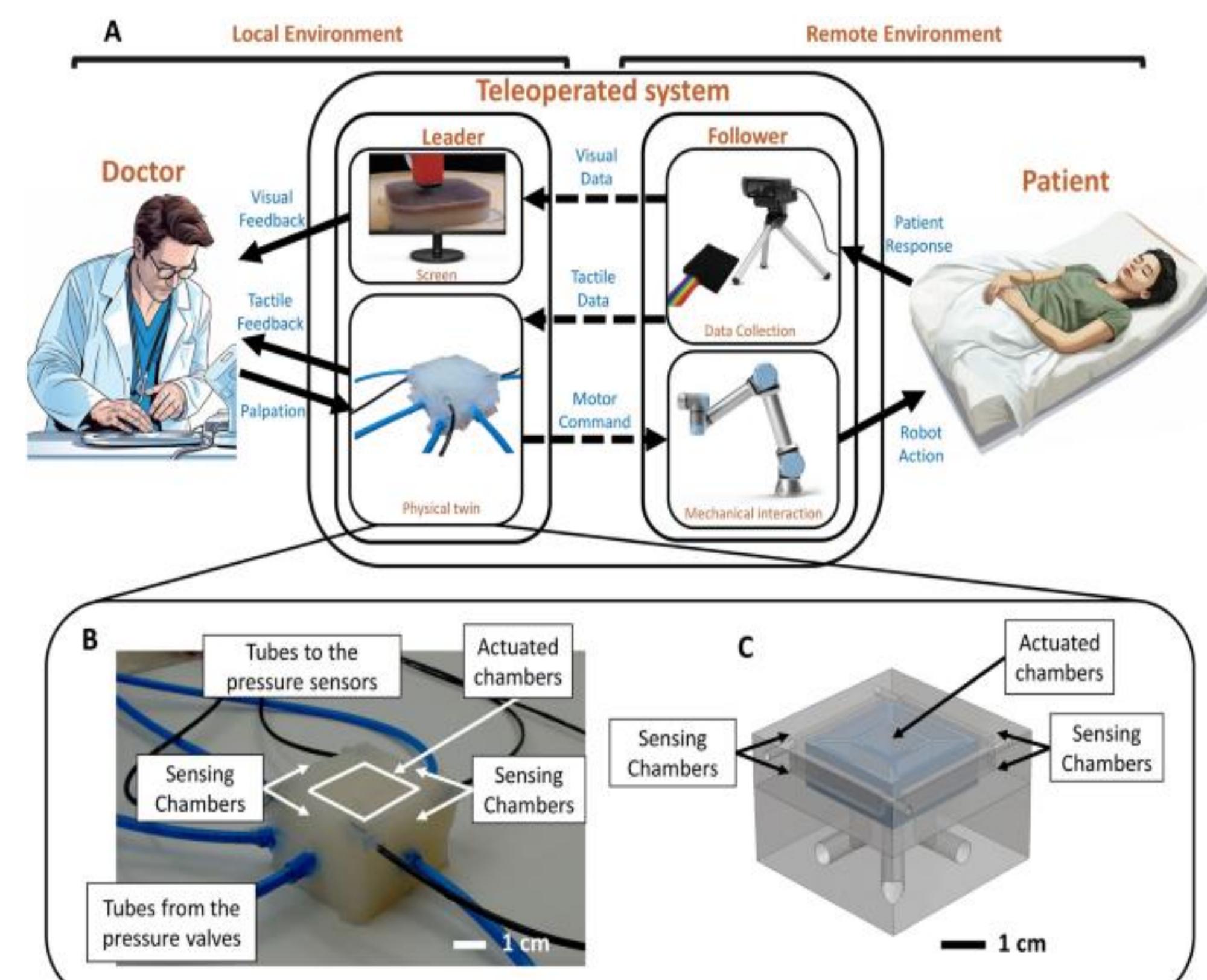
