PROBLEM STATEMENT

Hand tremor, loss of hand dexterity and fine motor disorders caused by Parkinson's disease, arthritis, spasticity after stroke, etc. are critical problems and physical therapy is required for recovery and rehabilitation. Unfortunately, there is no in-home smart therapeutic device to quantitatively assess treatment process and patients' pain level.

GAP IN LITERATURE

NO EFFECTIVE COMMERCIAL PRODUCT/ SERVICE IN THE MARKET

OUR HYPOTHETICAL SOLUTION:

TENSE Ball, a smart therapeutic device that constantly monitors and evaluates patients' performance, stress and pain level in at-home physical therapy sessions.

A. It identifies hand mobility, gripping patterns and correctness of the performed exercises, and tracks compliance and improvement with time.
B. It captures psycho-physiological data to assess stress and pain level that patient is experiencing before and after those exercises.
C. It detects hand tremors and other involuntary motion artifacts which allows for capturing of valuable patients prognostic information.

With such computational capabilities, TENSE Ball still maintains the innate features as its non-computational counterparts in the market, with a pleasant tactile experience that one expects from a squashy stress ball.

USER STORY BOARD & PROTOTYPE FUNCTIONALITIES

1. SHAKE: turn on the ball
2. HOLD: middle finger and thumb on poles (3 min)
3. PERFORM ACTIVITIES: therapy exercises
4. HOLD: middle finger and thumb on poles (3 min)
5. MONITOR: patient performance, pain & stress level

SMARTPHONE FOR REALTIME SENSOR DATA ACQUISITION & PROCESSING, AND MONITORING INTERFACE

1. EDA Measurements
2. Accelerometer
3. Triboelectric (TENG) electrode network

PROTOTYPE DEVELOPMENT

A network of Nylon threads as electrodes are incorporated in multiple layers of dielectric Silicone rubber

1. EDA sensor & evaluation board
2. Microcontroller
3. TENG conditioning circuit
4. Multiplexers
5. TENSE Ball (TENG Network)

CONCLUSION

TENSE Ball, our novel smart squeeze ball, is low-cost, low-power, and can improve the efficiency of hand therapies for those require hand recovery and rehabilitation.

FUTURE PLAN

A. Optimization of the circuit
B. Minimization of the board, and fully integration of the physical prototype
C. Signal processing, and hand activities classifications
D. User research and testing
E. Market development