

Figure 3. Vine-saber with a red glow

Problem Statement

Current toy lightsabers on the market are:

- Slow
- No automatic retraction
- Dangerous (hard plastic)

Our Solution

We used **pneumatic soft robot technology** to create a Vine Robot Lightsaber that offers:

- **Rapid extension** using a clutch mechanism
- **Motorized retraction**
- A **soft, inflated Dyneema blade** (safe)

Internals Showcase

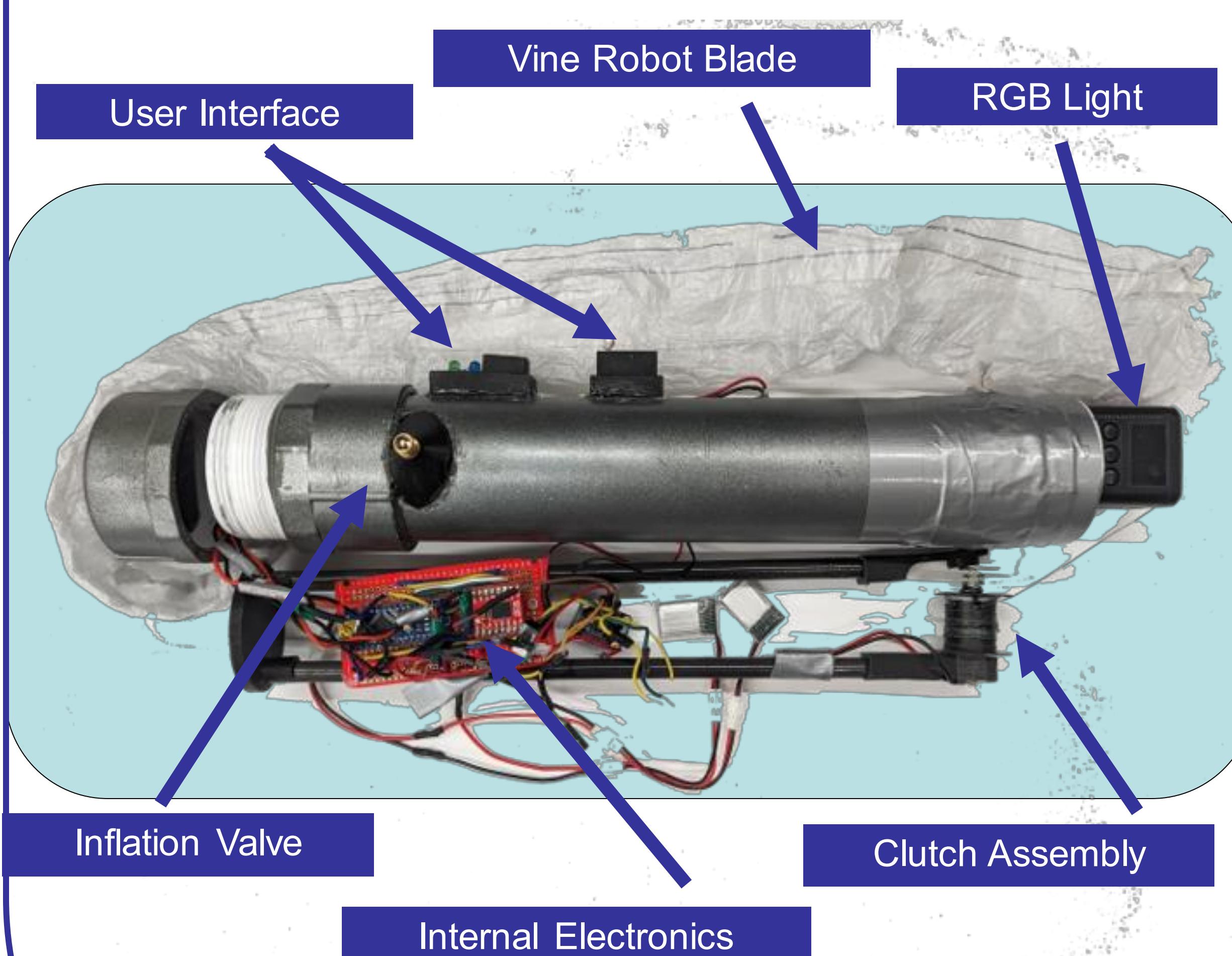


Figure 2. Internal showcase of the various subsystems in our lightsaber

References

M.M. Coad, R. P. Thomasson, L. H. Blumenschein, N. S. Usevitch, E. W. Hawkes and A. M. Okamura, "Retraction of Soft Growing Robots Without Buckling," in *IEEE Robotics and Automation Letters*, vol. 5, no. 2, pp. 2115-2122, April 2020, doi: 10.1109/LRA.2020.2970629.

