



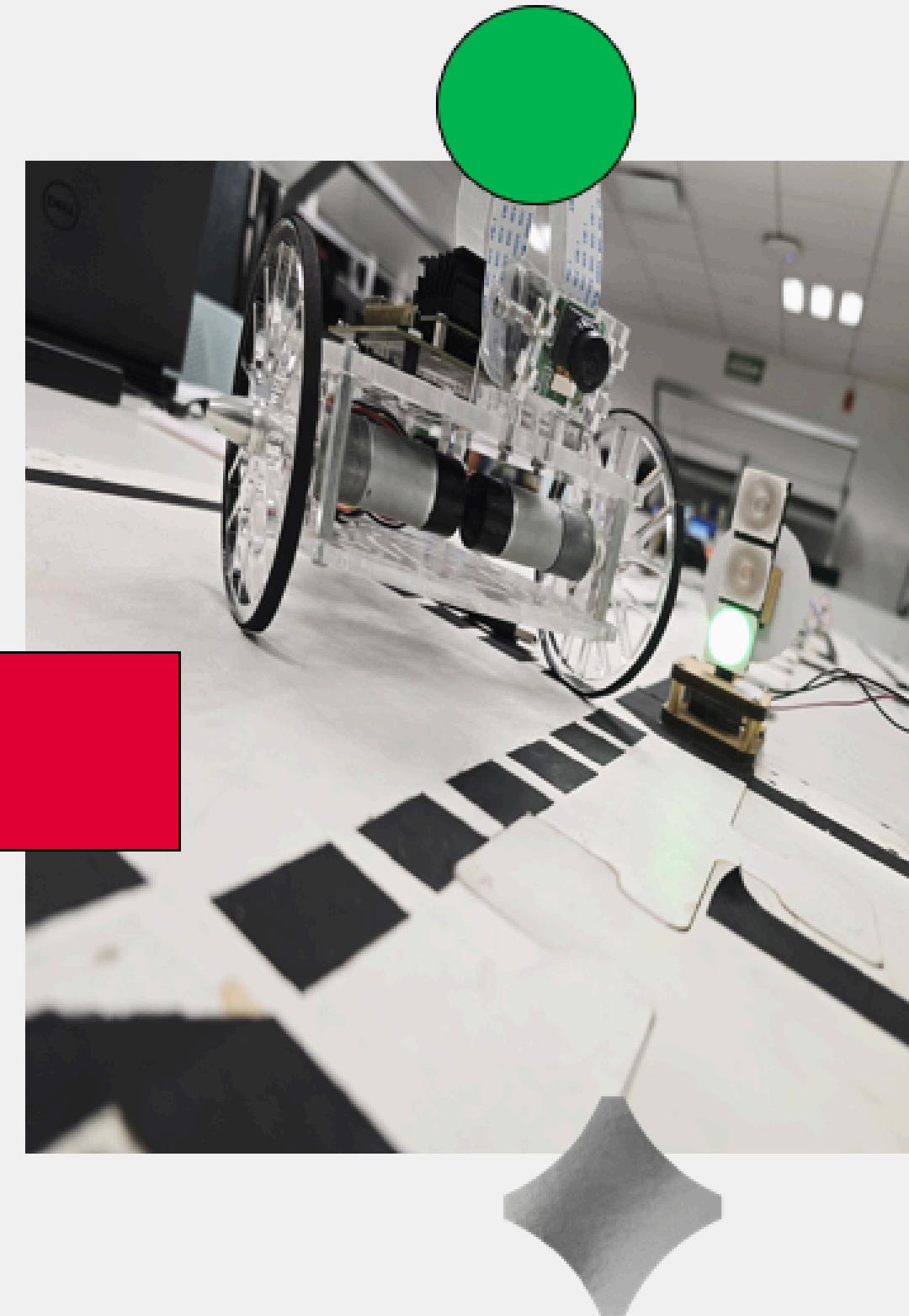
Tecnológico de Monterrey
Escuela de Ingeniería y Ciencias



Ei expo ingenierías

Grupo:

TE3002B-501



Health for
people



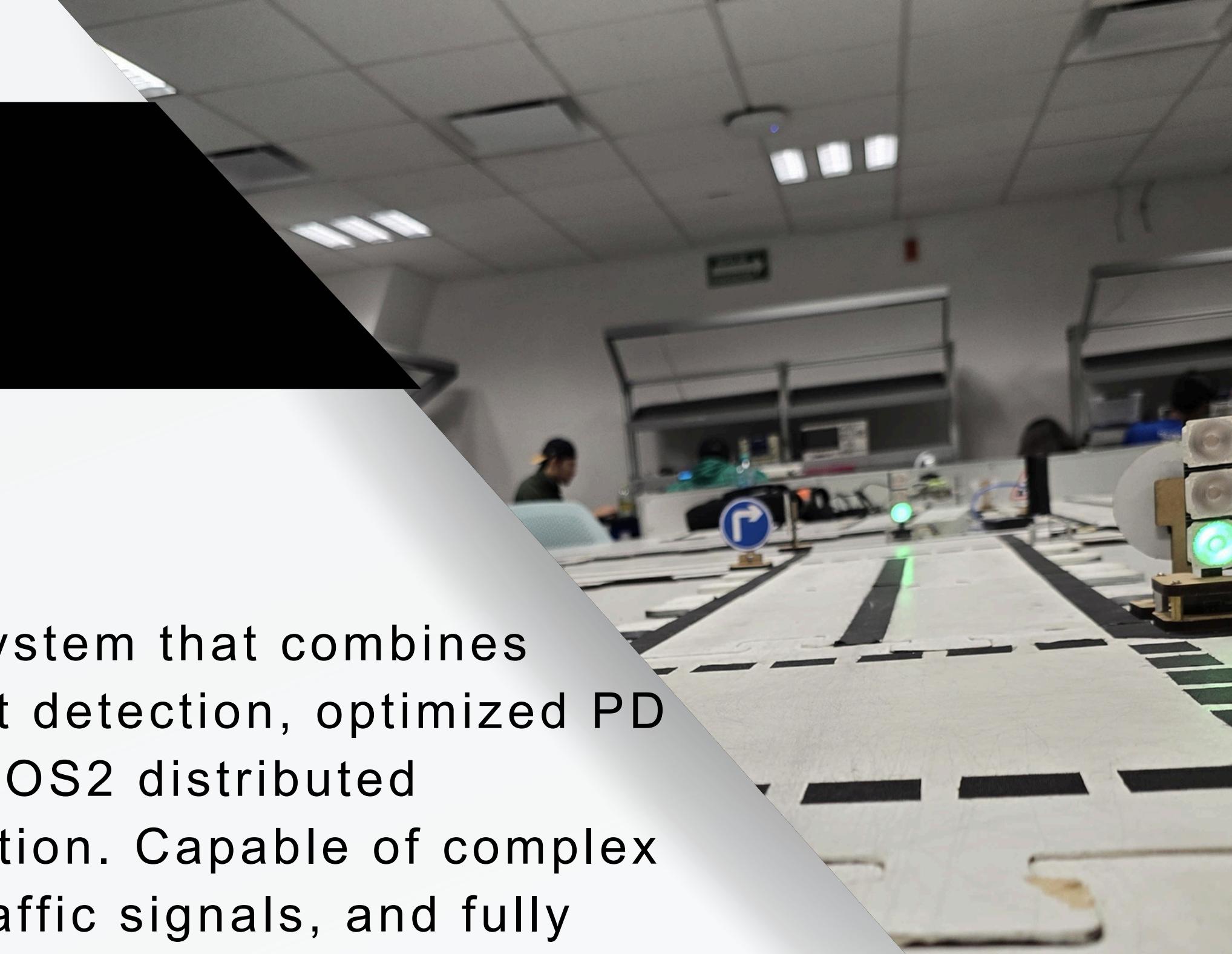
Climate & Sustainability
for the planet



Industrial Transformation
for prosperity

SITUATION

Advanced autonomous navigation system that combines YOLO neural networks for intelligent detection, optimized PD control for precise tracking, and a ROS2 distributed architecture for multi-node coordination. Capable of complex maneuvers, adaptive response to traffic signals, and fully autonomous navigation in dynamic environments



STRUCTURE

objective

Develop an advanced autonomous navigation system by integrating neural networks, ROS2 distributed control, and precision maneuvers

Approach



Algorithms and AI



Results



PLANTING

6 specialized ROS2 nodes
Vision + AI for intelligent sensing
Optimized PD control
Precise maneuvering at intersections
Real-time coordination

FLAG

Sistema de Estados Coordinados:

- ✓ flag_crossing → Pausa/reanuda line follower
- ✓ flag_signal → Procesa señales detectadas
- ✓ flag_light → Gestiona semáforos
- ✓ Sincronización entre 6 nodos ROS2
- ✓ Estados persistentes para robustez

LINE FOLLOWER

Control PD Inteligente:

- ✓ Kp=0.015, Kd=0.01 optimizados
- ✓ Velocidades adaptativas (0.04-0.125 m/s)
- ✓ Buffer filtering (3 muestras)
- ✓

$$\text{angular_velocity} = (\text{self.Kp} * \text{filtered_error}) + (\text{self.Ki} * \text{self.integral}) + (\text{self.Kd} * \text{derivative})$$

ODOMETRÍA

Navegación de Precisión:

- ✓ Movimientos exactos ($\pm 1\text{cm}$ precisión)
- ✓ Rotaciones controladas ($\pm 1^\circ$ precisión)
- ✓ Maniobras complejas (derecho/izq/der)
- ✓ Encoders diferenciales calibrados
- ✓ Pausas inteligentes entre movimientos

ARCHITECTURE

01

The camera obtains information from the environment

02

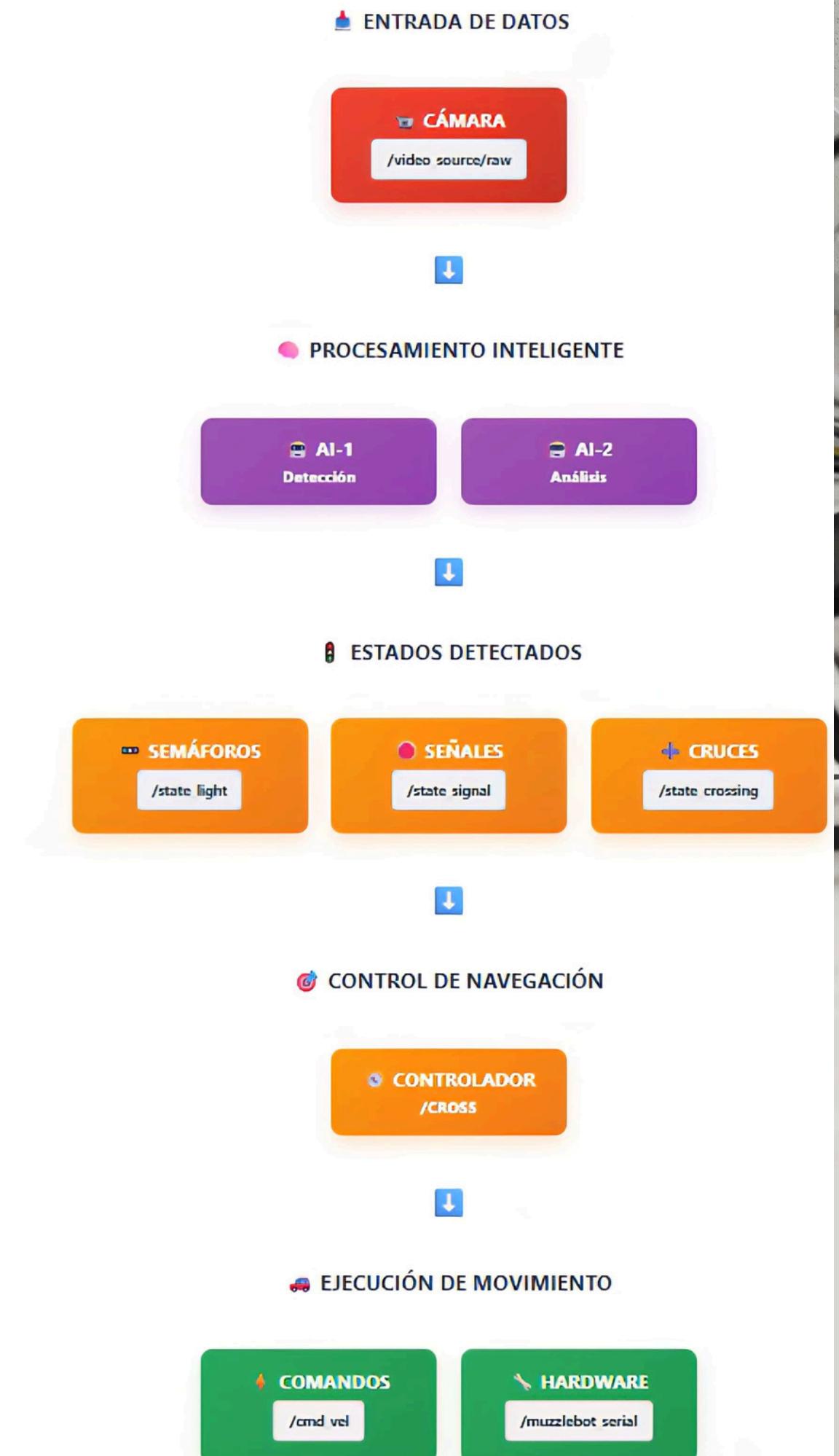
AI detects traffic lights, signs and intersections

