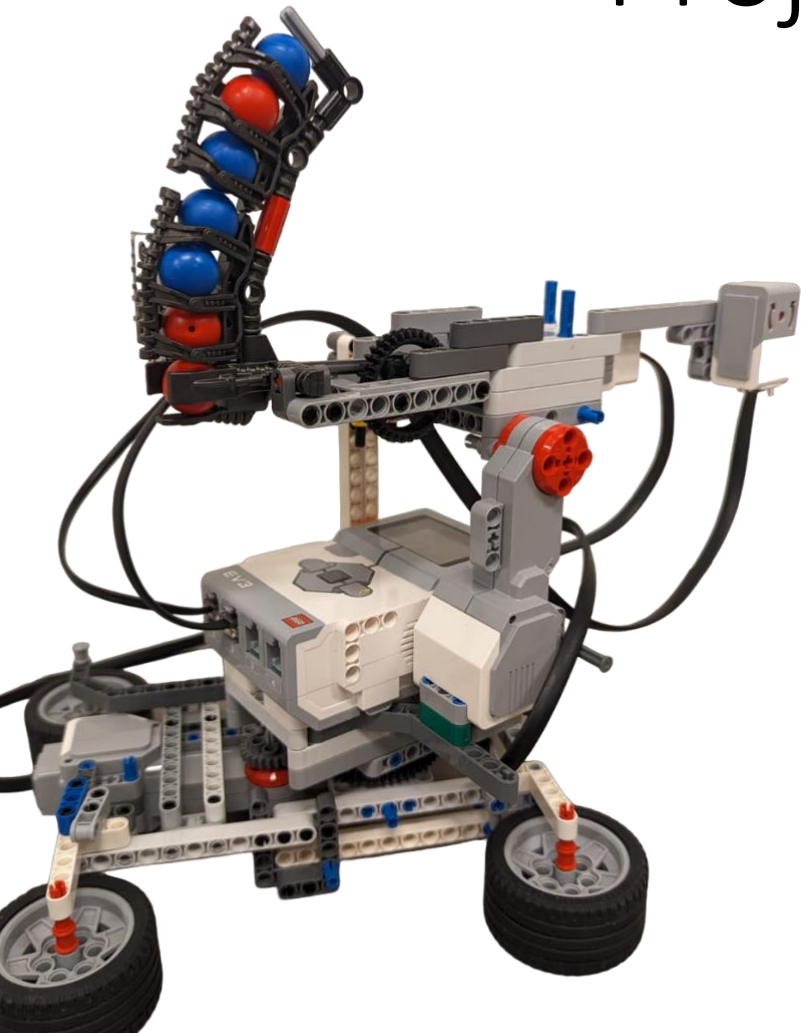
Project Anti-Drone system



Final report gold level
RedADS
15/01/2024

General specifications

Specification/functions:

Bronze

1. The System shall move 180° on Z axe and 90° on X axe.
2. The System shall detect a target located at minimum 5cm in front and up to 1,5m.
3. The System shall measure the distance of the target (assuming that it's size is known).

Silver

1. The object shall compute the angle and align the turrent to prepare to shoot at the target.
2. The System shall shoot down (hit) the target up to 1,5m radius from the turrent.

Gold

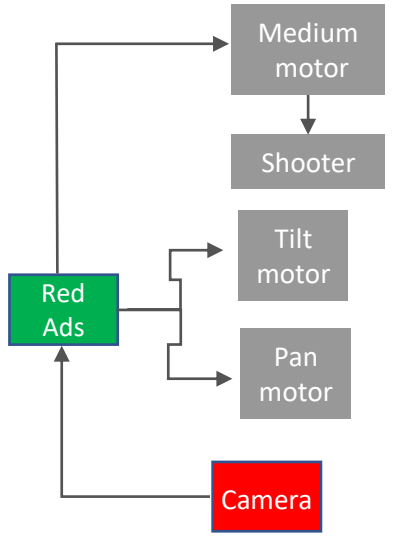
1. The system shall communicate with the PC of the user to report status and outcome of the mission

Design :

Motion (3 motors, 1 pressure launcher)

Sensor (1 camera)

Calculator (1 Lego Mindstorm Brick)



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Team

Project Manager
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Hardware Chief Engineer
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Software Chief Engineer
Antoine Wilson

Software Engineer
Shola Alabi Olayemi

Test chief engineer
Banhui Ren

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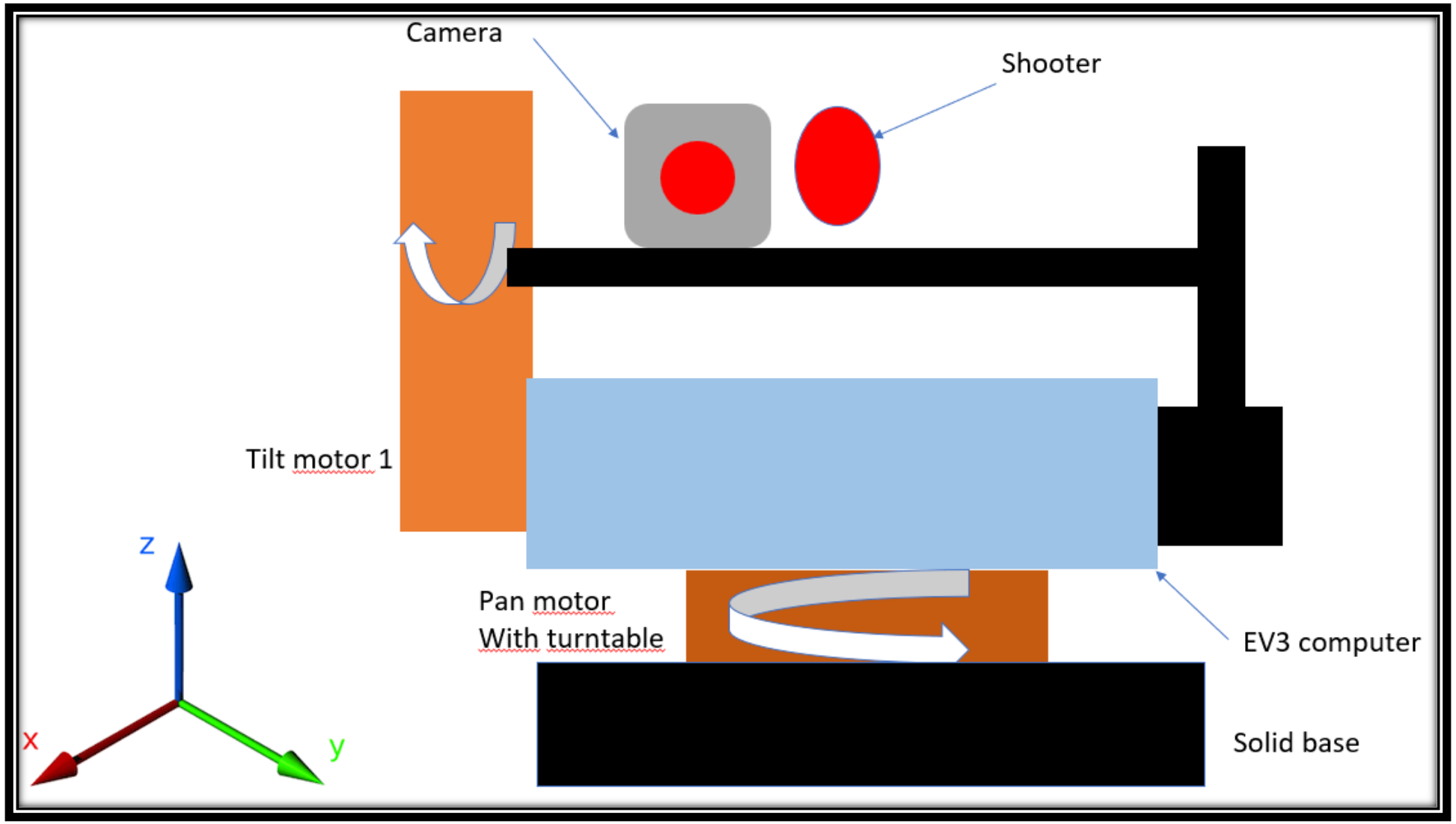
Hardware design : First design



