Designing a User Interface for Physical Therapy Students to Improve Rehabilitation Research through Clinical Involvement

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MOTIVATION

- Rehabilitation outcomes following stroke are currently limited in reducing long-term impairments in upper extremity movement.[1]
- To advance rehabilitation practice, we need to investigate the physiology underlying motor control and its recovery.[2]
- Clinical experts, such as physical therapists, often lack the computer programming and technical expertise to design and conduct such research.

OBJECTIVE

- To create a framework that integrates multiple hardware components into a customizable interface that is easy to use by physical therapy students to investigate movement impairments in a clinical setting.

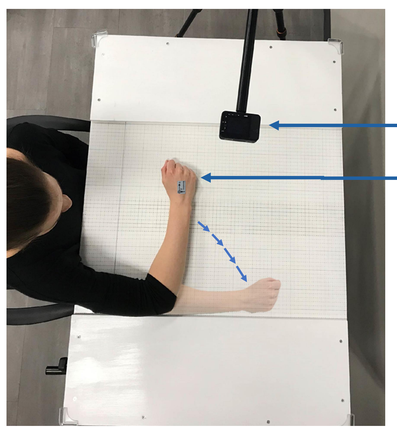
CONCLUSION

- Hardware was integrated for synchronous control and simultaneous recording of multiple physiological measurements
- The framework designed allowed a physical therapy student to investigate upper extremity movement from an easy-to-use interface.
- Future work to synchronize video camera data for simultaneous kinematic measurements will optimize the experimental design.
- Applications of computer science and engineering are essential for clinicians to conduct research in the rehabilitation environment to improve current rehabilitation practice

RESULTS AND METHODS

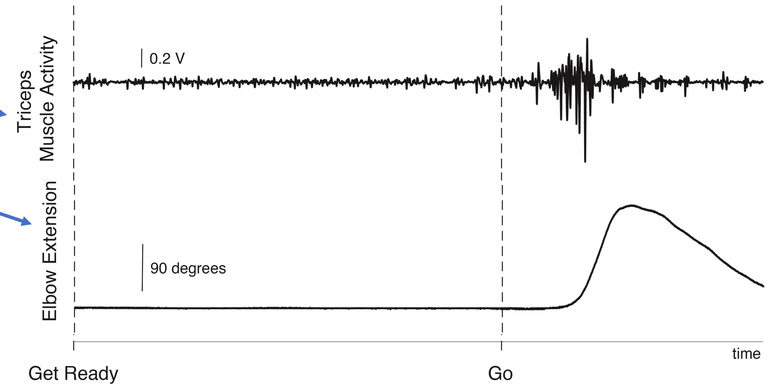
The design framework allowed valid physiological measures to be obtained simultaneously during upper extremity movement

Multiple hardware components were connected to a multi-channel PCI card to meet data timing and validity requirements[3,4]



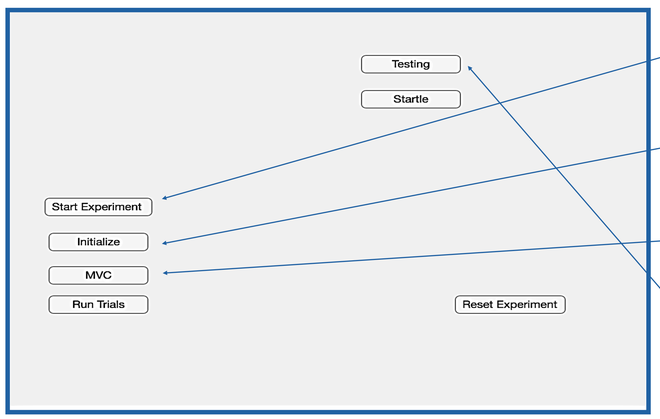
- Physiological data was measured simultaneously and in real time from **electromyogram** and **electrogoniometer** sensors

- An **accelerometer** and video camera were used to record kinematics of the upper extremity; the **video camera** was not synchronized.



The easy-to-use interface was designed with iterative feedback from the physical therapy student to allow clinicians to conduct research in the rehabilitation environment with maximum participant safety and minimal time.

- MATLAB was selected as the computer programming language to facilitate data collection and analysis.
- An iterative design approach was taken to refine the user interface with feedback provided by a physical therapy student, a novice to the field of computer science.



Configure the data acquisition system for use.

Record the initial values of the sensors with the upper extremity at rest.

Record the maximum voluntary contraction of each muscle measured with electromyography for analysis

Train participants for the research study

REFERENCES

1. Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC, et al. on behalf of the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Quality of Care and Outcomes Research. Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2016;47:e98-169.
2. Krakauer JW, Carmichael ST. Broken Movement: the Neurobiology of Motor Recovery after Stroke. 2017. MA: The MIT Press, Cambridge, UK.
3. Carlsen AN, Maslovat D, Lam MY, Chua R, Frankls IM. Considerations for the use of a startling acoustic stimulus in studies of motor preparation in humans. *Neurosci Biobehav Rev.* 2011;35:366-76.
4. Honeycutt CF, Perreault EJ. Planning of ballistic movement following stroke: insights from the startle reflex. *PLoS One*. 2012;7:e43097.