Robotic Knee Joint PE

IMT2018523
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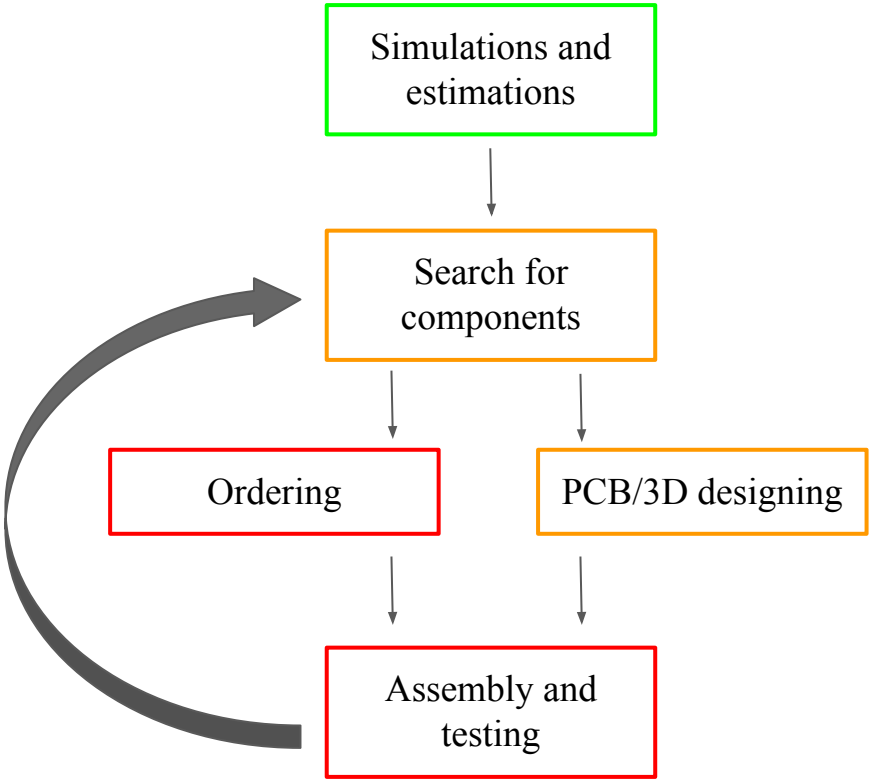
Planned workflow



Study and simulation

1. Average human leg (knee to ankle) length and weight estimated from papers.
2. Simulations in Webots to estimate required torque.
3. Verification with research papers(torque requirements, design details)

Simulation results

- ➔ Torque needed: **10Nm** typical peak, **60Nm** absolute worst. [1]
- ➔ Rotation angle range: <130° [2]
- ➔ Rotation speed: 90° in 1-10s or **10-30 RPM** as most
- ➔ Position control, torque control(if possible), telemetry for monitoring

[1] A Compact Rotary Series Elastic Actuator for Knee Joint Assistive System, 2010, Kong, Bae, Tomizuka: Fig 3
[2] MSD Manual professional version

Initial plan for motor

- ➔ NO reasonable motor gives that much torque
- ➔ Choose a motor with low torque, high RPM. Then use a gearbox to convert RPM to torque. (efficiency and feasibility??)
- ➔ 0.58Nm @ ~2000RPM implies ~30-50Nm @ ~30RPM
- ➔ Choices of motors: link
- ➔ Motor driver, control and gearbox are concerns now

Planned work

- ➔ Motor driver design and fabrication? (have driver available, but needs to be imported)
- ➔ Motor frame and gearbox design in Fusion 360
- ➔ Above designs to be tested using 3D printing initially.

Upcoming requirements(after return to campus)

- ➔ Motors
- ➔ Drivers and other sensors
- ➔ STM MCUs from CEEMS lab
- ➔ High power 24/36V power supply(20A surge, 40V atleast). Battery or PSU or SMPS
- ➔ 3D printer access time

Doubts

- ➔ Mechanical design of planetary gear-box
- ➔ Placement of Hall sensors
- ➔ High current, high power PCB design/motor driver sourcing