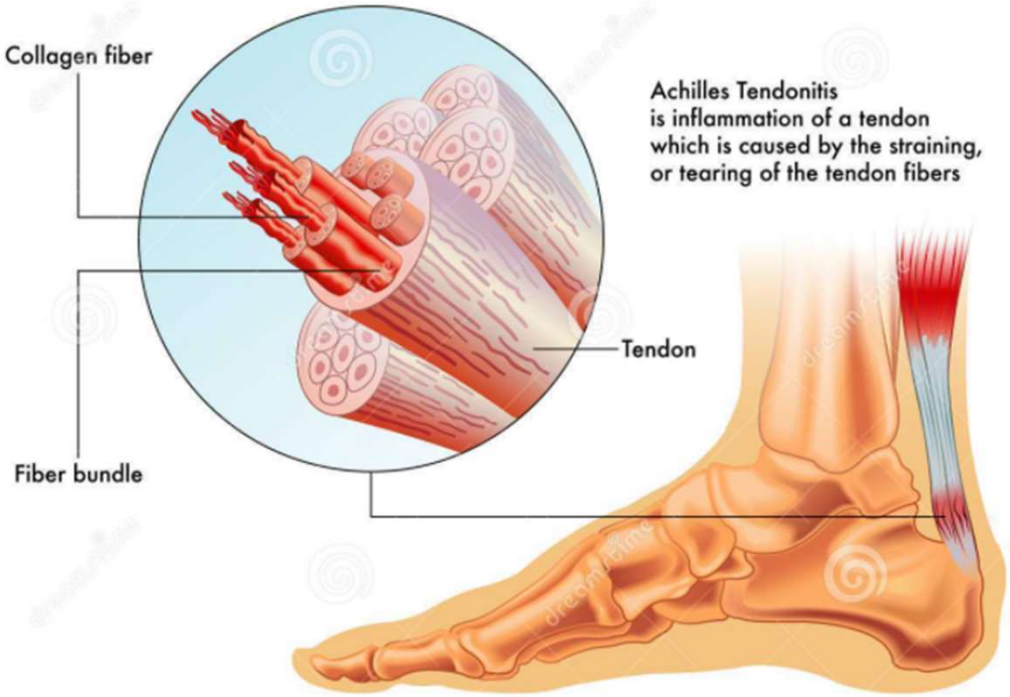
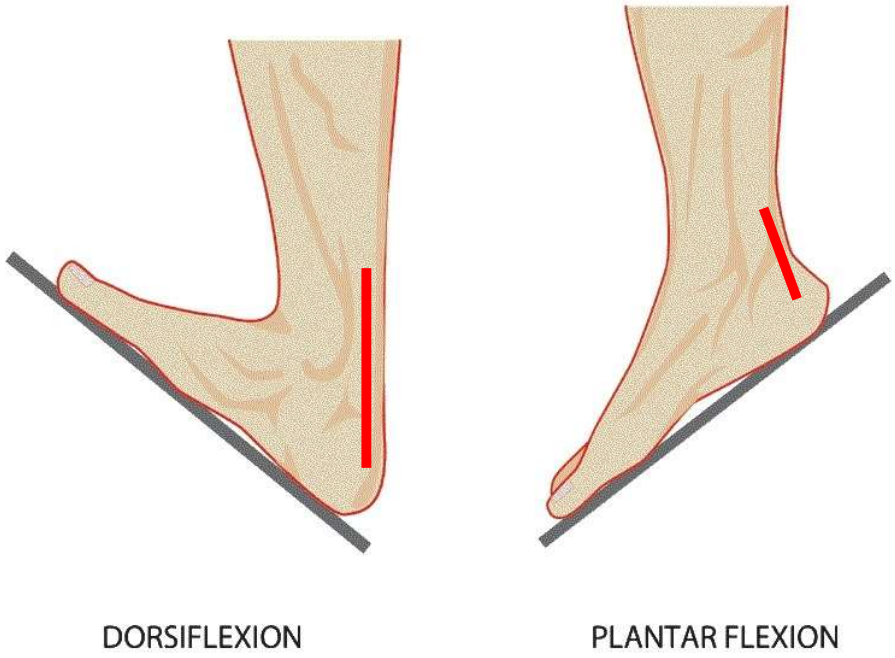
Real-time force monitoring for virtual physiotherapy management of injuries

