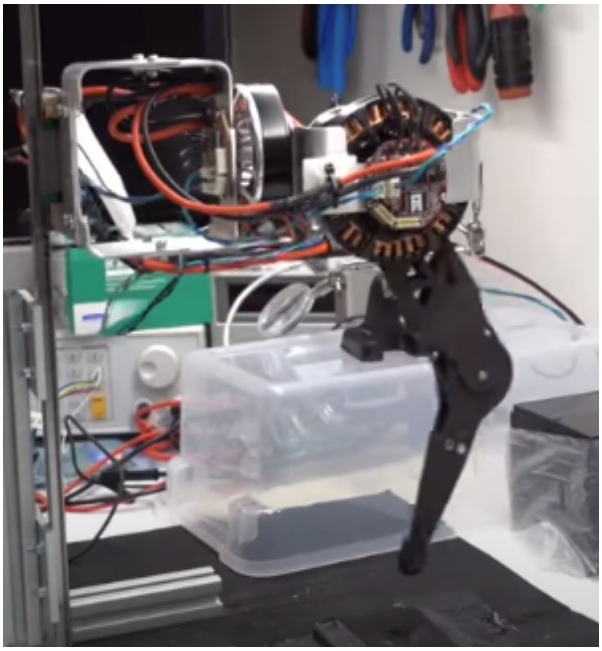
BLDC based actuator

This project aims to make a cheap actuator which can be used in multiple projects like inverse pendulum, wheel balance, quadruped. The reason for doing this project is, high torque digital servos are very costly, but we can make ones with similar performance for a fraction of the cost using BLDC motors.

Domains: Control System, PCB Designing, embedded systems (esp-idf), 3D designing, Power electronics, Robotics.



Deliverables

1. **(3 days) Understand BLDC Control Algorithms.**
   a) Trapezoidal
   b) Sine wave
   c) FOC
2. **(7 days) Understanding the working of DRV8305 and then re-evaluate if a better chip is available** for our application. Also decide appropriate motor type:
   a) Robu 5010
   b) Robokits 5010
   c) ML5010
3. **(14 days)** After chips are finalized, start circuit designing and make the schematics. (**Understand the open source controllers first**)
4. **(20 days)** Start PCB designing. Simultaneously work on gear mechanism (decide gear ratio, radius, material, etc.)
5. **(30 days)** Start working on firmware for the board once hardware is verified to work.
6. After the boards are verified, one can work on making it into a compact actuator with all the gears, motors, circuitry, etc in a single package. For example, check the MIT Cheetah actuator.

7. **(30 days)** Learn about Quadruped algorithms on CoppeliaSim, you can do basic gate tests on CoppeliaSim.
8. **(30 days)** Learn about aspects of the control system in this project.

Note:

1) Tasks 2,3,4,5,6 constitute hardware design, and task 6,7 constitute quadruped control. These are totally independent of each other, and can be done independently.
2) This is a project which must complete all its deliverables within 4-5 months, any delay will make this project useless to work on. We want everyone working on this project to adhere to the timing goals set by us.
3) Hardware verification takes a lot of iterations and time, so better to finish design part as soon as possible, so that team can start working on firmware as soon as possible.
4) The goal of this project is to make a hardware project with solid output which can be shown to professors and labs to secure guidance and funding to develop this further with better hardware.

End goal of project: We expect to have such a leg ready: Brushless Servo Leg Endurance Test - Lateral Failure, Compliant Robotics Actuator - Quadruped Robot #1 and Simple Cycloidal Robot Knee

Guidelines

1) Keep seniors in the loop with what you are doing.
2) Follow timeline given by seniors
3) Documentation of every small thing is a must. The end goal should be such that future members of SRA can easily replicate the same thing again by following the documentation.
4) Weekly meeting about progress on weekend.
5) Ask if you need any hardware, **“jitna mangte utna hi milta”**

Resources

- **Hackaday project**
  - 3D Printed Robot Actuator
- **YouTube Channels**
  - David Gonzalez
  - Paul Gold
  - Josh Pieper
- **Open-source BLDC Controllers**
  - https://github.com/byDagor/Dagor-Brushless-Controller
  - https://github.com/mjbots/moteus/tree/main/hw/controller/r4.5
- **BLDC Motor control algorithms**
  - Motor Control From Scratch
- **Discord**
  - https://discord.gg/2w9pe8bRtq (Moteus)