Design presented on the first meeting

Hardware solution

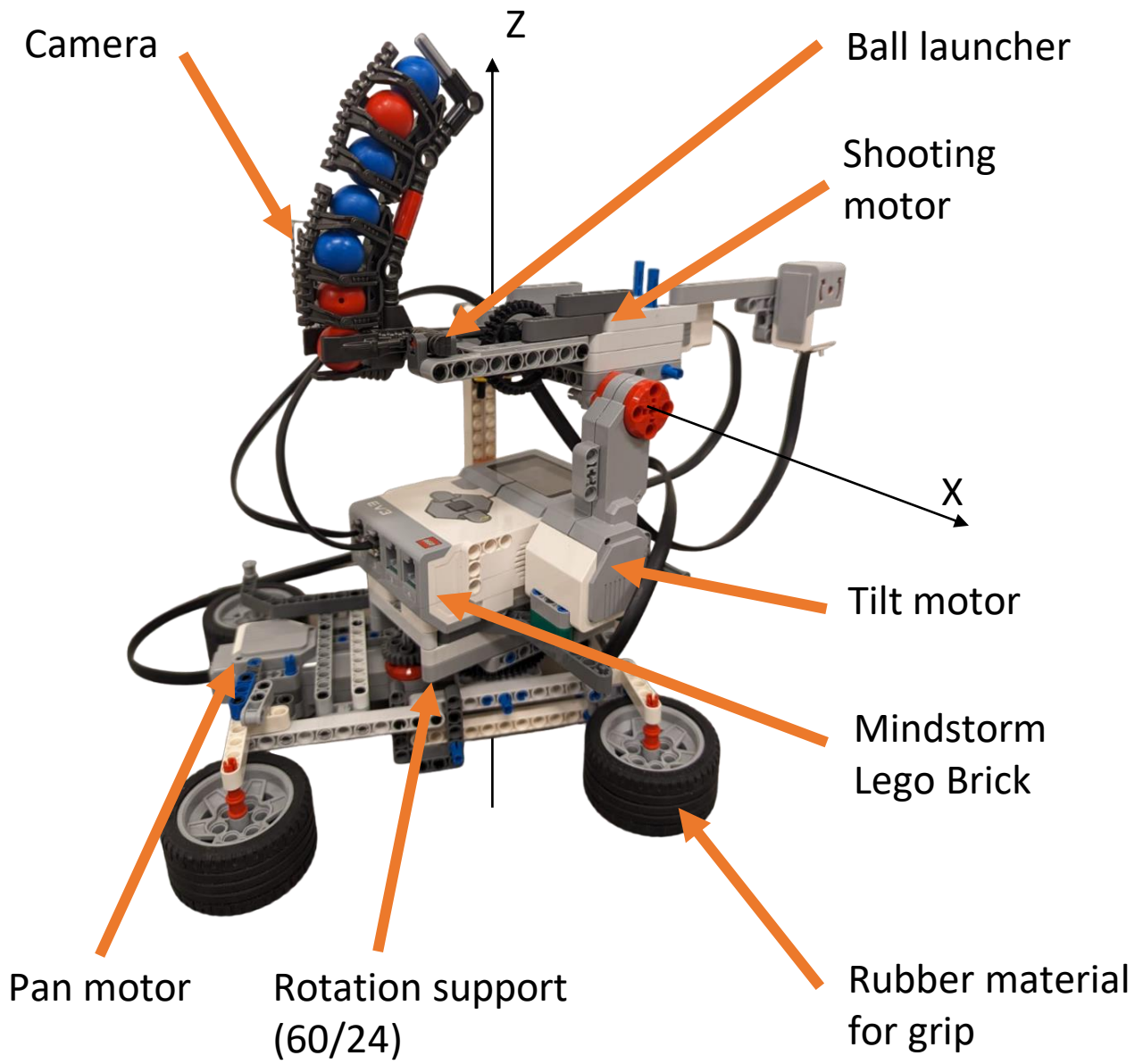
<u>Principal design choices :</u>

- A **solid base** for reduced vibration and robustness and rotation support for torque

