INTRODUCING AN ASSISTIVE REHABILITATION DEVICE:

GROUP N
DEC. 22, 2015

Solegait

Management

Shaquile Nijjer – Chief Executive Officer (CEO)
◦ Responsible for: software - data analysis

Zachary Nunn – Chief Technology Officer (CTO)
◦ Responsible for: hardware

Karsten Harder – Chief Operating Officer (COO)
◦ Responsible for: hardware

Alexandra Talpalaru – Chief Information Officer (CIO)
◦ Responsible for: software - data analysis

Ashley Lesperance – Chief Financial Officer (CFO)
◦ Responsible for: software - application

Pods

Quantify gait

Properly locate abnormalities

Assess and correct problems at the root

[1]

Outline

Background
◦ What is Gait?
◦ Motivation for this project

Market Competition

Schedule

High-Level Overview
◦ Design Overview
◦ Videos/Testimonials

Budget

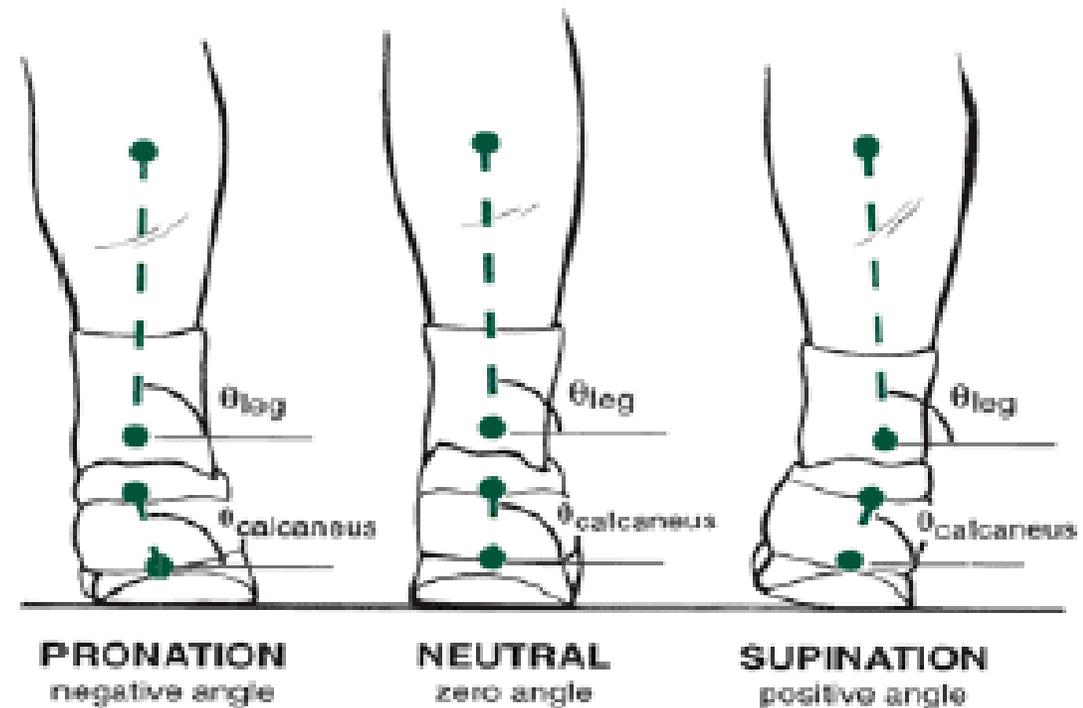Future Developments

Conclusion

Questions

Background

Over-Pronation
- Plantar fasciitis
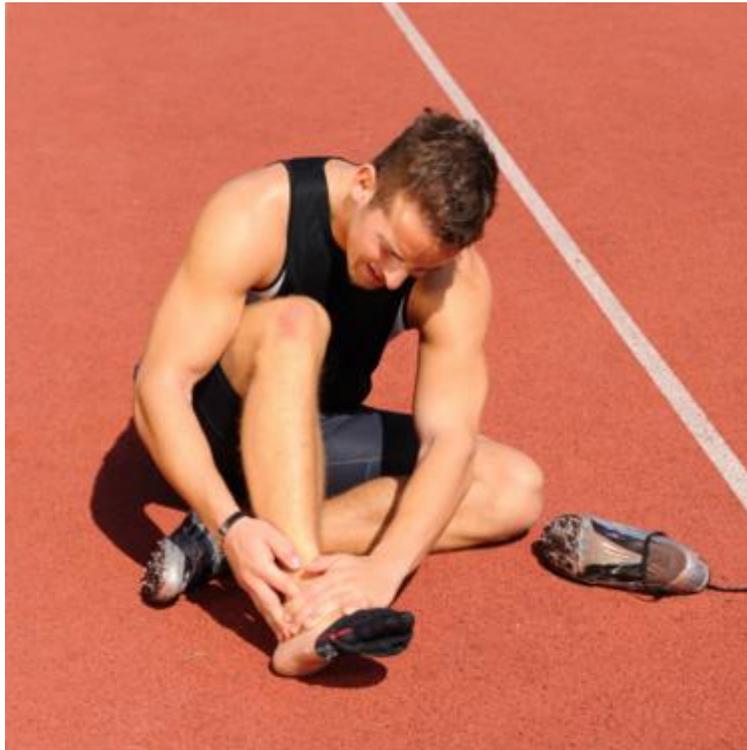- Problems with the Achilles
- Knee joint pain
- Hip joint pain

Over-Supination
- Ankle strain
- Decrease in walking efficiency
- hip joint pain
- low back pain
- etc…

[4]

Background (2)

[2]

[3]

