CVRA

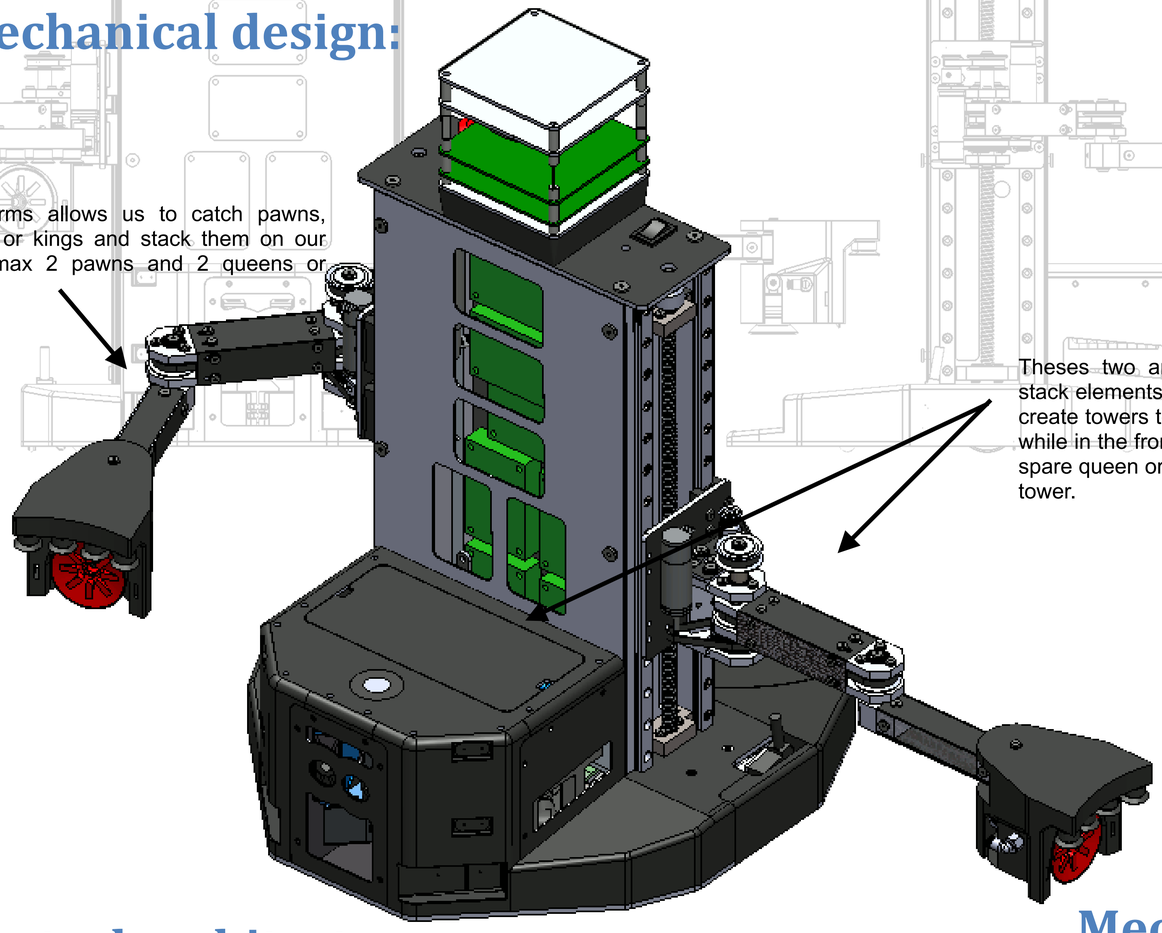
Club Vaudois de Robotique Autonome

Swiss team

Presents :