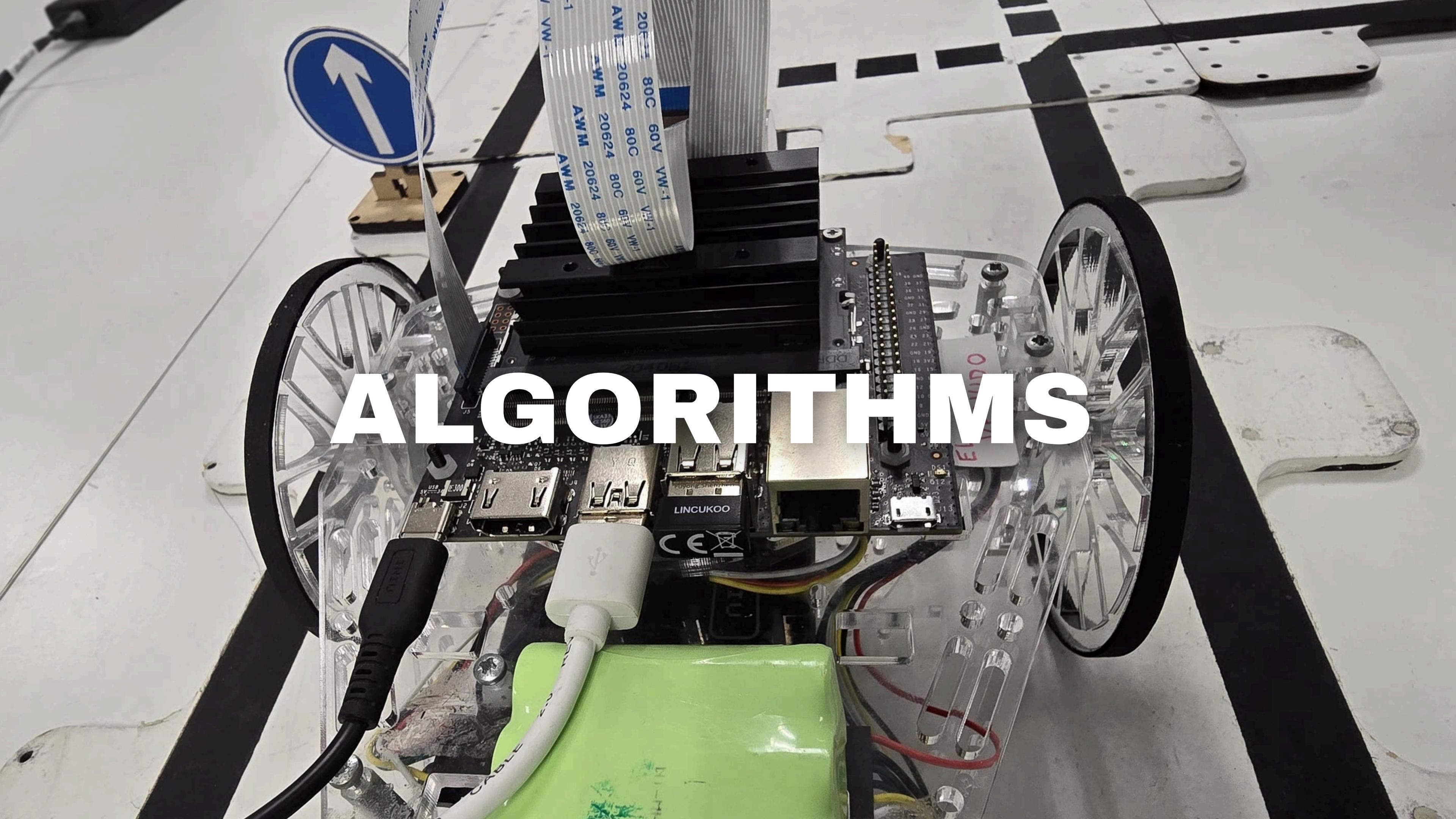
03

The controller decides what to do

04

The robot executes the movement



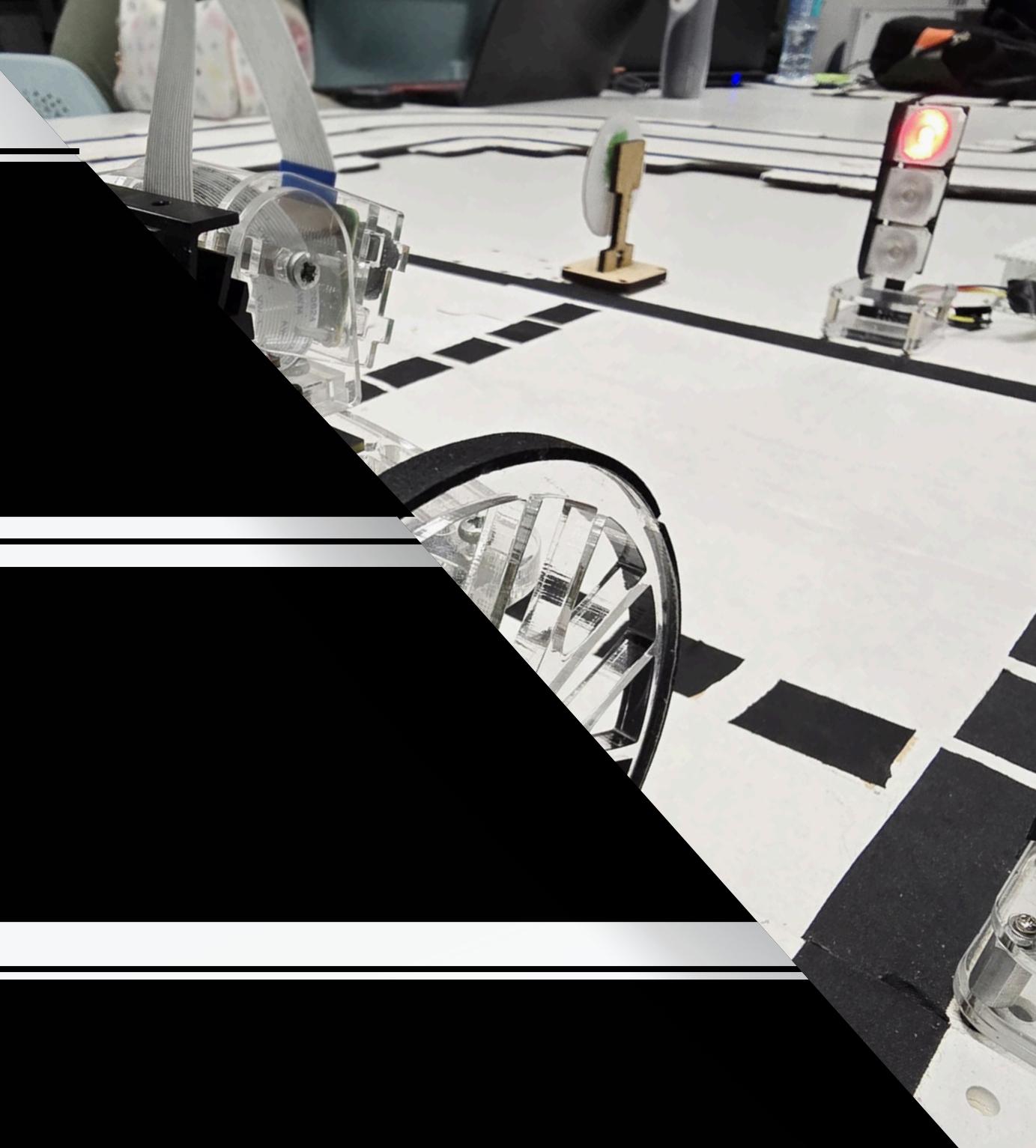
A collage of various electronic components and a road sign. In the center, large white letters spell out "ALGORITHMS". The background includes a blue circular road sign with a white arrow pointing left, several black heat sinks, a green battery pack, a white USB cable, a black power adapter labeled "LINCUKOO", and a small printed circuit board with a "CE" mark. A metal frame with a gear and a black and white photograph of a city skyline are also visible.