1.24.2020 – K.Merry

The Problem – Achilles Tendinopathy





Images taken from: https://getactivephysio.com.au/achilles-tendinopathy/
https://www.running-physio.com/insertional-achilles-tendinopathy/

Current Treatment Strategies

Conservative Management

- Non-invasive options including...
- Activity modification
- Orthotics
- Exercise therapies
- Ultrasound-based treatments
- Anti-inflammatory drugs
- Steroid injections
- Shock wave therapy

Surgical Treatments

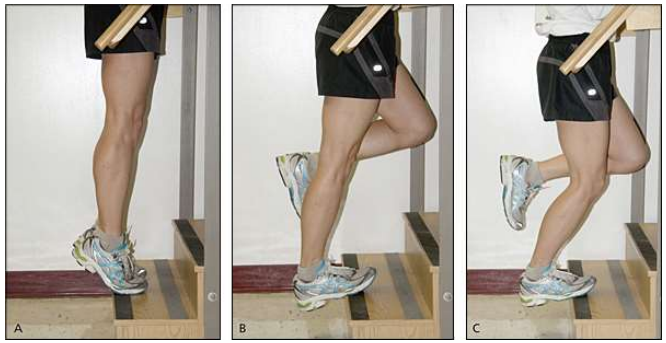
- Remove degenerative abnormal tissues
- Restore the vascularity (blood supply)
- Stimulate viable cells to reinitiate healing

Goals for exercise-therapy:

- Promote tendon healing by remodeling the tendon & reducing inflammation
- Elicit positive therapeutic effects through changes in compliance, functional strength, innervation, vascularity, or perception of pain

Exercise Therapy for Achilles Tendinopathy

Usual Care



Potential New Treatment Options

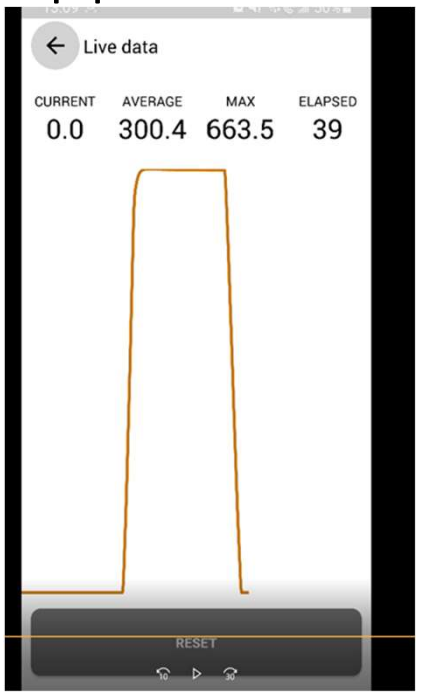
Photo © c/o collaborator Adamantios Arampatzis, used by permission.

Image: https://www.aafp.org/afp/2013/0401/p486.html

Exercise Therapy for Achilles Tendinopathy

Photo c/o collaborator Rob Morgan, used by permission.

