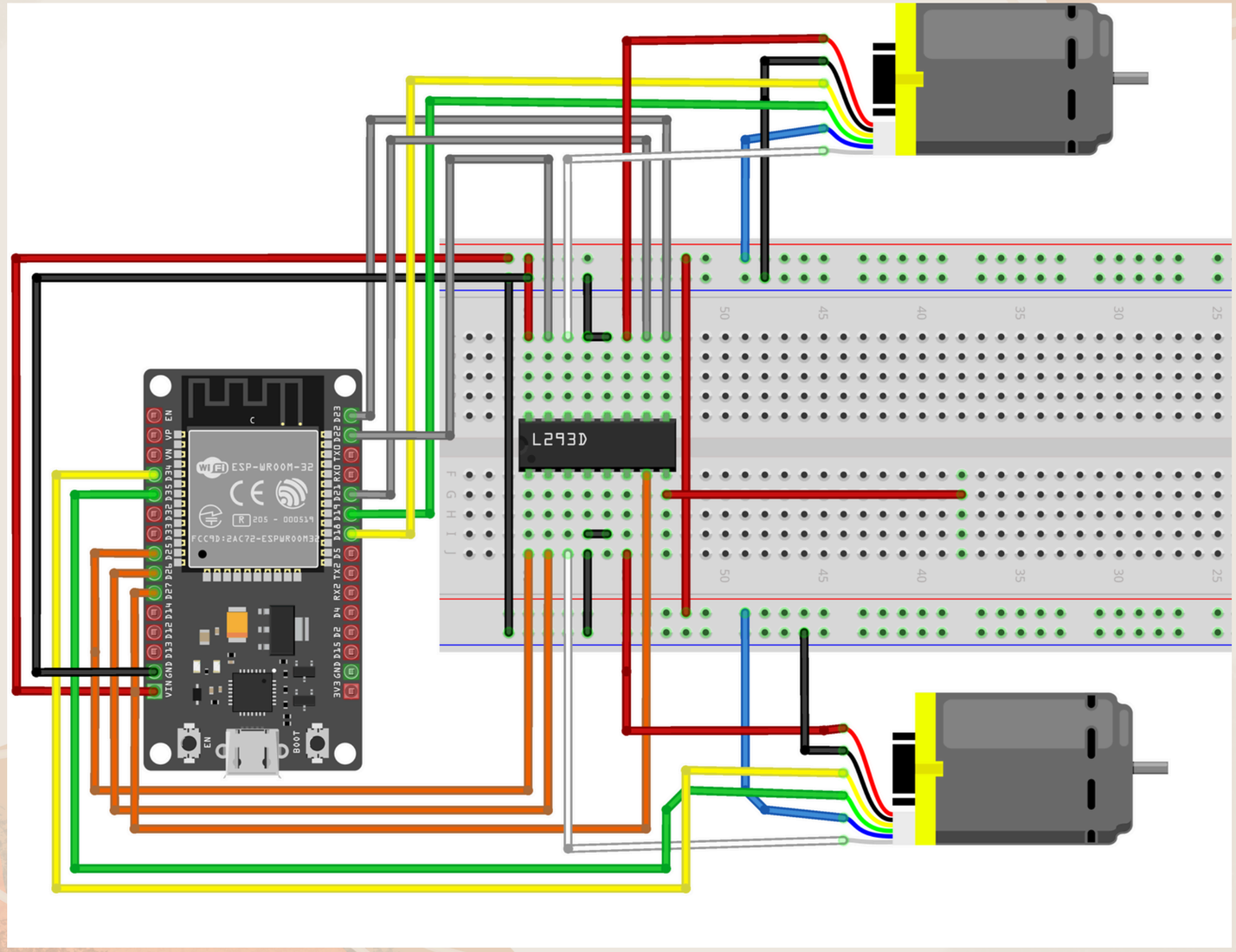
Motores encoder

INTEGRADO L299N

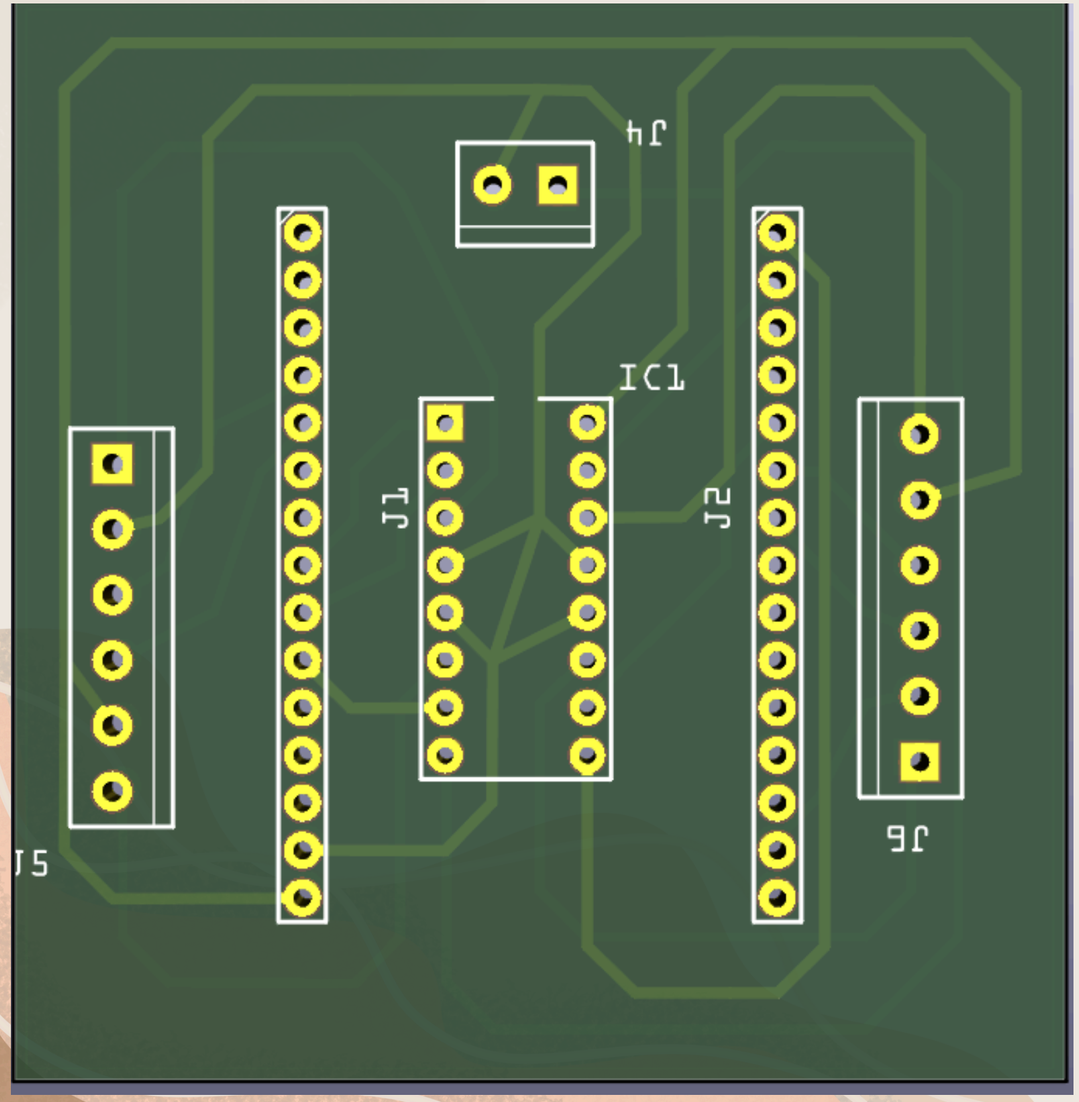