Motivation

Correct the users over-pronation or over-supination

Get an athlete back into their sport

recommend proper arch support products
- flat-foot

Improve an older adults walking strategy
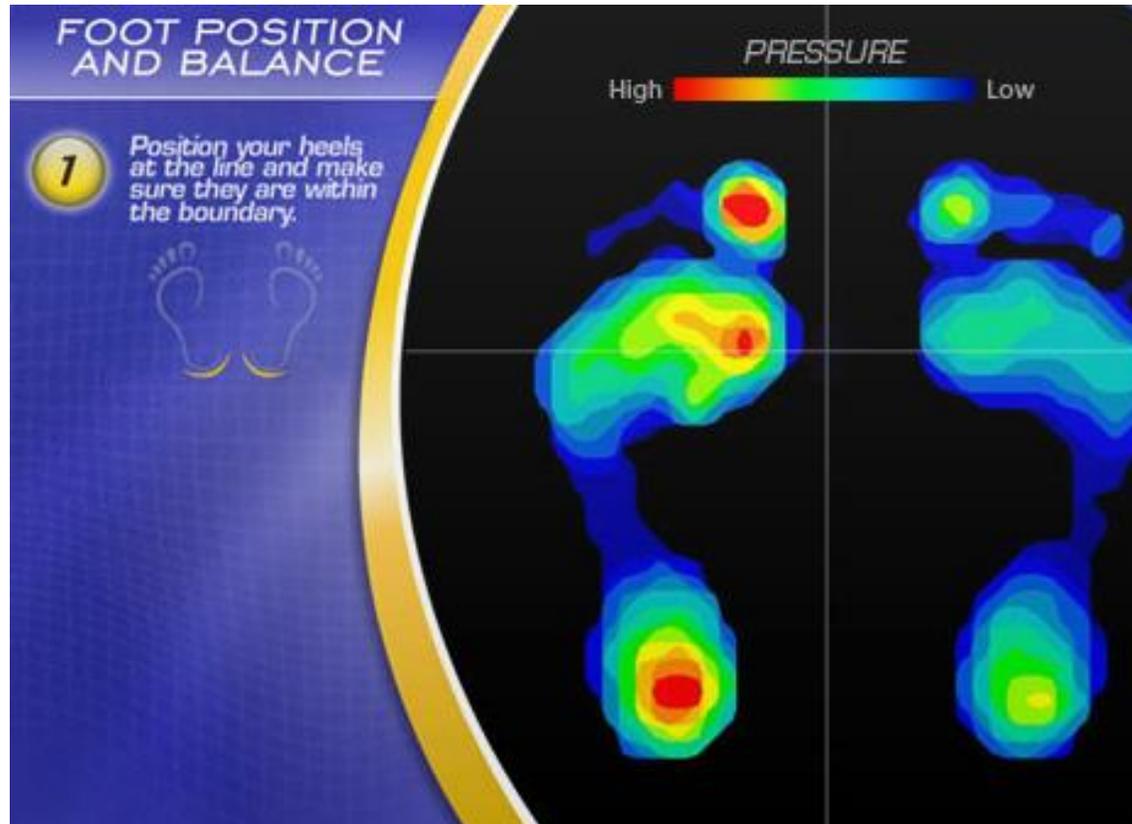- improve their quality of life

[6]

Current products on market

[7]

Product	BTS Gaitlab
Description	Reflective markers, IR video cameras, inertial sensors, GRF measurement walkway, wireless EMG, workstation, video recording system, TV screen, control station
Location	Laboratory
Cost	$100,000 + $205/assessment

Current products on market: Pressure sensing system

[8]

Product	Dr. Scholls Custom Fit Foot Mapping Tech
Description	2,000 pressure sensors Lift foot one at a time to identify how areas of foot pressure may change in motion
Location	Drugstores
Cost	Unavailable for users

Current products on the market: Moticon: OpenGo

[11]

Product	OpenGo
Description	Force-Sensitive insole. Provides Pedobarograph data Clinical & research
Cost	$4000 - $7000

Design outline
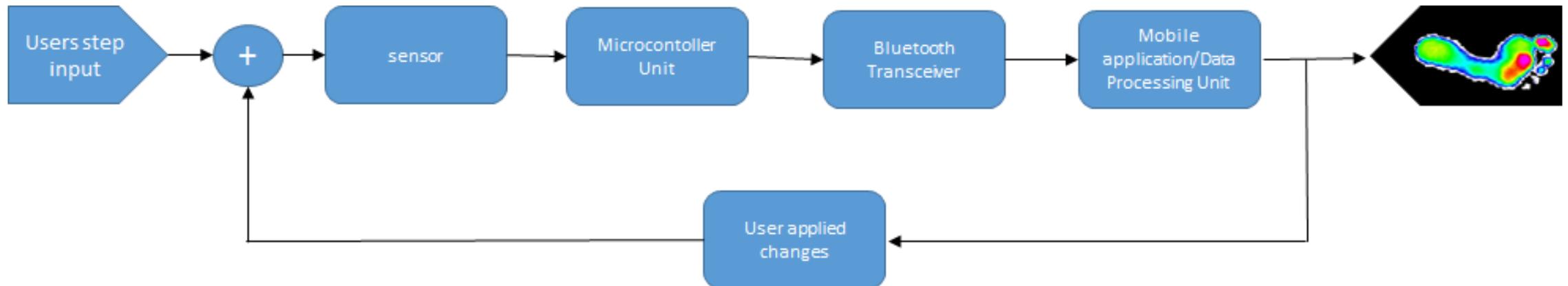
Schedule

| ACTIVITY	START	(DAYS)	COMPLETE	September			30-Sep	October				November				December
				8-Sep	15-Sep	22-Sep	30-Sep	6-Oct	13-Oct	20-Oct	27-Oct	3-Nov	10-Nov	17-Nov	24-Nov	1-Dec
Order parts	9/5/15	25	100%	■	■	■										
Connect sensors to arduino	9/30/15	5	100%				■									
Insole design	9/30/15	10	50%				■	■								
Calibration and noise filtration	10/1/15	20	0%					■	■	■						
Sensor map algorithm	10/20/15	10	0%							■	■					
Mobile app	10/25/15	25	0%								■	■	■	■		
Incorporate Bluetooth	11/5/15	20	0%										■	■	■	