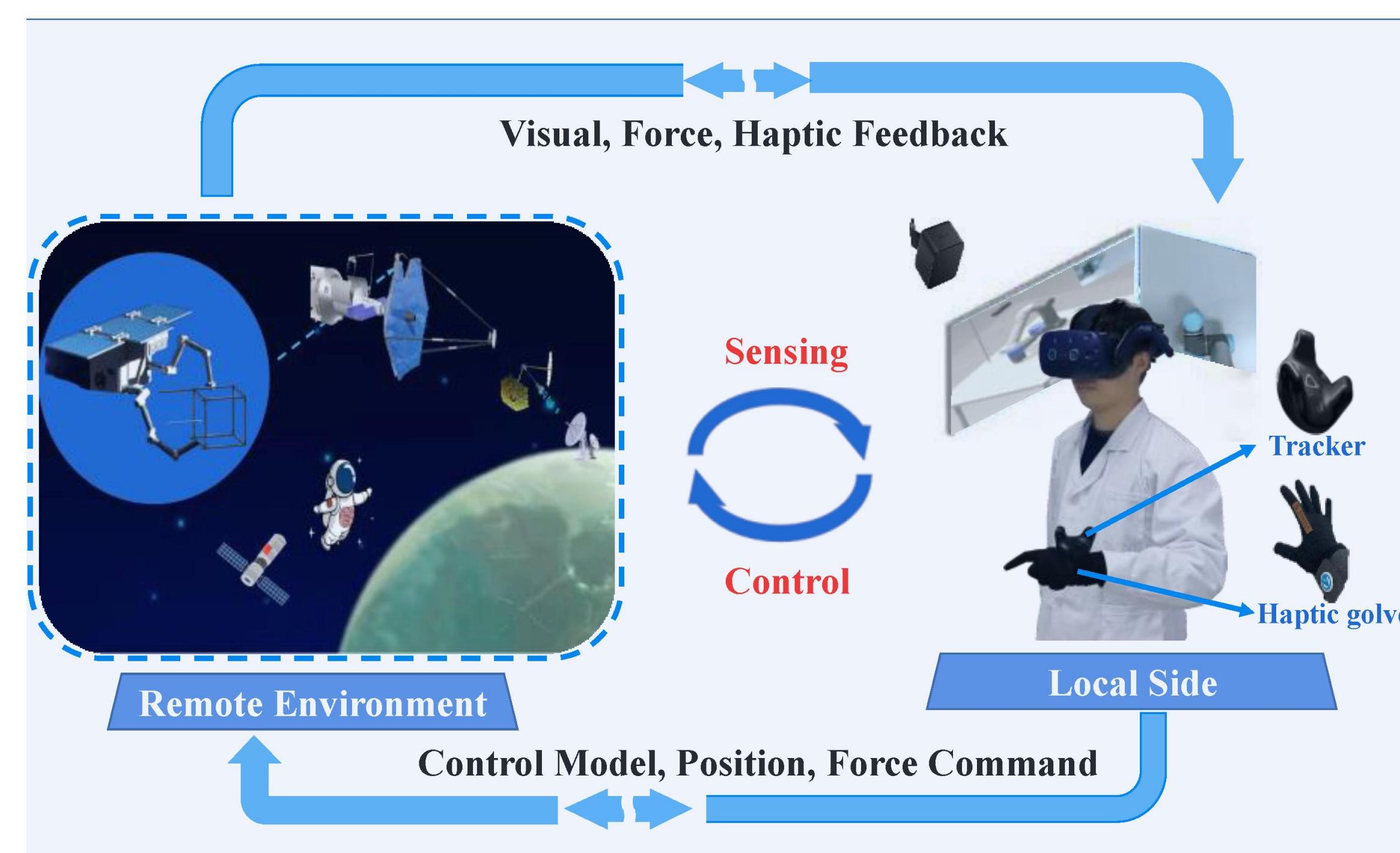


