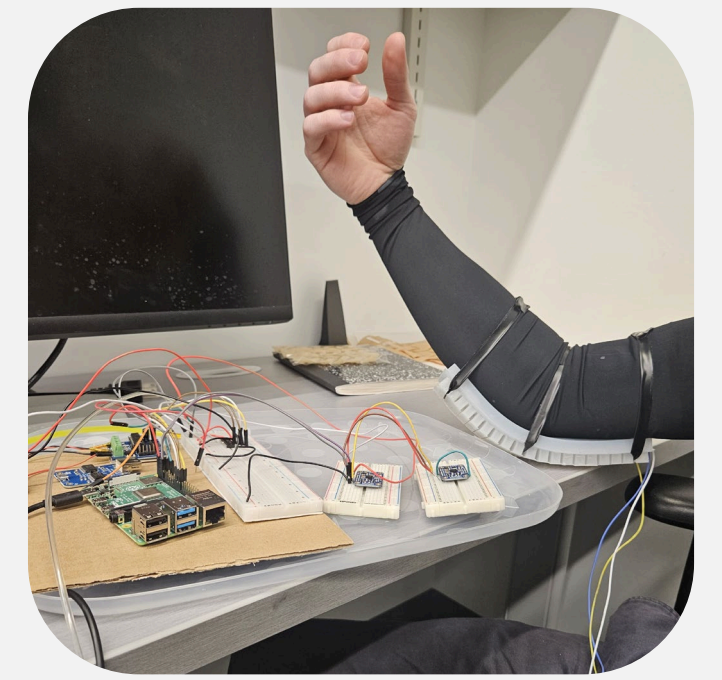




Development of Elbow Exoskeleton with Printed Stretchable Electronics and Sensors

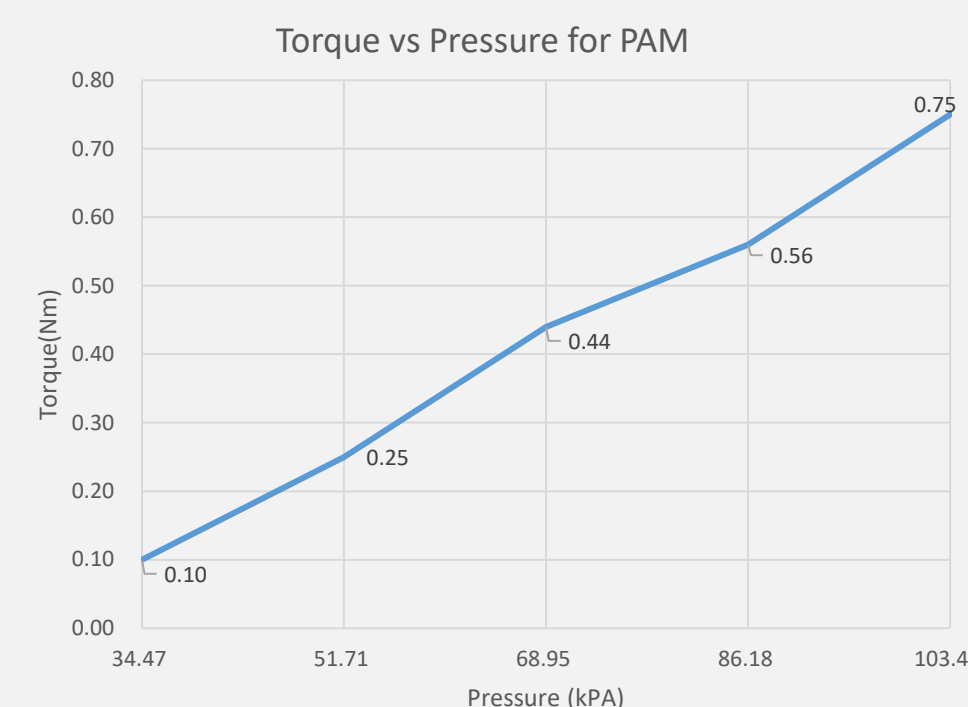
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Advisors: Pratap Rao (MME) and Lane Harrison (CS)