Schedule (Revised)

ACTIVITY	START	(DAYS)	COMPLETE	September				October			November				December		
				8-Sep	15-Sep	22-Sep	30-Sep	6-Oct	13-Oct	20-Oct	27-Oct	3-Nov	10-Nov	17-Nov	24-Nov	1-Dec	7-Dec	14-Dec	21-Dec
Order parts	9/5/15	25	100%																
Connect sensors to arduino	9/30/15	5	100%																
Insole design	9/30/15	10	100%																
Calibration and filtration	10/1/15	20	100%																
Sensor map algorithm	10/20/15	10	100%																
Mobile app	10/25/15	50	100%																
Incorporate Bluetooth	11/5/15	45	100%																

Insole design

Solegait

Force Sensitive Resistor(FSR)

FSR

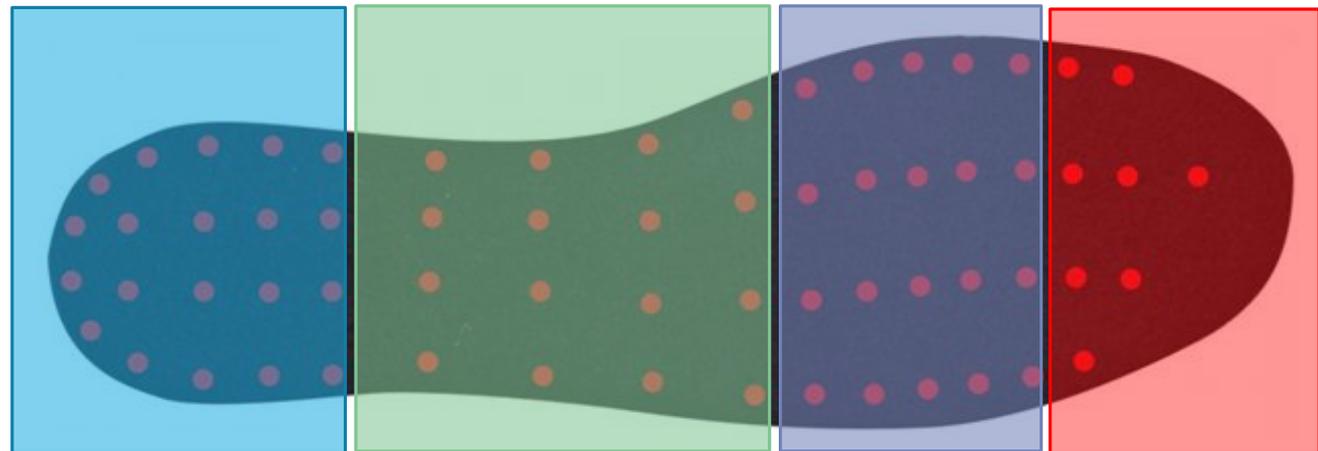High Resistance   Medium Resistance   Low Resistance
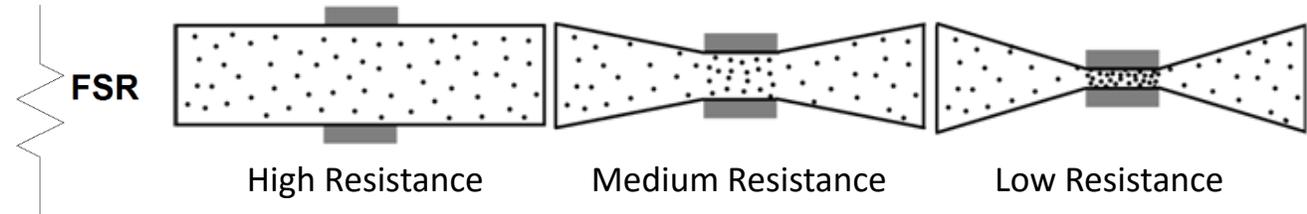
Sensor Layout