# Teleoperation Controllers

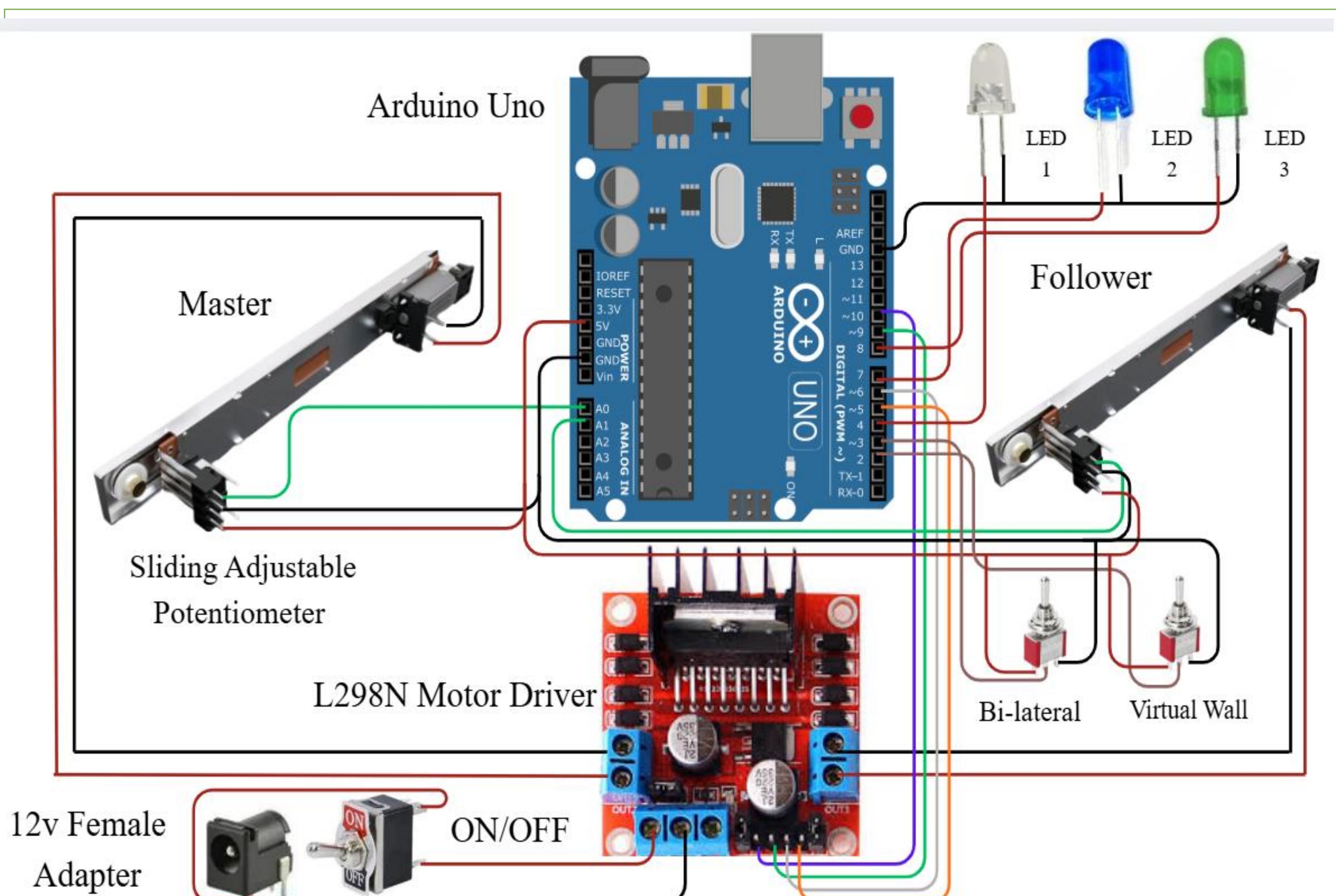


## Introduction and Motivation

- Teleoperation Controllers emerged to let humans safely and accurately operate robots from a distance when tasks are too dangerous, unreachable, or require human judgment.
- Medical procedures, space exploration, undersea research, and military activities all make extensive use of teleoperation.