Project Overview

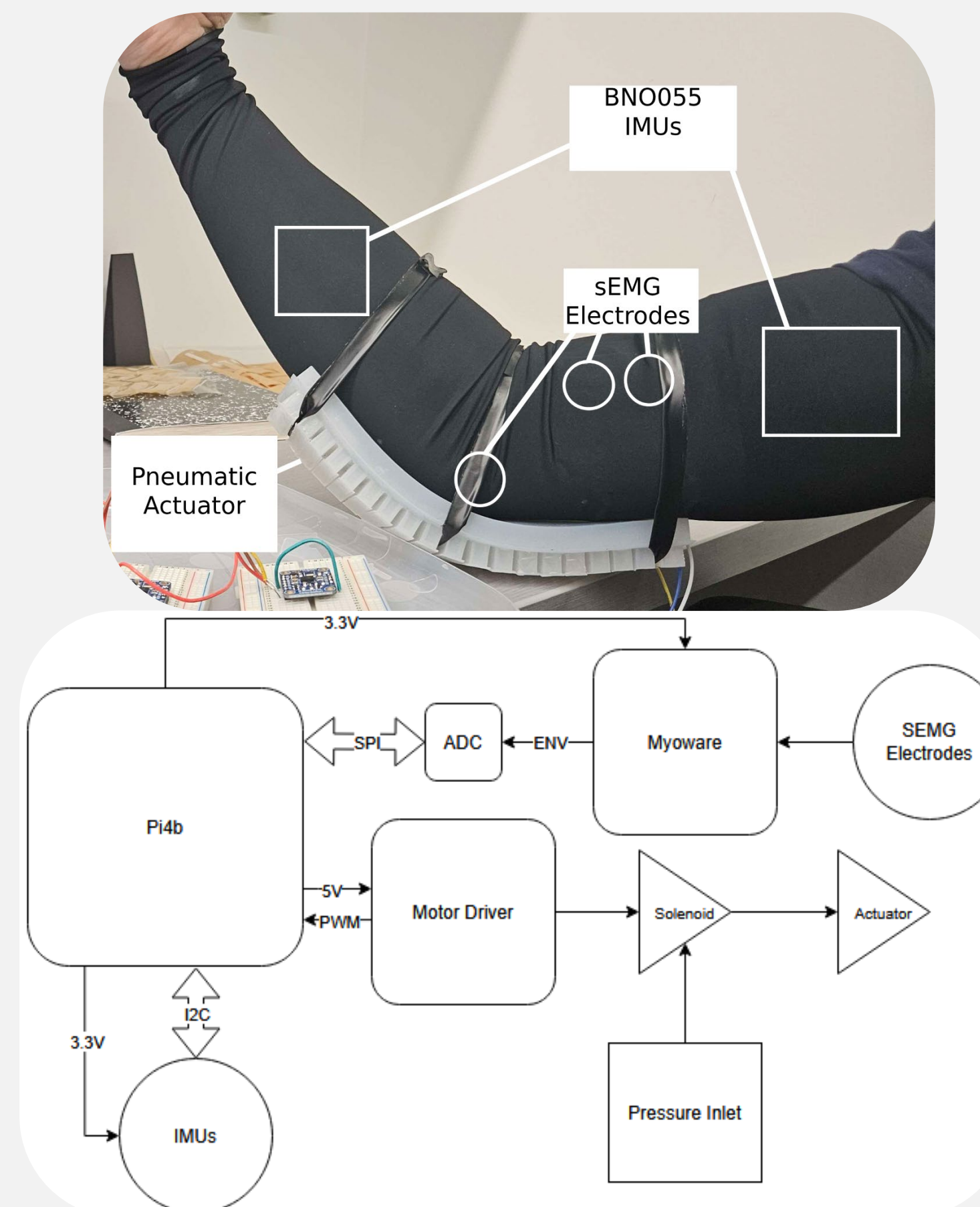
This project integrated stretchable electronics into a soft elbow exoskeleton, enabling surface electromyography (sEMG) sensing, motion tracking, and angular speed control. Our progress could be used to build a comfortable prototype that eliminates bulky fasteners and single-use electrodes. This could allow for the assistance of users with limited strength, helping them perform tasks that would otherwise be difficult or unattainable.

PAM (Pneumatic Artificial Muscle)

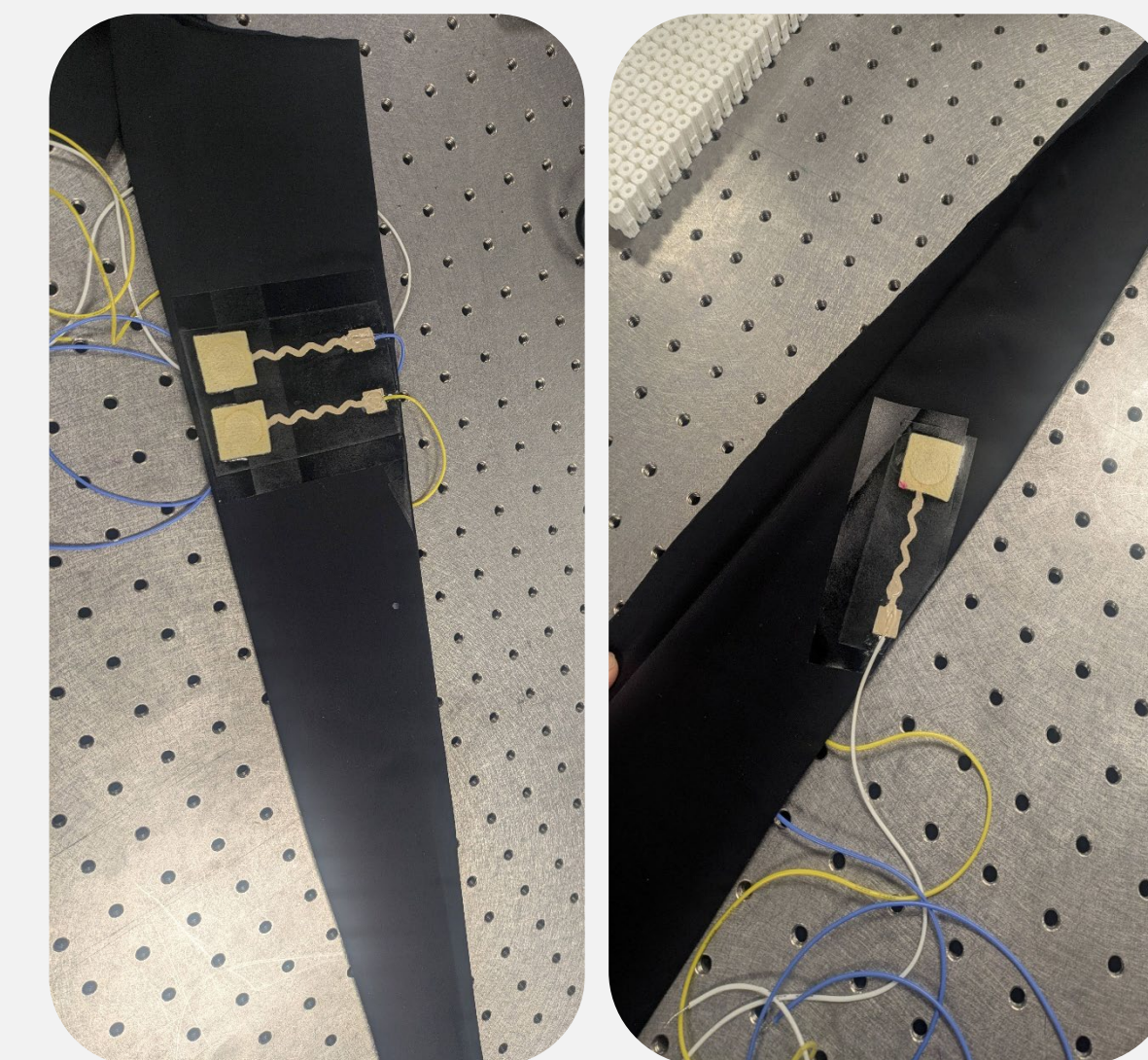


- Soft
- Linear Torque vs Pressure
- Safe

Electronics Overview



Sleeve and Electrodes



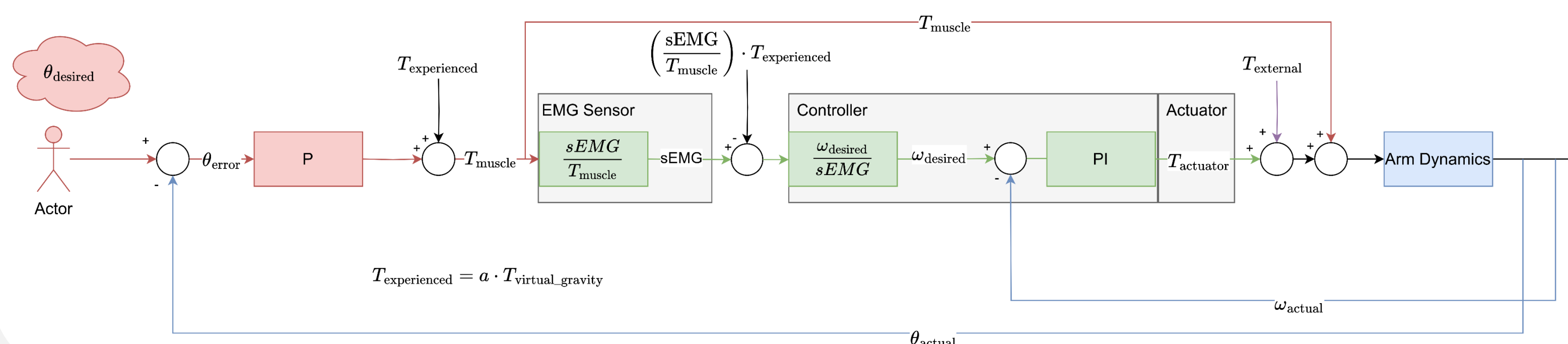
- Sleeve**
- Stretchable
 - Comfortable
 - Tight fit
- Electrodes**
- Stretchable
 - Reusable
 - Laminated onto wearable sleeve

Conclusions

- **Actuator**
 - Use of a soft silicone led to low force output
 - Testing has shown that the force output is proportional to the input pressure
 - Thicker actuator base avoids leaks and ruptures
 - Using no-stretch fabric instead of paper in the base of the actuator is more durable
- **Control System**
 - Successfully aids a simulated unable user to reach their desired angle
 - Actuator torque is smooth with no drastic changes
- **Sleeve and Electrodes**
 - The stretchable electrodes provide a comfortable user interface
- **Sensors**
 - Use of Myoware Muscle sensor caused noise and reliability issues
 - All other sensors have tested well for their respective functions
- **Next Steps**
 - Scale up the system by using a stiffer silicone and higher pressure-rated solenoid
 - Investigate power and air supplies

Modeling, Control, and Simulation

■ User ■ Exoskeleton System ■ Arm Dynamics ■ External Disturbance



- Simulated user and control system in Python
- PI control of angular speed
- User muscle effort determines desired angular speed