Fuente de Poder

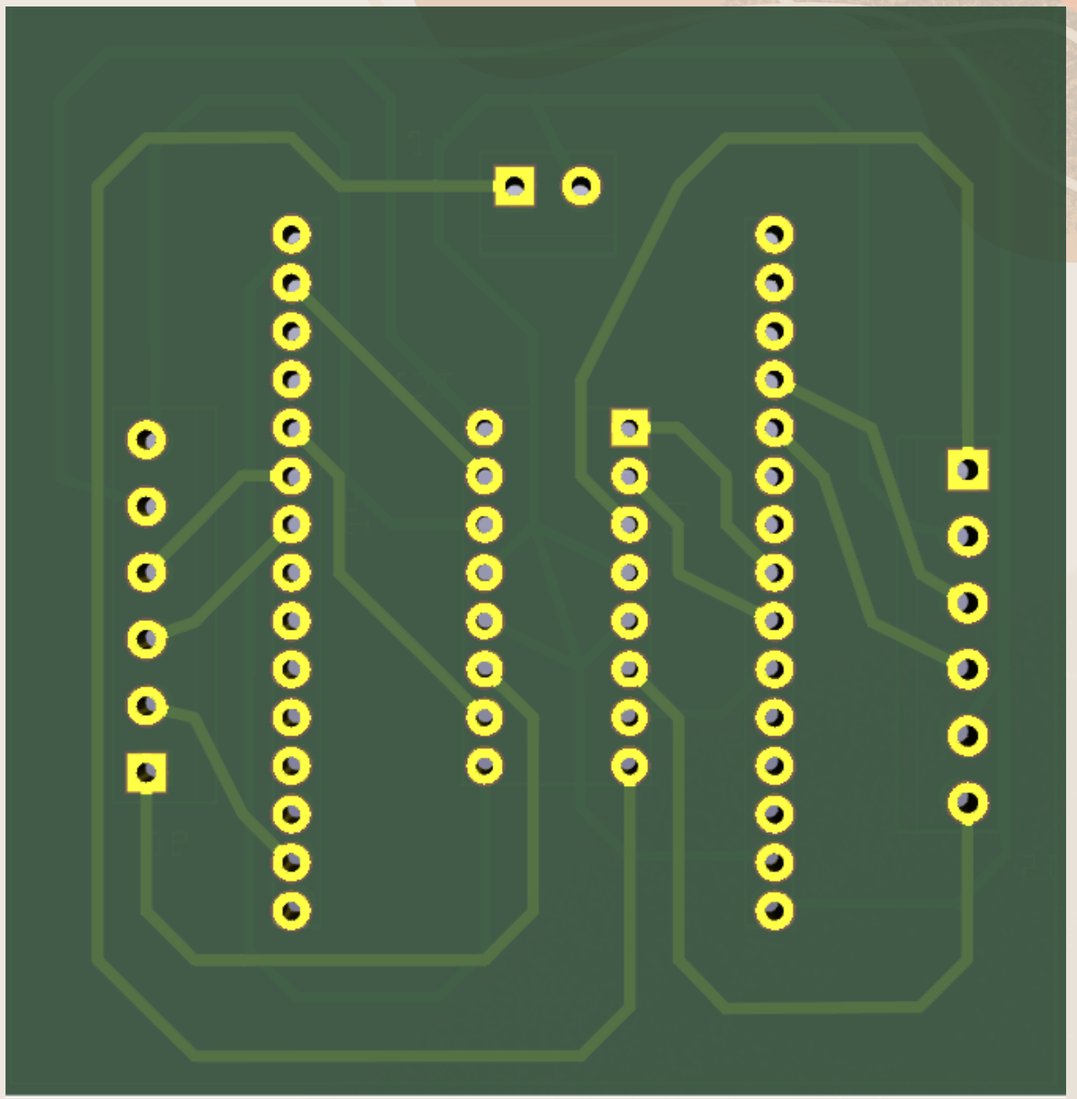
Cables de conexión

CIRCUITO CONTROLADOR DE MOTORES