ALGORITHMS

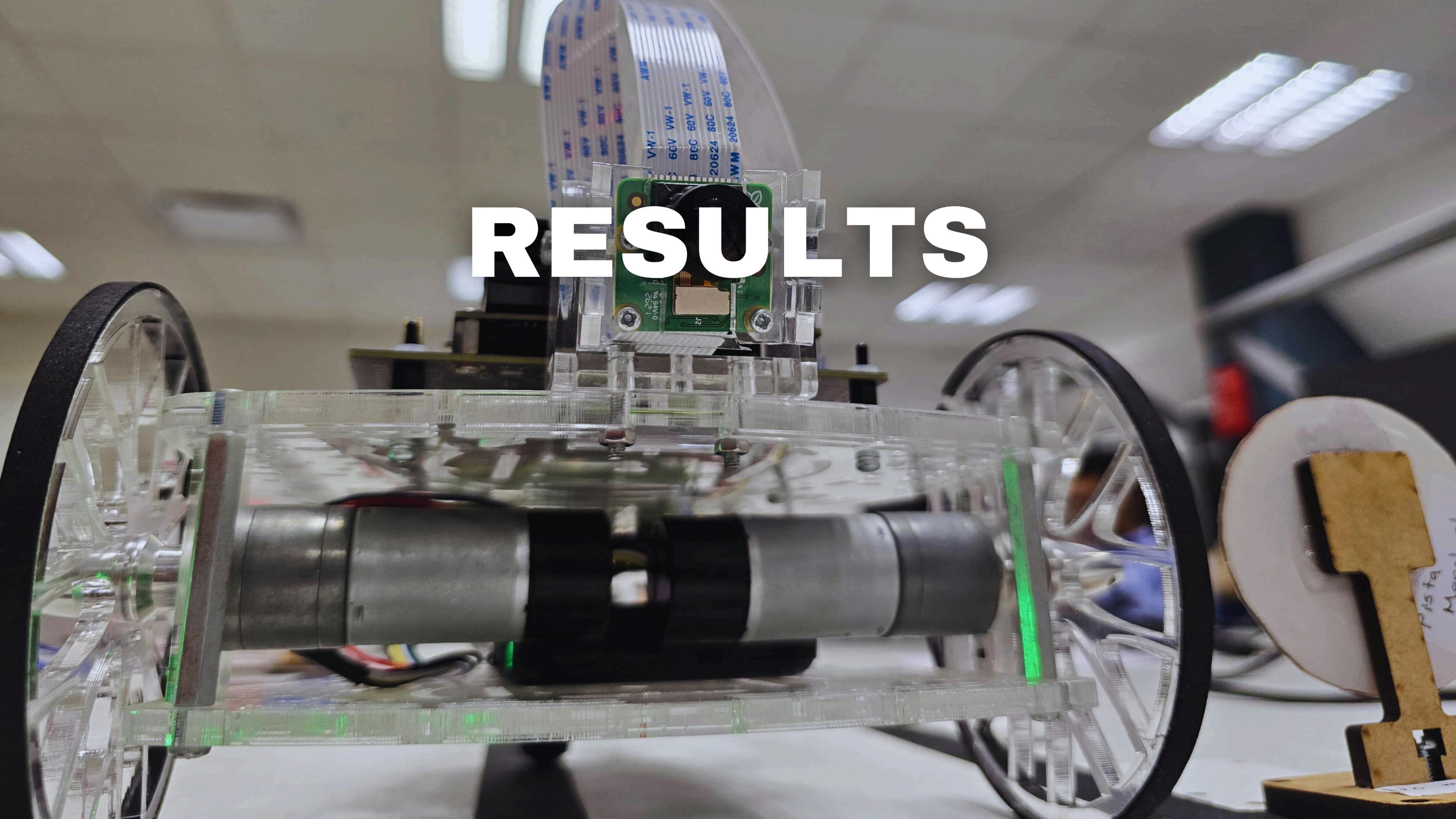
FLAG

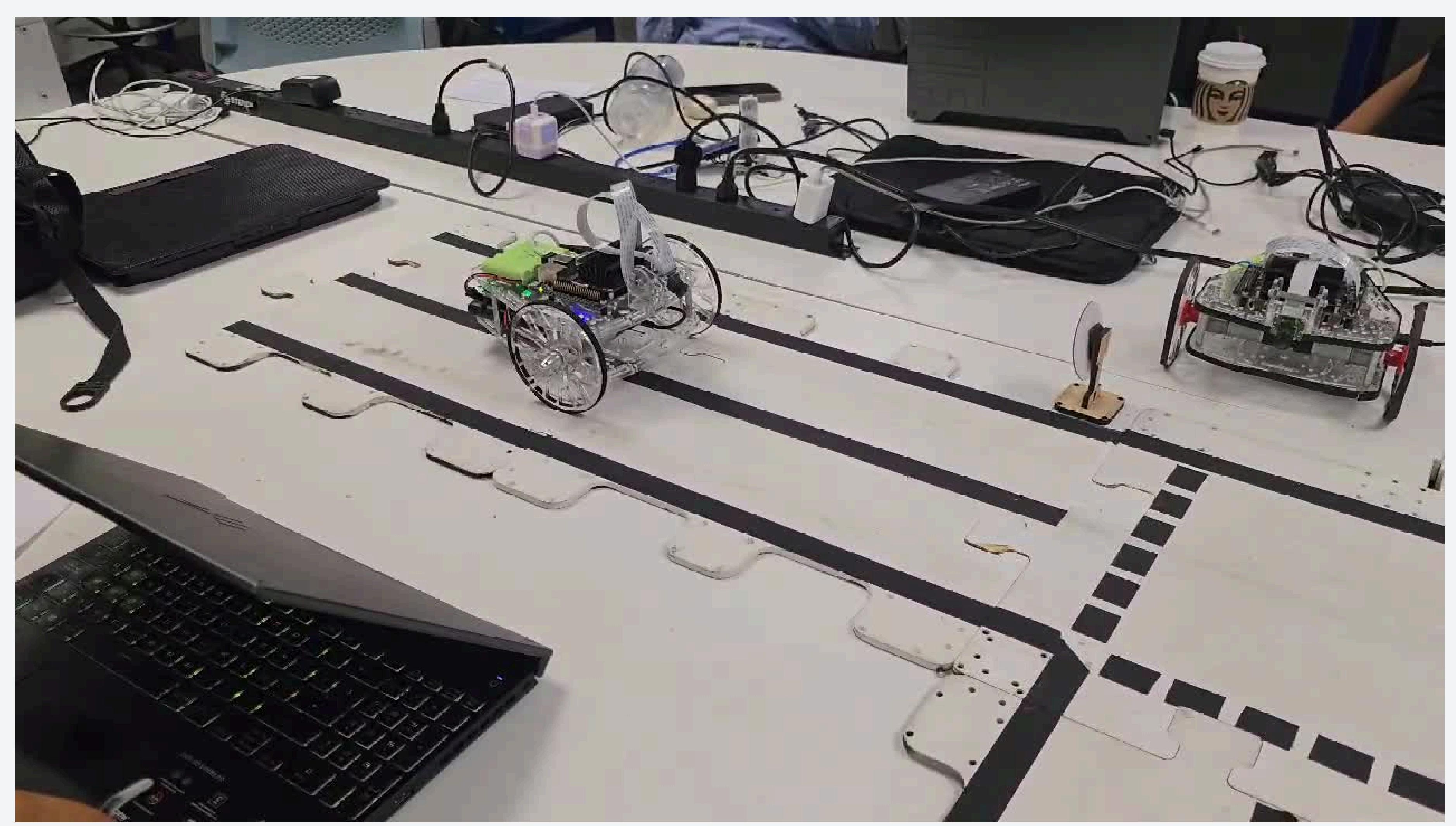
LINE FOLLOWER

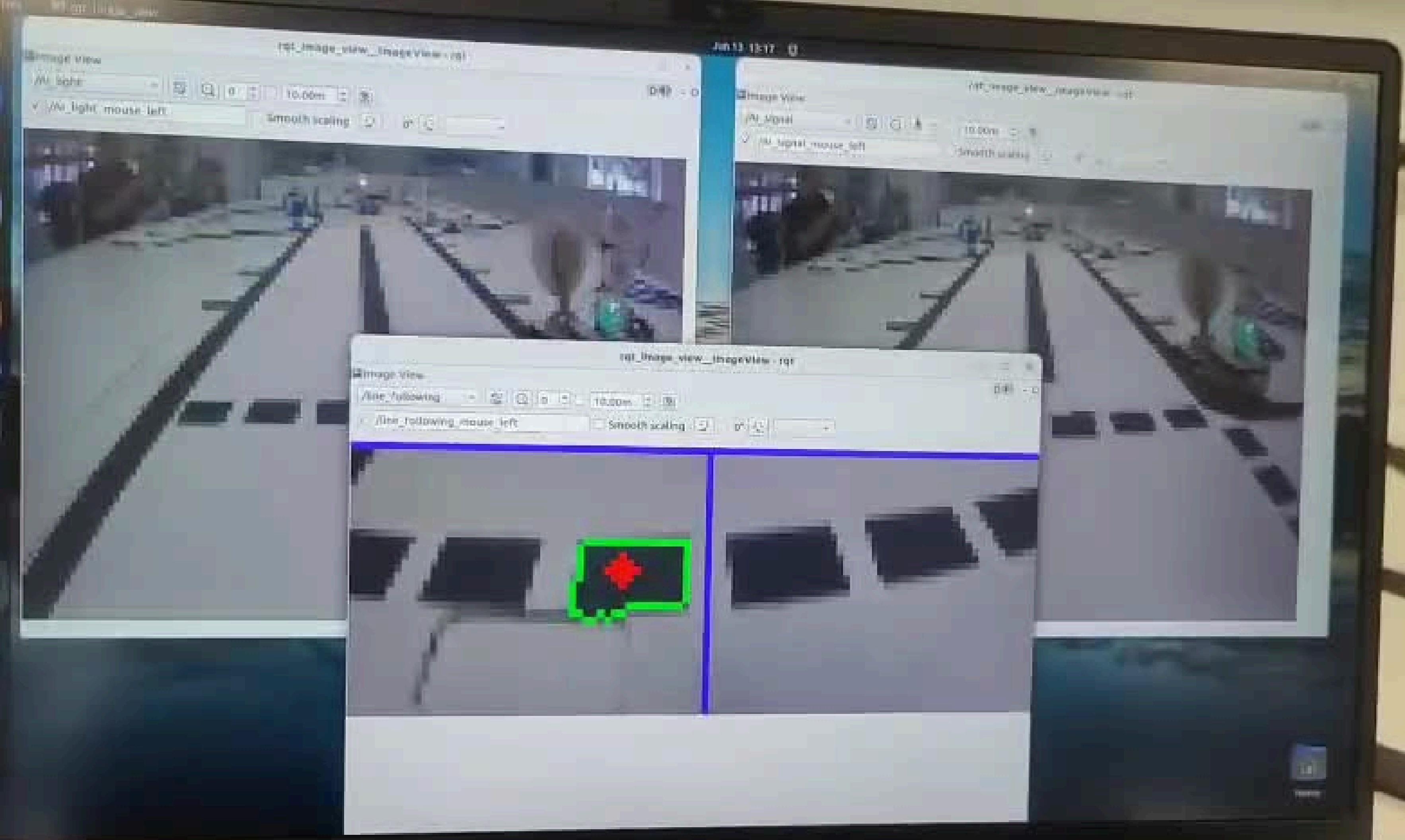
ODOMETRY

