CARDANO ROBOTICS

ROME, ITALY | JUNIOR SOCCER OPEN LEAGUE


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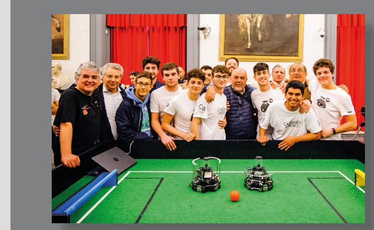
ABSTRACT AND TEAM

We are Cardano Robotics, an Italian Team formed by four students of the ITIS G Cardano institute. We develop two robots, goalie and goalkeeper in order to participate to the competitions. Each robot has a PIC18F87K22 as main processing unit, a PIC18F26K22 as the line sensors controller, an omnidirectional vision system we developed ourselves used for finding the ball and goals and various sensors to get informations about the status of the robot. The two robots have omni-wheels, the goalie has a dribler and a kicker.

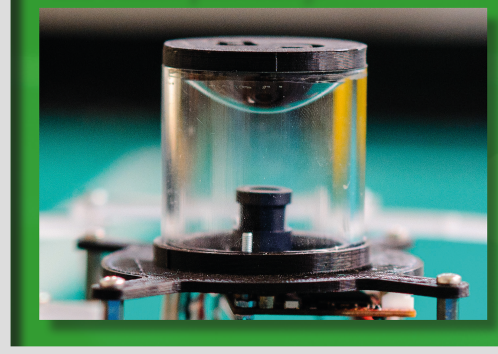


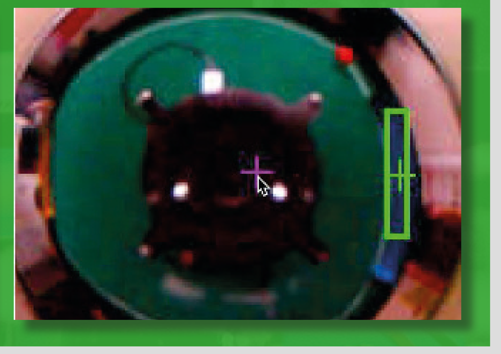
Here is our team, we've well separated tasks but we always work together in order to get the best results. Our robots are worth about 600$ each.
This is the timeline of our progress since year 2017.

- SEP '17 - PREPARATION
  First steps w/ OpenCV and Python
- DEC '17 - DESIGN
  Mechanic and electronic design
- FEB '18 - ASSEMBLY
  PCB, milling and software structure
- APR '18 - ROMECUP
  Fifth place at RomeCup
- JUL '18 - NEW DESIGN
  New robot design, first steps
- SEP '18 - ASSEMBLY
  New robot assemlby and testing
- NOV '18 - SOFTWARE
  Software refinement and final retouchment
- APR '18 - WIN
  First Place at RomeCup

OMNI VISION SYSTEM (about 150$)

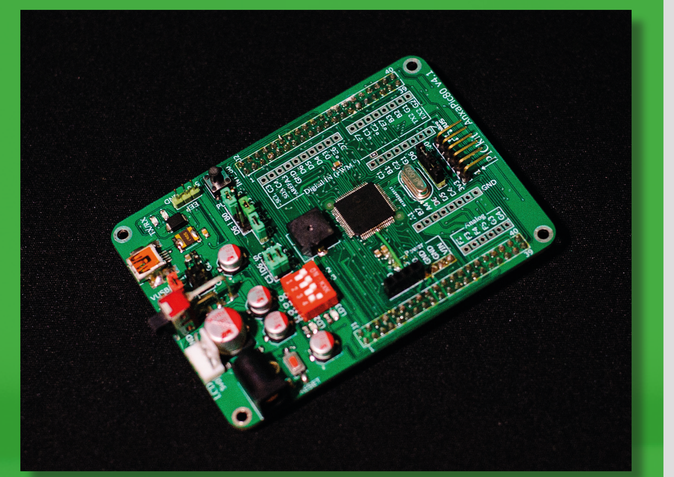
We use an OpenMV H7 camera as main vision unit. It is programmed to recognize the orange ball and one goal, then the camera sends the angle and distance from the center values through UART. On previous releases we used a Raspberry with an USB camera but the system was too slow and not so much efficent. Despite the high level of customization of the OpenCV library we decided to switch to a simpler but more efficent vision system.
Above the camera is placed an omnidirectional mirror that is a reflective PVC sheet molded around a 3D printed hyperbolic shape. We also 3D printed the OpenMV support in order to fit to the robot perfectly.