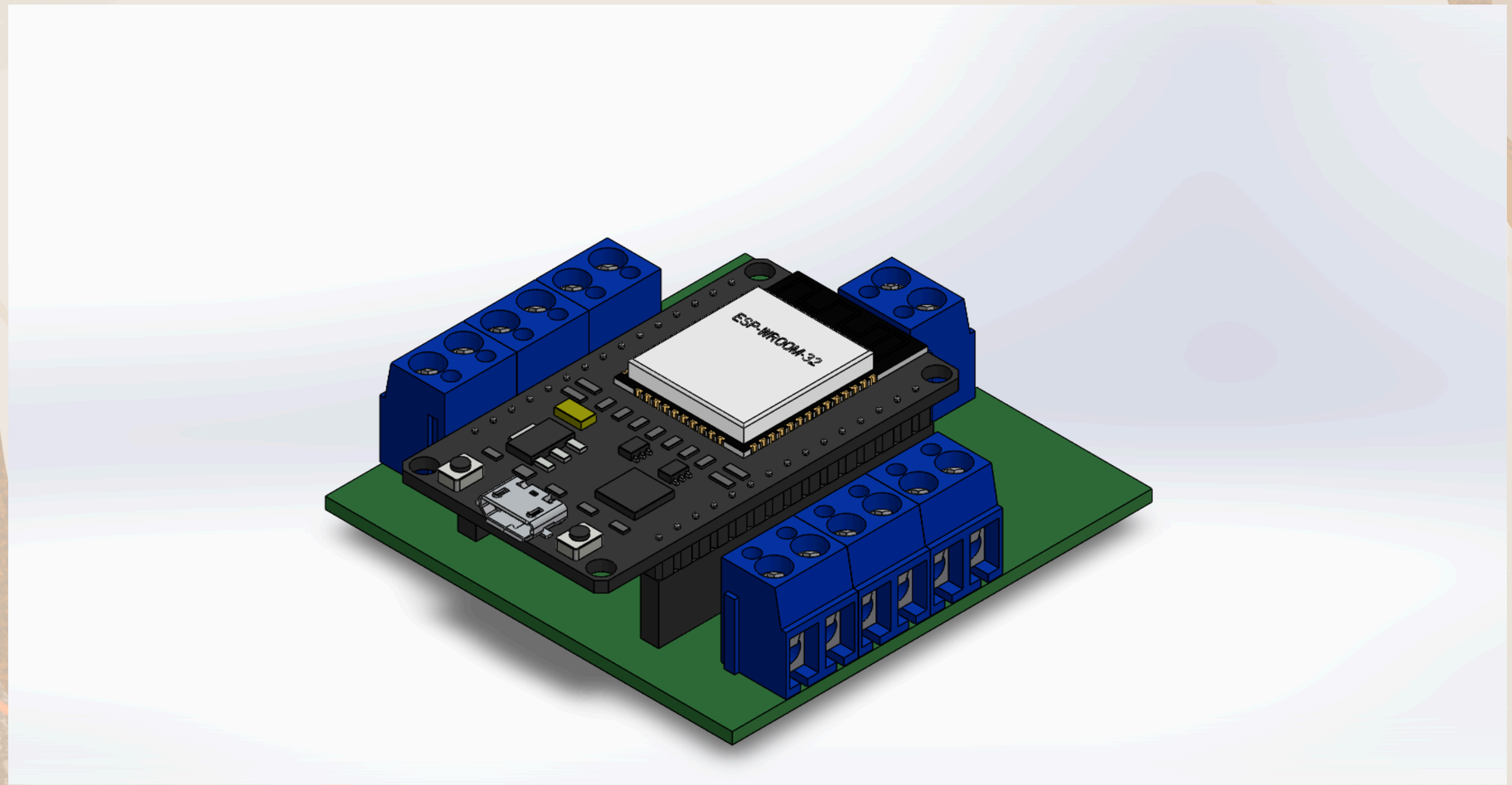


PCB

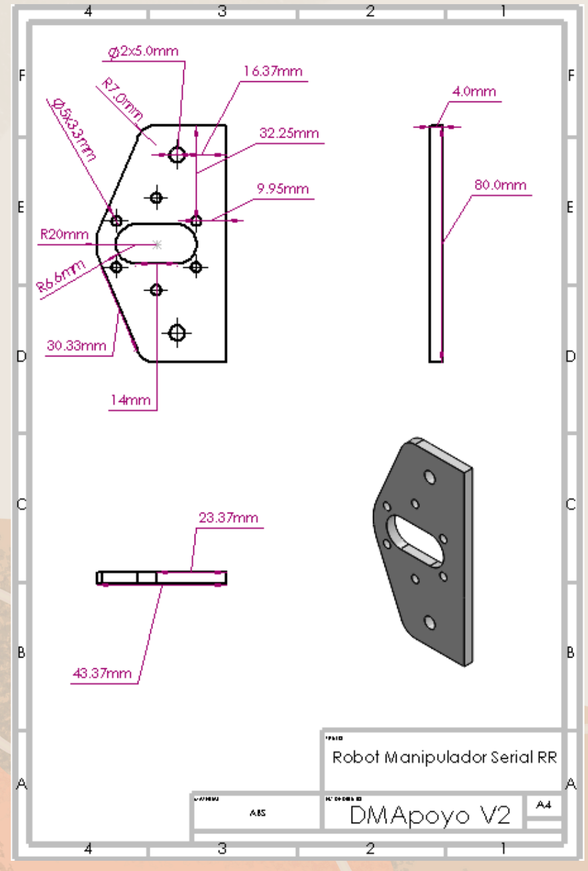


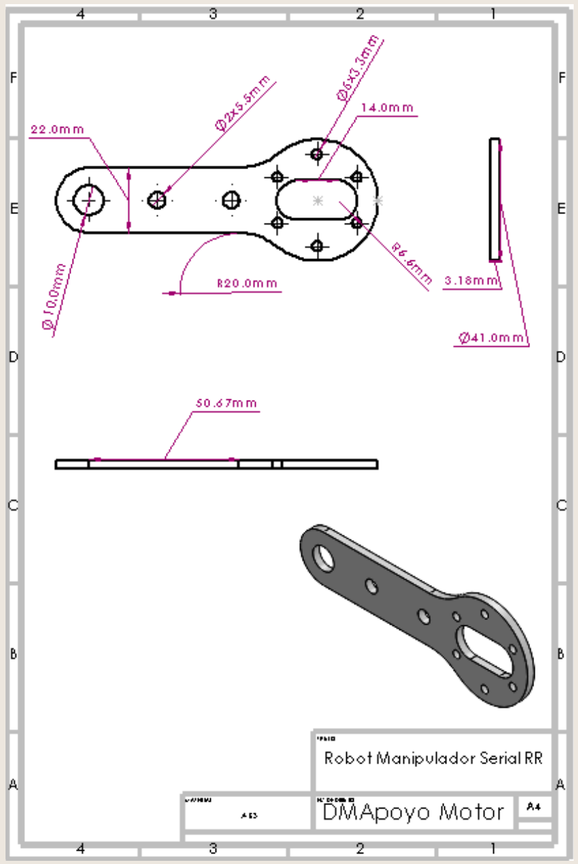