Debra

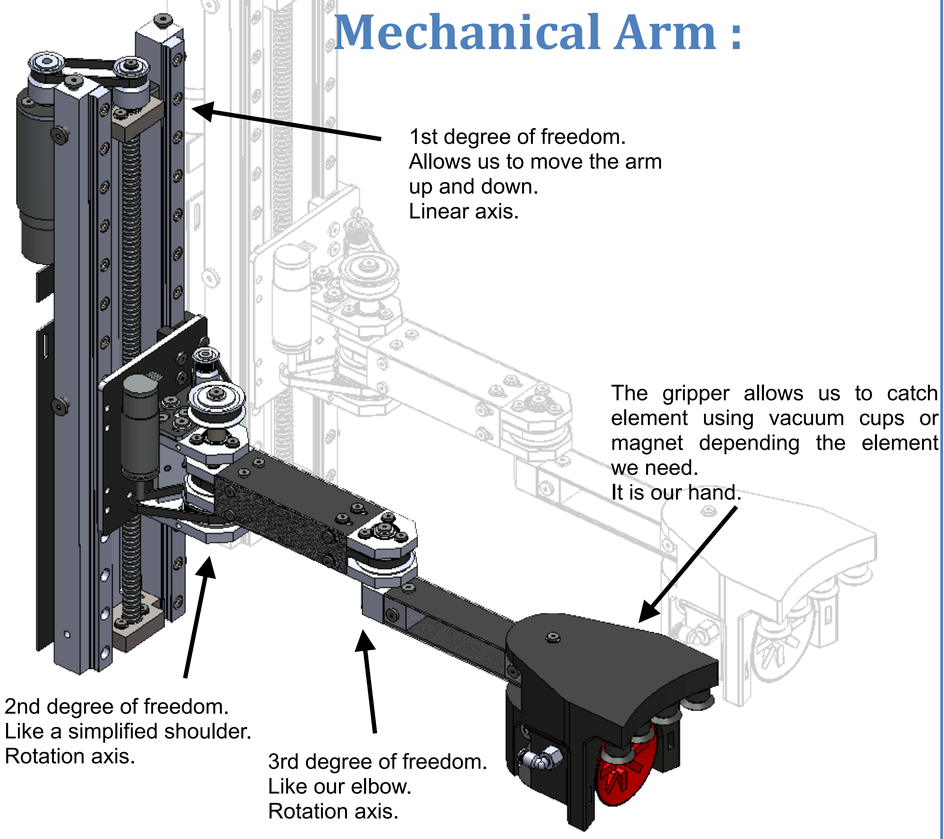
Mechanical design:



Each arms allows us to catch pawns, queens or kings and stack them on our robot (max 2 pawns and 2 queens or kings)

Theses two areas are use to stack elements. On the rear, we create towers to raise our score while in the front we just carry a spare queen or king for the next tower.

Mechanical Arm :



1st degree of freedom.
Allows us to move the arm up and down.
Linear axis.

The gripper allows us to catch element using vacuum cups or magnet depending the element we need.
It is our hand.

2nd degree of freedom.
Like a simplified shoulder.
Rotation axis.

3rd degree of freedom.
Like our elbow.
Rotation axis.

Control architecture :

This year, we decide to design our own control system keeping in mind performance and flexibility for the future. To do so, we decide to use:

- A FPG board (Cyclone IV) programmed in VHDL and C with a soft processor NIOS-II. The FPGA board control all actuator and most of the sensor. We use many different modules as IO depending what is needed for the currant robot. This year, we use the following modules:
  - Digital and analog input (two separate module)
  - Digital output
  - One Brushless DC motor with encoder
  - Two Dc motors with encoders