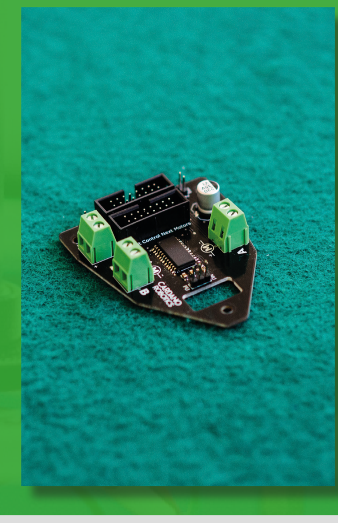
MAIN BOARD (about 30$)

Our school in the past year developed a board based on a PIC18F87K22. It has got a design similar to some commercial boards like Arduino or Raspberry. It is the main board of the robot, which is connected to the line system (with another PIC) and to the OpenMV camera through USART. Its main purpose was to use it on a robot, since it was under development years ago. It turns out that is a powerful and perfectly fitting device for our tasks.



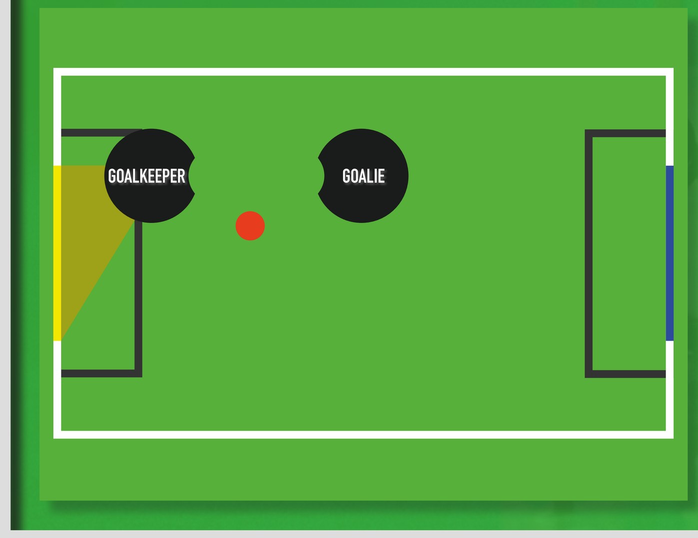
MECHANICS AND MOVEMENT (about 300$)

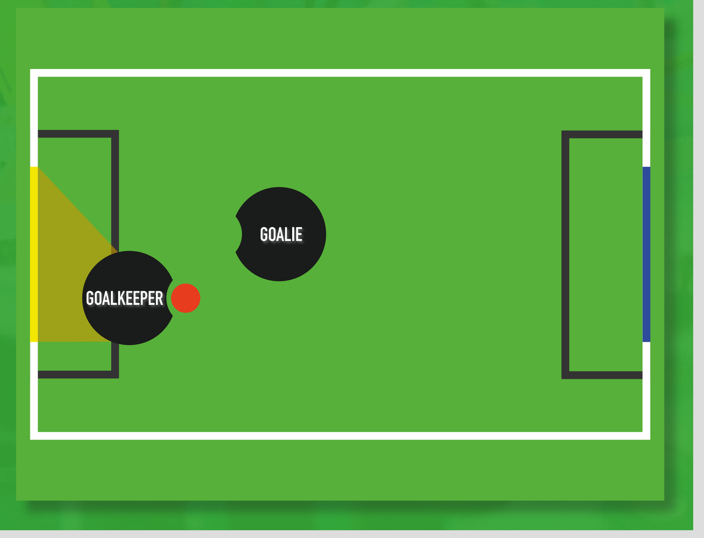
We use omnidirectional wheels on our robot, attached to four 485 RPM DC brushed motors, 12V powered. Motors are driven by two L6206 STMicroelectronic drivers and the driver board was designed by us to fit the microcontroller needs. All the polycarbonate layers are milled by us. We've got small machines such as CNC machine motorized by us and a small manual lathe.

GOALKEEPER SOFTWARE

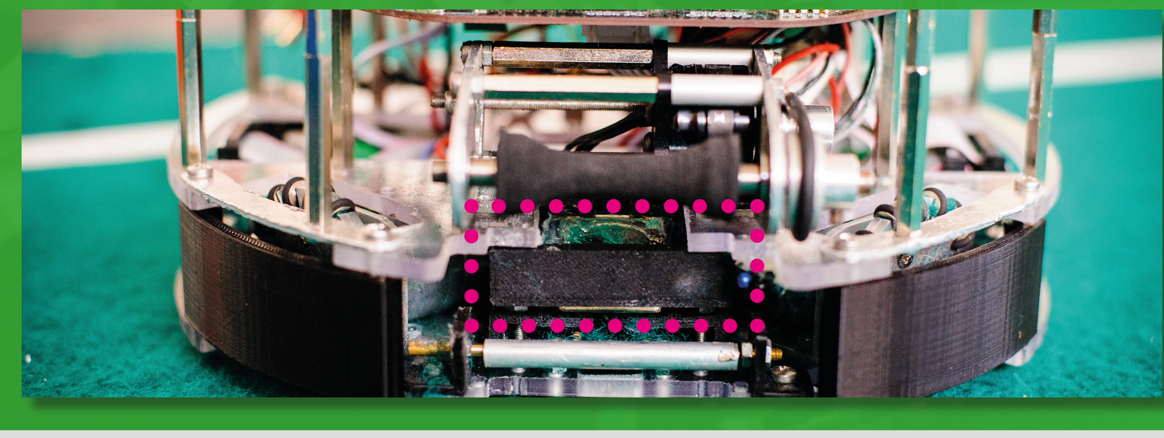
The goalkeeper is programmed to mainly align to the ball the fastest way possible. This is accomplished by speeding up the vision script and the main processor script, deleting the unused parts of the software and optimizing the existing blocks. By reading the VL53L0X sensor and the data of the camera the robot remains aligned to the center of the goal.





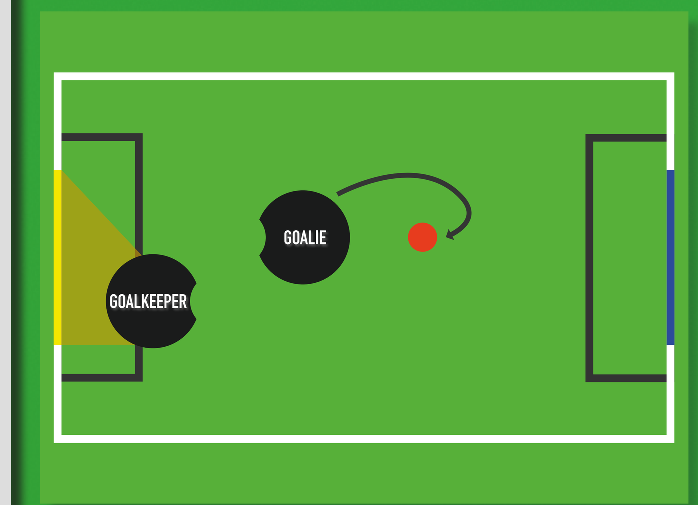
KICKER (about 30$)

