

Modernizing 'Twister': A Programmable Arduino Controller for Axial Tone



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BACKGROUND

- **Postural Tone:** Postural tone - the continuous, subconscious, low-level contraction of muscles - provides the stable foundation for voluntary movement and is crucial for balance and responding to environmental disruptions^[1].
- **Twister:** The Mind in Movement Lab uses "Twister," a custom device that applies slow (1 deg/s) controlled rotation to a standing participant via a rotating platform, measuring the resulting trunk muscle torque to study axial postural tone^[2].
- **Prior Research:** Twister has been used to study postural tone in relation to chronic pain^[3], Parkinson's-related disability^[4], light touch responses^[5], postural instructions^[6], and proprioception^[7].

THE PROBLEMS

- **Risk of Human Error:** Manual parameter entry (e.g., rotation angle, velocity, duration) introduces risk of input errors, potentially invalidating trial results and compromising participant data integrity.
- **Inefficiency:** Manual parameter changes between trials take ~1 minute, wasting researcher and participant time, increasing fatigue, and reducing trials per session.
- **Limited Trajectories:** The current control system restricts Twister to simple, pre-programmed movements, preventing complex motion patterns.

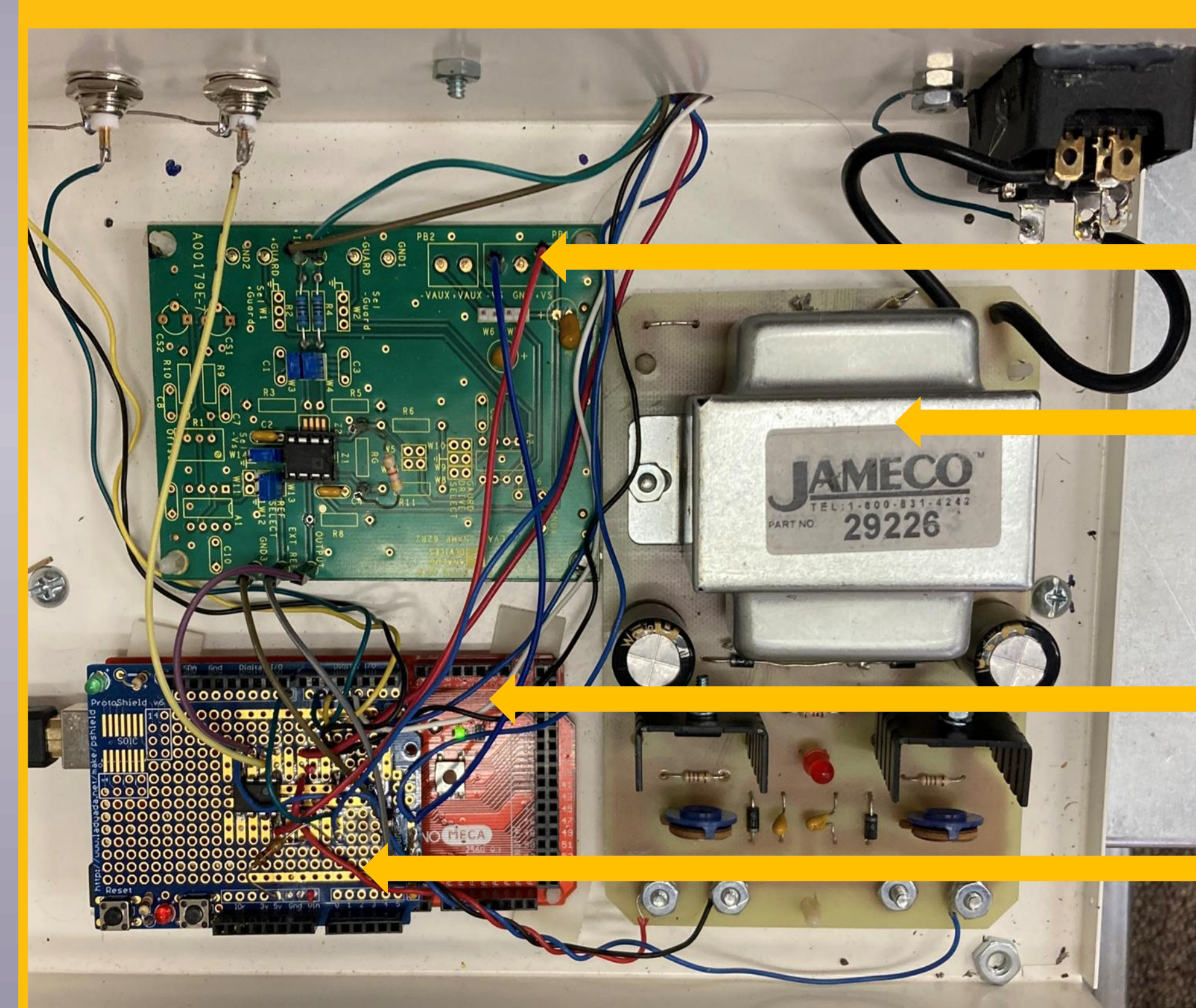
THE GOALS

- Develop a two-part MATLAB/Arduino software system
 - Integrate a new Arduino and motor driver shield as the new hardware controller
 - Implement a plain-text protocol file system (.txt) for parameter-free experiment setup
 - Validate through benchtop testing, protocol comparison, and human subject trials.
- Together, these improvements will expand Twister's research capabilities and reduce experimental error.

