QUADRUPED ROBOT

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SPECIFICATIONS

Creation of a quadruped robot capable of picking up waste in various environments. Incremental approach : Leg design

- Maximum robot mass : 15 kg
- Forward speed : 1 m/s
- Minimum autonomy : 30 minutes
- Lower cost

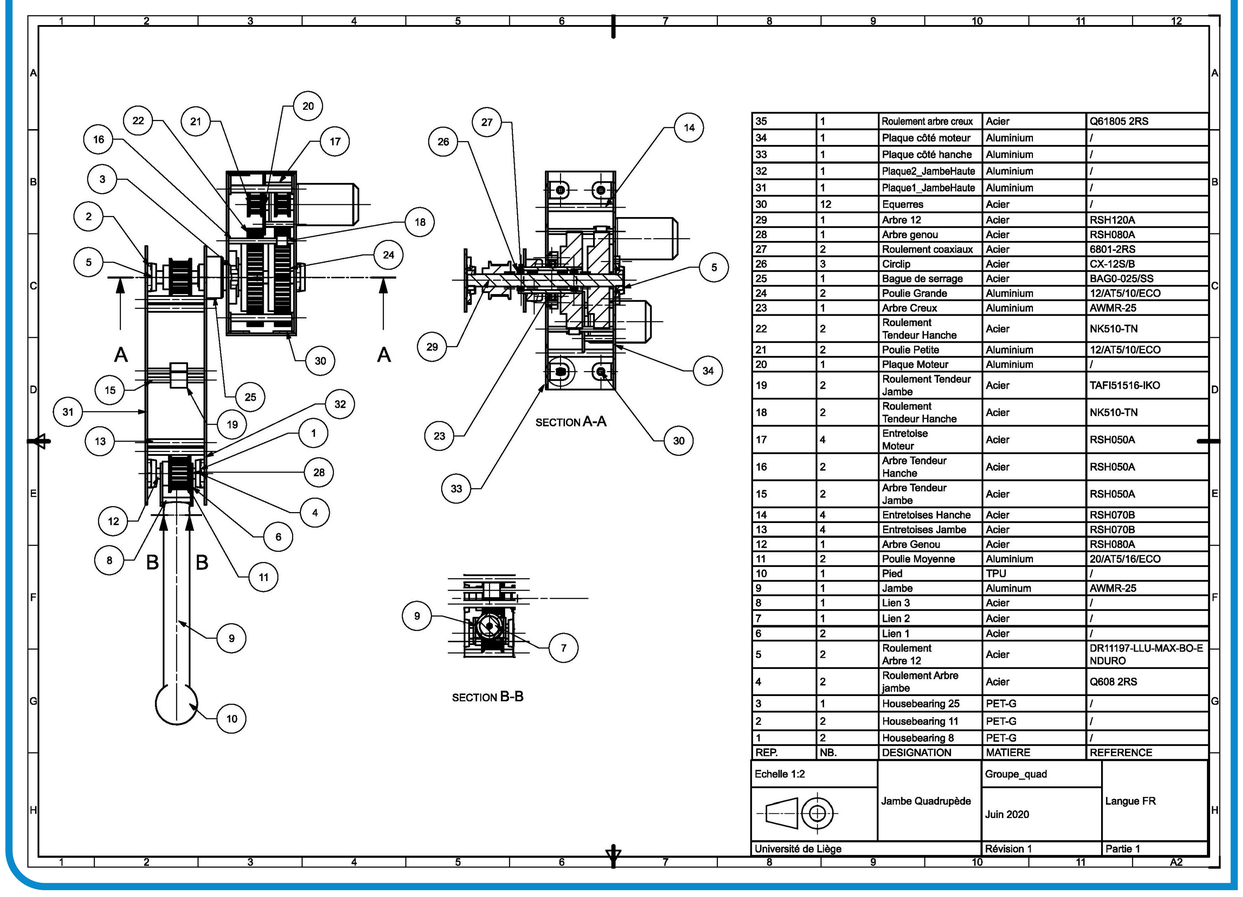
CHOICES

- Choice of leg topology : Series Articulated
  - to decrease the inertia of the leg
  - to increase the working space
- Choice of degrees of freedom : 2 dof
  - HFE : Hip Flexion/Extension
  - KFE : Knee Flexion/Extension
- Leg optimization
  - High torque density motor : For robotic type applications, we need high torques (Order of magnitude : 1 to 2 Nm/kg required at the joints for stroke) associated with a low speed of rotation. This demand is difficult to meet since the motors are designed to rotate fast with very low torque. The ideal situation would be to have a lot of torque for a given mass : the torque density is maximised.
  - Low leg inertia : The mass of the leg, as well as its inertia must be minimized. Minimizing the mass will be done mainly in the choice of materials. Also, to reduce the inertia of the leg, a mechanism where the actuators will be placed in the hip will be preferred, which implies the creation of transmission systems.
  - High torque control : the robot moves around and has to pick up objects, it must effectively control its interaction with its environment. What affects torque control are mainly imperfections in the transmission, such as friction and backlash.