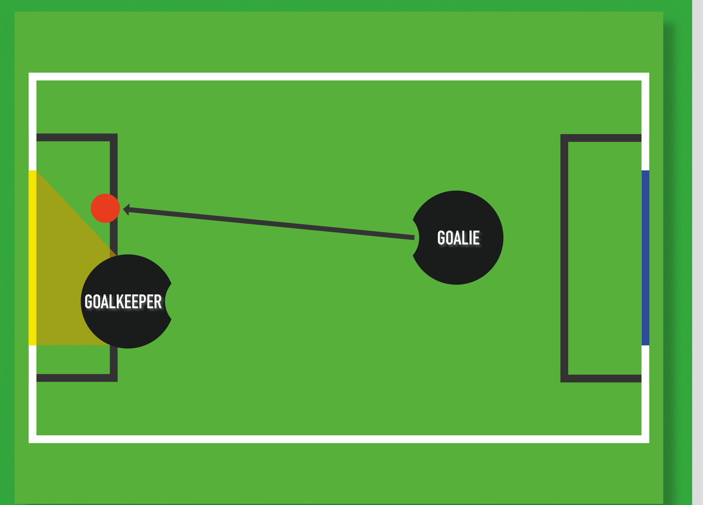
We use a 12V solenoid (JF-0826B) as a kicker device. It is powered by a board made by us which can step up the voltage from the LiPo up to 40V. We've got a potentiometer to regulate the power of the kick. At 40V we have the correct power to mantain the kicker in the maximum allowed force. The kicker is mantained in place by a 3D printed piece designed by ourselves. Also the flat frontal part of the piston is made in 3D printed material. It was very difficult to find space for the kicker device, but we finally did it.



GOALIE SOFTWARE

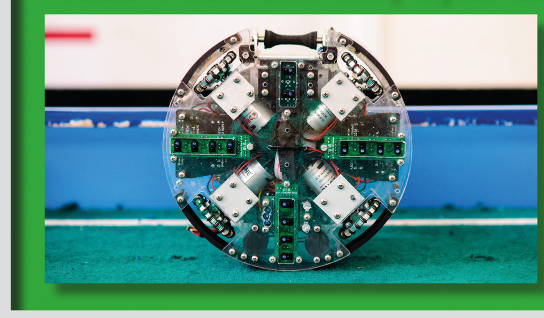
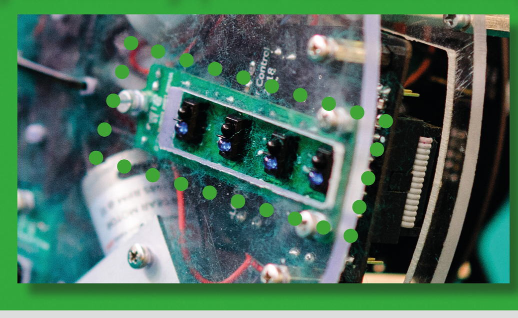
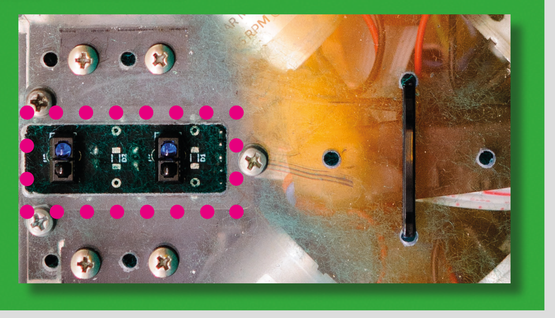
Goalie has to take scores in order to win the match. So it's programmed to be really offensive to play in its game style. The first step is to position the robot behind the ball by using the omniwheels to reduce time need, then the robot uses dribbler to catch the ball and align to the goal. The final step is to shoot the ball in the empty part of the goal using our kicker.





LINE SYSTEM (about 50$)

We have four "satellite" boards with four sensors each (marked green), except the north one which has got only two sensors because of lack of space. Sensors are TCRT5000 and we built the small board surrounding it. We have a masking process for the ball when it's out of bounds. On a first release the satellite boards were only of 2 sensors each (marked purple) causing too much gap and therefore an imprecise behavior.

DRIBBLER (about 60$)

In front of the robot we have an active dribbler (marked red in the photo). It's driven by a brushless motor, which it can rotate at about 12'000RPM, but we have a sort of transmission that increases torque and reduces speed at about 2'000RPM. We also have a passive dribbler which is a simple aluminium pipe (marked green in the photo). The passive dribbler helps the ball rotate faster and better. Most of the parts of the dribbler are recycled from old printers.