TEXAS A&M UNIVERSITY
Engineering

Lab-Assisting Robotic Manipulator (LARM)

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TEXAS A&M UNIVERSITY
ROBOTICS TEAM & LEADERSHIP EXPERIENCE

Problem Definition

Robotic arms prove useful in areas ranging from manufacturing to space exploration. However there is a distinct lack of cheap robot arms that are used in medical and wet-lab settings. LARM aims to develop a robot arm that will perform tasks such as holding instruments & containers, repetitive tasks such as pouring and stirring, and performing aspirations & injections.

Design Approach

The design of LARM focuses on reach, stability, and accuracy. Each step of the design process is optimized to allow the end product to achieve a target position with minimal error.

Design requirements:

- 6 Degrees of freedom to allow for 3-DOF positioning & 3-DOF orienting.
- Minimum reach of .6m (≈2ft).
- Minimum payload of 1kg (2.2 lbs).
- Different end effectors for multiple applications like syringes or grippers.
- 321 Kinematic structure, which creates a wrist joint at which precise motions can be isolated.

Hardware

Our work for Spring ‘25 consisted mainly of completing the first design of our end-effector, wrist, base, and 2nd link. We were able to complete our wrist prototype along with a syringe end-effector.

Summary of joint designs:

- First joint will consist of a 90 N-m stepper motor attached to a belt drive.
- This motor will rotate a platform that houses the second 90 N-m motor.
- Third motor is 24 N-m, followed by 20 and 60 kg/cm servos to manipulate the wrist.
- This wrist joint will allow precise end effector movements and orienting, allowing tasks such as pouring, stirring, injecting, or dispensing.