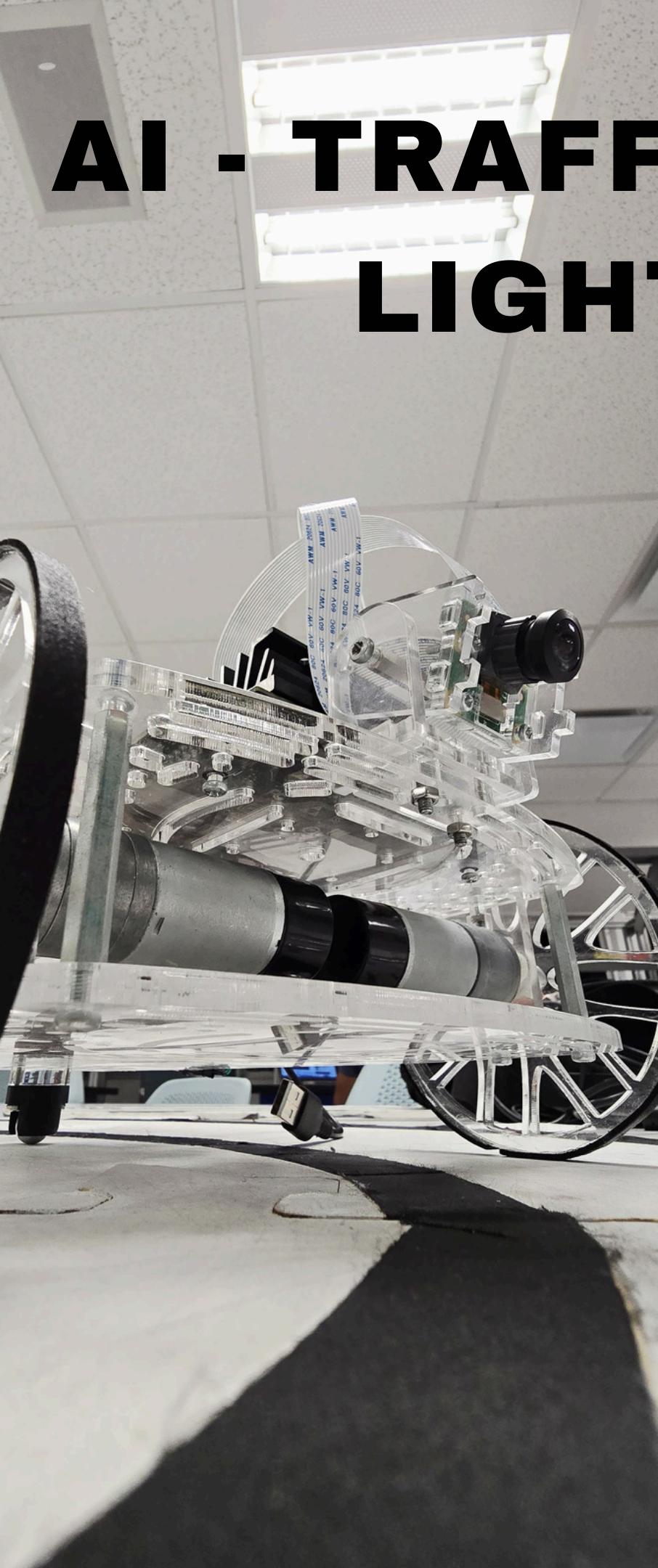


RESULTS







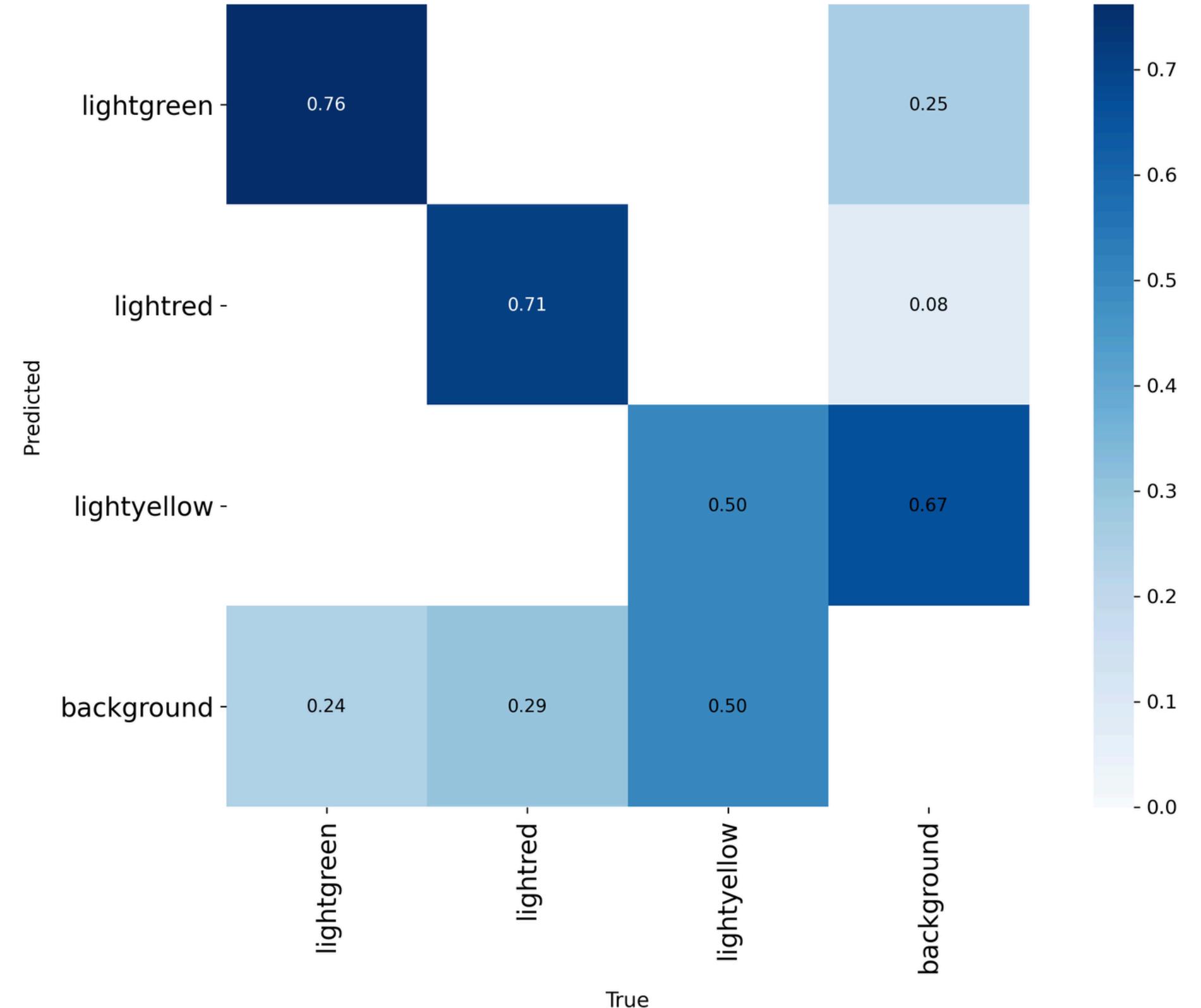


AI - TRAFFIC LIGHT

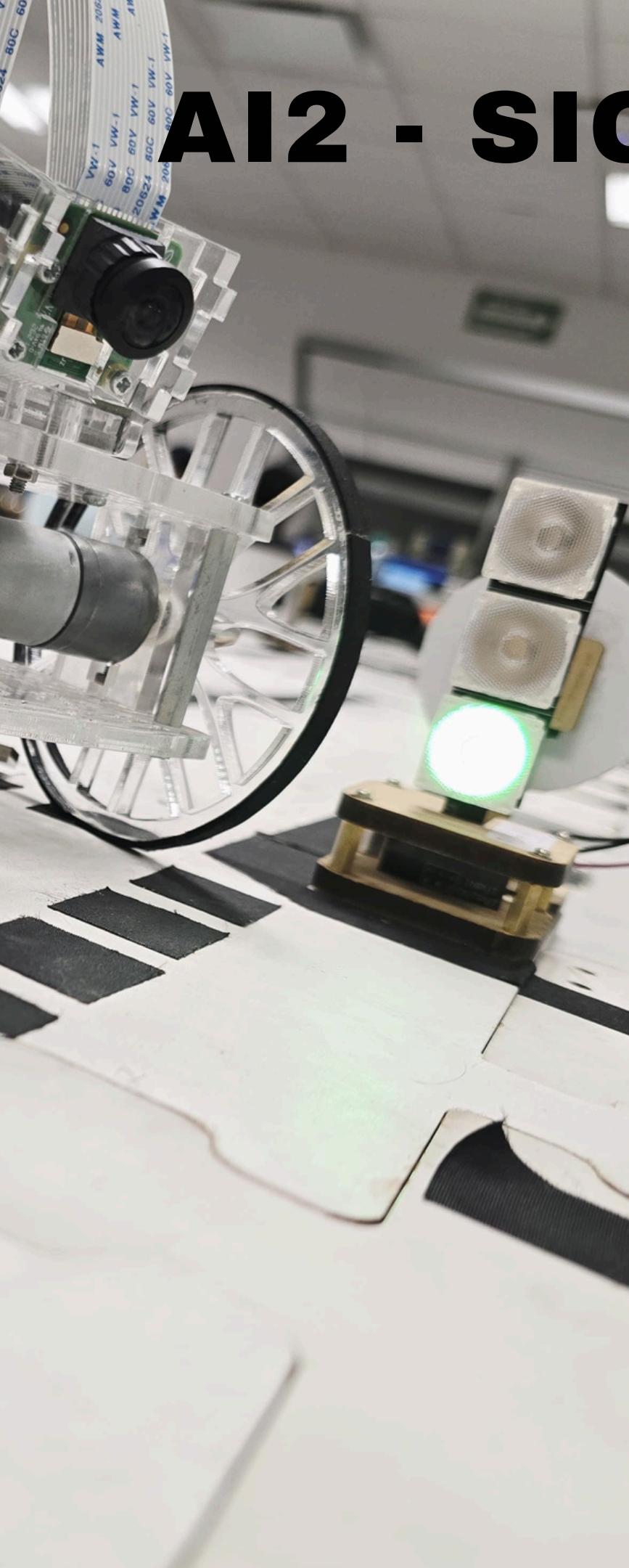
Parámetros:

- epochs: 200
- imgsz: [128, 96]
- Learning rate inicial : 0.01
- Learning rate final: 0.001

Confusion Matrix Normalized



- Momentum : 0.937
- Weight decay: 0.0005
- Warmup epochs: 5
- **Modelo:** Yolo11L (25m)



