

VISUAL CONTROL OF A ROBOTIC ARM

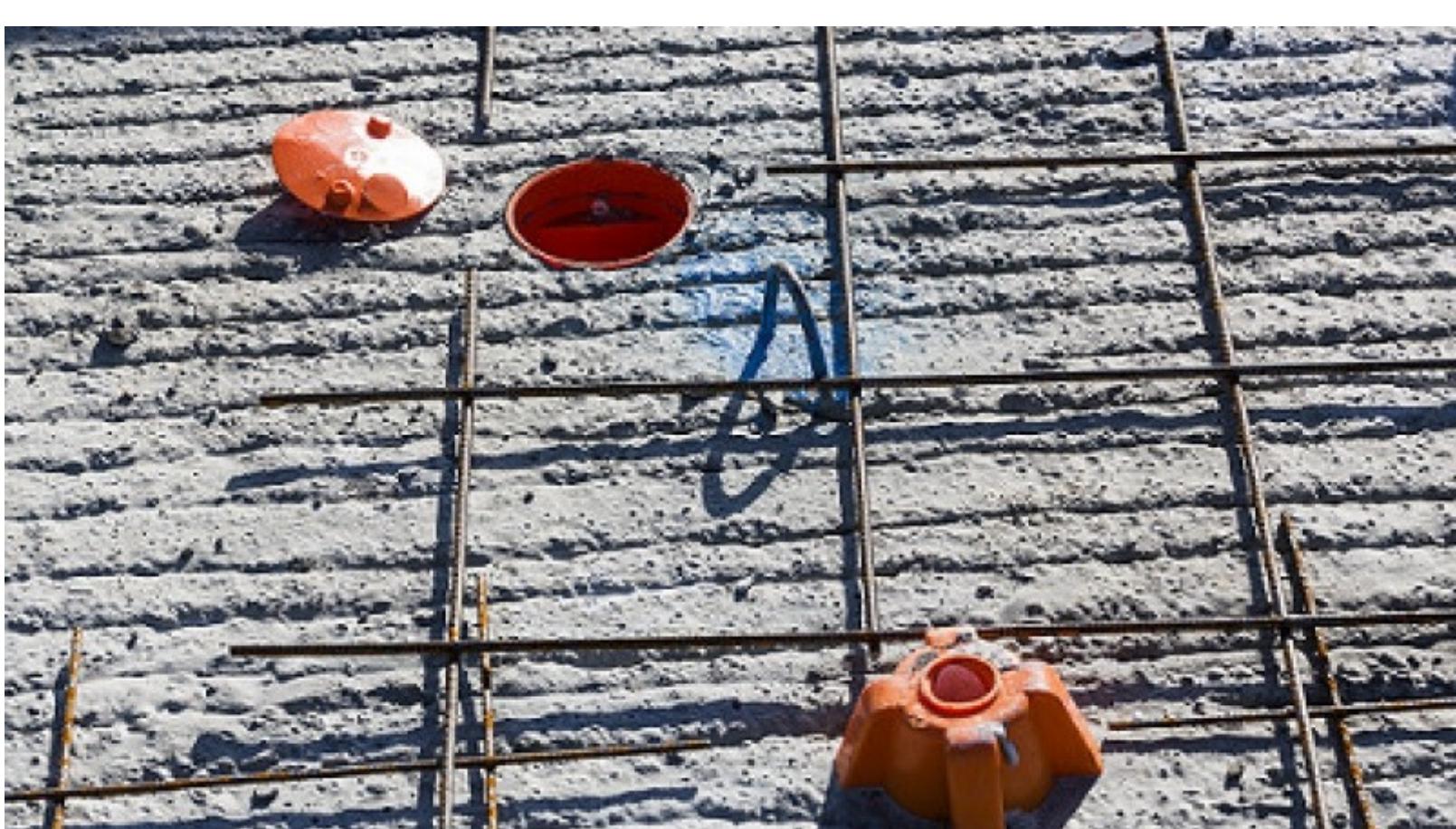
Demonstrating an automated production line robot

CONTEXT KP1

KP1 is one of the biggest precast concrete producers in France. Precast concrete is produced by casting concrete in a reusable mould, which is then cured, transported to a construction site and then lifted and put into place. Precast concrete parts can greatly reduce construction time, cost and the risk of injury.