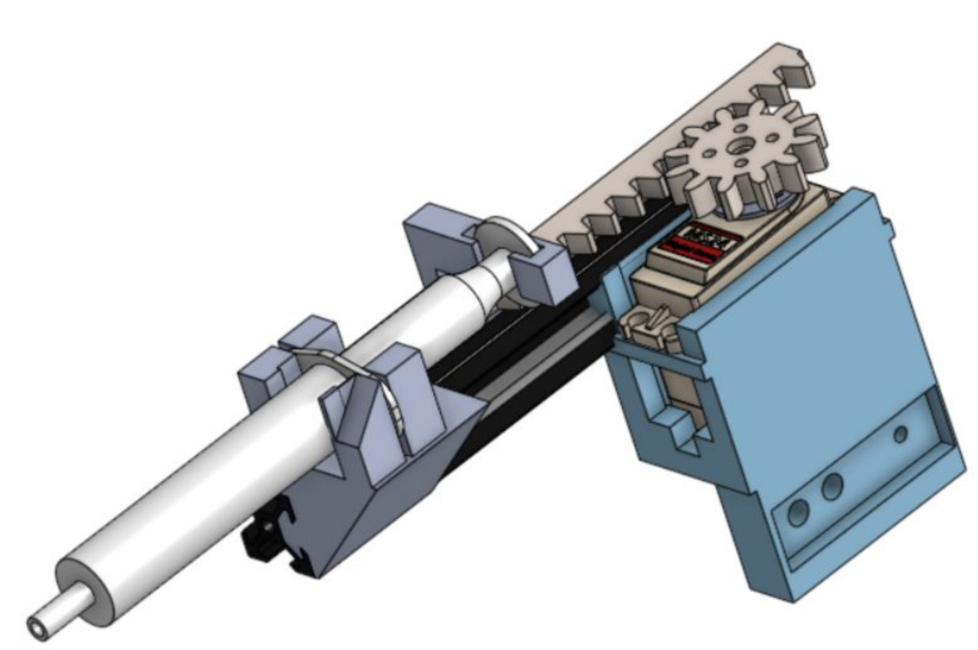

Figure 1: Syringe End Effector

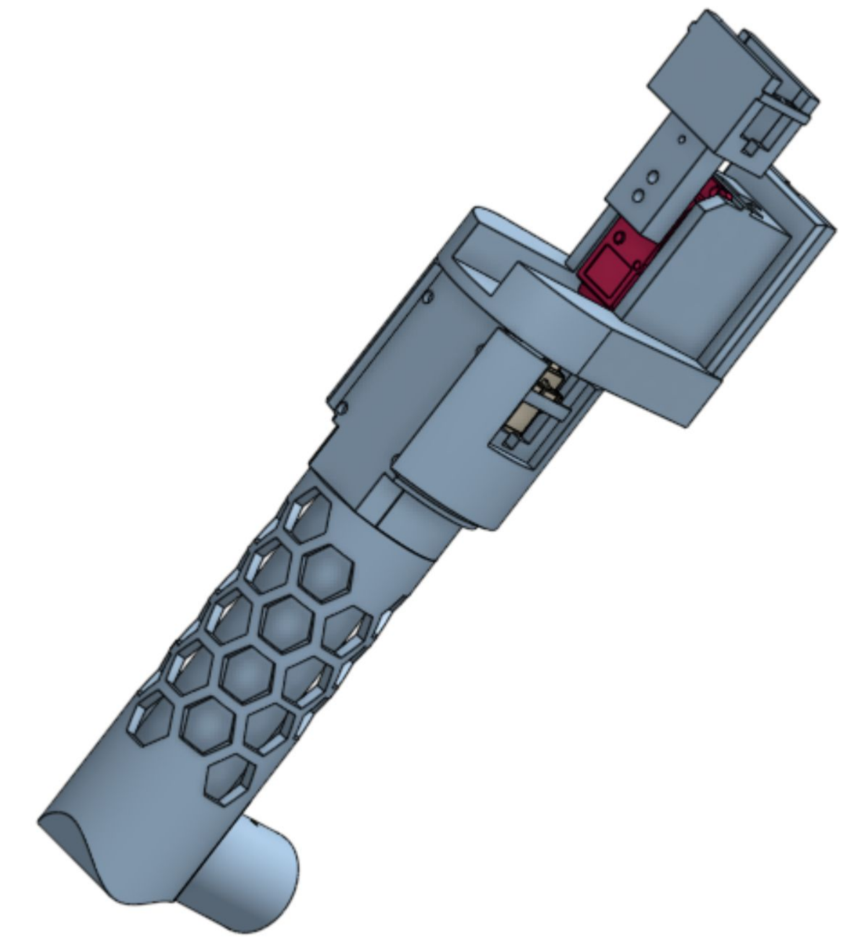

Figure 2: Wrist and Upper Arm

Electrical

Our electronics start with a 48V power supply, connecting to a voltage reducer that goes to buck converters that regulate the voltage/current going to our motors and servos.

