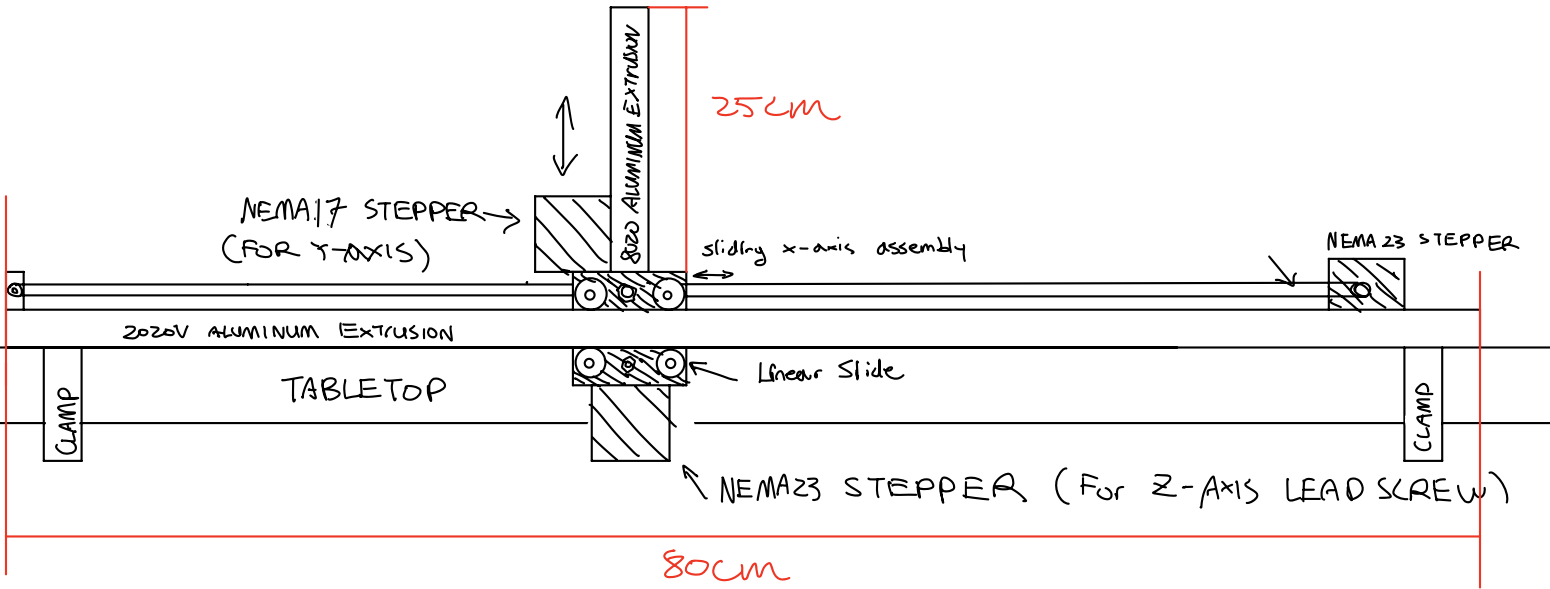


# - ROBOT ARM PRELIMINARY DESIGN

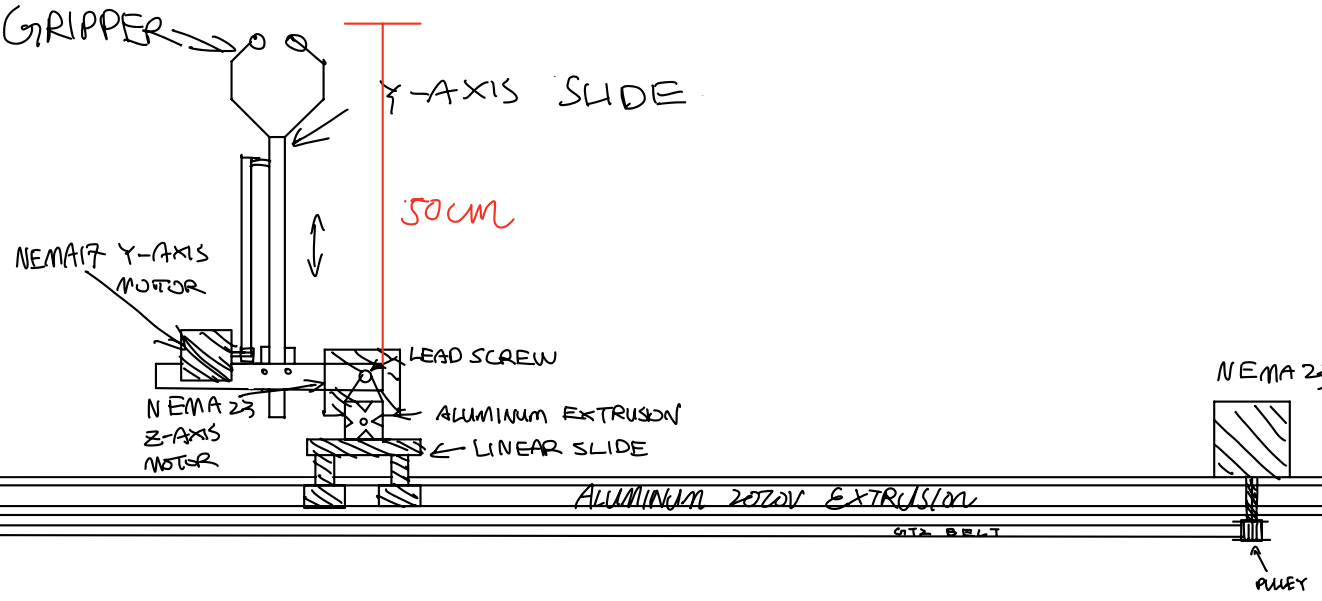
I considered building a robot arm composed of rotational joints -- much like a human's arm.

However, after considering our use case requirements, I decided that a Cartesian design -- similar to a 3D printer, is more appropriate. Doing precise motional control required by our use case in a rotational joint design is difficult because angular error is easily amplified over a long distance: 2mm repeatability at the gripper over an 50cm long arm requires  $\arctan(2/500) = 0.22$  degrees repeatability. The typical stepper motor has a 1.8 degree resolution. Even if we geared it, the gearing mechanism would also need to be low backlash, which is difficult to achieve. On the other hand, a cartesian mechanism can benefit from a pulley mechanism, which is zero backlash.

