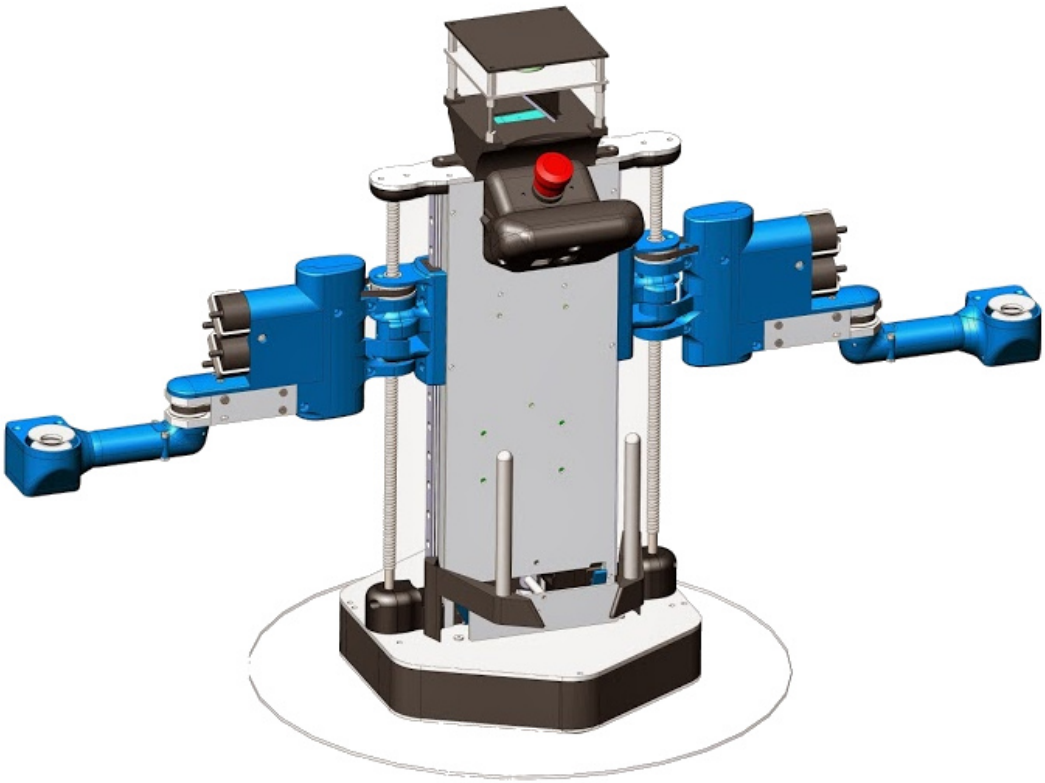
Club Vaudois de Robotique Autonome

Eurobot 2014 : Pilot Study



March 11, 2014

1 General information

- This project study can be published before the contest.
- Team name : CVRA (Club Vaudois de Robotique Autonome).
- Team location : Renens, Switzerland.
- Budget : About 3000 CHF, plus sponsors.

2 Robots

This year the club will engage two robots which are evolutions of previous years' designs. The first one will have two arms, a differential drive and has code name "Debra 4". The second one will have an holonomic base, and is nicknamed "Nastya 2".

2.1 Debra 4

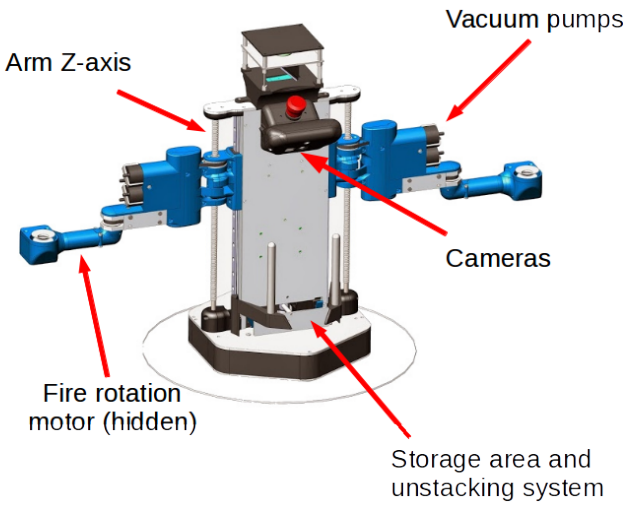


Fig. 1: Debra 4 robot. Height : 350 mm. Perimeter : 695 mm.

Debra 4 is our biggest robot, dedicated to rotating the fire on the correct side, although fruits may be implemented if time allows it. At the beginning of the game, it will quickly go to the fires' positions and take them with its arms (using vacuum). It can then find the orientation of the fire using fixed color sensors and store them in front of the robot. For unloading the fire, Debra can either unstack them using its arms or it can push them out from the bottom of the stack using a small lever.

Motors Debra 4 uses two Faulhaber 2232-012-SR motors with a 20:1 reduction, rated at 8.7 W at 12 V, overvolted at 14.8 V. Those motors allows us to use our max acceleration (wheel slippage) to $0.8\,\mathrm{m\,s^{-1}}$. All the motors in the robots are driven using custom power electronics.

Positioning Debra 4 will use a standard, encoder-based odometry to find its position on the table. We will also use an inertial measurement unit to have an additional source of information. These two techniques will be merged using a Kalman filter.