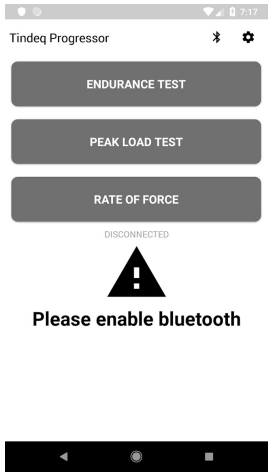
App Readout

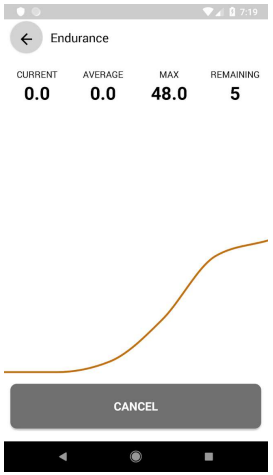


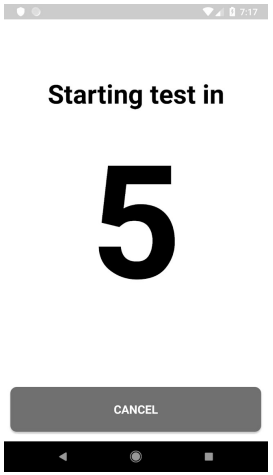
Tindeq *Progressor*

Technical Features

- Capacity: 150kg
- Accuracy: calibration at 0kg and 63kg
- Battery: ~17hrs continuous (coin cell battery)
- Dimensions: 80 x 50x 25mm
- https://tindeq.com/product/progressor/