AI2 - SIGNALS

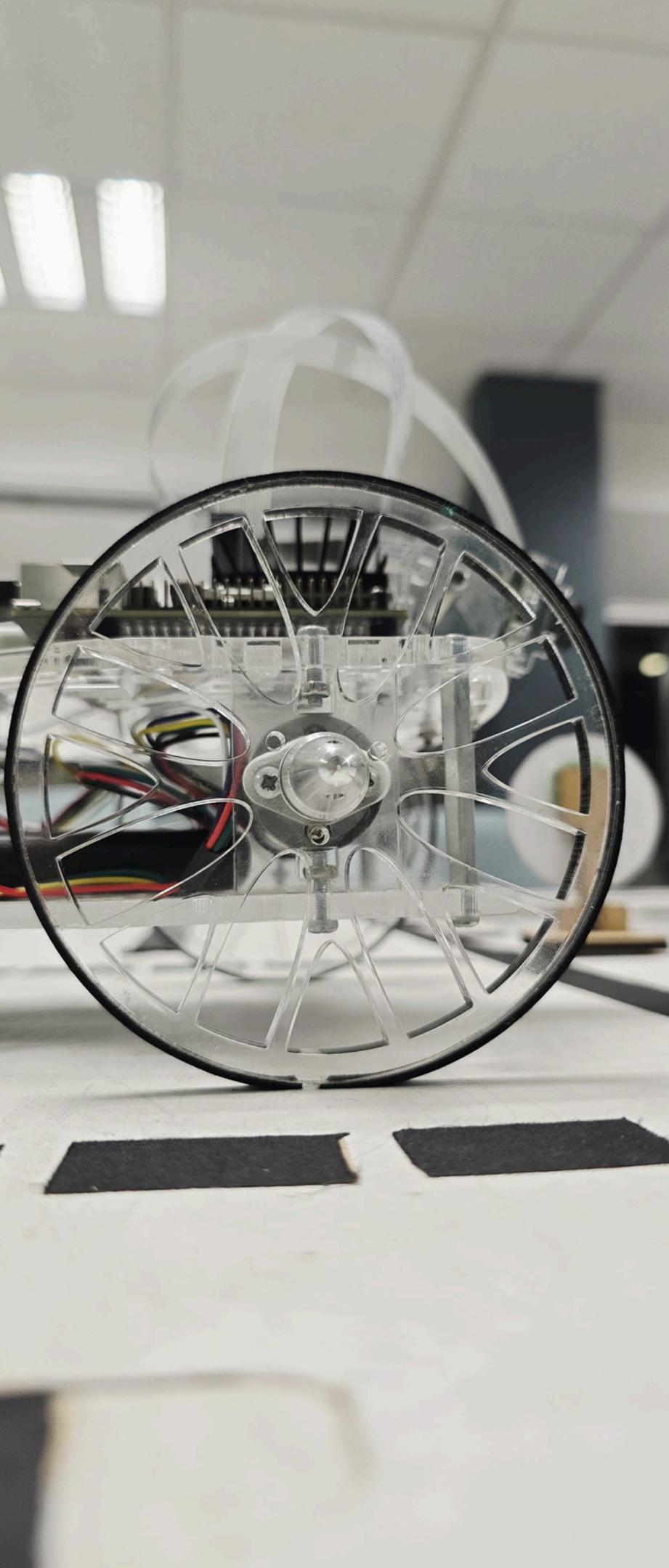
Parámetros:

- epochs: 150
- imgsz: [128, 96]
- Learning rate inicial : 0.01
- Learning rate final: 0.001

Confusion Matrix Normalized



- Momentum : 0.9
- Weight decay: 0.001
- Warmup epochs: 10
-



SYSTEM ACCURACY

50%

5/10

01

The light model is not robust

02

Variety of ambient lighting

03

The network is not robust enough to support multiple processes at the same time.

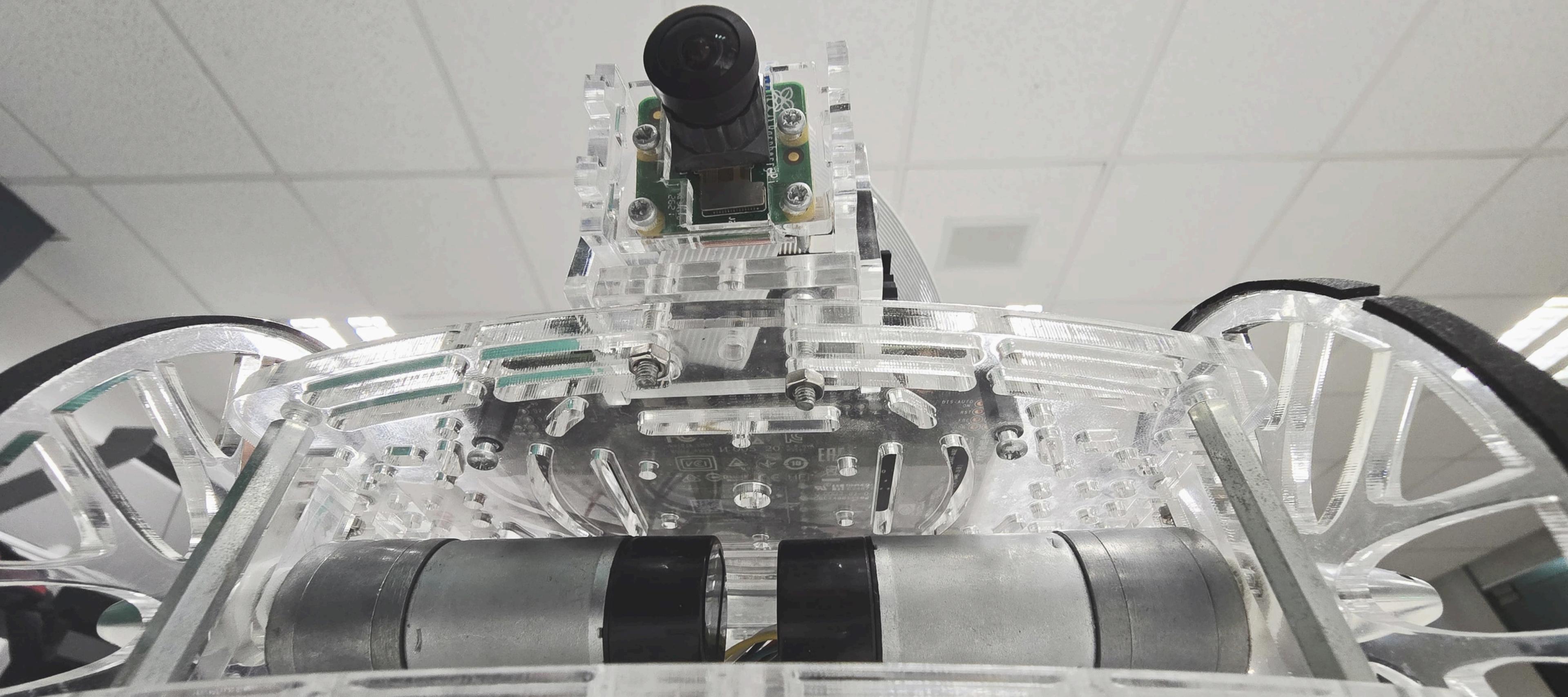
04

Still unsophisticated algorithm for complex cases.

05

Derivation of encoders

THANKS



Créditos:

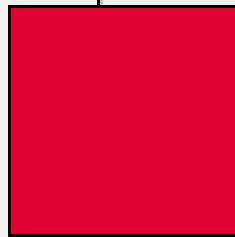
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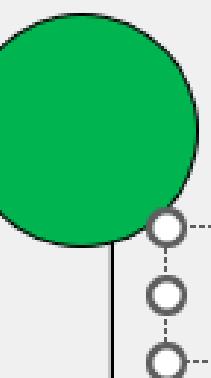
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