- A design with very **few pieces** for scalable design

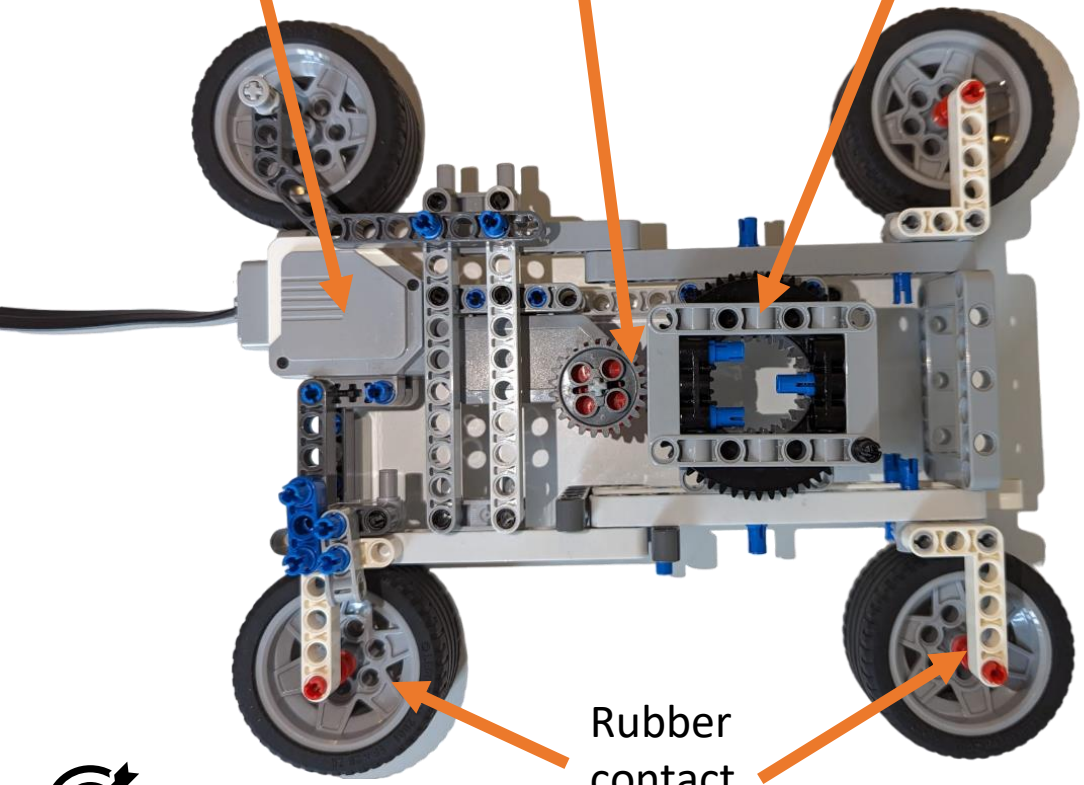
- A **compact shooting system** and on the **same axis** with the camera for the balistics