## Circuit Diagram



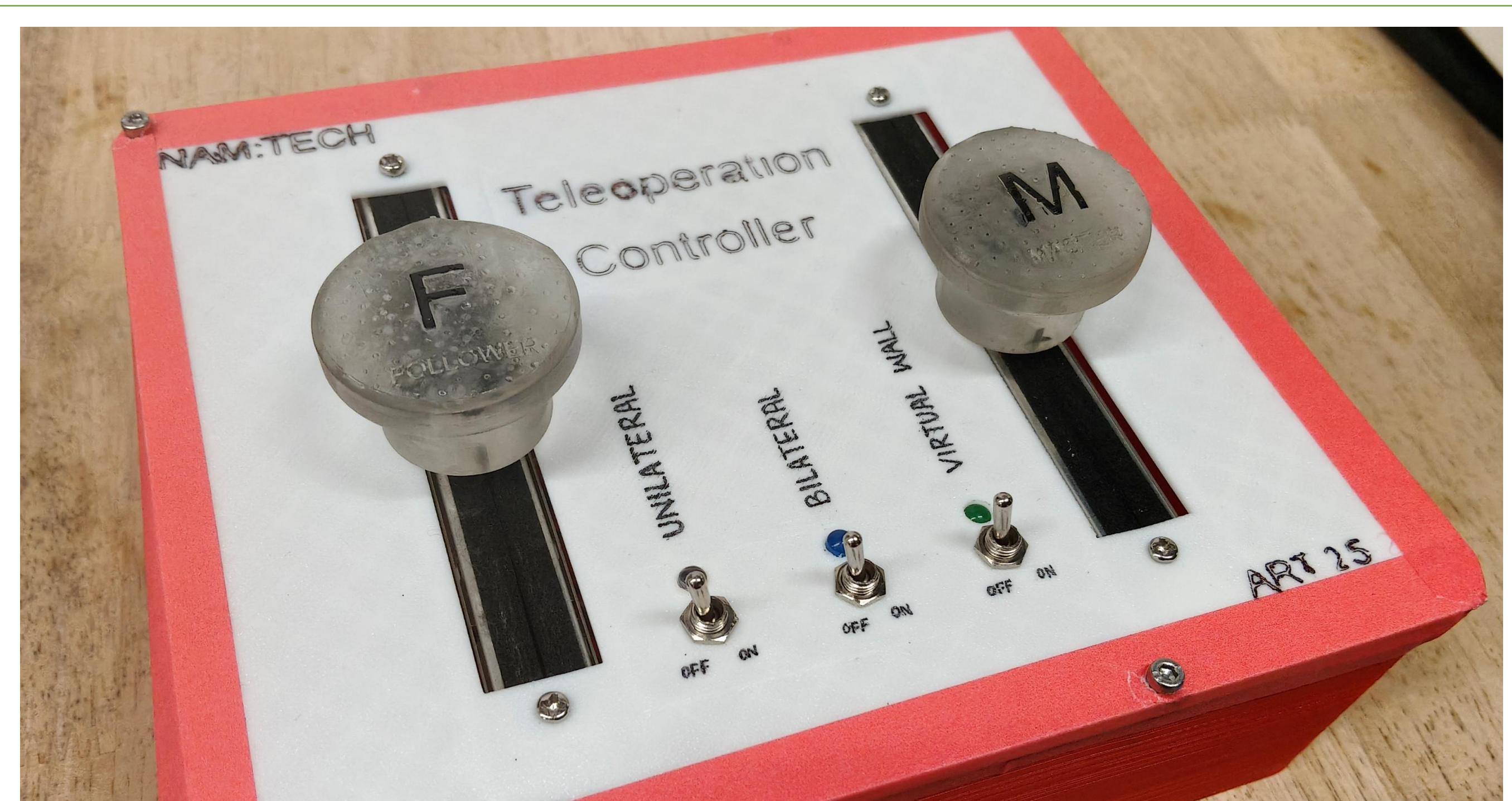
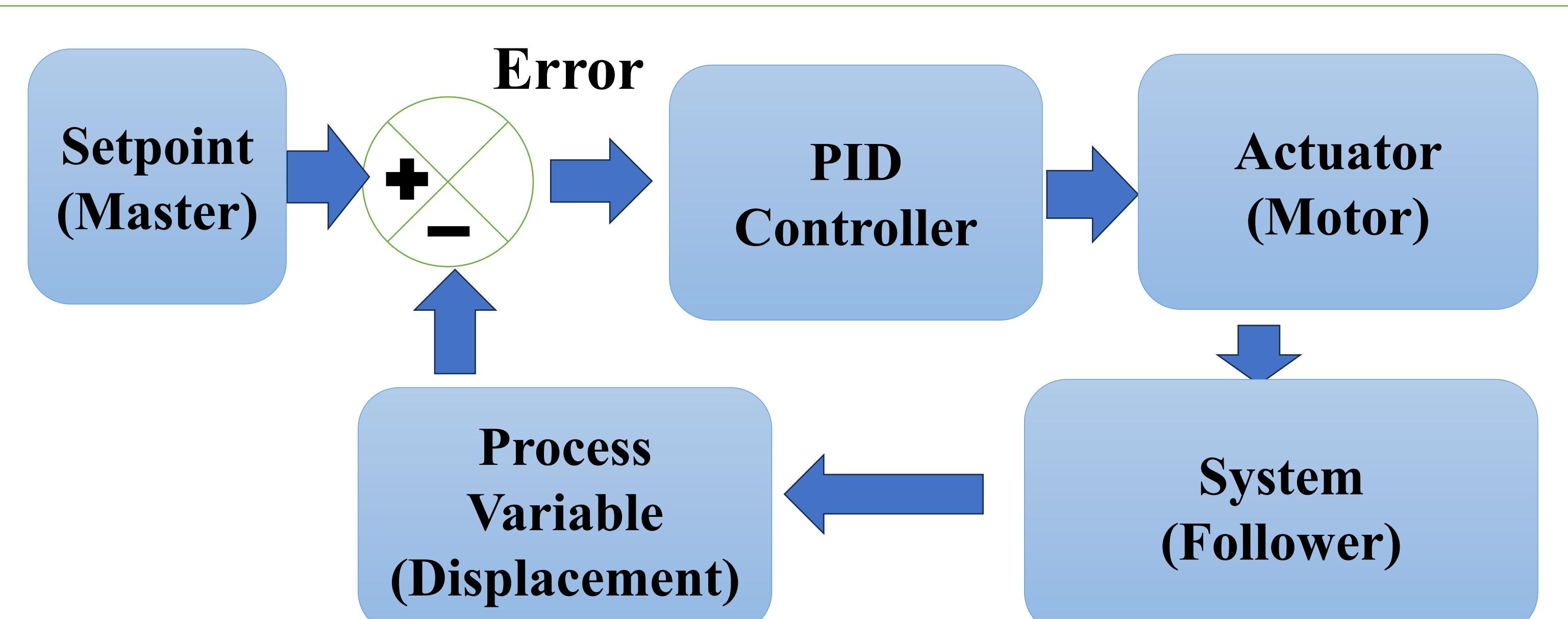
## Conclusion and Future Work