Operation

- Our lightsaber is **initially pressurized** using a Schrader Bike Valve in its fully extended state to x Psi.
- It is then able to be **spooled** using the limit switch button on the hilt.
- Once the lightsaber is in its fully retracted state, users can rapidly extend the blade by depressing the button at the top of the hilt to **unclutch** the spool.
- The pressure in the hilt will cause the lightsaber blade to **extend**.
- An RGB Lume Cube allows the lightsaber to **glow** to a user-specified color.

Clutch Design

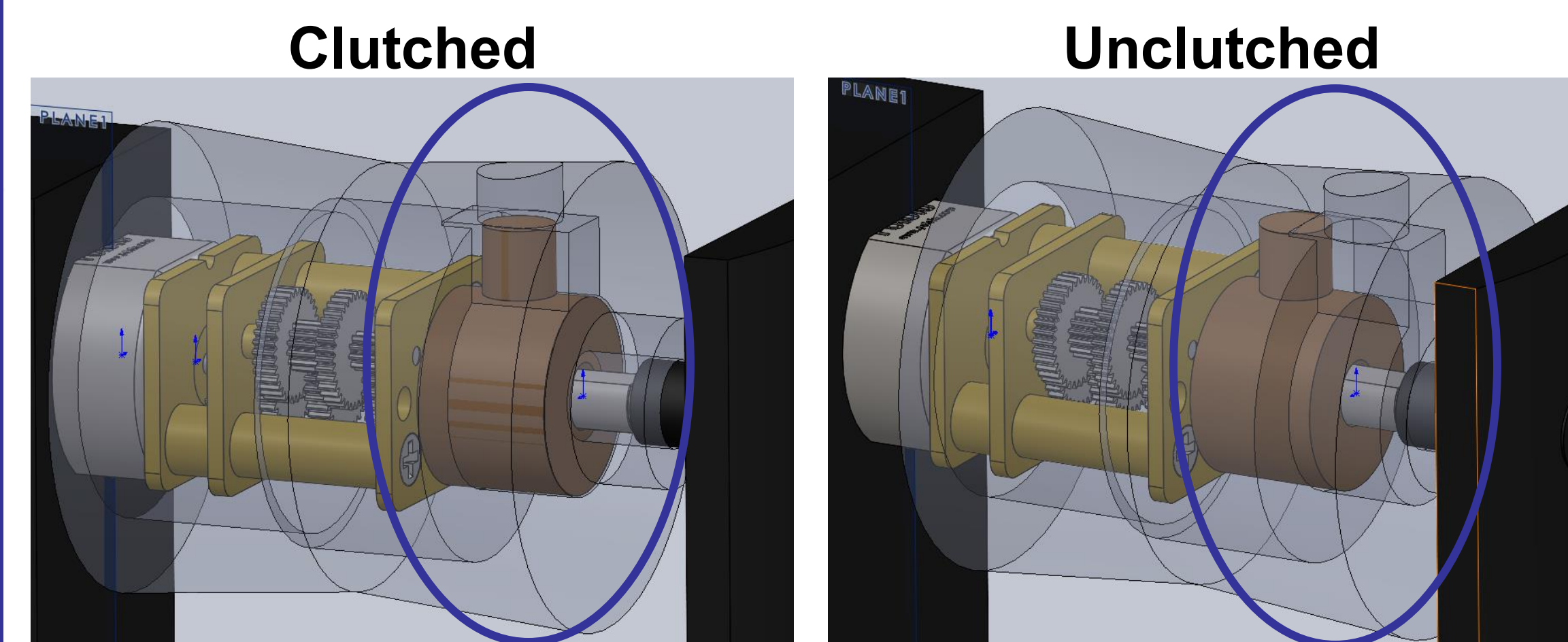


Figure 4. Clutch Assembly

- A mechanical button on our hilt physically slides our spool off the motor shaft allowing it to free spin
- A spring is located opposite the button to passively return the spool back into position