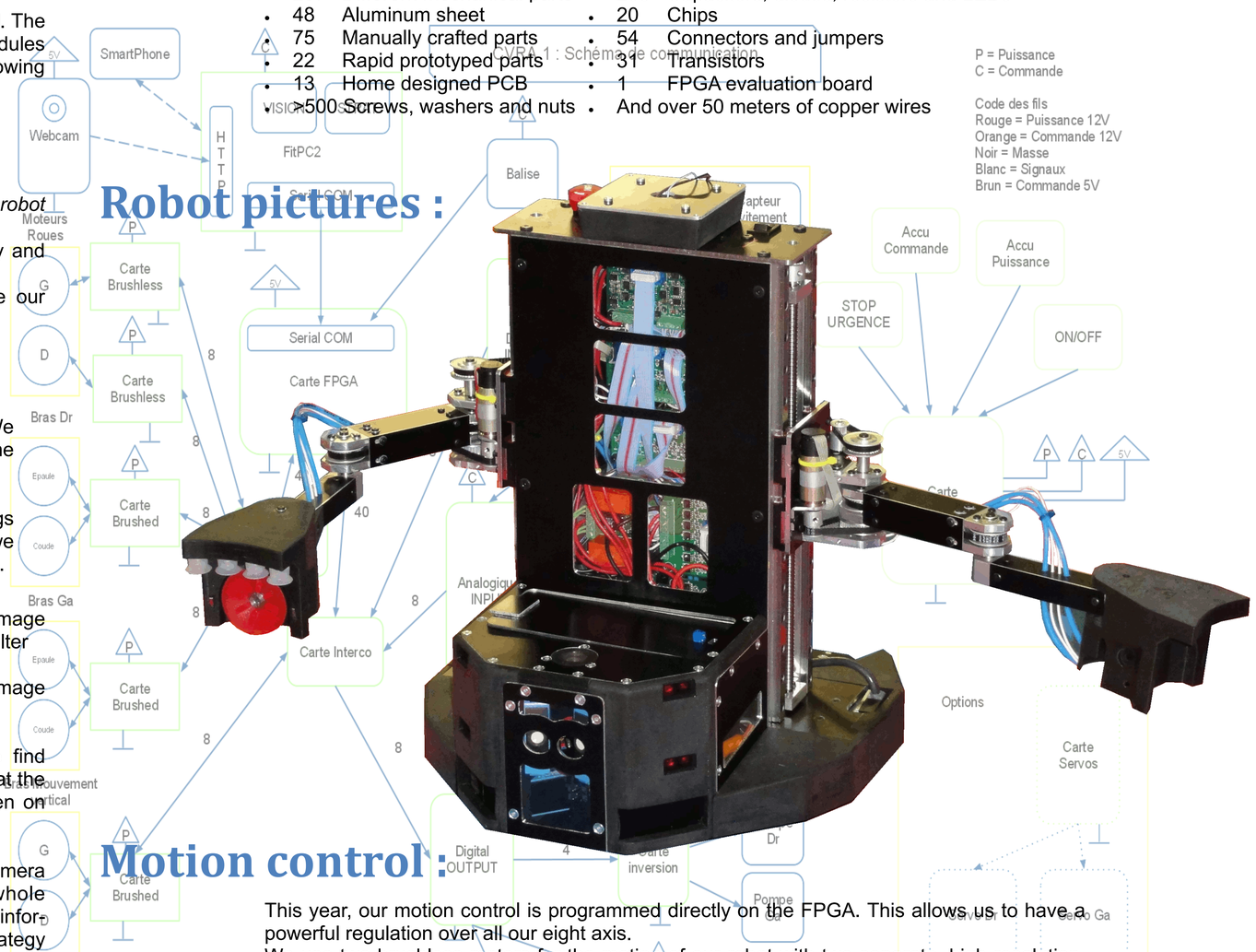
  You will find more information about the FPGA board and modules on our other robot poster ***Black Pearl***
- A computer for the AI and vision processing programmed on Python for fast, easy and advance programming
- A power board that give us the energy we need when we need it and manage our accumulator discharge.

Mechanical facts :

Debra is maid of about1500 parts. Theses parts are:

- 207 Different mechanical parts
- 48 Aluminum sheet
- 75 Manually crafted parts
- 22 Rapid prototyped parts
- 13 Home designed PCB
- >500 Screws, washers and nuts
- 208 Capacitors, diodes, resistors and LEDs
- 20 Chips
- 54 Connectors and jumpers
- 31 Transistors
- 1 FPGA evaluation board
- And over 50 meters of copper wires

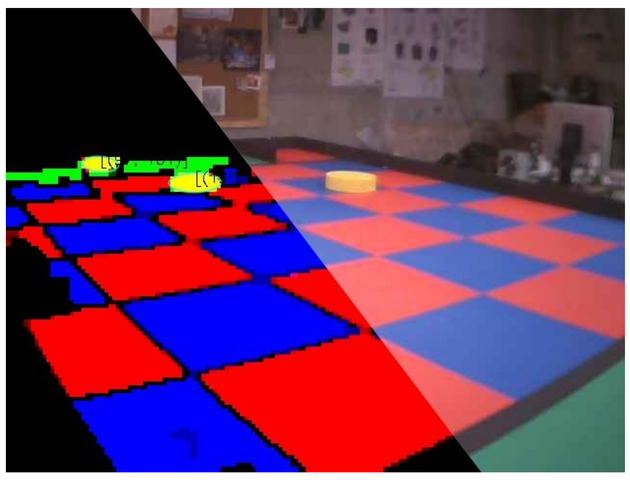
Robot pictures :



Vision system :

We chose to place our camera on a fix position to facilitate the image acquisition. We place it on a fix beacon and process the image with our computer on the robot. The wireless link is a common WiFi because it's easy, cheap and very reliable.

We can see nearly the entire play area. Our process find pawns, queens and kings (without distinction between queens and kings). The towers are detected and we calculate how many pawns are stack and if a queen/king is on the top to correct mistake.



On the right, the image with a light color filter

On the left the image after processing.

We see that we find the pawns and that the position are written on the top.

We use the camera during the whole game. It send all information to our strategy (AI) which react to score as much point as possible.