There are two important steps for slab production

- tying together the steel reinforcement bars and prestressing steel cables at their intersection points using a metal wire.
- add features such as channels for electrical wiring and mounting points for lights.



KP1'S PROBLEM

The aim of this project is to develop a demonstrator to convince KP1's higher-up to invest in the digitalization of their production lines. The robotization of this procedure will improve the operator's working conditions, as it is currently done by hand and is very time consuming. The second part is less physical, however it requires high accuracy as the architectural plans need to be followed precisely.

OUR SOLUTION

This demonstration will help us simulate the production environment and procedures. Different features are represented by plastic pieces and the steel reinforcement bars are simulated by a drawing lines on a piece of paper.

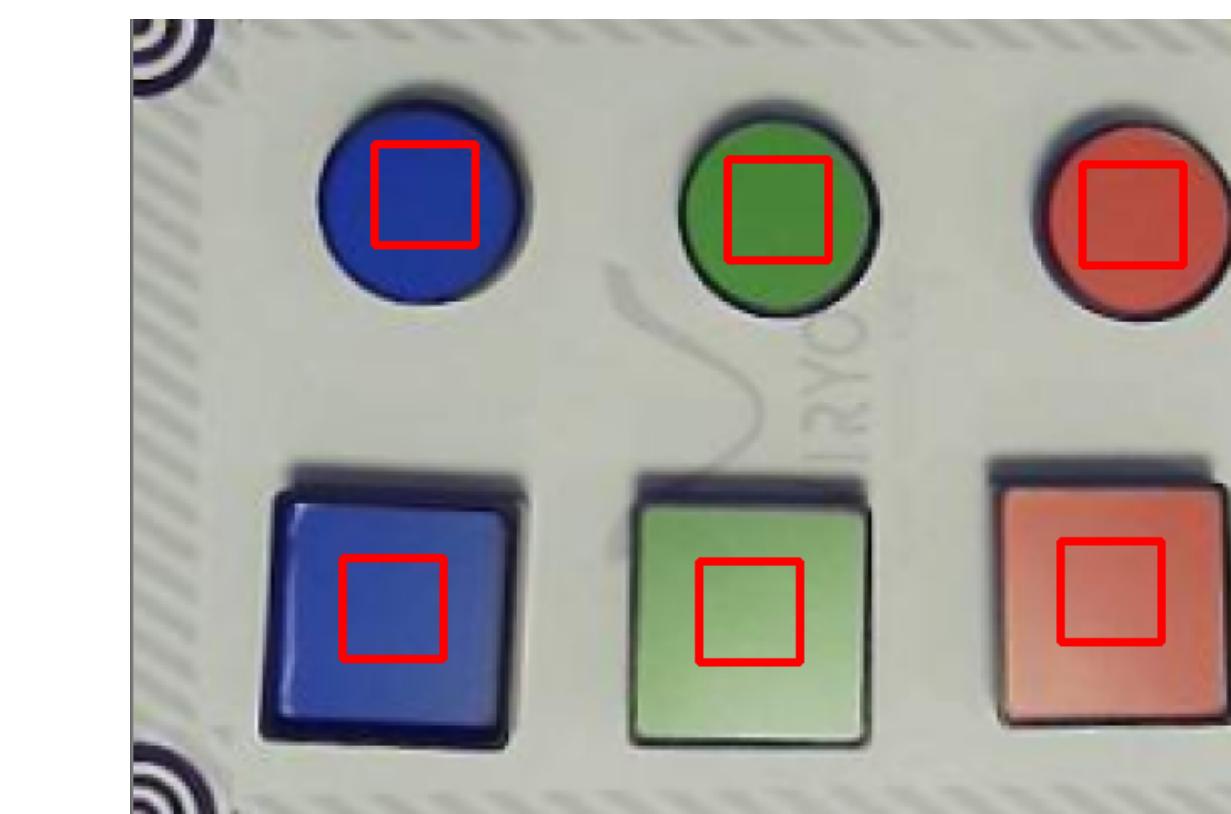
1

OBJECT DETECTION



Firstly the arm's integrated camera captures an image of the workspace. The image is:

- cleaned in order to remove shadows that can disturb the detection algorithm.
- analysed by a computer vision algorithm (OpenCV) to detect all the objects.
- an AI sorts the different objects according to their shape and colors.