TWISTER



CONTROL BOX INTERIOR



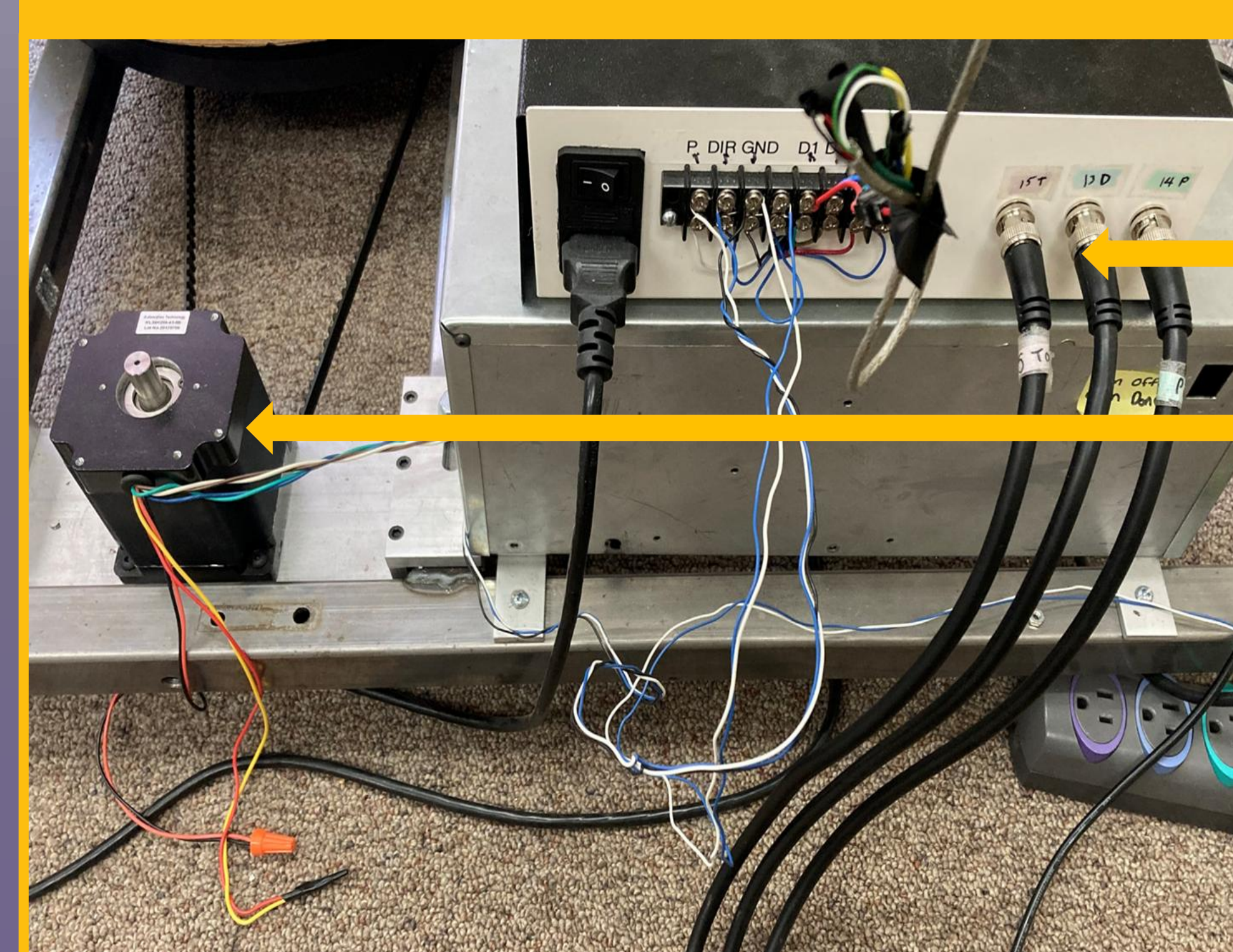
SIGNAL AMPLIFIER

POWER SUPPLY

ARDUINO

MOTOR CONTROL SHIELD

CONTROL BOX EXTERIOR

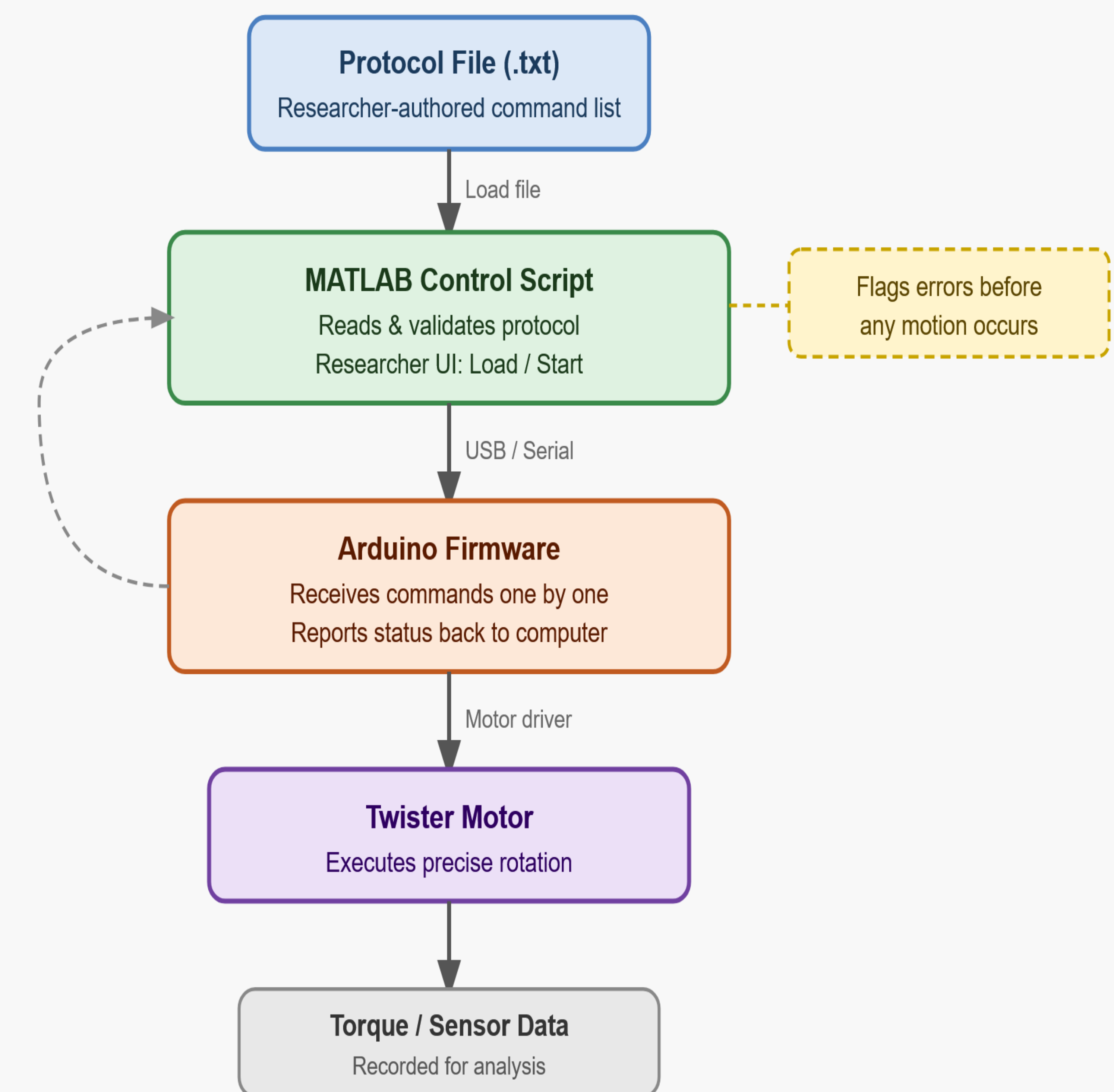


DATA OUTPUT TO PC

STEPPER MOTOR

SYSTEM OVERVIEW

Twister Software System — Logic Flow



[1] Cacciatore, T. W., Anderson, D. I., & Cohen, R. G. (2024). Central mechanisms of muscle tone regulation: Implications for pain and performance. *Frontiers in Neuroscience*, 18, 1511783. <https://doi.org/10.3389/fnins.2024.1511783>

[2] Gurfinkel, V. S., Cacciatore, T. W., Cordo, P., Horak, F., Nutt, J., & Skoss, R. (2006). Postural muscle tone in the body axis of healthy humans. *Journal of Neurophysiology*, 96(5), 1511-1520.

