Research On A Multi-Degree-Of-Freedom Modular Soft Snake Robot

Hongyi Hu, The Overlake School, USA

Q1: Problem & Objectives

- **Practical scenario:** new design of soft-body snakes capable of real-life situations
- **History:** rigid and soft-body snake robots by various team
- **General problems:** complicated, rigid bodies lead to stiff movements, lack a simple control system and visual feedback
- **Inspiration:** snakes' wave-like motion and ability to traverse narrow passages.
- **Improvements:** new single-opening mold that reduces leakage, real-time video feedback, and remote control with a phone. Fully modular design for easy replacement

Q2: Project Design

A: Front Camera Unit
B-E: Segment Module
    B, D: Pneumatic System
        B: Silicone Rubber Chamber
        D: Solenoid Valves
    C: Rigid Body
    E: Control Unit

Screenshot of Remote Control App

Q3: Data Analysis & Results

Effect of the wall thickness and diameter of the chamber
- Diameter: Larger the diameter the larger the angle
- Wall Thickness: thinner the walls the larger the angle
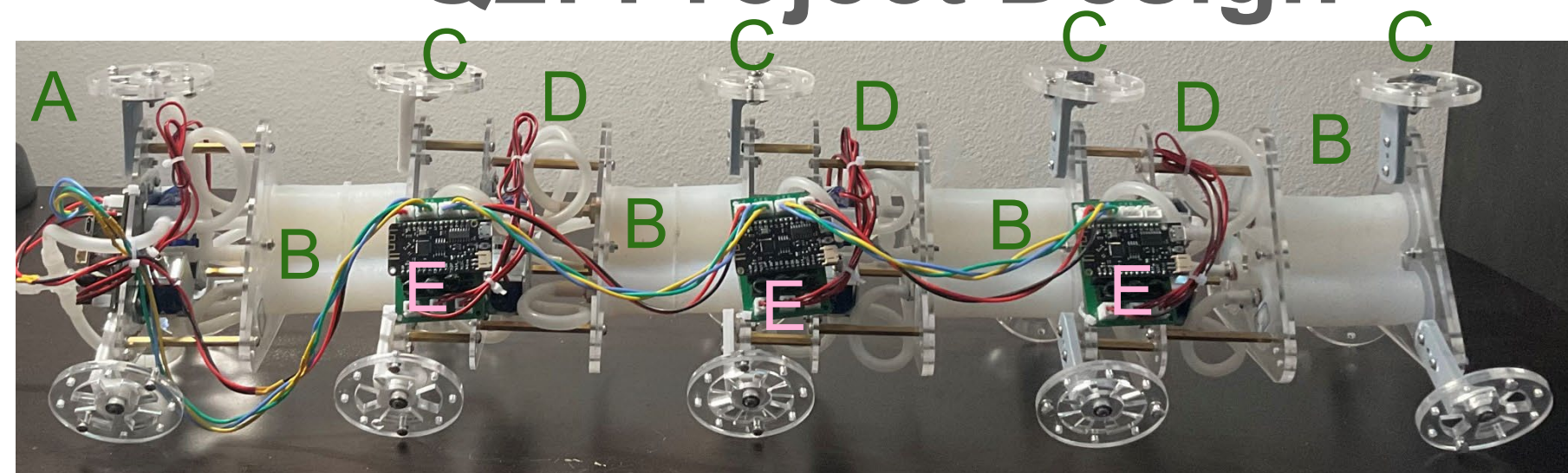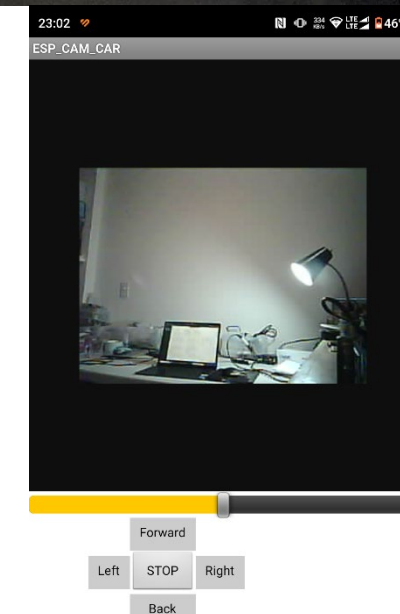- Travel Speed: 10.05cm in 14.74s

2. Silicone Mold
- Spring: more durable and flexible without embedded spring
- Mold: The final design is the most airtight

3. Simulation of taking turns in pipelines:
- Speed: to be resolved by increasing air pressure
- Versatility: to be resolved by modeling more locomotion

Q4: Interpretation & Conclusions

- **1. Structure:** the robots consist of an electronics system, a pneumatic system, and the remote control system. The remote control system receives commands from the phone and translates that into commands for each segment; The electronics system then controls the flow of air and the pneumatic system drives the robot
- **2. Function:** the robots can move forward, backward, and adjust direction; remote control allows for visual feedback from the robot and controls the snake's motion
- **3. Future plans:** the robots should be further improved by increasing speed, adding object recognition, implementing SLAM, and longer-distance remote control.