Opponent detection We have planned to build an optical absolute positioning beacon system, but it may not be ready for the contest due to the complexity of the project. If we cannot make it in time, we will fall back on last year's beacon system (fig. 3). The relative simplicity of this second design makes it very reliable and easy to implement, which guarantees that it will be ready for the Belgium and Switzerland contests.

Power supply The robot is powered by a single 14.8 V lithium-polymer battery, which gives us a run time of at least 40 min.

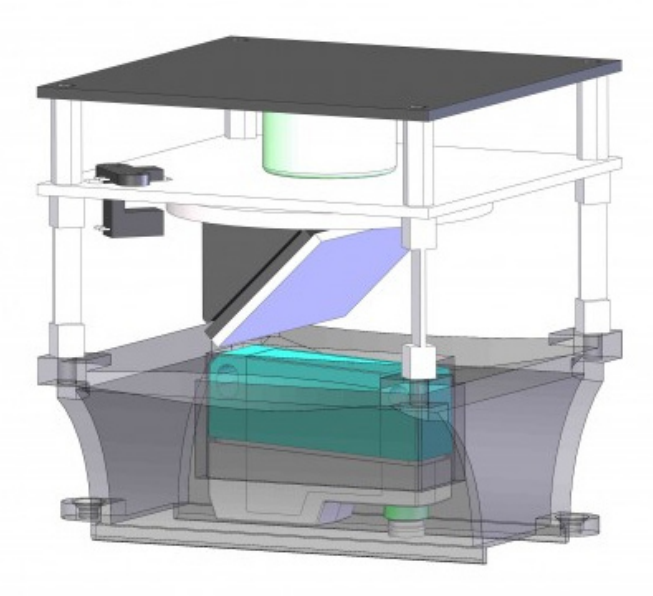


Fig. 2: Fallback beacon system. A reflex-type industrial sensor is mounted in the base (blue). It emits a LED beam (not laser), which is reflected on the rotating mirror (purple). A reflector is placed on the opponent robot, which allows for reliable detection. An index sensor (upper left, black) allows the robot to know the relative angle to opponent.

Sensors In addition to the encoders and the beacon system, Debra has a few sensors to find the current orientation (color) of the fires. The two main sensors for this application are two Sick color sensors, mounted on the side of the robot. To measure a fire's color, the robot must take it with one arm and approach it near the sensor. We also have a range camera to find the fire's location which is combined to a color camera for decision making.

Computing Both of our robots have two processing unit :

- An x86-based embedded PC running Linux is used for computer vision, path planning and state synchronization with Nastya (WLAN link).

- An FPGA board with an Altera Nios 2 softcore processor is used for real time operations, such as motor control. We run UC/OS-II on this board, an industrial and proven RTOS, free for academic and hobby use.

The two boards communicate via TCP/IP over serial, which make communication testing and debugging very easy thanks to tool like Wireshark.

2.2 Nastya 2

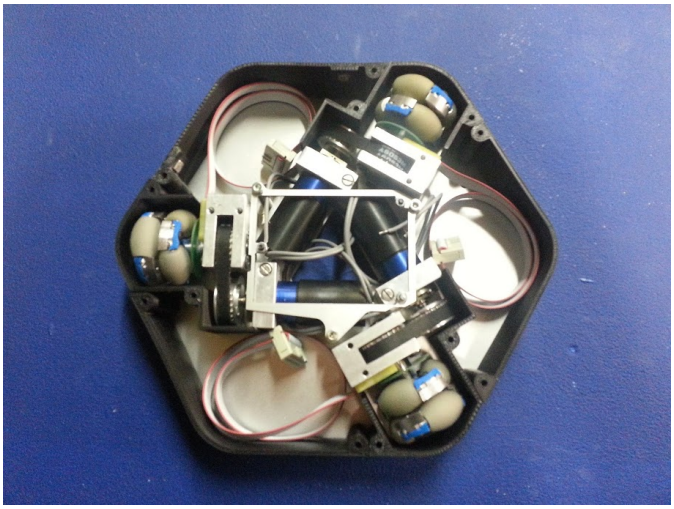


Fig. 3: Nastya original version (2013). The second version will be mostly the same with a scale up to reach the new perimeter of 695 mm. The CAD of Nastya 2 is not complete yet.

Nastya 2 is our secondary robot, responsible for the spears, frescos and mammoths capture. As it has shares many design decision with Debra, only differences will be presented.

Motors Nastya uses 3 motors instead of only 2 because of its holonomic drive. The holonomic wheels are custom made to reduce play and allow for better precision.

Sensors We *may* have sensors on Nastya 2. Have not decided yet. Sensors are nice. I like sensors.

3 Team members

- Antoine Albertelli, 21: Lead programmer, Debra.
- Florian Reinhard, 21: Lead programmer, Nastya.
- Patrick Spieler, 22: Inter-board communication.
- Pius von Däniken, 23: Motion planning.
- Romain Bersier, 29: Mechanical engineer, Debra.

- Boris Pillionnel, 23: Mechanical engineer, Nastya.
- Patrick Eugster, 29: Electrical engineer.
- Mathieu Rouvinez, 28: Machining and advanced mathematical wizardry.
- Guillaume Schaufelberger, 18: Mechanical engineer.
- Jessica Schmid, 19: Electrical engineer.
- Thierry Prêtre, 21: Sponsoring and public relationships.
- Dominik Reukauf, 23 : Computer vision.

4 Sponsors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