FLEXTECH

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Outline

- Motivation and Background
- Technical Case
- Ideal Customer and Competition
- Business Case and Costs
- Risk Analysis and Management
- Sustainability
- Self Reflection
- Plan for 440
- Demo
- Conclusion

The Team

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Motivation

- Recovery can be over a year [2]

- Compromised ACL can lead to unwanted knee positions

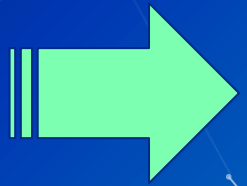
250,000 ACL injuries per year in Canada and US alone [1]

Photo by Gabriel Lynn

Motivation

Current Solutions:

- Soft Braces
- Hard Braces:
  - Limit range of motion and promote muscle atrophy
  - Expensive
- Physiotherapy



TechBrace:

- Inexpensive
- Data Collection
- Non-restrictive
- Prevents muscle atrophy
- Subconscious support

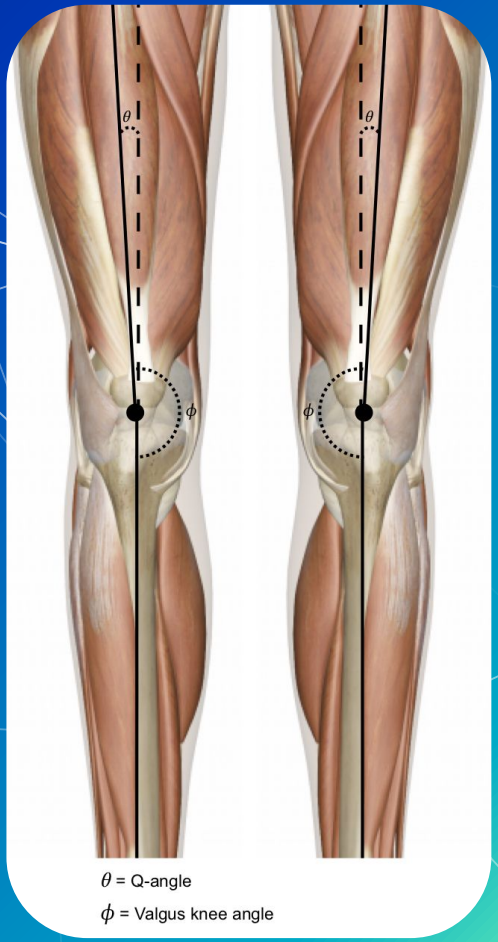
Background

Angle Deviation

- Valgus angles of the knee put extra strain on ACL
- Angles measured from tibia and femur

Electrical Stimulation

- Physiotherapy exercises require conscious thought
- Neuromuscular pathways developed
- Treat and prevent muscle atrophy with activity or electrical stimulation
  - NMES



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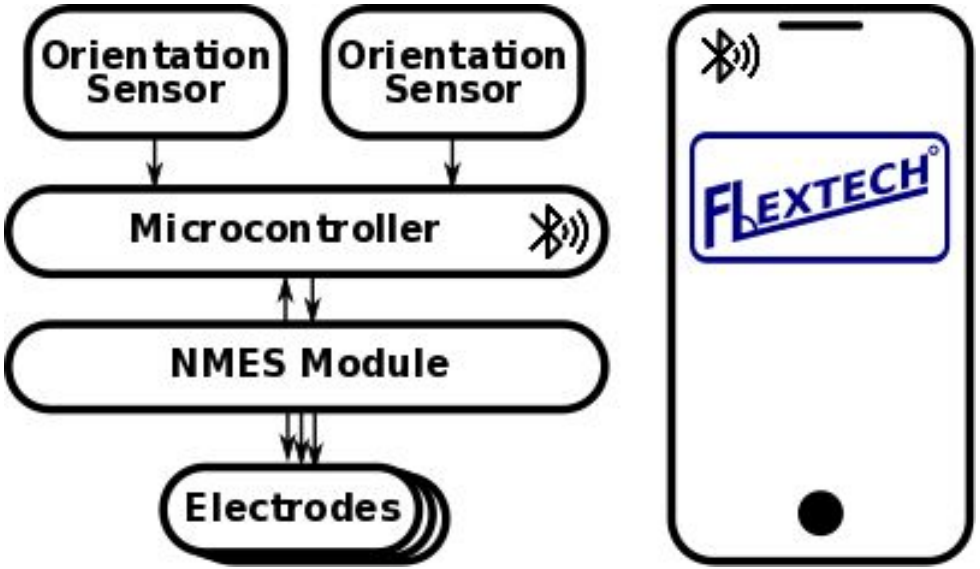
Technical Case

- Angle detection System
- Muscle Activation System
  - PC: Vibration Motor
  - PT: NMES module
- App



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Technical Case: Materials

Overall System:

- Espressif ESP32 microcontroller
- Knee Brace
  - Breathable
  - Adjustable (11.8’-20.5’)
  - Anti-slip
- 1000mAh Lithium-polymer battery

[9]

Technical Case: Materials

Muscle Activation System:

- DC-DC converter
- Electrodes:
  - Non-woven fabric
  - Re-usable
  - Self-adhesive