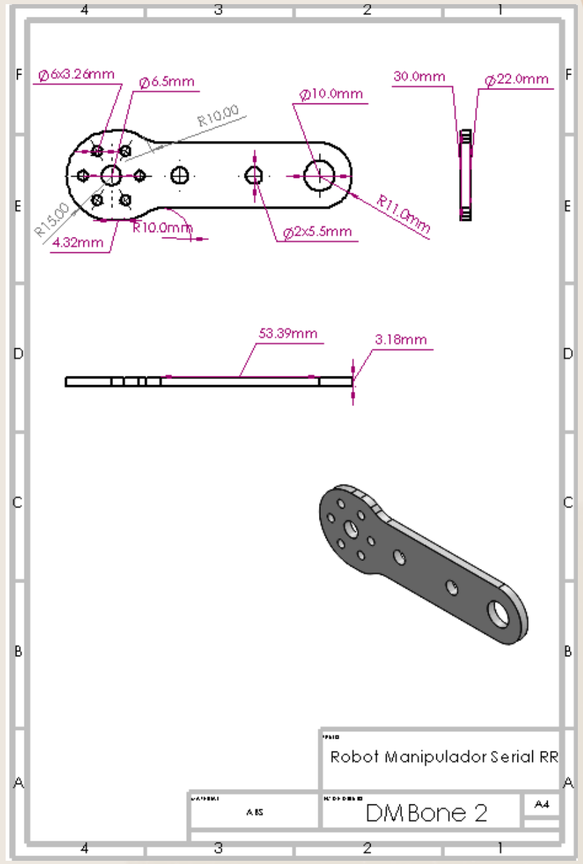
Representación grafica del PCB



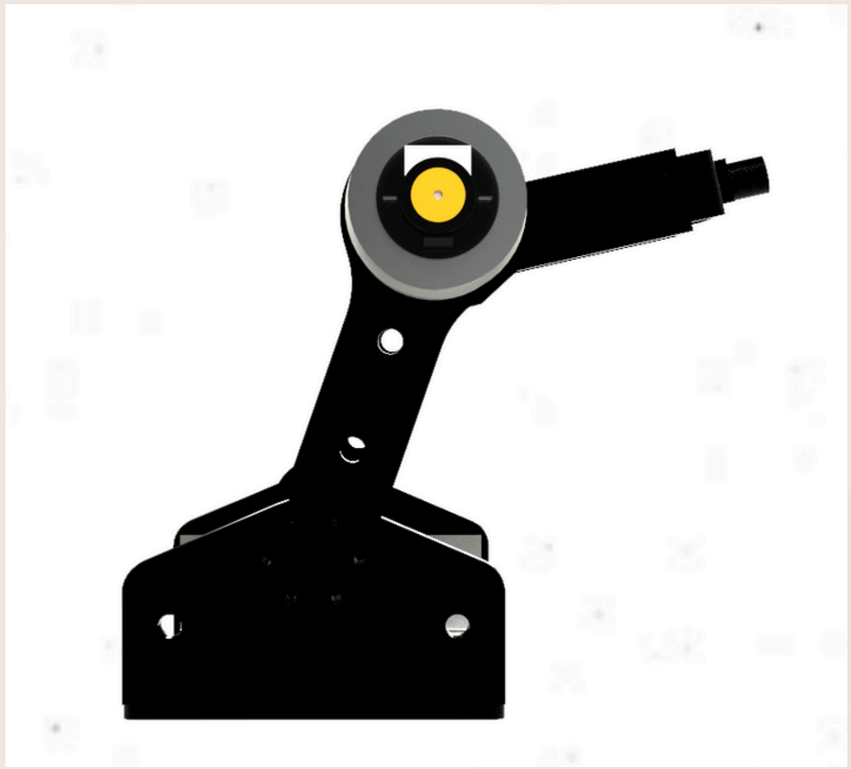
MODELO MECANICO