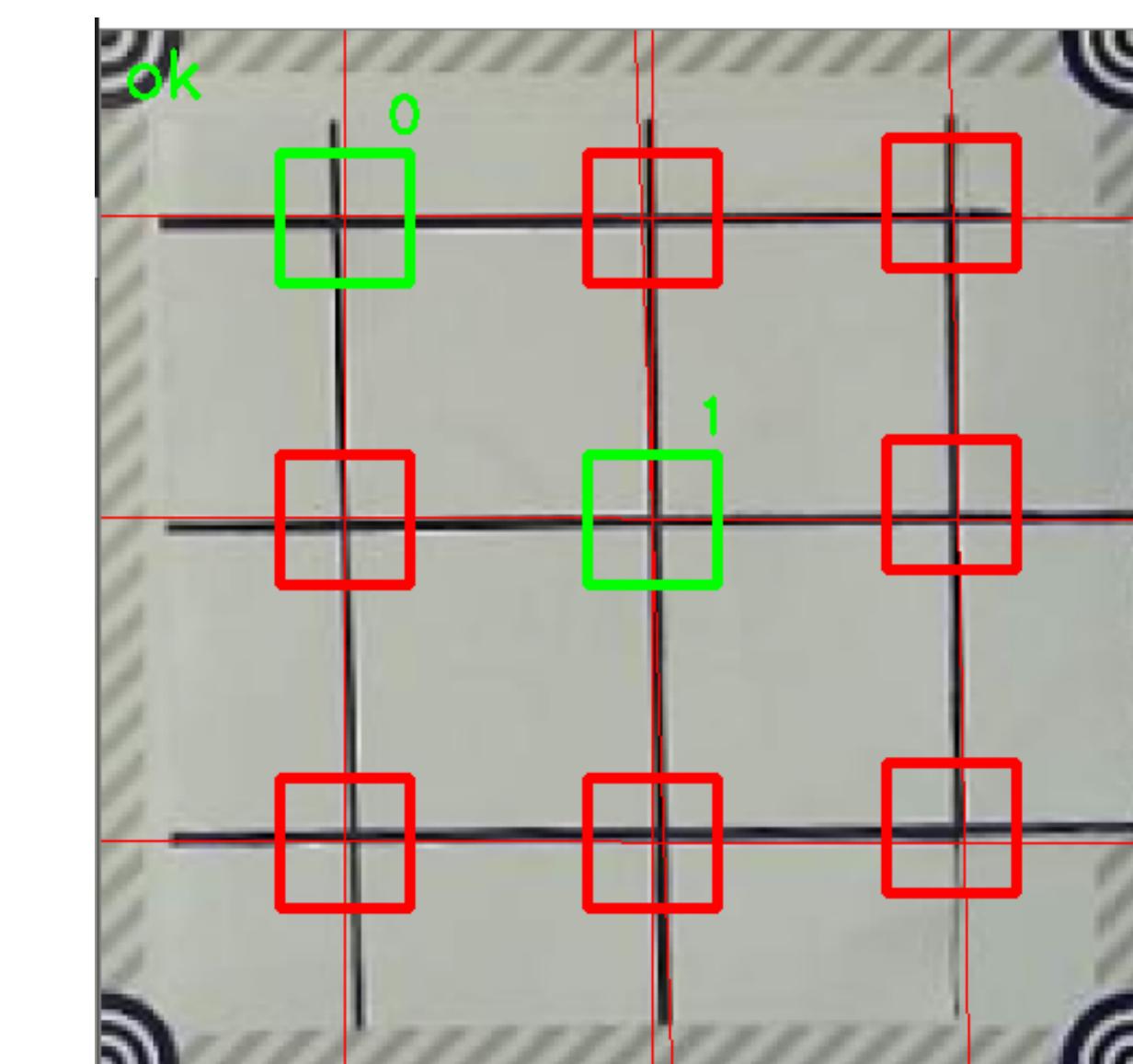


2

LINE DETECTION

The arm captures an image of the concrete reinforcement bars, which is then analysed by an algorithm. The goal is to:

- detect the lines in the image (uses the Hough transform to extract line segments from the image)
- to identify the points where the lines cross
- transform intersection coordinates from pixel values to real positions for the robot's arm.