Angle Detection System:

- IMUs

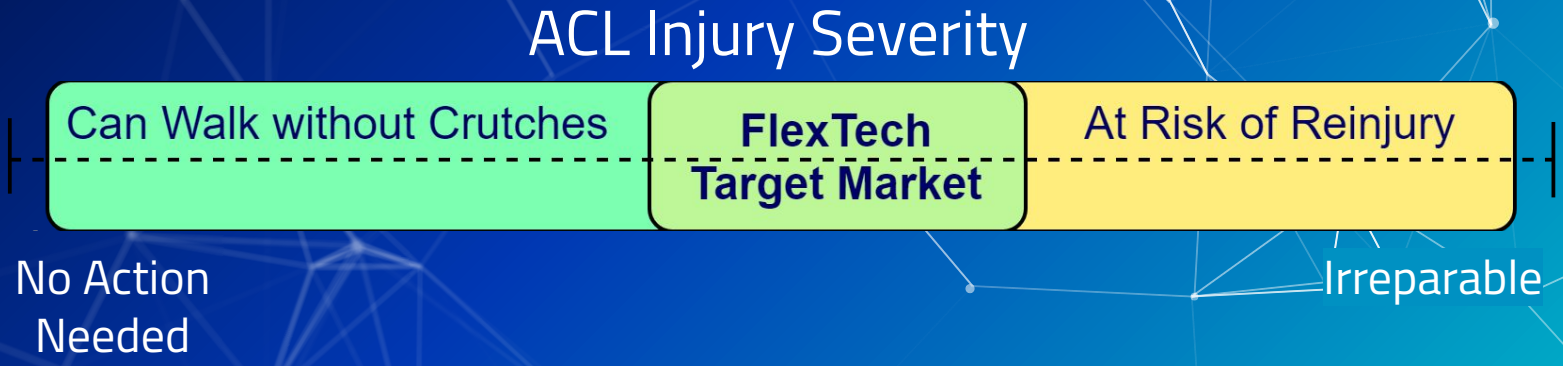
[10]

Technical Case: Schedule

	Estimated	Actual-to-Date
Proof of Concept	April 15, 2019	Fully Realized
Prototype	Late June	Planning and testing
Product Ready	Early August	Planning only

Ideal Customer

- ACL Injury
- Pre or post surgery
- Professional athlete to a weekend warrior
- Target athletic markets



Competition

Minimize time to recovery

No other knee brace manufacturers perform [4]:

- Real time angle deviation detection
- Real time position correction by electrical stimulation

Custom-fit Hard Braces	Electronic IoT Knee Braces
Breg, Bauerfeind, Ossur, DONJOY ✓ Perform well ✗ Expensive ✗ Muscle Atrophy	DONJOY X4 [5] Primarily monitoring and app interaction Communicate with doctor

Current Market

$5 Billion expected global market value for braces and supports in six years [7]

100,000 ACL reconstruction surgeries performed each year in the United States [6]

Custom-fit products: $750 to $2200 CAD [8]
FlexTech Production Cost per unit: $250
Reusability

Business Case and Costs

Financing:

- Wighton Engineering Development Fund
- The Engineering Science Student Endowment Fund (ESSEF)

Subsystem	Cost
Angle Sensing System	$86.32
Muscle Activation System	$82.38
General	$84.67
Total Development Cost	$253.37

Risk Analysis and Management

Risk Analysis:

1.Safety

Electrical Safety

2. Performance

Complication of Human Motion

Management:

1.Safety

Robust Circuit Design

Water-Resistance

2. Performance

Data Collection

Algorithm Optimization

Adherence to Standards

Safety and Performance Standards

Medical Device Software

Battery Standards

Wireless Communication Standards

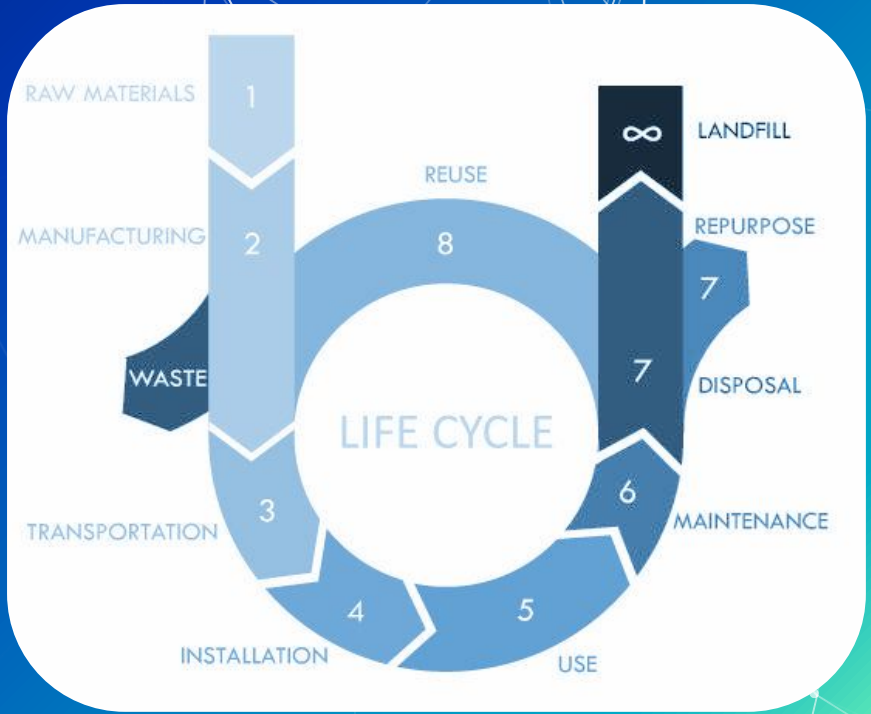
[13]