20 in Heel of Foot
16 in Arch of Foot
20 in Ball of Foot
8 in Toe of Foot

A total of 64 FSR sensors

Insole Circuit

D1 **5V**

D2 **5V**

D3 **5V**

D4 **5V**

D5 **5V**

D6 **5V**

D7 **5V**

D8 **5V**

A1 A2 A3 A4 A5 A6 A7 A8

5V

FSR

Analog Read

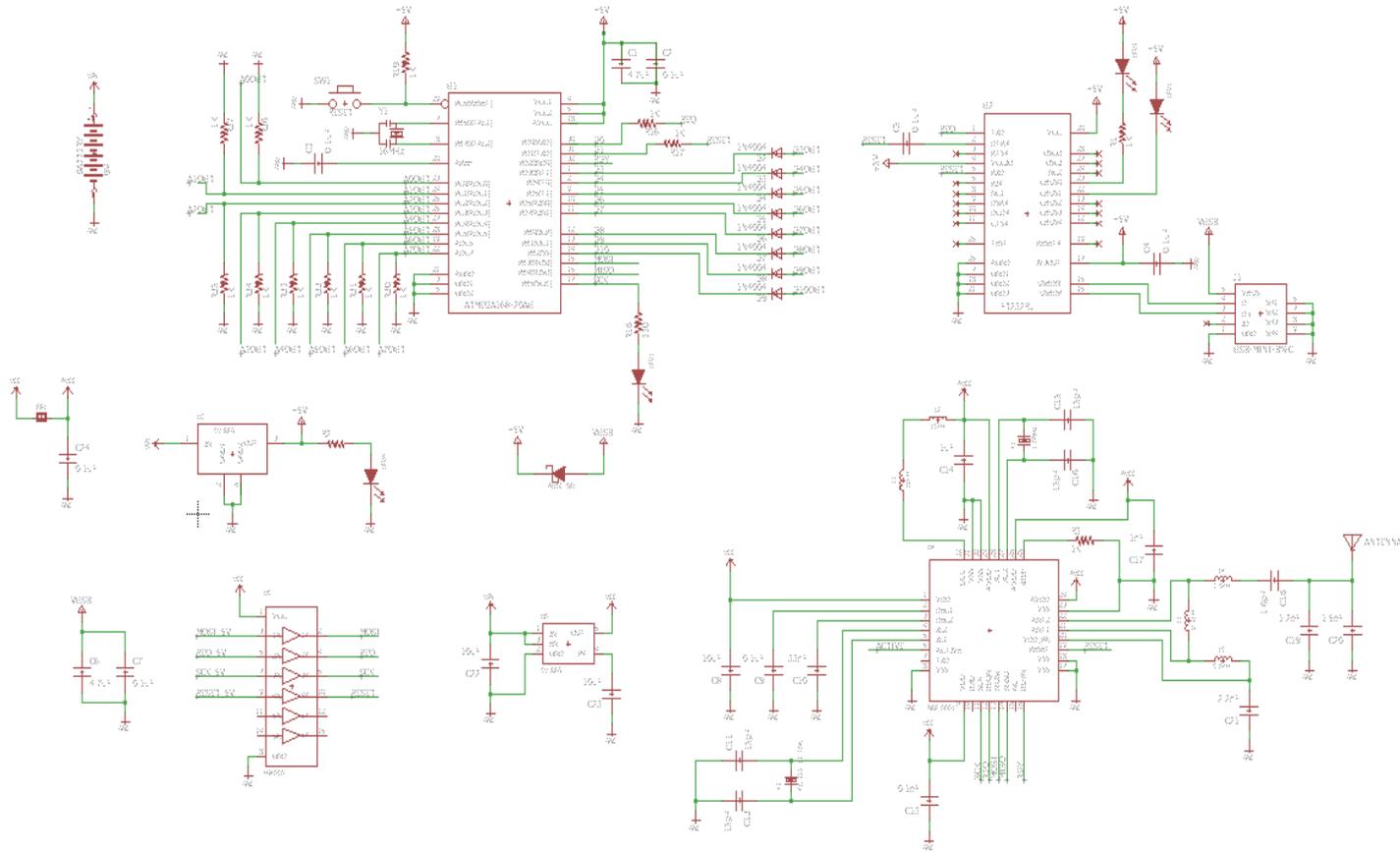**1K**
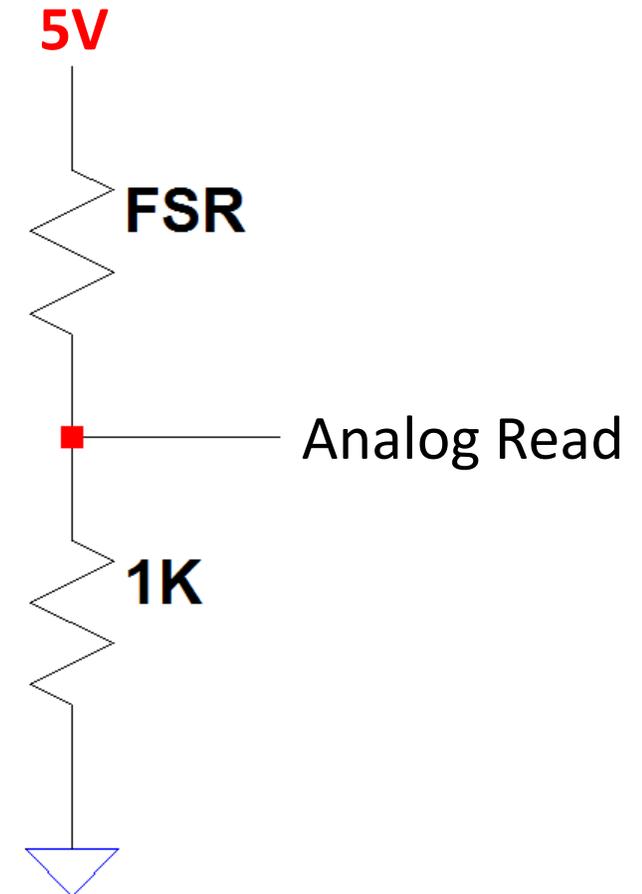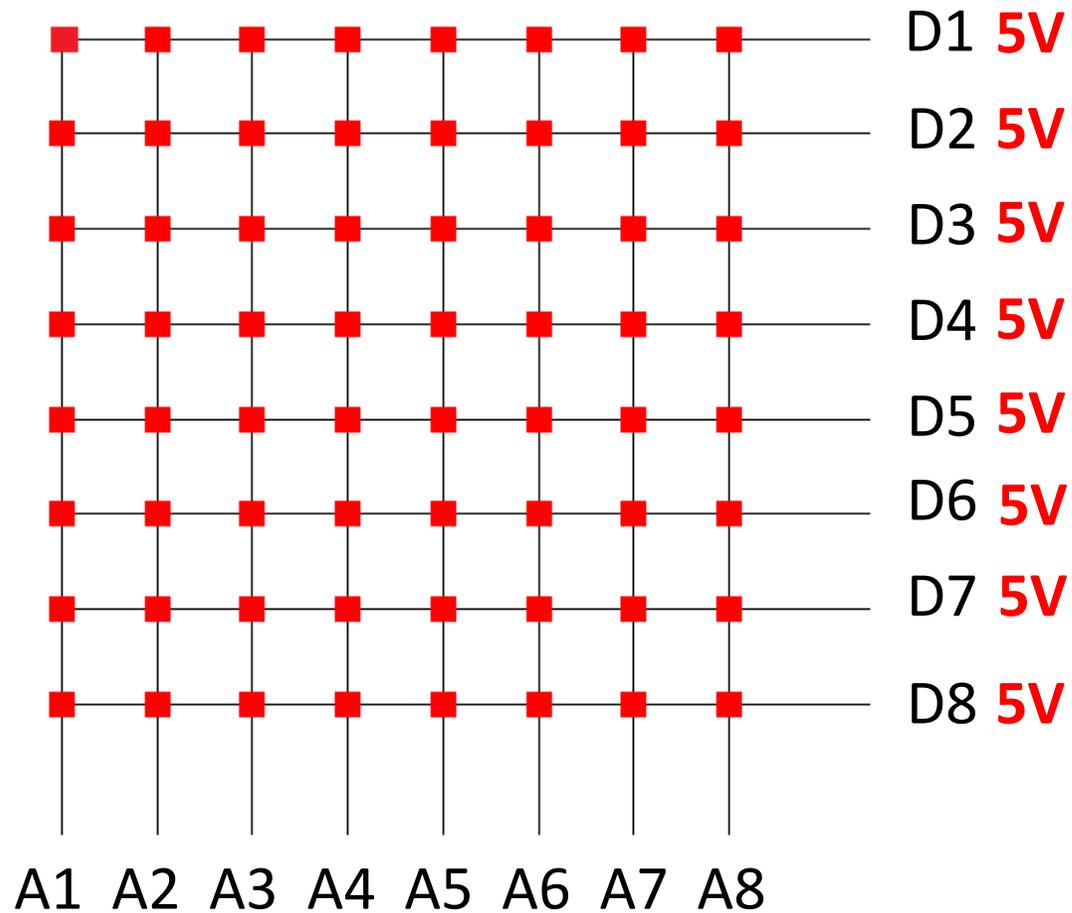
Black Box Design