[3] Cacciatore, T. W., Gurfinkel, V. S., Horak, F. B., Cordo, P. J., & Ames, K. E. (2011). Increased dynamic regulation of postural tone through Alexander Technique training. *Human Movement Science*, 30(1), 74-89. <https://doi.org/10.1016/j.humov.2010.10.002>

[4] Franzén, E., Paquette, C., Gurfinkel, V. S., Cordo, P. J., Nutt, J. G., & Horak, F. B. (2009). Reduced performance in balance, walking and turning tasks is associated with increased neck tone in Parkinson's disease. *Experimental Neurology*, 219(2), 430-438.

[5] Franzén, E., Gurfinkel, V. S., Wright, W. G., Cordo, P. J., & Horak, F. B. (2011). Haptic touch reduces sway by increasing axial tone. *Neuroscience*, 174, 216-223.

[6] Cohen, R. G., Gurfinkel, V. S., Kwak, E., Warden, A. C., & Horak, F. B. (2015). Lighten Up: Specific Postural Instructions Affect Axial Rigidity and Step Initiation in Patients With Parkinson's Disease. *Neurorehabilitation and Neural Repair*, 29(9), 878-888. <https://doi.org/10.1177/1545968315570323>

[7] Cohen, R. G., Baer, J. L., Bershaw, M., Covill, A., Green, M., Hillend, C., Lolley, A., Wander, B., & Billings, C. G. (2026, Mar 27). *Forward head posture: Cognitive causes and cognitive consequences* [Poster presentation]. 96th Annual Convention of the Rocky Mountain Psychological Association, Boise, ID.

Learn more about our research at the Mind in Movement Lab Website:

