Mechatronic Design Individual Lab Report (ILR02)
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Team: Team 2
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Individual Progress

Since the previous lab demo, I focused on implementing and testing motor control for the Motors Lab. My primary contribution was integrating a stepper motor subsystem using a 28BYJ-48 stepper motor and ULN2003 driver, as well as supporting DC motor speed control and overall program integration. The stepper motor was configured for 2048 steps per revolution and operated at 12 RPM, which provided smooth and reliable bidirectional motion. The motor shaft was marked with colored tape and mechanically stabilized to clearly show position changes during operation (Figure 1).

I also assisted with DC motor control using PWM output from the Arduino, including implementing a minimum duty cycle threshold to overcome static friction. This work was incorporated into a single Arduino program structure designed to support multiple motor types and sensor inputs, as required by the lab specification.

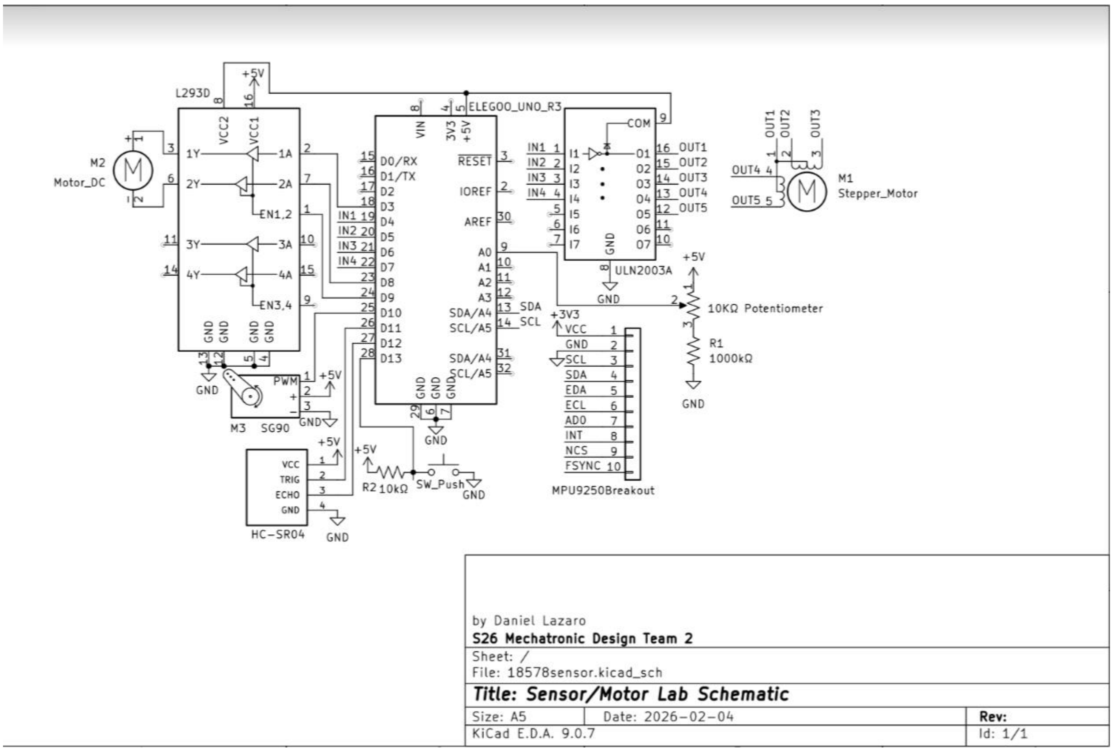
Challenges

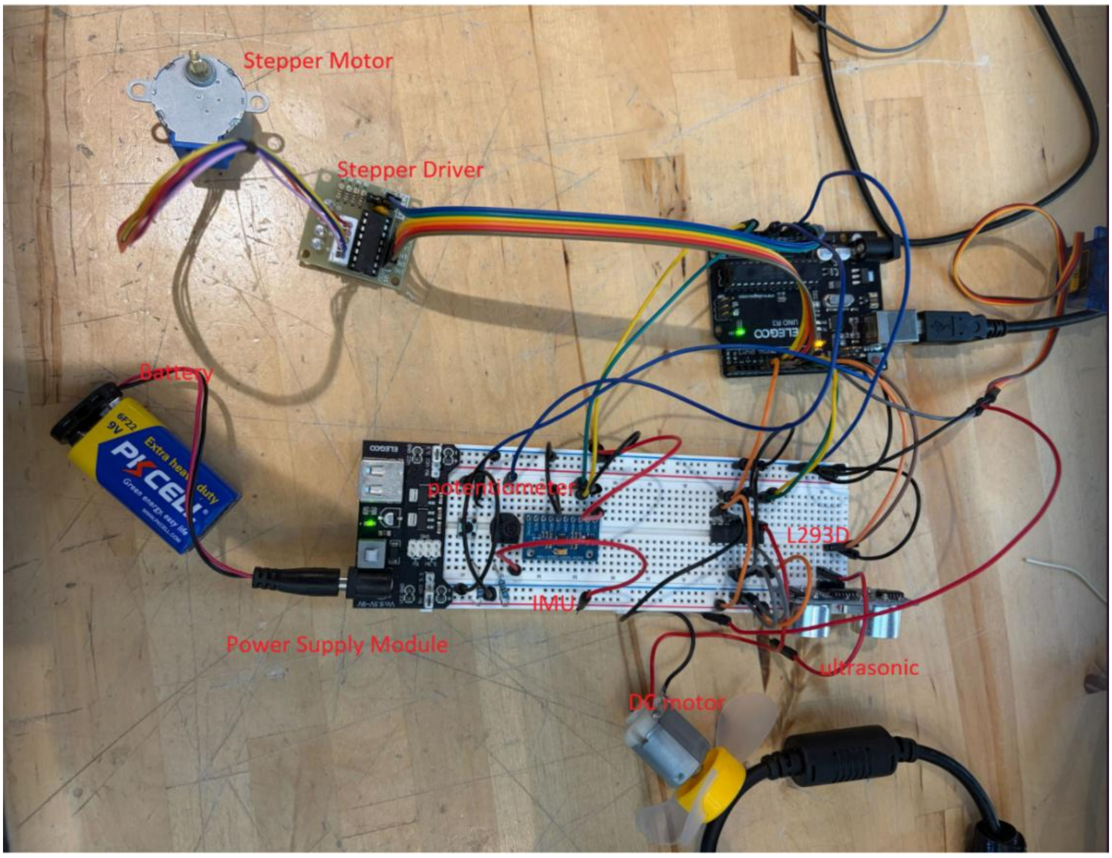
A significant challenge encountered during this lab was diagnosing a non-responsive DC motor despite correct software behavior. Serial communication confirmed that PWM commands were being received and executed correctly by the Arduino; however, the motor failed to rotate. This issue was ultimately traced to a hardware limitation rather than a software error. After identifying the root cause, I handed over the responsibility for completing the DC motor wiring and encoder integration to Dan. I then redirected my efforts toward robot leg and mechanism design to ensure continued progress on the mechanical subsystem of the project while the motor control hardware issue was resolved in parallel.

Teamwork