This is our drone !
Its 13x11 cm and completely yellow

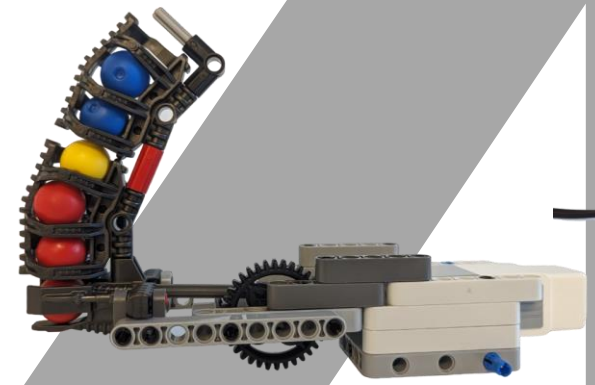


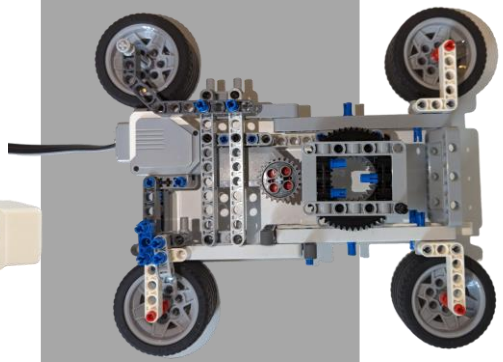
Hardware solution

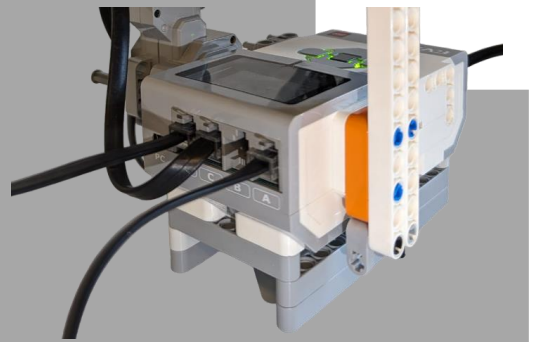
A solid base



A few pieces







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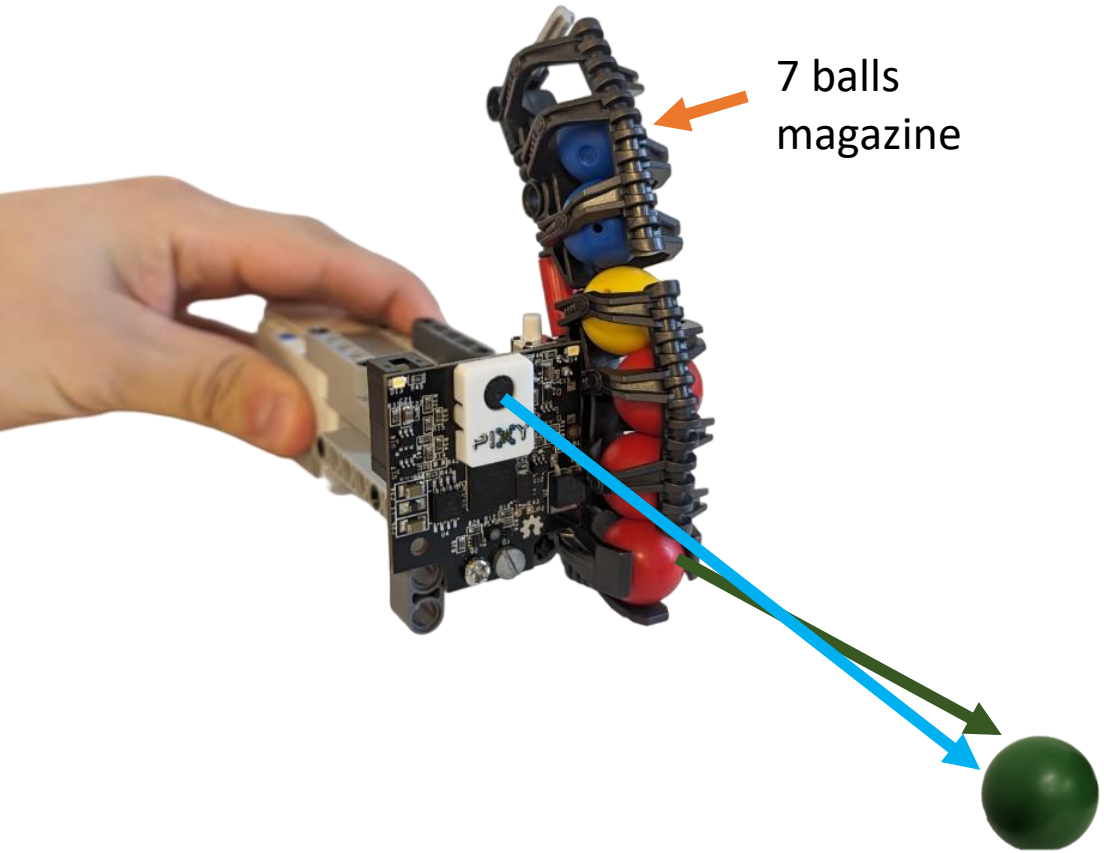
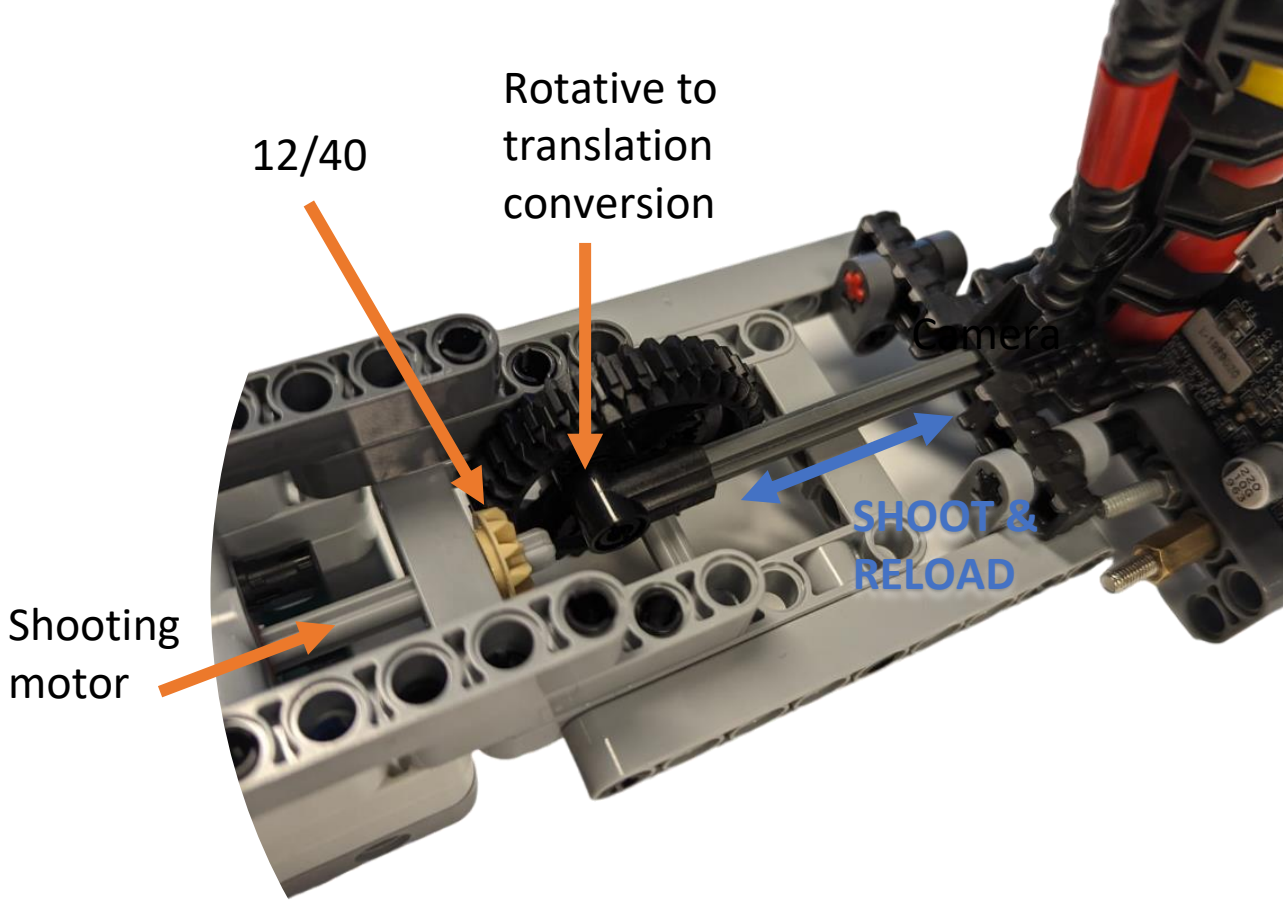
Hardware solution

A **shooting system compact** and on the **same axis** with the camera for the balistic