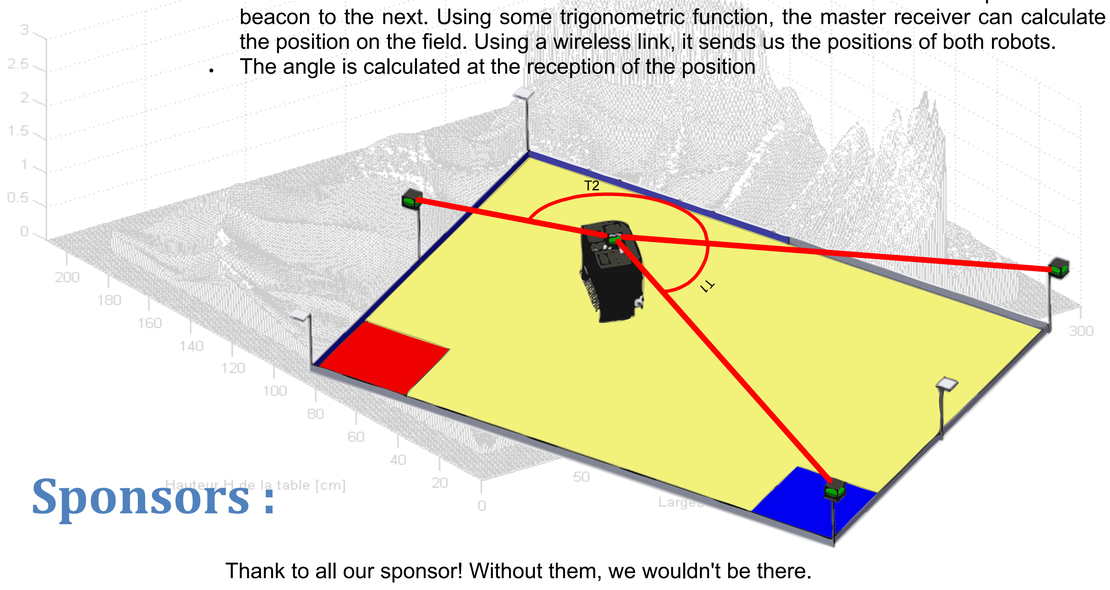
Motion control :

This year, our motion control is programmed directly on the FPGA. This allows us to have a powerful regulation over all our eight axis.
We use two brushless motors for the motion of our robot with two separate, high resolution, encoders to avoid drifting imprecision and regulation oscillation.
Each arm use three DC motors with encoders to move. Each motor has his own regulator and is controlled by a process that control all motors together to insure maximum accuracy and speed.
The process that control each arm are linked to the robot motion and robot sensor to track and handle object on the move.

Beacons system :

The beacons system gives us both robots location on the table. The key points are:

- There are 3 receiver beacons on the side of the field linked by wire.
- Each robot has its own laser emitter beacon. On theses beacons, the laser is reflected on a cylindrical mirror to transform the circular beam to a vertical line. The mirror is mounted on a motor which rotates constantly so the laser hits each receiver.
- The beacons around the field measure the time the laser beam takes to pass from a beacon to the next. Using some trigonometric function, the master receiver can calculate the position on the field. Using a wireless link, it sends us the positions of both robots.
- The angle is calculated at the reception of the position



Strategy :

This year, our robot AI is very complex. During the first three quarter of a game, it calculates the best trajectory to do the best score avoiding the other robot. In the last quarter, it check if the opponent invalidate any of our tower and correct theses "mistake". If all our tower are in good position we try to pick opponent points but so fare, without any success.

Members and Tasks :

Antoine Albertelli (Debra)
Programmer engineer, Motion

Florian Glardon (Debra)
Programmer engineer, Strategy

Joseph Lemaître (Debra)
Programmer engineer, Vision

Michael Jeanneret (Debra)
Electronic engineer, FPGA IO

Patrick Eugster (Debra)
Electronic engineer, Beacon

Romain Bersier (Debra)
Mechanical engineer, Robot design

Thierry Prêtre (Debra)
Sponsoring, Vision programmer

Boris Pillionnel *(Black Pearl)*
Mechanical engineer, Robot design

Cédric Debétaz *(Black Pearl)*
Programmer engineer, collision avoidance system

Olivier Wenger *(Black Pearl)*
Programmer engineer, Strategy

Rouven Althaus *(Black Pearl)*
Programmer and electronic engineer, Motion and FPGA modules

Vincent Kern
Poster design (from USA) and troublemaker ;-)

All our member are needed to chose the concept of our robot

As a team, all member help on every task to share our knowledge.

Sponsors :

Thank to all our sponsor! Without them, we wouldn't be there.

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