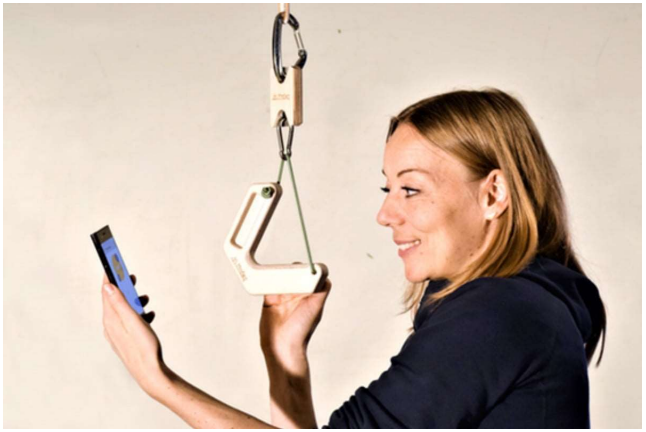






https://tindeq.com/

Project Motivation



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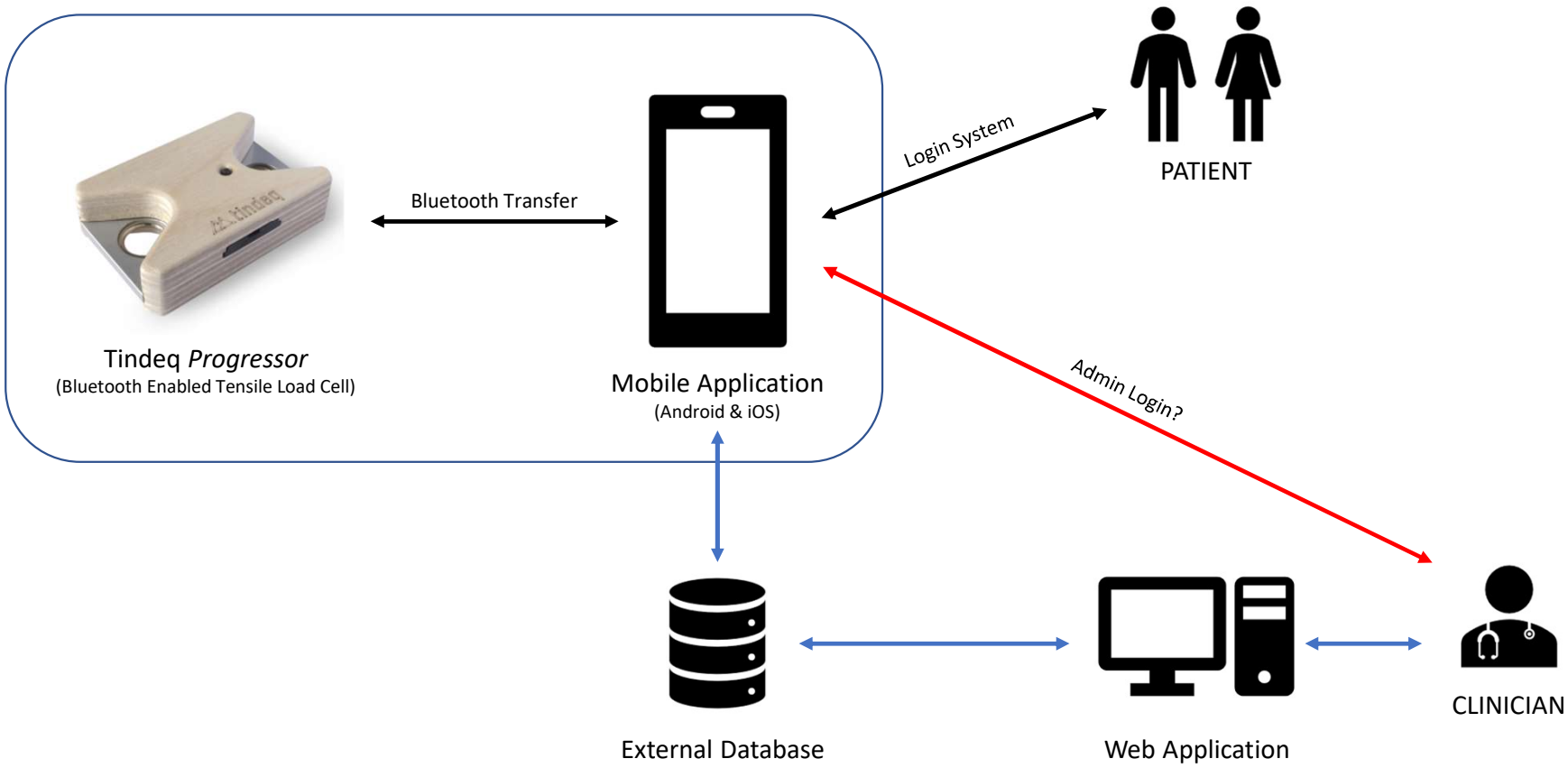
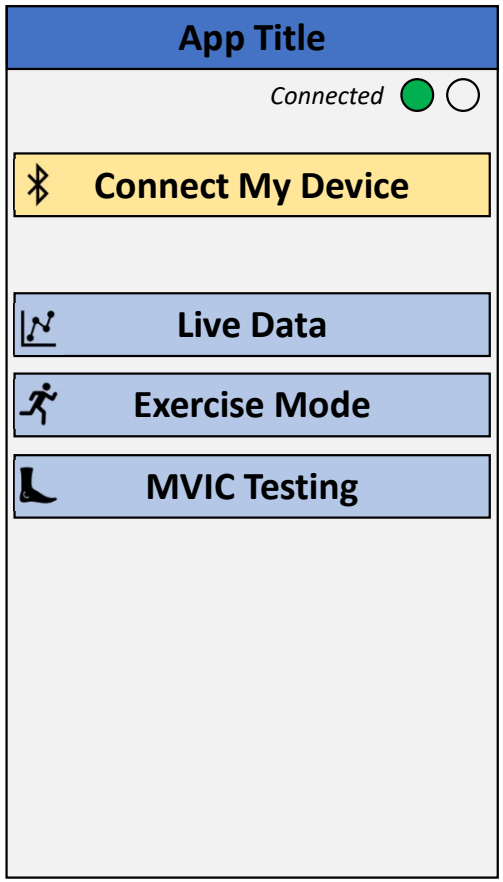
Project Goals

- Display exercise goals to the user
- Log progress such that a clinician can monitor progress remotely
- Allow for remote tailoring of the exercise program (e.g. change in number of sets, reps, target load, etc.) by a clinician.

Anticipated System Architecture

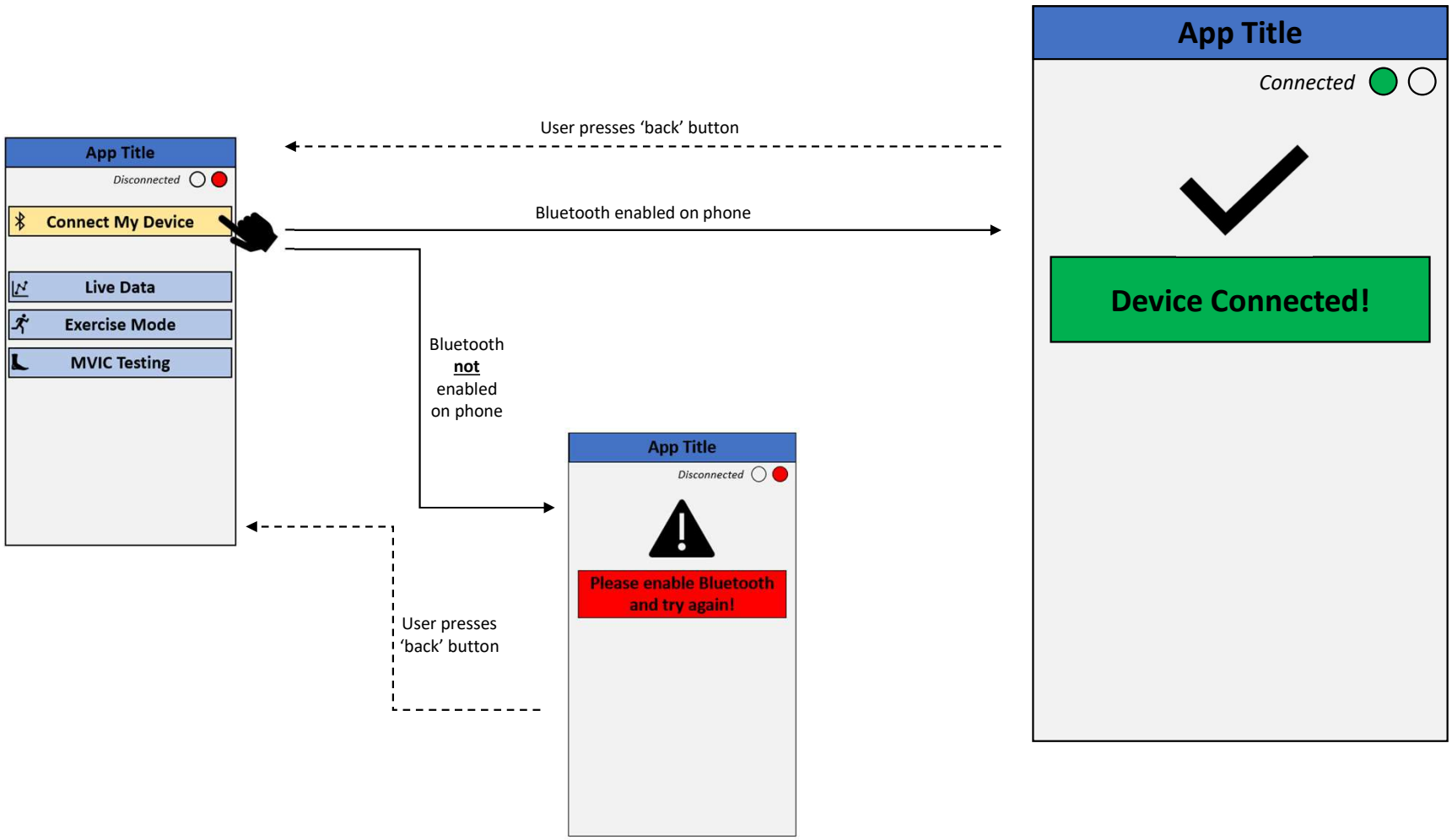


Home Screen


App Title
Connected
Connect My Device
Live Data
Exercise Mode
MVIC Testing

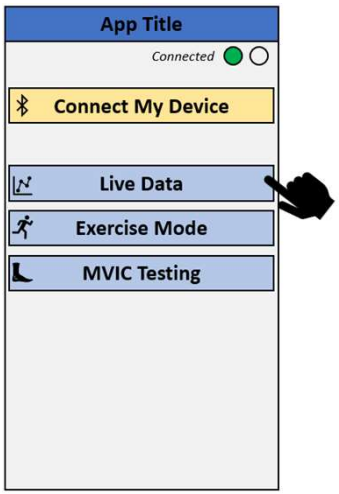
LEGEND
Primary Action →
Secondary Action - - - →

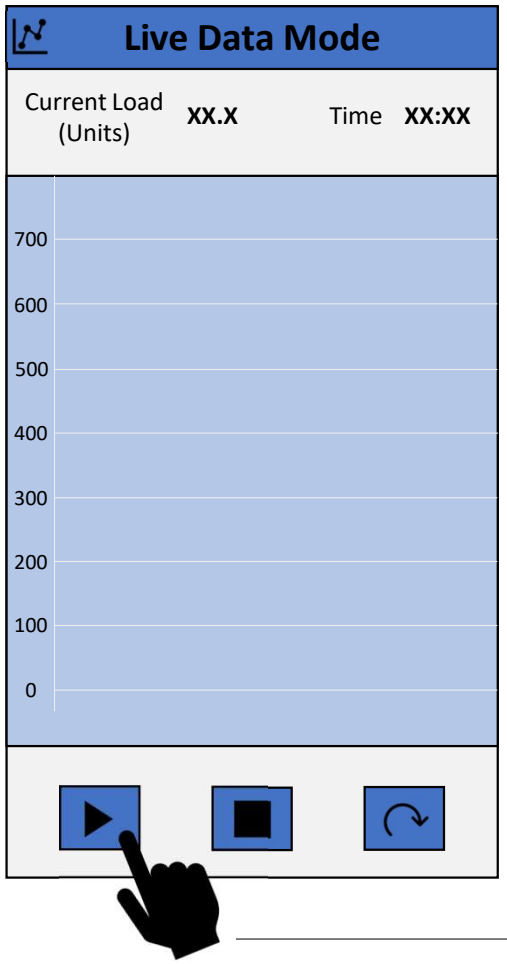
Connectivity Screens

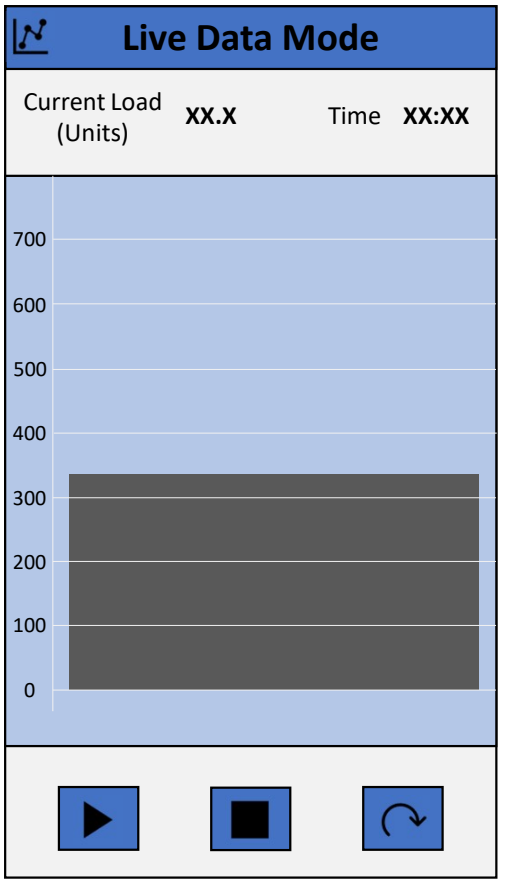


Live Data Mode

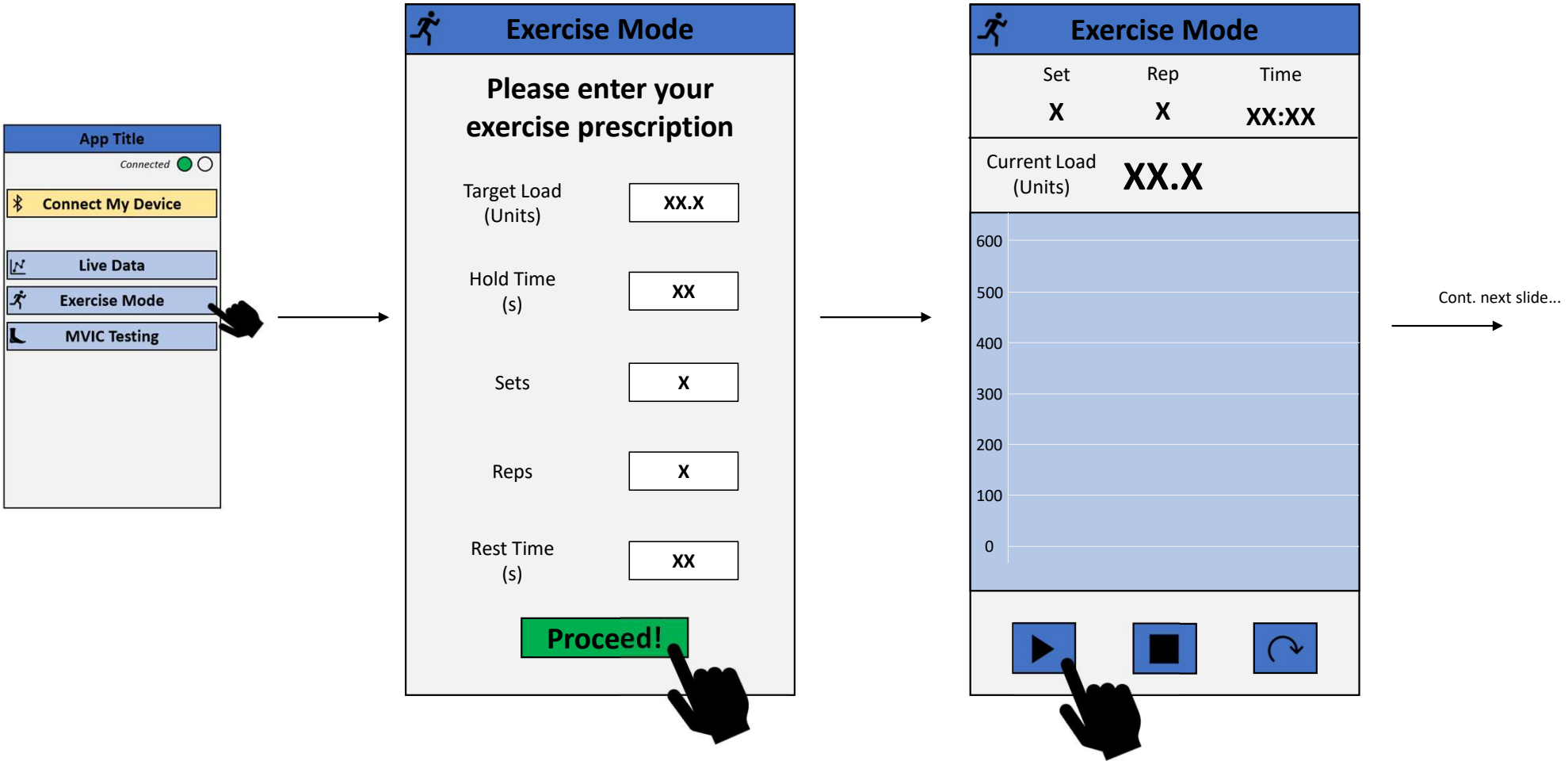
User presses ‘back’ button







Exercise Mode



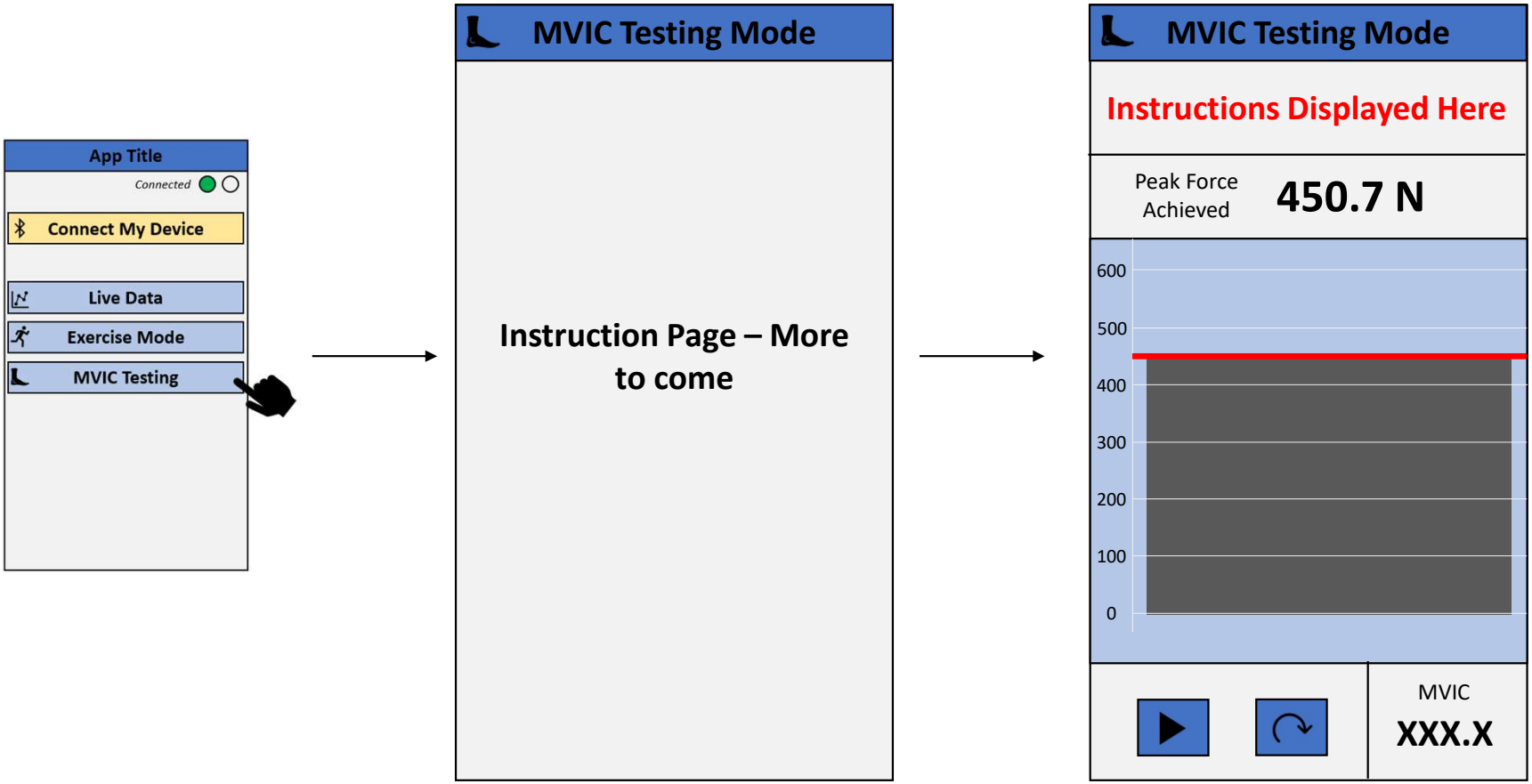
Exercise Mode – Live Bar Plot

...You get the idea. Details on exercise mode still TBD.

MVIC Testing Mode

- *MVIC* = Maximum Voluntary Isometric Contraction
- Definition: The greatest amount of tension a muscle can generate and hold, however briefly, as in muscle testing.
- Importance for us:
  - Helps the clinician derive appropriate target load based on %MVC
  - One way of assessing progress—higher MVC = Muscle-tendon unit getting stronger

MVIC Testing Mode



Summary

Overall Project Goals

MVP:

- Mobile app (iOS/Android) which can help guide users through an exercise-therapy regimen by using data visualization and biofeedback (e.g., colour changes, sounds, etc.)

- Visualization of exercise summaries over time (e.g., number of reps completed/day, peak force achieved/day)—exact data to be summarized still TBD

- A way of allowing the clinician to see user summary data + modify exercise prescription (e.g., separate 'admin' login account to app? Web portal?)

- A way of exporting the data from a specific user over their entire program (~12wks)—exact data to be exported still TBD, but will need to store data for the 12wk program on the user's device