- System Performance: Teleoperation systems with force feedback (bilateral or virtual wall modes) give better control, accuracy, and safety than unilateral systems.
- Effect of Control Modes:
  - Unilateral Control:** Simple but lacks feedback.
  - Bilateral Control:** Provides a more realistic touch and greater precision.
  - Virtual Wall Control:** Improves safety by preventing collisions.
- ☐ Future work includes integration of **load cell** to demonstrate the force control

## Control Modes

1. **Unilateral Control:** Involves one-way communication.
2. **Bilateral Control:** The master and follower devices communicate in both directions
3. **Virtual Wall Control:** The virtual wall mode introduces a software-based safety feature

## PID Block Diagram



**Components Used:** Arduino Uno, Linear Potentiometer, Motor Driver, LEDs, Toggle Switches & Jumper wires

## References

- Peng, Shigang, Xiang Cheng, Meng Yu, Xiangchao Feng, Xinyu Geng, Shaofan Zhao, and Pengfei Wang. 2023. "Collision Risk Assessment and Operation Assistant Strategy for Teleoperation System" Applied Sciences 13, no. 7: 4109. <https://doi.org/10.3390/app13074109>
- Costi, L., Iida, F. Multi-silicone bilateral soft physical twin as an alternative to traditional user interfaces for remote palpation: a comparative study. *Sci Rep* 13, 23014 (2023). <https://doi.org/10.1038/s41598-023-50329-4>