Arduino Board
- Voltage Limits: 6-20V
- Memory: 32KB
- Clock Speed: 16Mhz
- 5V Regulator and Auto-Selector
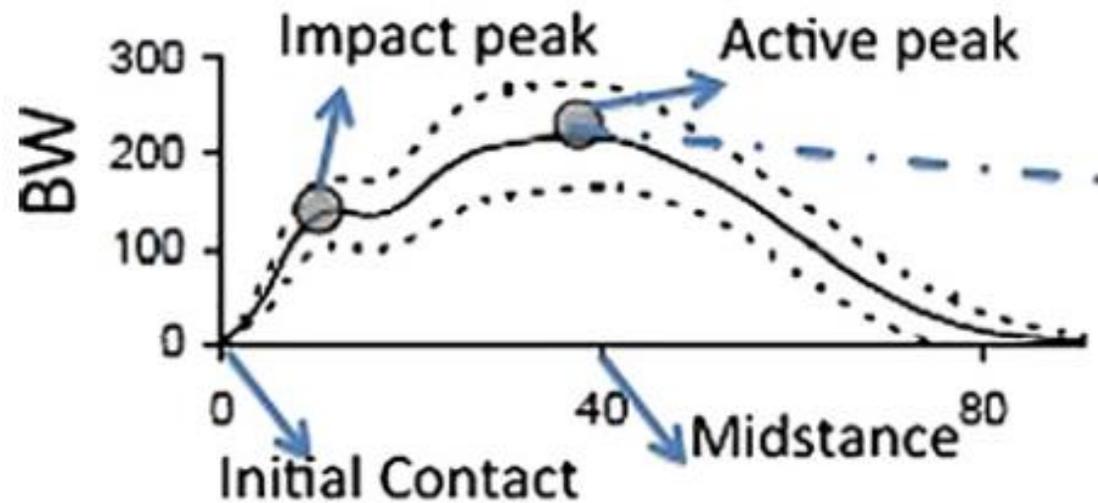
Bluetooth Board
- Voltage Limits: 3.3-16V
- Clock Speed: 8MHz
- Low Energy to Reduce Power Loss
  ◦ 10 meter range

  ◦ Battery
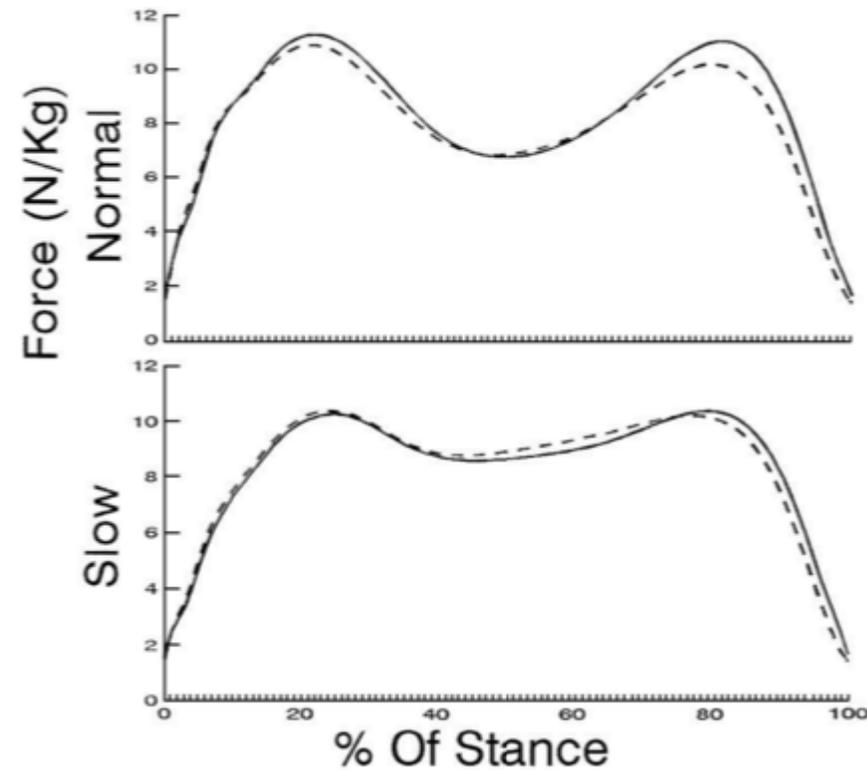 ◦ 9V power
  ◦ Reliability of 2hours at full power