Measured Performance

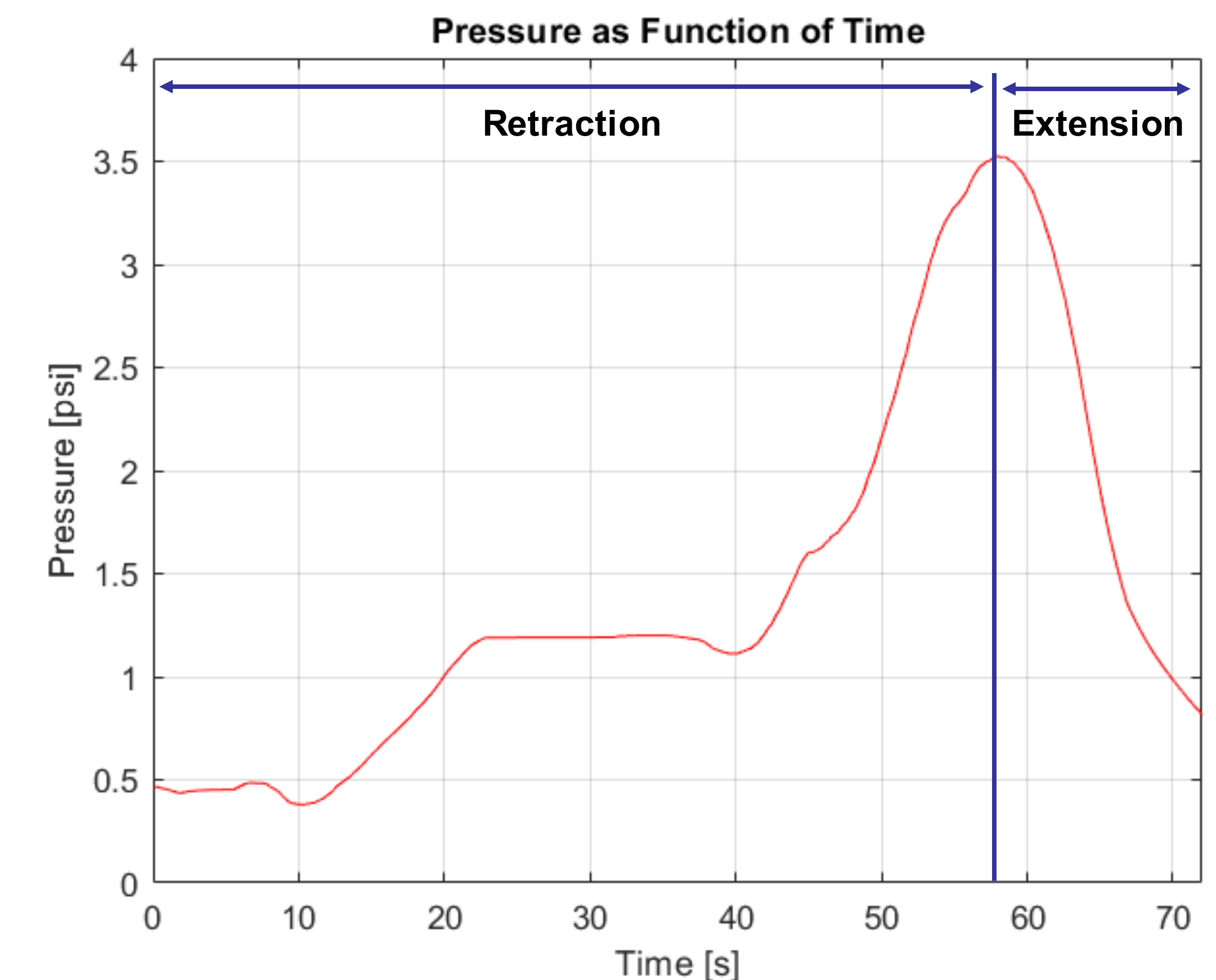


Figure 5. Pressure inside the vine-saber as it retracts and extends as a function of time taken using an Adafruit MS8607 pressure sensor.

Conclusion

We successfully created a prototype lightsaber using pneumatic soft robot technology. **We achieved our base criteria of fast extension, smooth motorized retraction, and illuminating the blade.**

We faced major challenges in buckling, choosing motor specifications, and switching design decisions deep in our design process.

Future works that we were not able to address would be faster spooling using a spring and improving the leaks in the lightsaber handle.

Acknowledgments:

Professor Hawkes, Dr. Marks, Matt Devlin, Charles Xiao, Anders Seawright