[12]

Sustainability Considerations

Cradle to Cradle Philosophy

- Production
- Use
- Maintenance
- Disposal



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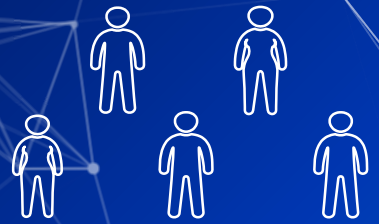
Self Reflection



- Communication is key!
- Let people use their individual strengths to strengthen the project as a whole
- Everyone brings something different to the project
- Time management is critical to success
- Development process for 440 will include more thorough testing
- As a team we work well together and motivate each other

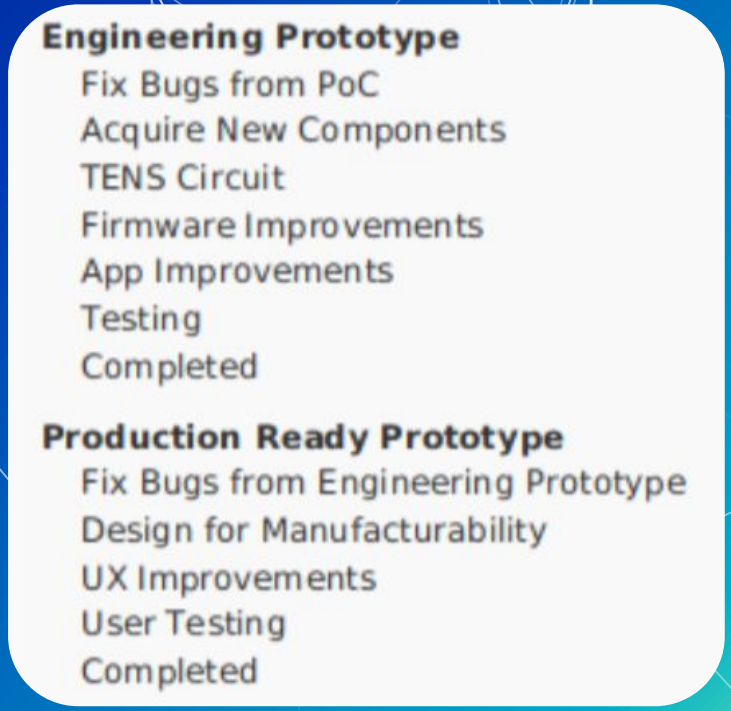
Plan for 440

Beta Prototype:

- Completed mid-semester
- Refined version of PoC
- Satisfy most of the testing requirements

Production Ready (Pilot) Prototype:

- Completed by the end of ENSC440
- Final Iteration of TechBrace
- Usability consideration
- Tested thoroughly



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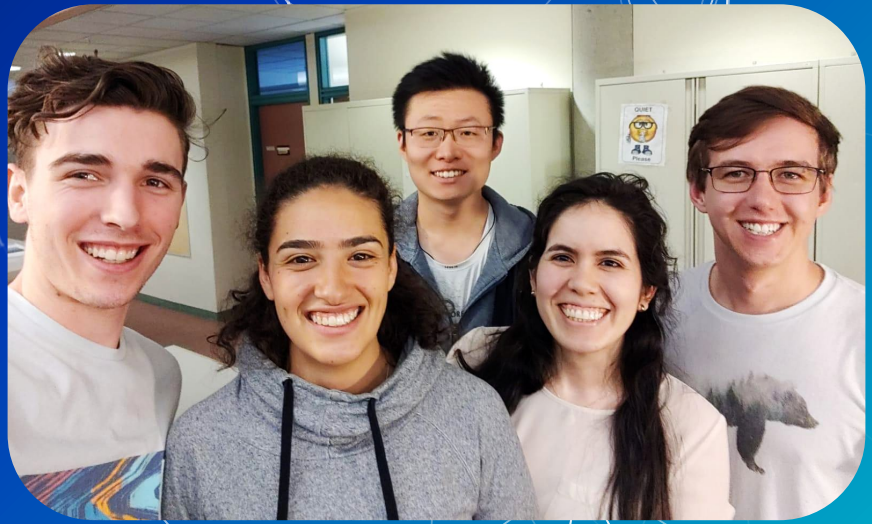
Demo

Conclusion

- Still challenges ahead
  - Angle detection
  - Muscle stimulation
  - App
- Optimistic about development
  - Research
  - Testing
  - Meeting with external mentors



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