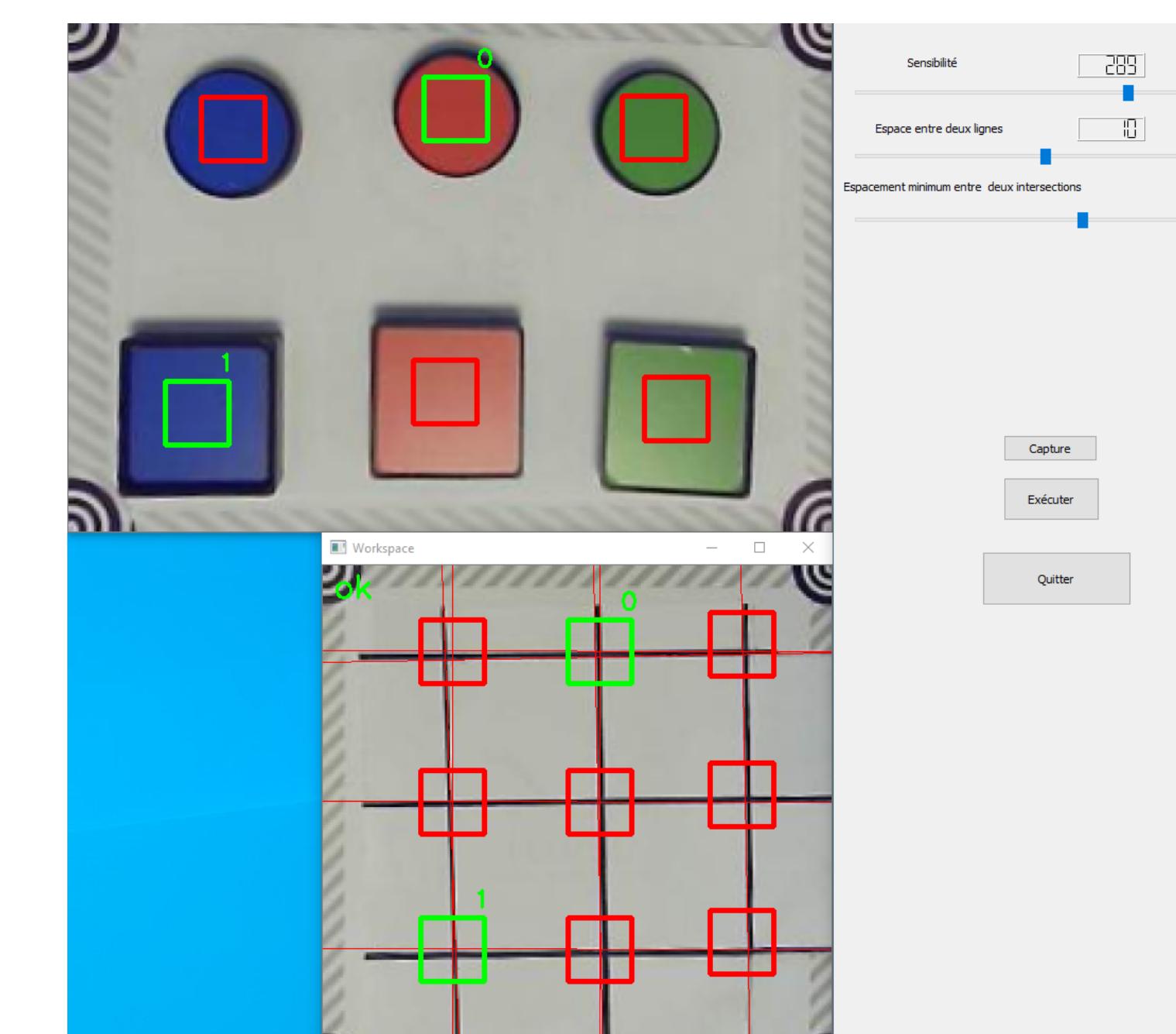


3

USER INTERFACE

Factory workers use a simple application to interact with the arm. The application:

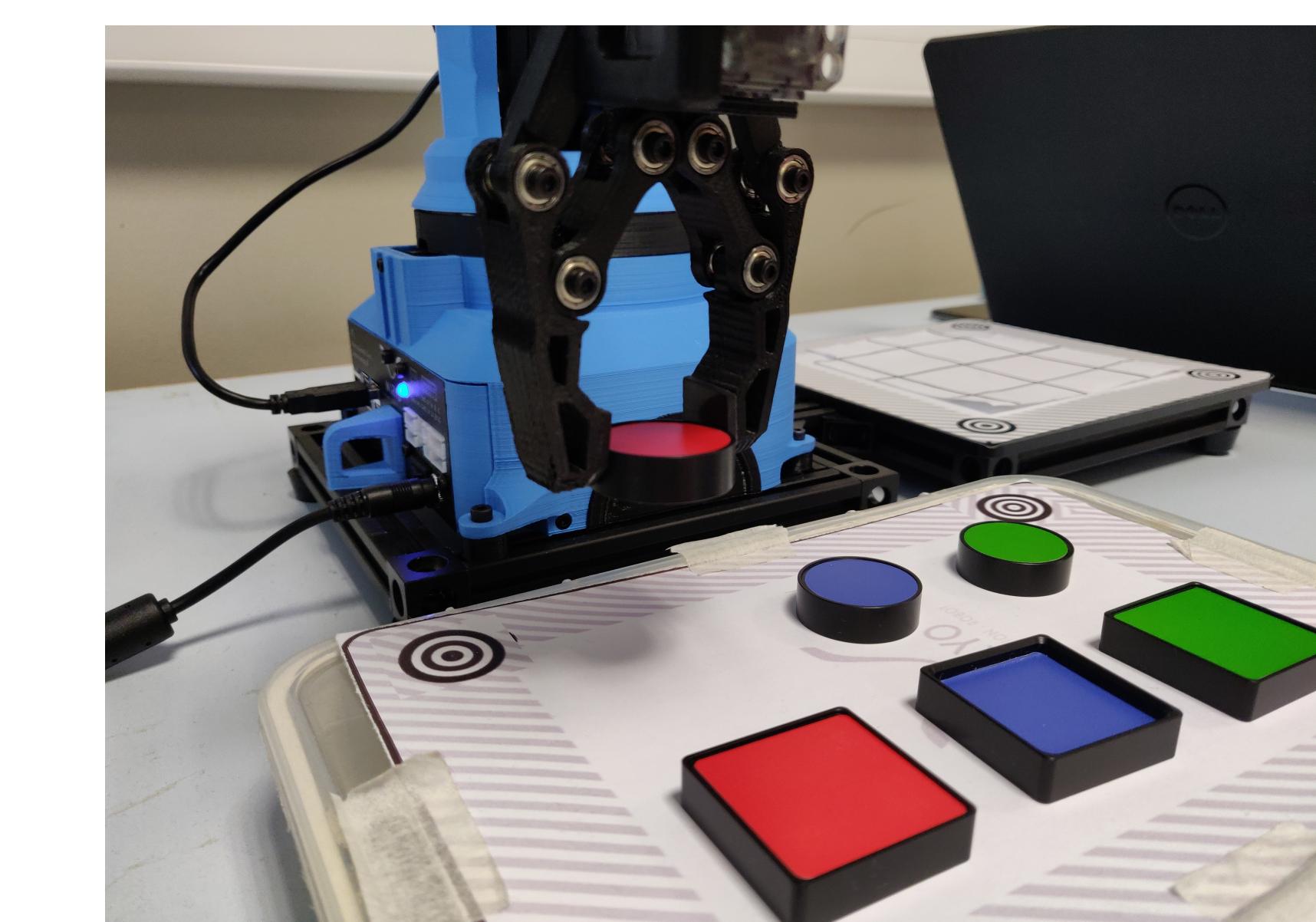
- displays an image of the "vision" of the robot
- presents different actions that the robot can perform
- lets the user adjust some image parameters in order to detect more or fewer lines and intersections.



4

ROBOT COMMUNICATION AND EXECUTION

The user can enter the IP address of the robot and connect to it via WiFi or ethernet. The Arm executes the actions programmed by the user.



CONCLUSION

We demonstrated that it is feasible to automate a part of the production line. The computer vision algorithm seems to work well enough under ideal lighting conditions, the robot is accurate for the purposes of this demo and the user interface is intuitive enough to use without much training. It remains to be seen if the project can be scaled up and be used under real working conditions.