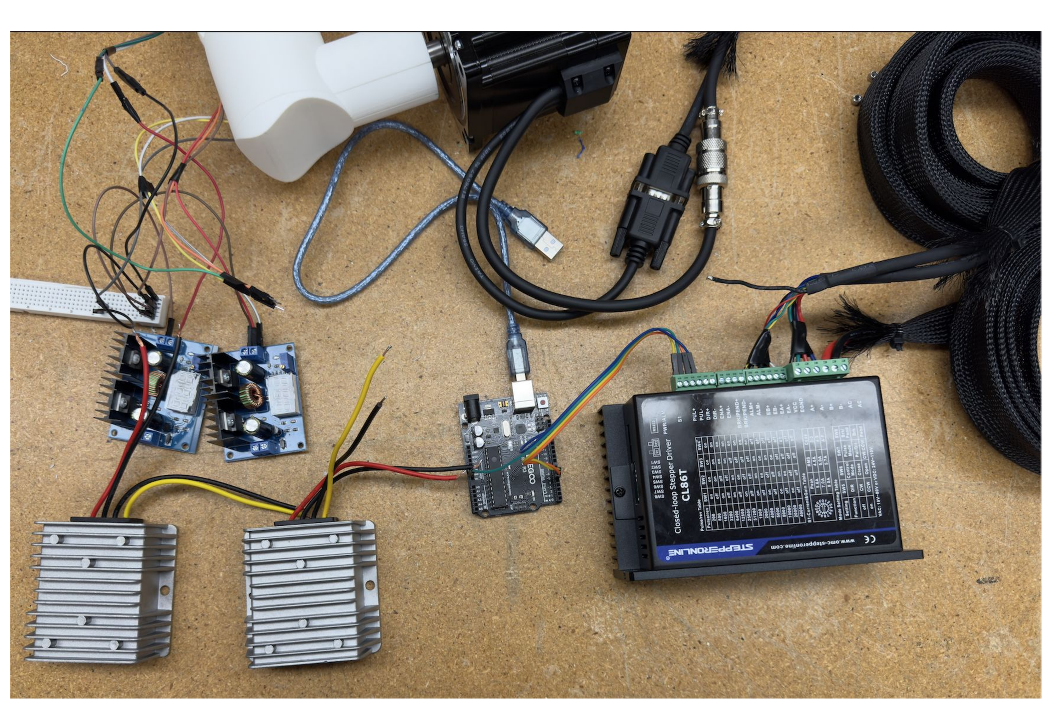

Figure 3: Motor driver connected to controller

Control

An inverse kinematics algorithm will be used to position the robot to a point within its operating space. Our careful design enables a kinematic solution simpler than many other robotic arms.

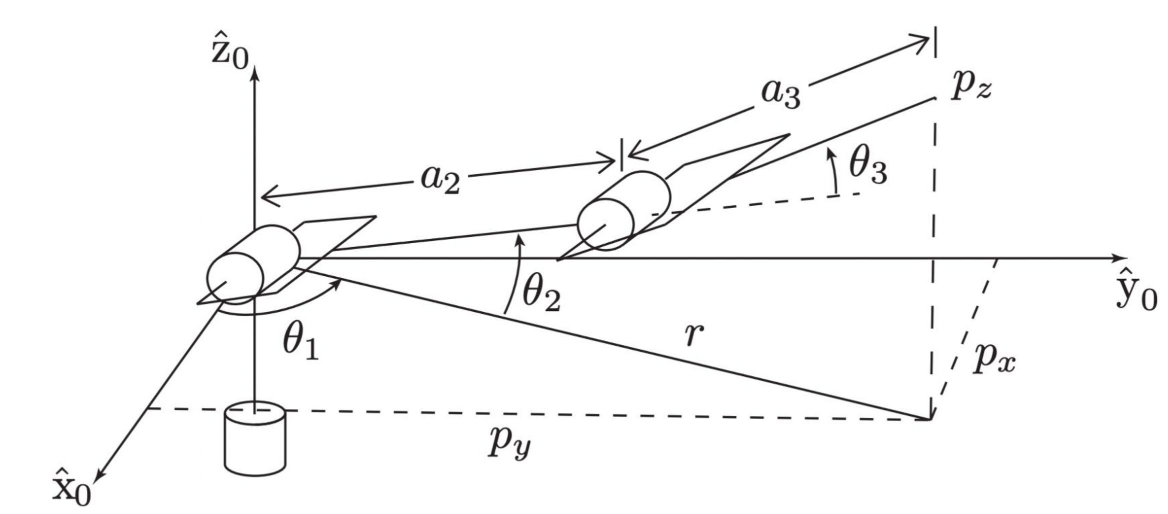

Figure 4: Simplified 3-DOF kinematic diagram

Next Steps

- Design casings to protect circuitry while arm is in use.
- Prototype and test 1st link.
- Iterate upper arm design and improve structural stability.
- Further develop the base design and begin prototyping.
- Begin working on program to automate motion based on inverse kinematic calculations.

Texas A&M University Robotics Team and Leadership Experience (TURTLE) Lab