Power
Ground
Bluetooth
Analog
Digital
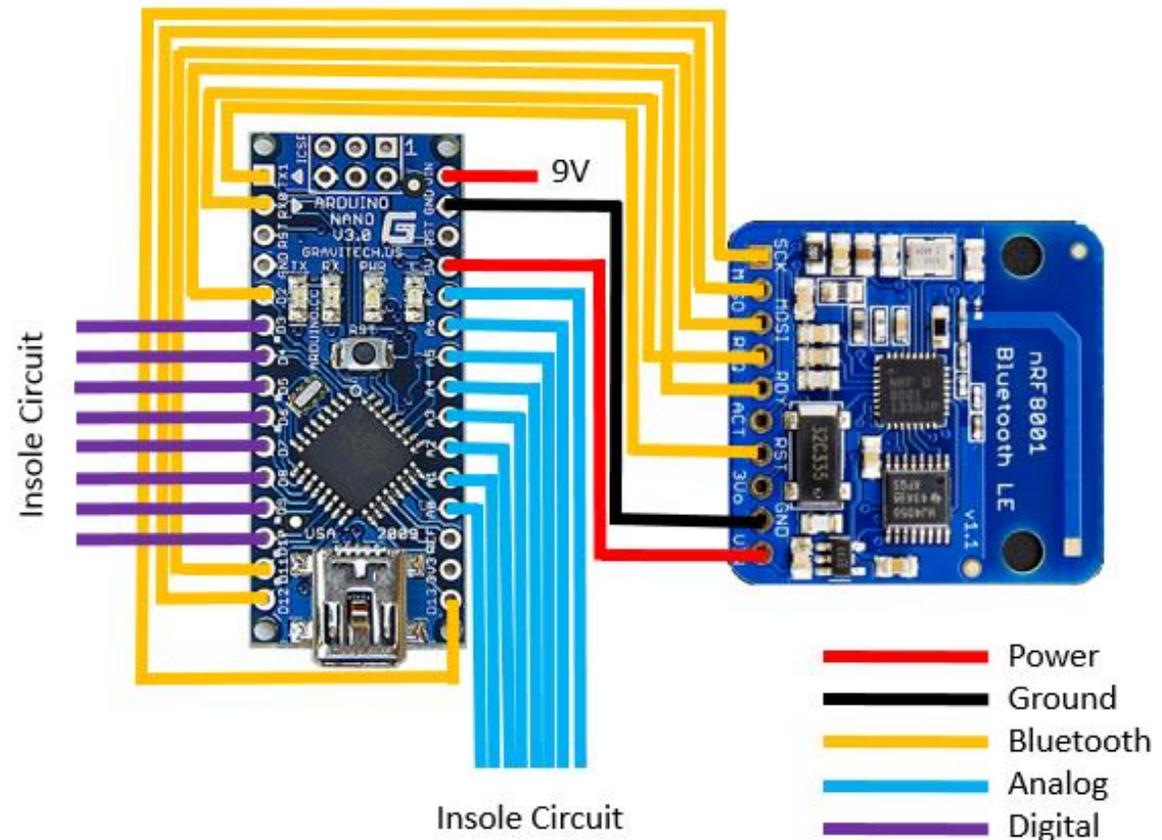
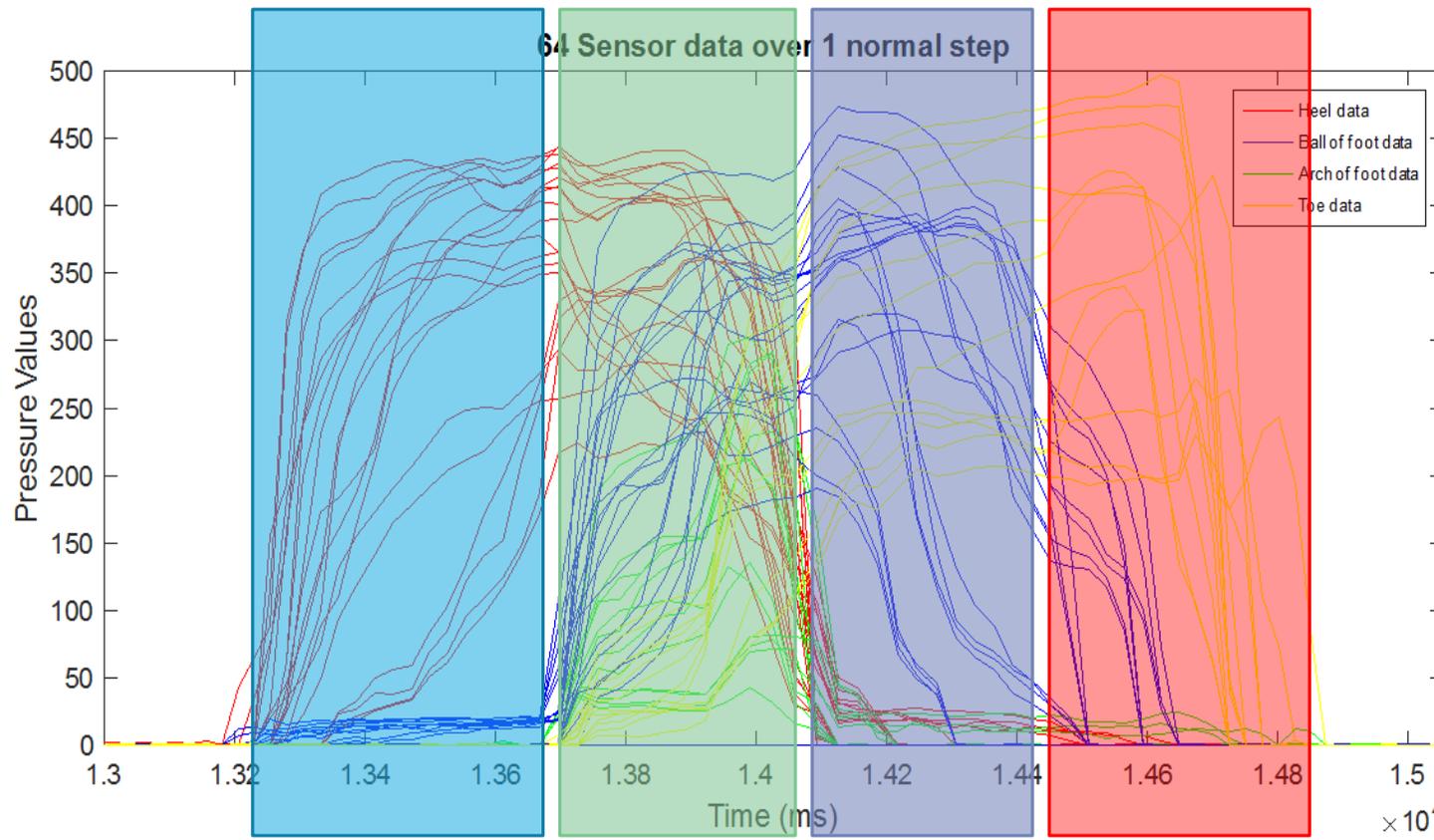# PCB Design
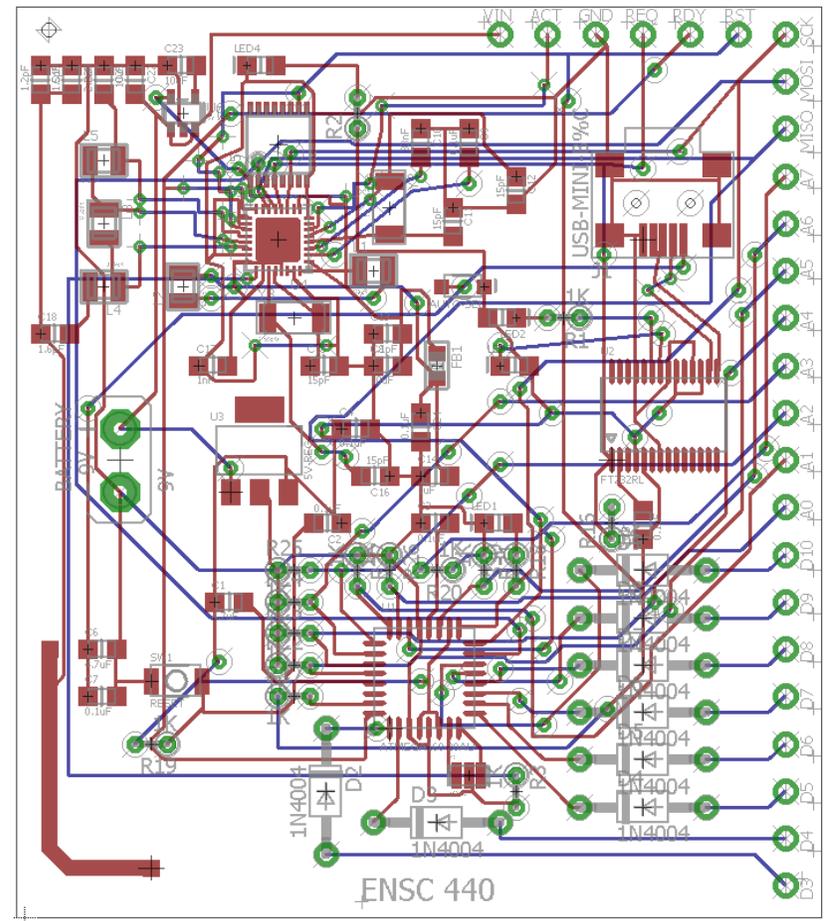
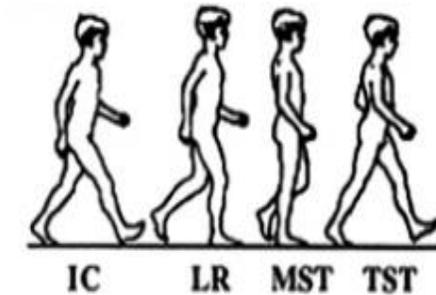# Ground Reaction Force (GRF)