During lab time, I focused on developing and testing the Arduino code for the DC motor and stepper motor subsystems. Dan assisted with circuit wiring and hardware debugging for the DC motor and encoder, and he also worked on integrating sensors with the motor control logic. Yecheng was responsible for implementing and testing the RC servo motor, including verifying its range of motion and control behavior. Hongru focused on developing the graphical user interface, enabling communication with the microcontroller and providing a method to monitor and command motor states.

Figure


L293D
M2
Motor_DC
ELEGOO_UNO_R3
ULN2003A
M1
Stepper_Motor
10KΩ Potentiometer
R1
1000kΩ
M3 SG90
HC-SR04
R2 10kΩ
SW_Push
MPU9250Breakout
by Daniel Lazaro
S26 Mechatronic Design Team 2
Sheet: /
File: 18578sensor.kicad_sch
Title: Sensor/Motor Lab Schematic
Size: A5
Date: 2026-02-04
Rev:
KiCad E.D.A. 9.0.7
Id: 1/1


Stepper Motor
Stepper Driver
Battery
potentiometer
L293D
IMU
Power Supply Module
ultrasonic
DC motor

Plan

For the hexapod project, I plan to investigate leg mechanisms based on a Klann linkage – style structure, with the goal of developing a mechanical configuration in which a single motor can drive three legs on each side of the robot through a shared linkage system. To achieve this, I will begin by reviewing existing Klann linkage geometries and adapting them to our size and load requirements, followed by preliminary CAD modeling to evaluate range of motion and ground contact behavior.

As an initial step toward this goal, I have already designed and fabricated a preliminary leg mechanism in which a single motor drives two legs through a mechanically coupled linkage. This prototype was developed to reduce actuator count while maintaining coordinated leg motion, and it demonstrates the feasibility of using linkage-based mechanisms—similar in concept to Klann-style linkages—to generate leg trajectories suitable for walking. The current design provides a practical foundation for extending the concept to a three-leg-per-side configuration in future iterations.