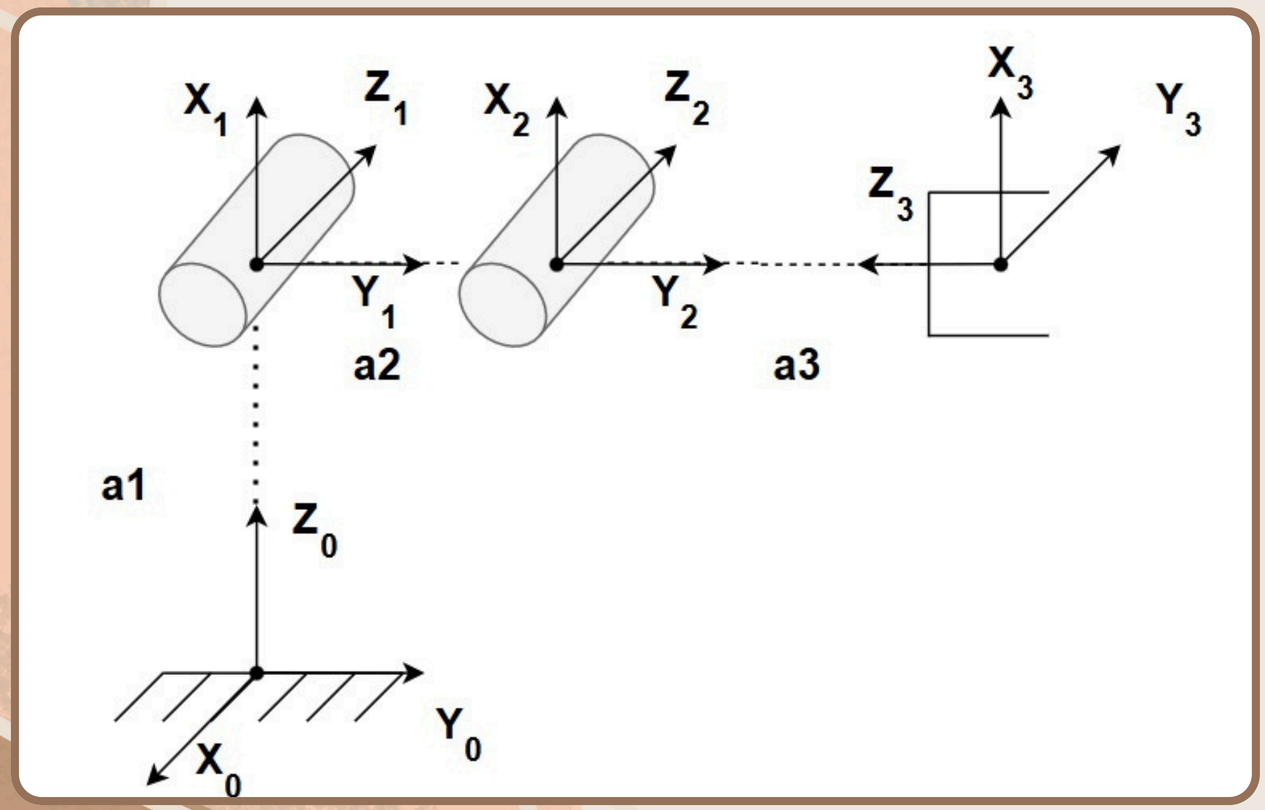




MODELO MECANICO



CINEMÁTICA DIRECTA



Operación del marco 1 al marco 0:

$$A_0^1 = T_z(a_1) = \begin{bmatrix} 0 & 0 & -1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & a_1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Operación del marco 2 al marco 1:

$$\mathrm{A}_1^2 = R_z(q_1)\cdot T_y(a_2) = \begin{bmatrix} \cos(q_1) & -\sin(q_1) & 0 & 0 \\ \sin(q_1) & \cos(q_1) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & a_2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} \cos(q_1) & -\sin(q_1) & 0 & -a_2\sin(q_1) \\ \sin(q_1) & \cos(q_1) & 0 & a_2\cos(q_1) \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

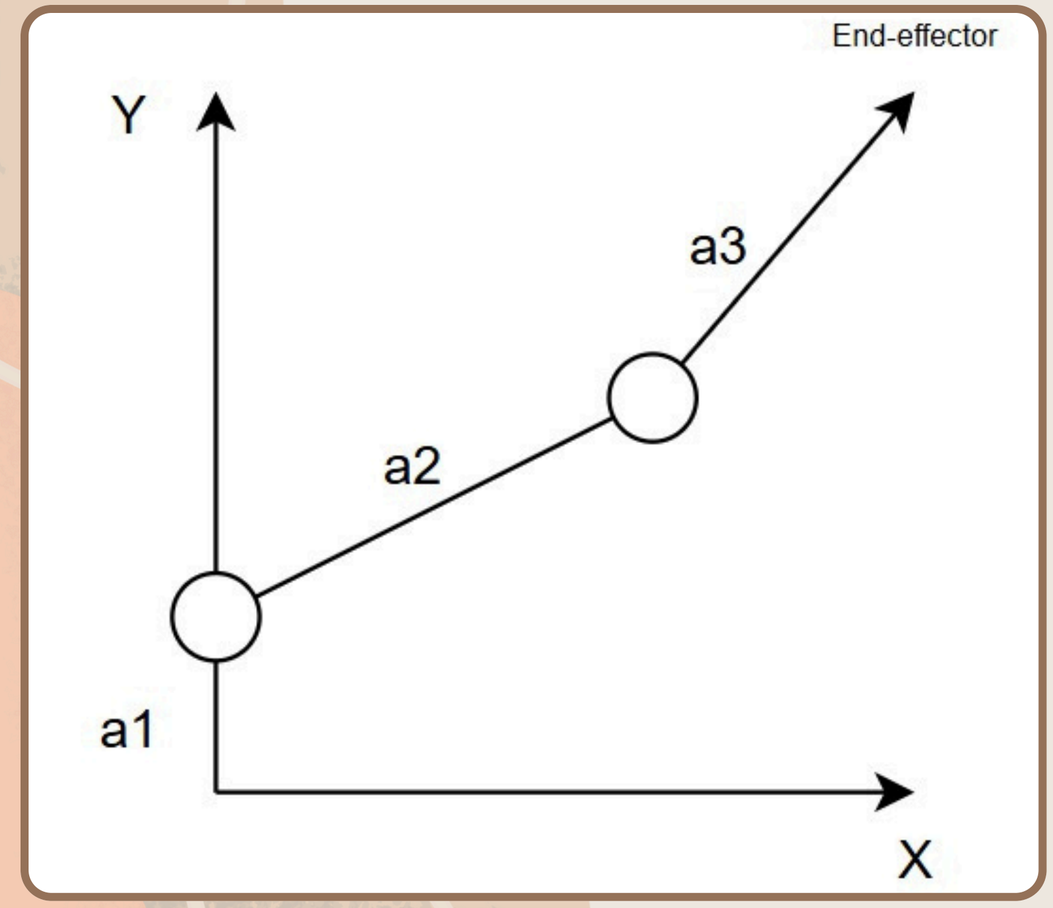
Operación del marco 3 al marco 1:

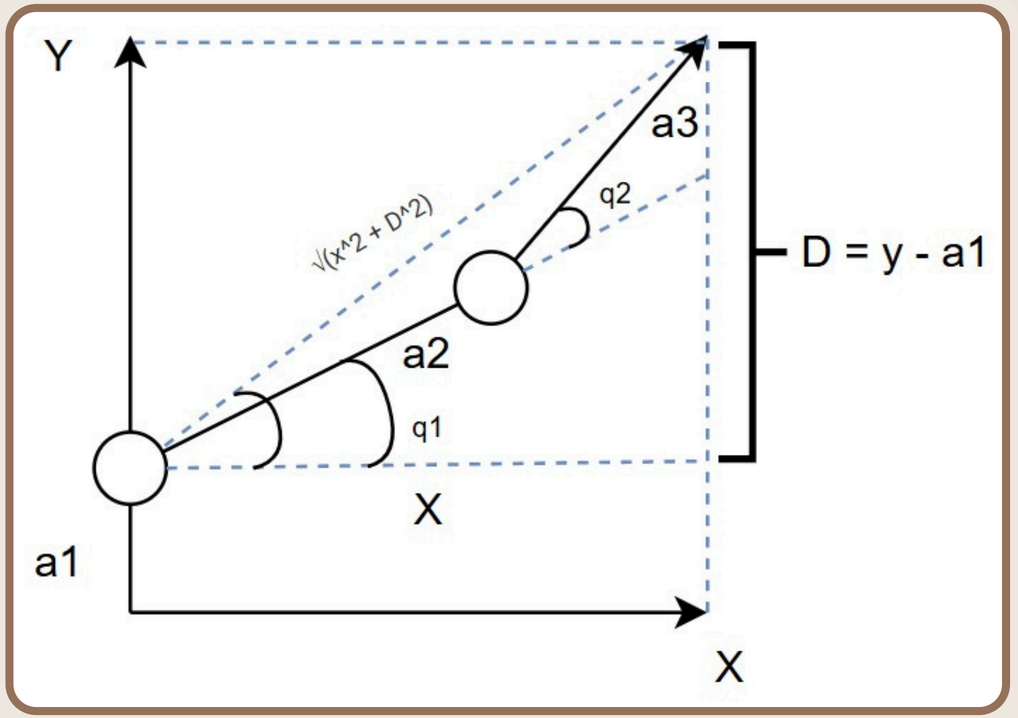
$$\mathrm{A}_2^3 = R_z(q_2)\cdot T_y(a_3) = \begin{bmatrix} \cos(q_2) & -\sin(q_2) & 0 & 0 \\ \sin(q_2) & \cos(q_2) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & a_3 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} \cos(q_2) & -\sin(q_2) & 0 & -a_3\sin(q_2) \\ \sin(q_2) & \cos(q_2) & 0 & a_3\cos(q_2) \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

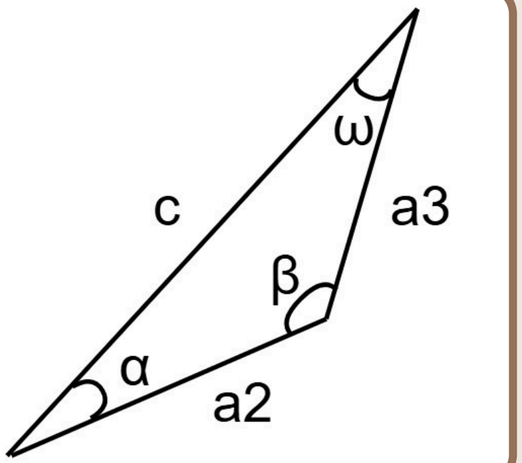
Resultado:

$$\mathrm{T}_f = A_0^1 A_1^2 A_2^3 = \begin{bmatrix} 0 & -1 & 0 & 0 \\ \sin(q_1+q_2) & 0 & -\cos(q_1+q_2) & a_3\cos(q_1+q_2)+a_2\cos(q_1) \\ \cos(q_1+q_2) & 0 & \sin(q_1+q_2) & a_1-a_3\sin(q_1+q_2)-a_2\sin(q_1) \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

CINEMÁTICA INVERSA







Por medio del triángulo obtusángulo se puede obtener q2 por medio de la ley de cosenos.

$$c^2 = a_2^2 + a_3^2 - 2 * a_2 * a_3 * \cos(180 - q2)$$

$$-\cos(180 - q2) = \frac{x^2 + D^2 - a_2^2 - a_3^2}{2a_2a_3}$$

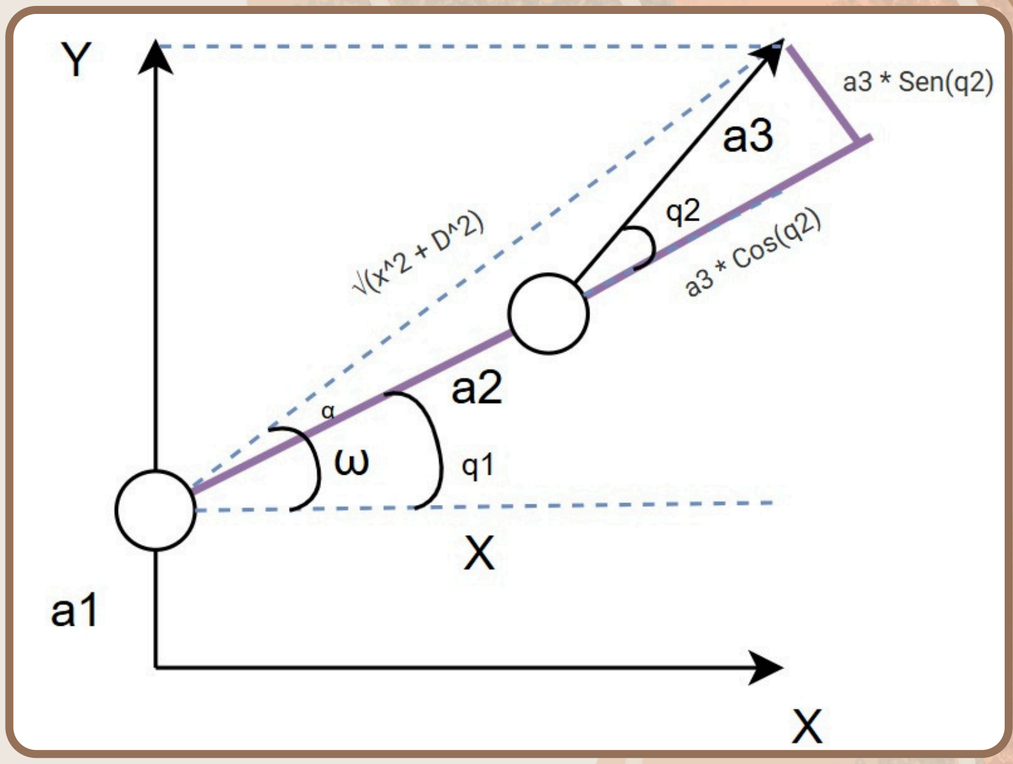
$$(q2) = acos * (\frac{x^2 + D^2 - a_2^2 - a_3^2}{2a_2a_3})$$