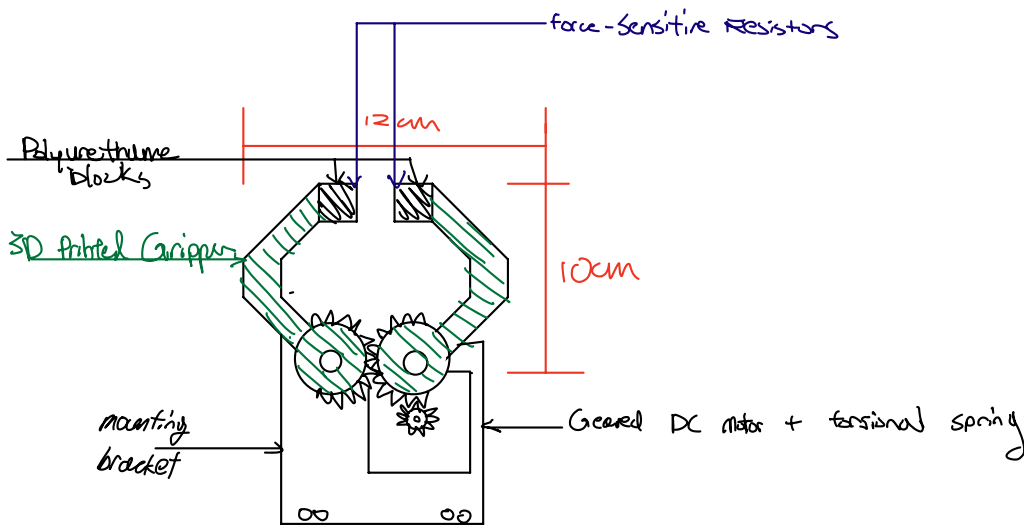
## 1.1 Overall Design - Side view



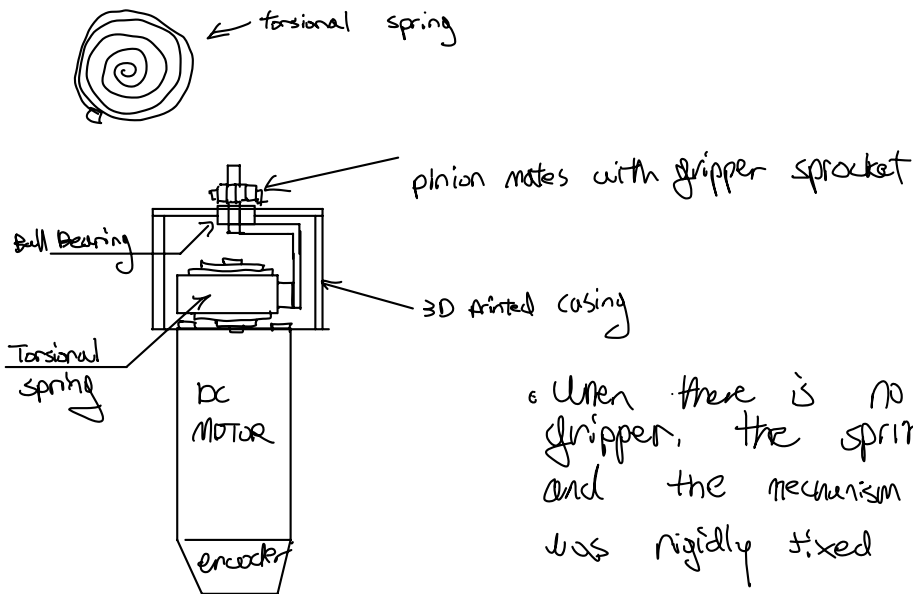
## 1.2 Overall Design - Top View



## 2.1 Gripper design

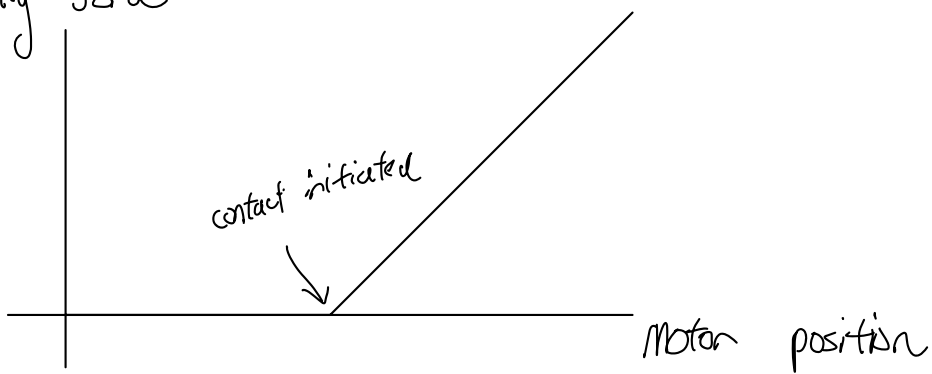


## 2.2 Variable force output Design



- When there is no force on the gripper, the spring has no effect, and the mechanism works as if the motor was rigidly fixed to the motor,
- When the gripper makes contact, force at the point of contact is proportional to torque in the spring. Torque in the spring is in turn proportional to how far the motor has turned after contact.

gripping force



With this design, we can control force relatively easily by just turning the motor.

