Syed Akbar Zamin
L2
LSU Health Sciences Center, New Orleans, LA

Mentors' Names: Dr. Sean Savitz and Dr. Shayan Shams
Mentors' Affiliations: Department of Neurology at McGovern School of Medicine, TX and Applied Data Science Department at San Jose State University, CA

"A Low-cost Biofeedback Tool for Automated Assessments of Upper Extremity Function in Stroke Patients"

Studies report up to 85% of stroke survivors experience upper extremity (UE) hemiparesis[1] and 78% fail to achieve the average UE function for their age, even after 3 months of treatment[2]. Limited access to outpatient rehabilitation for these survivors worsens the issue; in Texas, 71% of rural counties lack rehabilitation clinics for stroke patients. To mitigate issues involving healthcare accessibility, research has been undertaken to automate scoring of the Fugl-Meyer assessment, the standard stroke rehabilitation scale describing upper extremity motor function, to alleviate physician burden and inform physical therapists of disabilities. We aim to demonstrate the feasibility of using a single handheld camera for motion detection and machine learning methods to score gross and fine upper extremity motor skills with accuracies comparable to traditional methods involving complex recording equipment.

Investigators recorded Fugl-Meyer assessments performed by consenting stroke patients (N=45) presenting with acute or subacute weakness or unilateral hemiplegia resulting from ischemic or hemorrhagic stroke. Two deep-learning motion detection algorithms extracted *xy*-positional coordinates of body joints and hand joints from the study activity videos. We developed and tested the predictive ability of four machine learning models, eXtreme Gradient Boosting (XGBoost), a convolutional neural network (CNN), recurrent neural network (RNN), and dilated CNN, and compared the results with scores provided by a licensed occupational therapist.

The item-wise prediction accuracies are 0.838 ∓ 0.214, 0.764 ∓ 0.155, 0.807 ∓ 0.165, 0.827 ∓ 0.162 for each model listed above, respectively. Strong correlation between model prediction and total Fugl-Meyer scores are seen when analyzed by patient or group-wise; correlation coefficients average 0.89 and range between 0.83 and 0.951.

This novel method demonstrates potential to conduct telehealth rehabilitation evaluations with low-cost and pre-existing technologies. This system should reduce physician and therapist burden and improve accessibility to healthcare rehabilitation among geographically isolated and patient population living with disabilities.

References:

1. Levin, M. F., Kleim, J. A., & Wolf, S. L. (2009). What do motor "recovery" and "compensation" mean in patients following stroke? Neurorehabilitation and Neural Repair, 23(4), 313–319.
2. Mayo, N. E., Wood-Dauphinee, S., Ahmed, S., Gordon, C., Higgins, J., McEwen, S., & Salbach, N. (1999). Disablement following stroke. Disability and Rehabilitation, 21(5-6), 258–268.

References:

1. Levin, M. F., Kleim, J. A., & Wolf, S. L. (2009). What do motor “recovery” and “compensation” mean in patients following stroke? Neurorehabilitation and Neural Repair, 23(4), 313–319.

2. Mayo, N. E., Wood-Dauphinee, S., Ahmed, S., Gordon, C., Higgins, J., McEwen, S., & Salbach, N. (1999). Disablement following stroke. Disability and Rehabilitation, 21(5-6), 258–268.