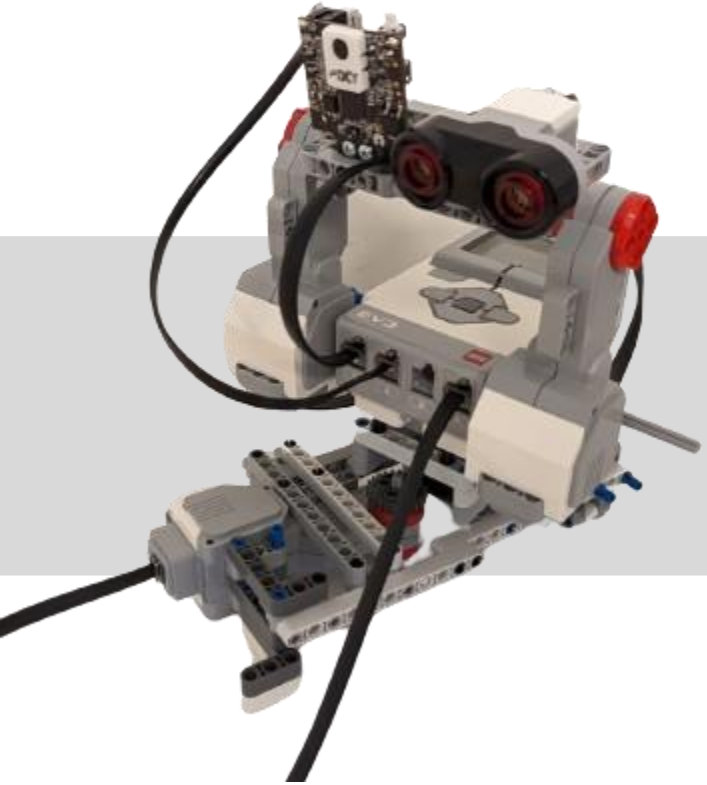


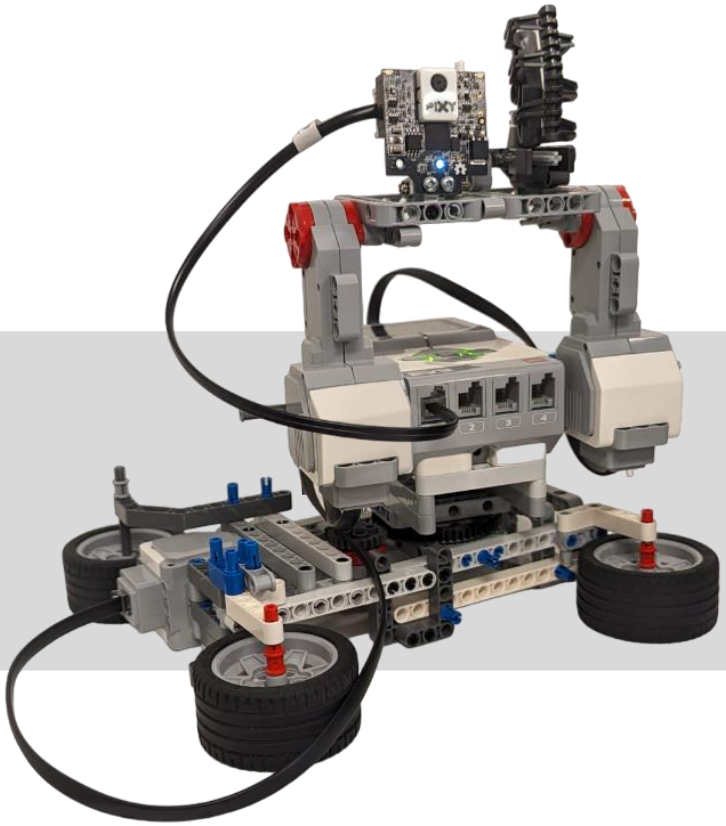


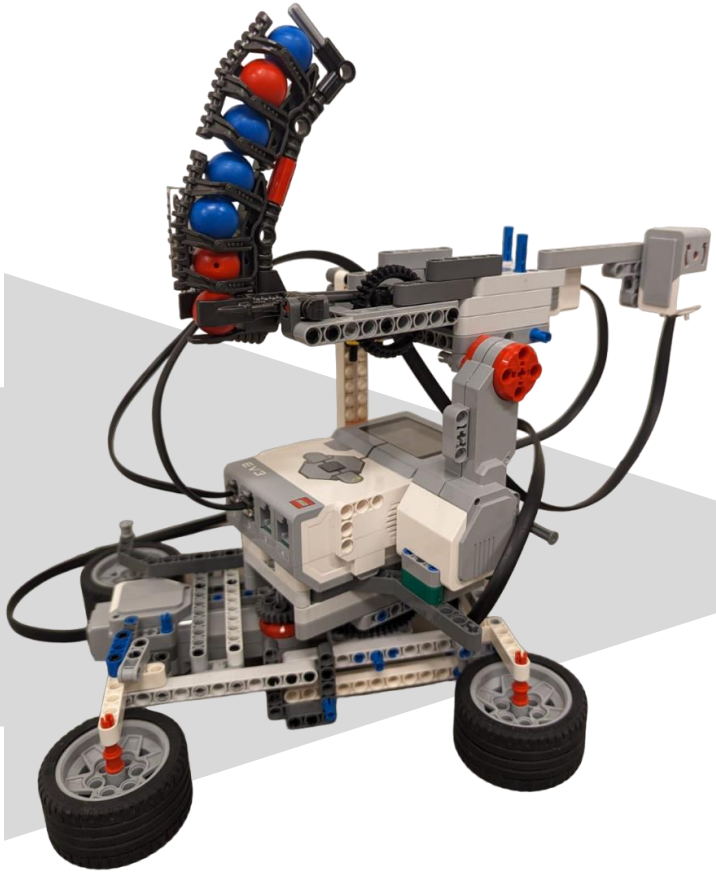
<u>Impact of the hardware on the balistic</u>

- The shooter as a left biased shoot angle
- The laucher need to move to shoot, the camera won’t be align then

Hardware solution







A design that changed with 3 iterations

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Software solution

Sequence Diagram

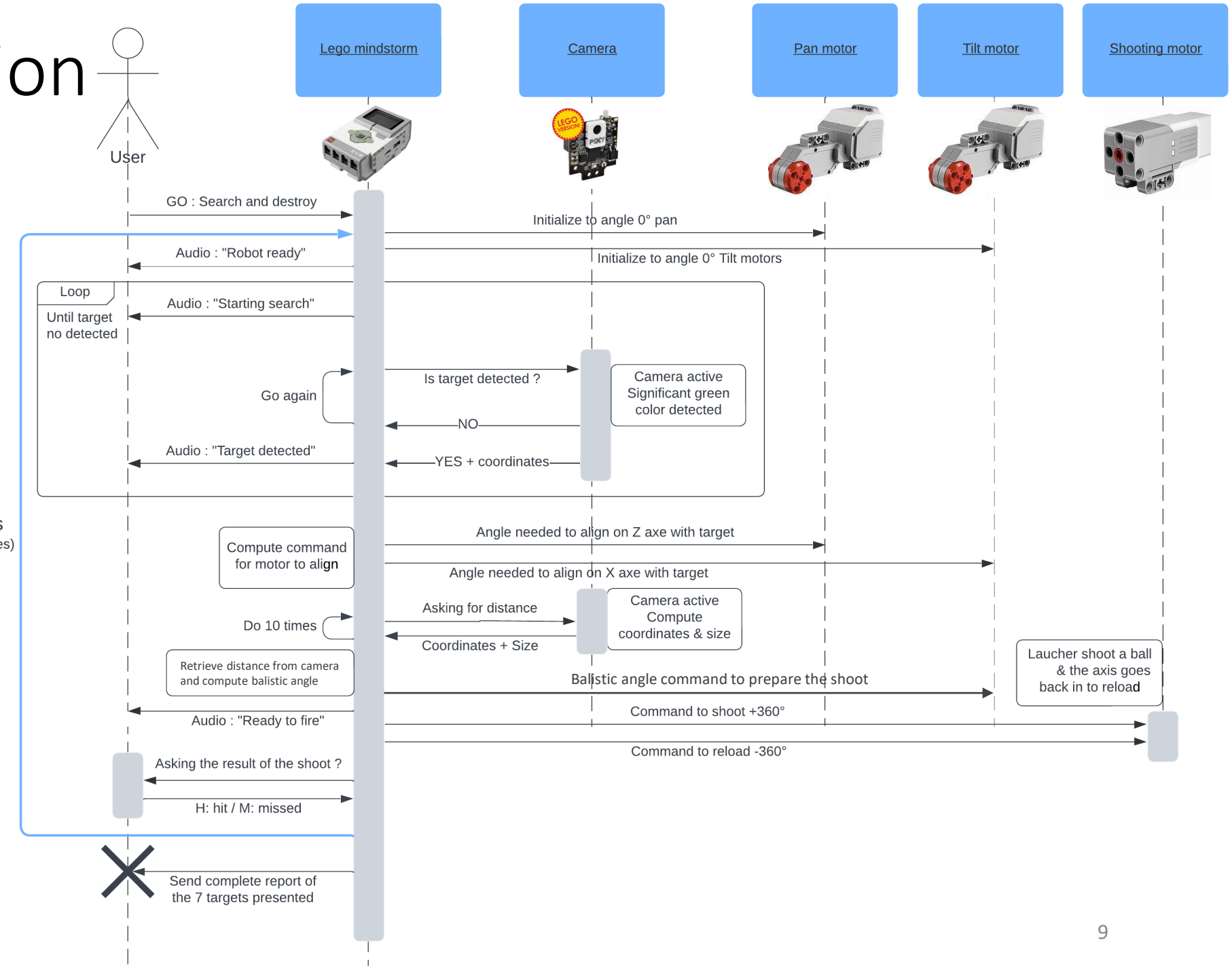
Initialization

Search the target
Scan the all environment

Align with the target

Compute distance
and balistic angle
and then shoot/reload

Mission report



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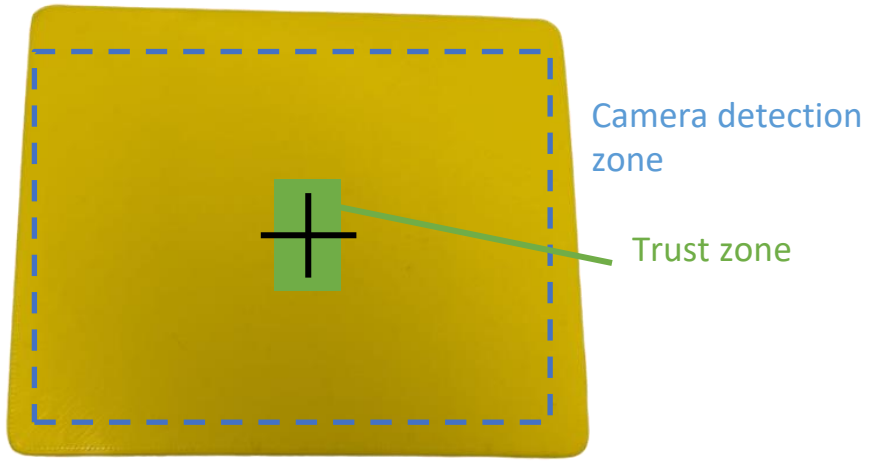
Software solution : How to align ?

Align_camera_on_target()

Compute_distance_target()

15/01/2024
11:45



Distance accurate ⟷ False positive

Camera detection zone

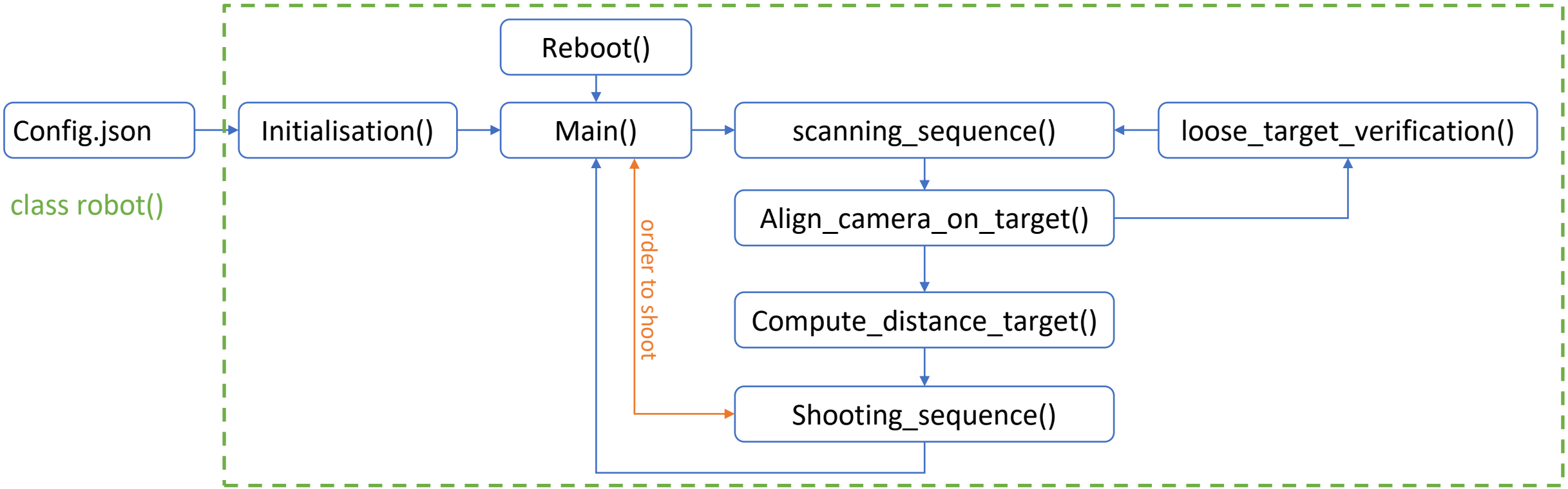
Precise alignement ⟷ Oscillation due to command

Trust zone

Software solution : Code architecture

from ev3dev2.motor

from pixycamev3.pixy2



Problem encountered and limitations

The system shall …	Pass/Fail	Limitation	Problem encountered
scan 180° on Z axe and 90° on X axe	Pass	Not continuous but step by step	Multi-threading difficult to make work
detect a target located at minimum 5cm in front and up to 1,5m	Pass	Losing the target in light	Camera disconnection, Camera response to light uncertain
measure the distance of the target (+-10%)	Fail	Need same light exposition constently	Camera response to light uncertainly and the object is detected smaller
compute the angle and align the turrent to prepare to shoot	Pass		
shoot down (hit) the target up to 1,5m radius from the turret (30% of the time)	Pass		
communicate throught all step on status and actions	Pass	No audio cue	Slow speaking features ➔ slow reaction time
communicate with the PC of the user to report outcome of the mission	Pass	Coordinates difficult to read	

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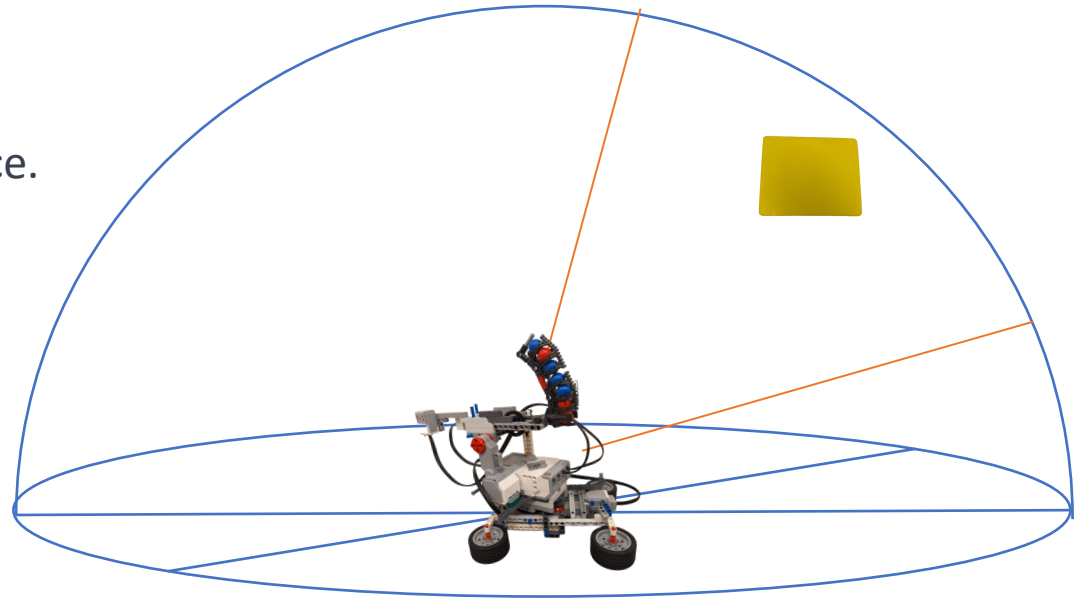
Robot Testing Scheme Comprehensive Overview

Condition of tests :

- No obstacles in a 1.5m semicircle environment at ISEP.
- The robot is located in the center of the circle.
- A target (yellow card) within 1.5m range.
- The entire robot's software and hardware components are in place.



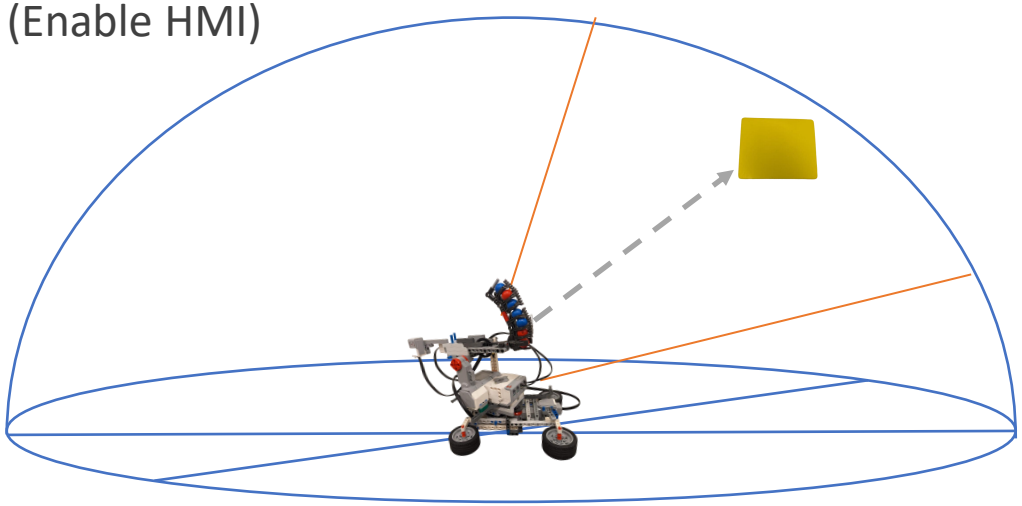
Actions :

- Power on the robot.
- Select your mode and parameters in config file.
- Upload the code to the robot and start.
- Present one target (vertical to the ground) to the robot.
- If the target is shot, press H(hit), if not press M(miss)
- move the target to 6 different distances and elevation.

Robot Testing Scheme Comprehensive Overview

Verification :

- ✓ Robot can continuously change direction to **scan the entire area** if the target is not detected within its current field of view.
- ✓ If the camera **detects the target**, robot can be rotated to face the target at the **right angle and be static**.
- ✓ **Within 3 seconds** of detecting the target, the robot can **fire the ball** at the right angle and **hit the target**.
- ✓ Shooting **accuracy of 30%** or more.
- ✓ Robot **emits cue** when it is switched on, finds a target, is ready to fire.
- ✓ Computer can get the information about the robot and the target. (Enable HMI)
- ✓ Mission report is sent



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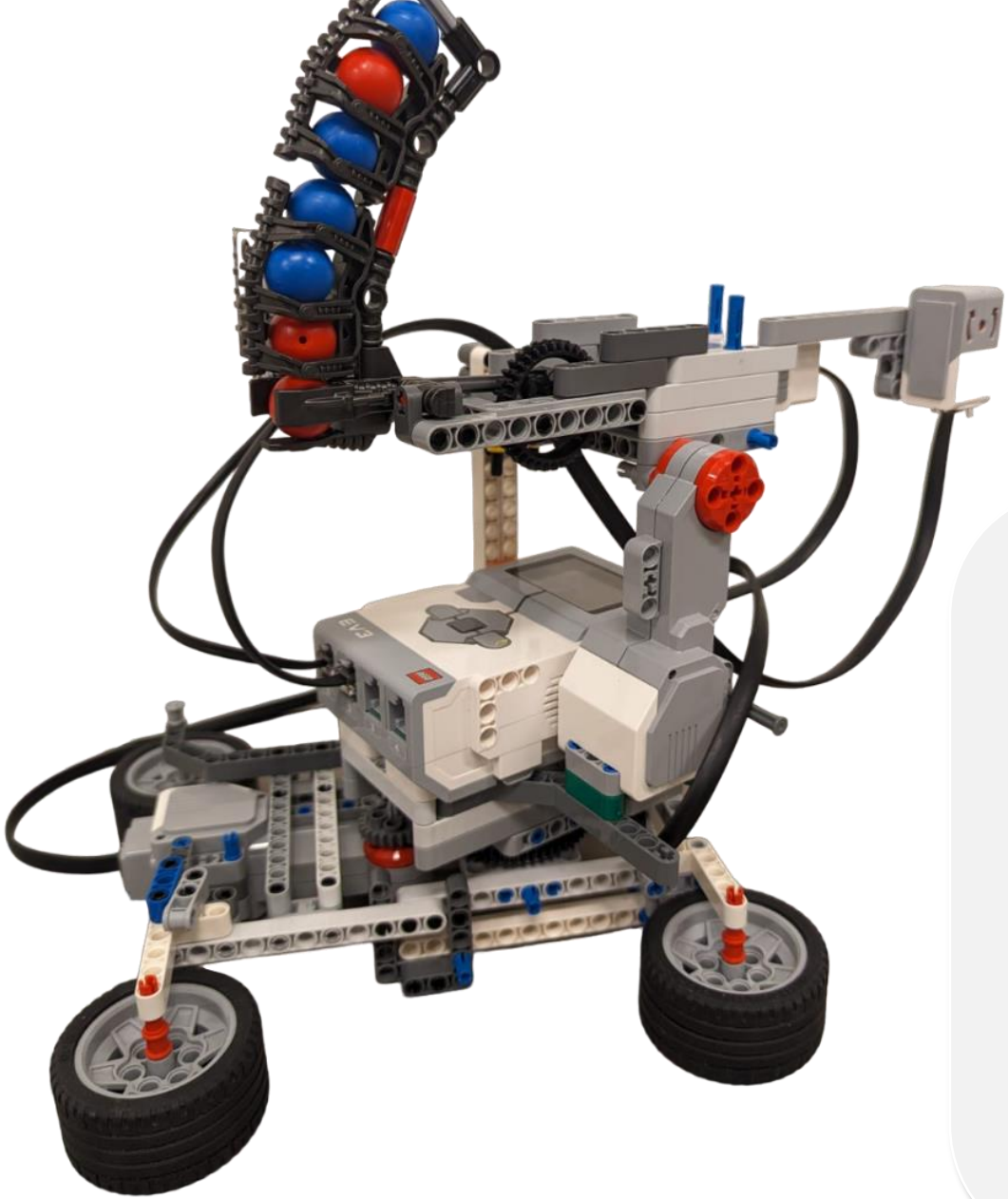
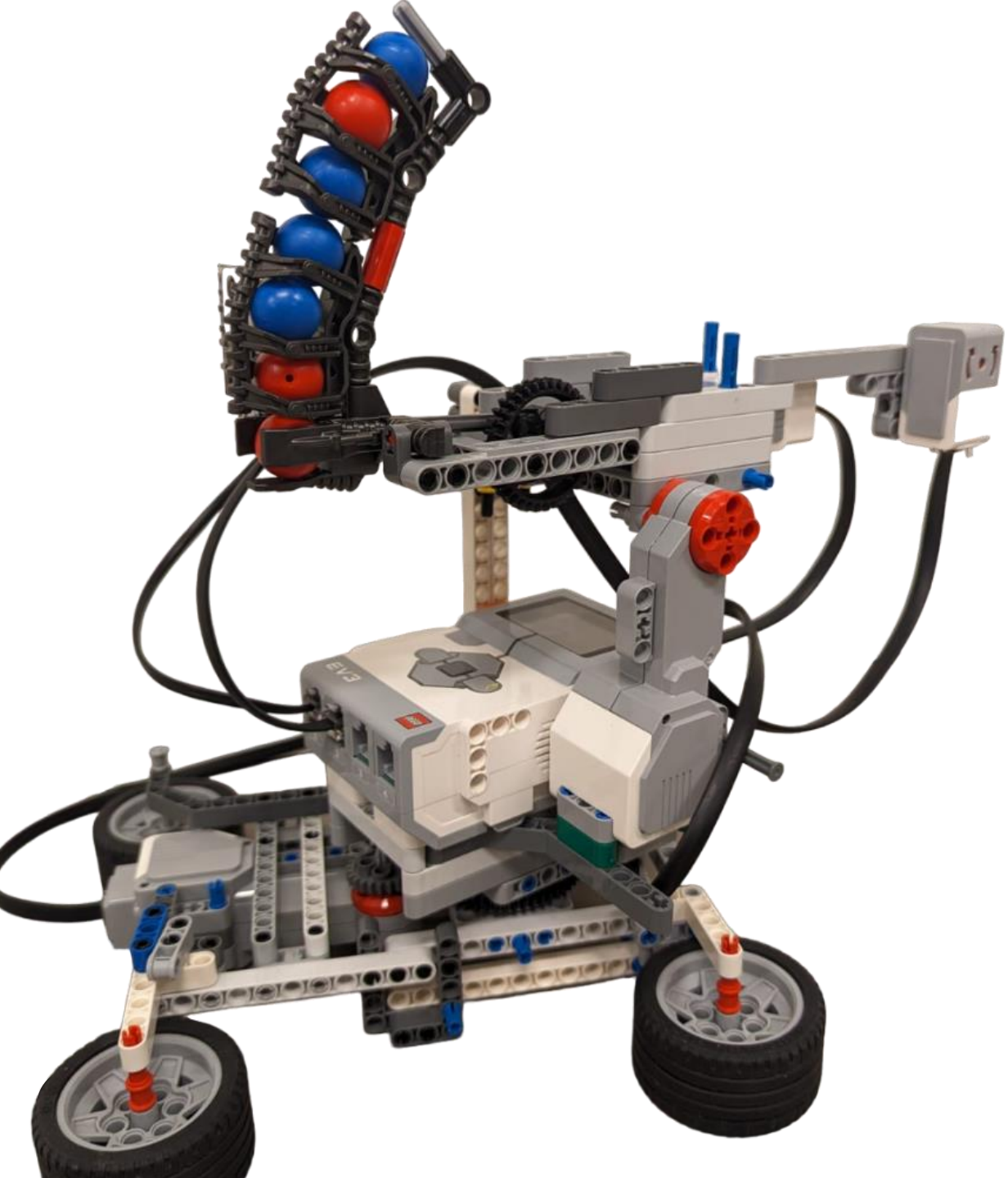


Gold Level

DEMO



Thank you

for your attention

redADS team