  Solution : Quasi-direct-drive actuation (single stage reduction with a ratio less than 10:1). The output torque is increased, friction losses are minimized, backdrivability is increased, and ease of design is improved, which reduces the cost.

- Motor : APS 4260S SENSORED OUTRUNNER BRUSHLESS MOTOR 100KV 1200W
- Battery : Turnigy Lipo 6s 20C 20000mAh
- Motion transmission : Pulley and belt transmission 5:1

MECHANISM



REP.	NB.	DESIGNATION	MATIERE	REFERENCE
35	1	Roulement arbre creux	Acier	Q61805 2RS
34	1	Plaque côté moteur	Aluminium	/
33	1	Plaque côté hanche	Aluminium	/
32	1	Plaque2_JambeHaute	Aluminium	/
31	1	Plaque1_JambeHaute	Aluminium	/
30	12	Equerres	Acier	/
29	1	Arbre 12	Acier	RSH120A
28	1	Arbre genou	Acier	RSH080A
27	2	Roulement coaxiaux	Acier	6801-2RS
26	3	Circlip	Acier	CX-12S/B
25	1	Bague de serrage	Acier	BAG0-025/SS
24	2	Poulie Grande	Aluminium	12/AT5/10/ECO
23	1	Arbre Creux	Aluminium	AWMR-25
22	2	Roulement Tendeur Hanche	Acier	NK510-TN
21	2	Poulie Petite	Aluminium	12/AT5/10/ECO
20	1	Plaque Moteur	Aluminium	/
19	2	Roulement Tendeur Jambe	Acier	TAFI51516-IKO
18	2	Roulement Tendeur Hanche	Acier	NK510-TN
17	4	Entretoise Moteur	Acier	RSH050A
16	2	Arbre Tendeur Hanche	Acier	RSH050A
15	2	Arbre Tendeur Jambe	Acier	RSH050A
14	4	Entretoises Hanche	Acier	RSH070B
13	4	Entretoises Jambe	Acier	RSH070B
12	1	Arbre Genou	Acier	RSH080A
11	2	Poulie Moyenne	Aluminium	20/AT5/16/ECO
10	1	Pied	TPU	/
9	1	Jambe	Aluminum	AWMR-25
8	1	Lien 3	Acier	/
7	1	Lien 2	Acier	/
6	2	Lien 1	Acier	/
5	2	Roulement Arbre 12	Acier	DR11197-LLU-MAX-BO-ENDURO
4	2	Roulement Arbre jambe	Acier	Q608 2RS
3	1	Housebearing 25	PET-G	/
2	2	Housebearing 11	PET-G	/
1	2	Housebearing 8	PET-G	/

Echelle 1:2	Jambe Quadrupède	Groupe_quad	Langue FR
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CONTROL AND TESTS

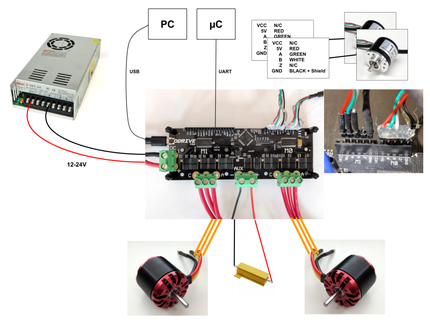
Use of a microcontroller Teensy 3.6 to control the robot thanks to a motor controller (Odrive)

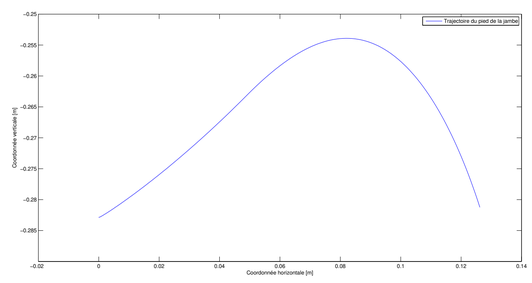
- Programmation with Arduino
- Possibility to control the leg in position, current and torque
- Possibility to know at each time step the values of parameters of each motor

Tests can be made thanks to Odrive's librairies used in Arduino

- Resolution of static and dynamic movement of the leg in Matlab
- Thermal and torque motor testing

Illustration of link between microcontroller, Odrive and motors and foot trajectory obtained with dynamic resolution thanks to Newmark method





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