Para q1:

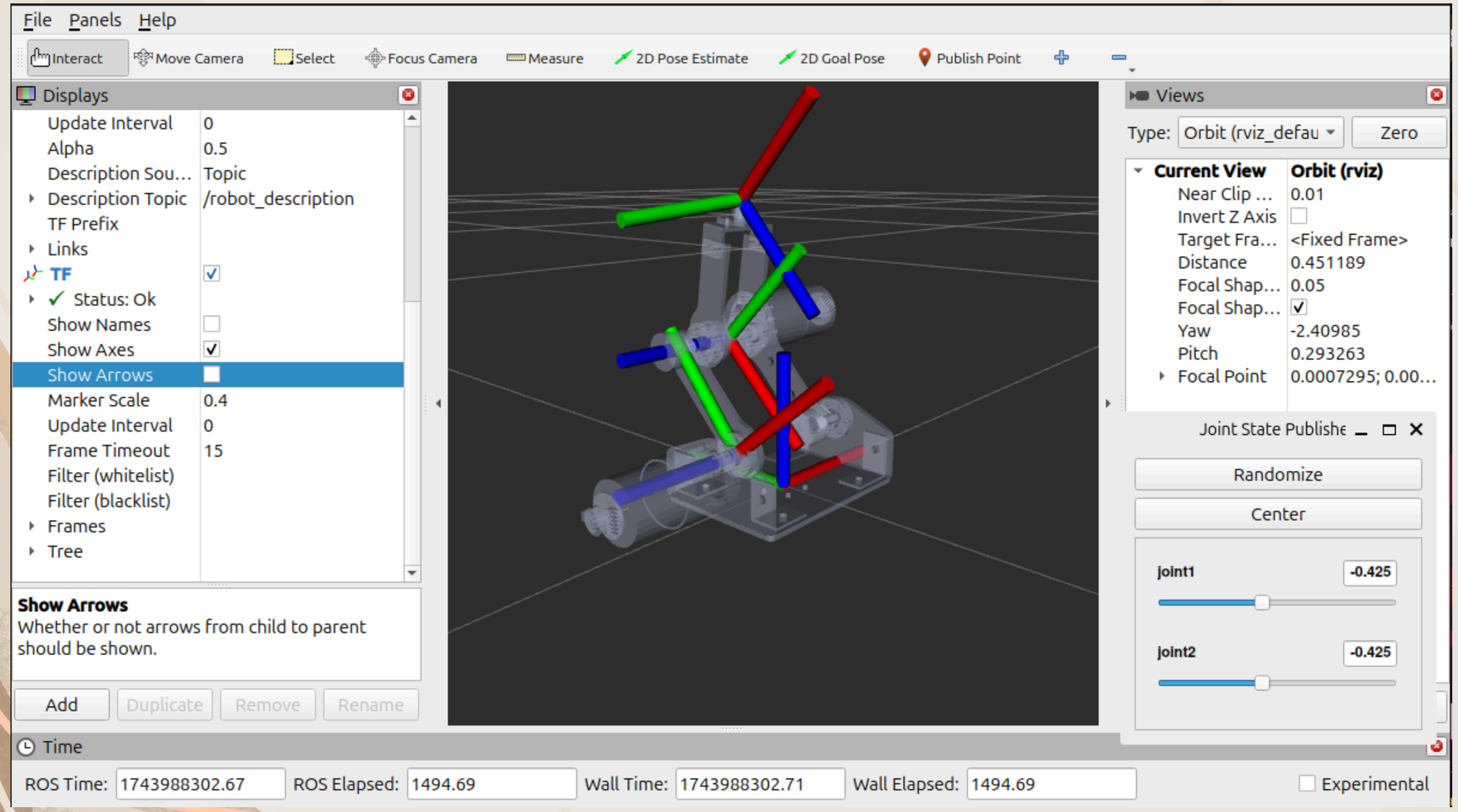
$$q1 = w - a$$

$$(q1) = atan * (\frac{D}{X}) - a$$

$$(q1) = atan * (\frac{D}{X}) - atan * (\frac{a_3 * sen(q2)}{a_2 + a_3 * Cos(q2)})$$



Visualización del modelo en Rviz



GRACIAS