[12]

[13]

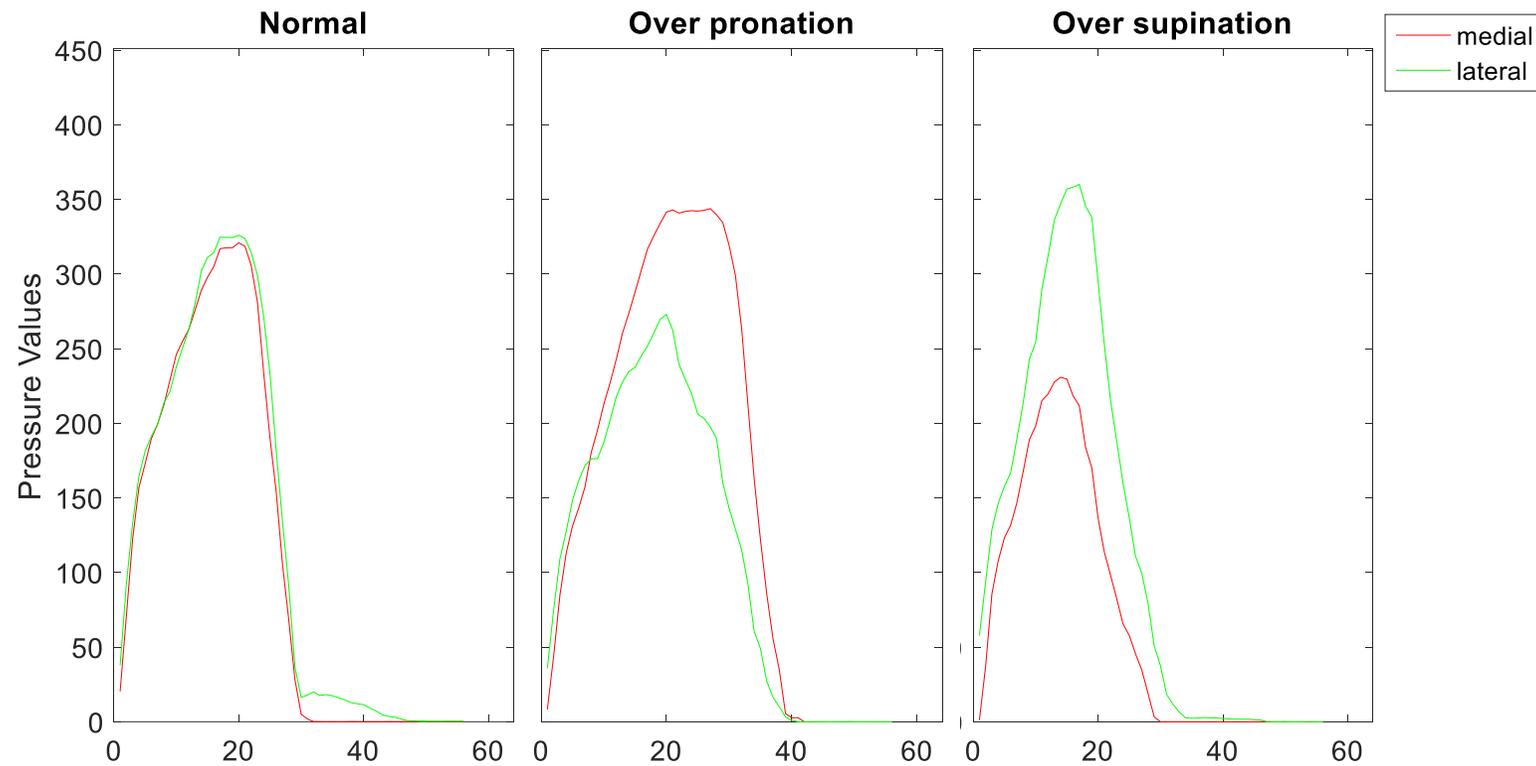# Data & data processing

High signal to noise ratio

Identify gait stages in the stance period

- Initial contact
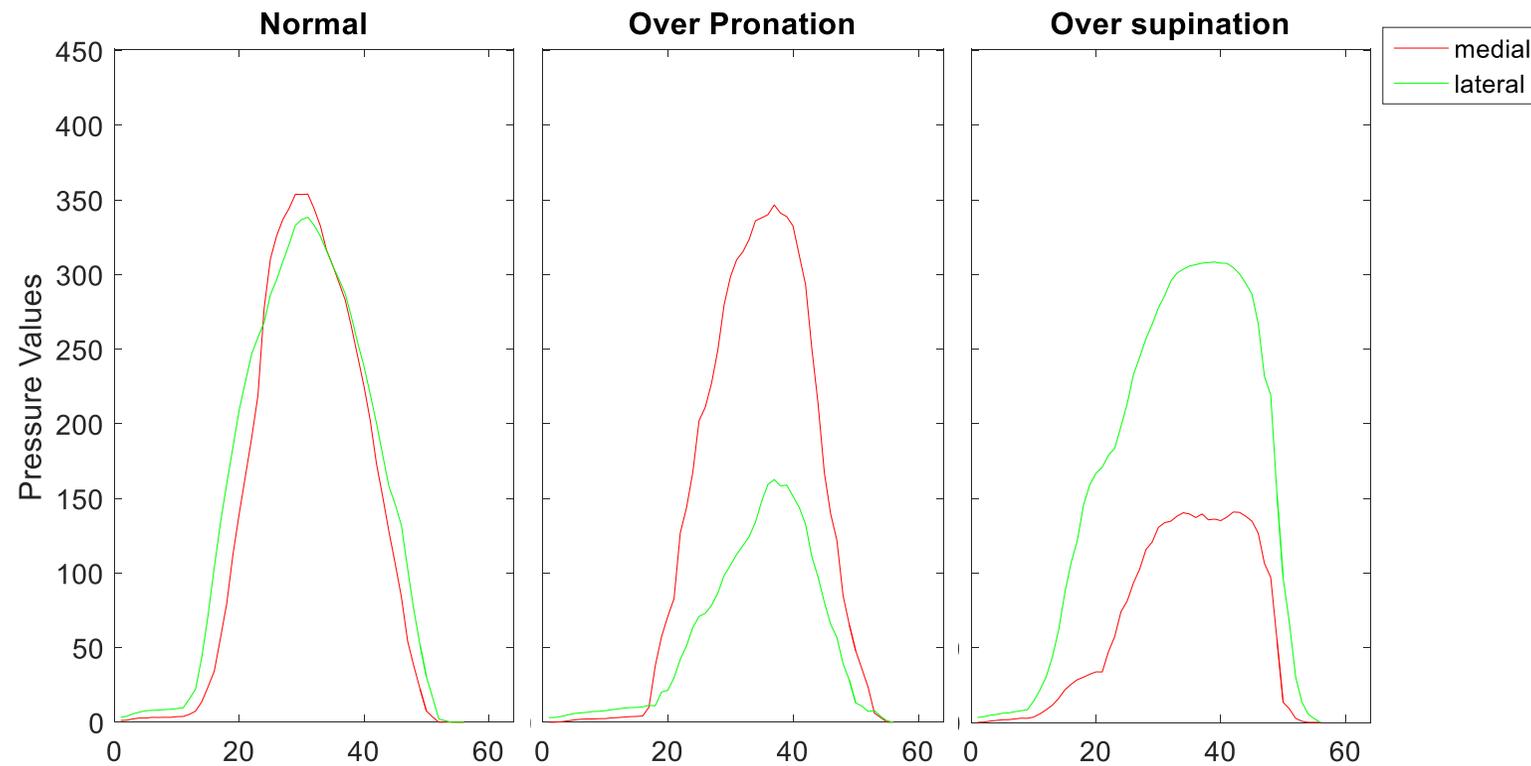- Loading response
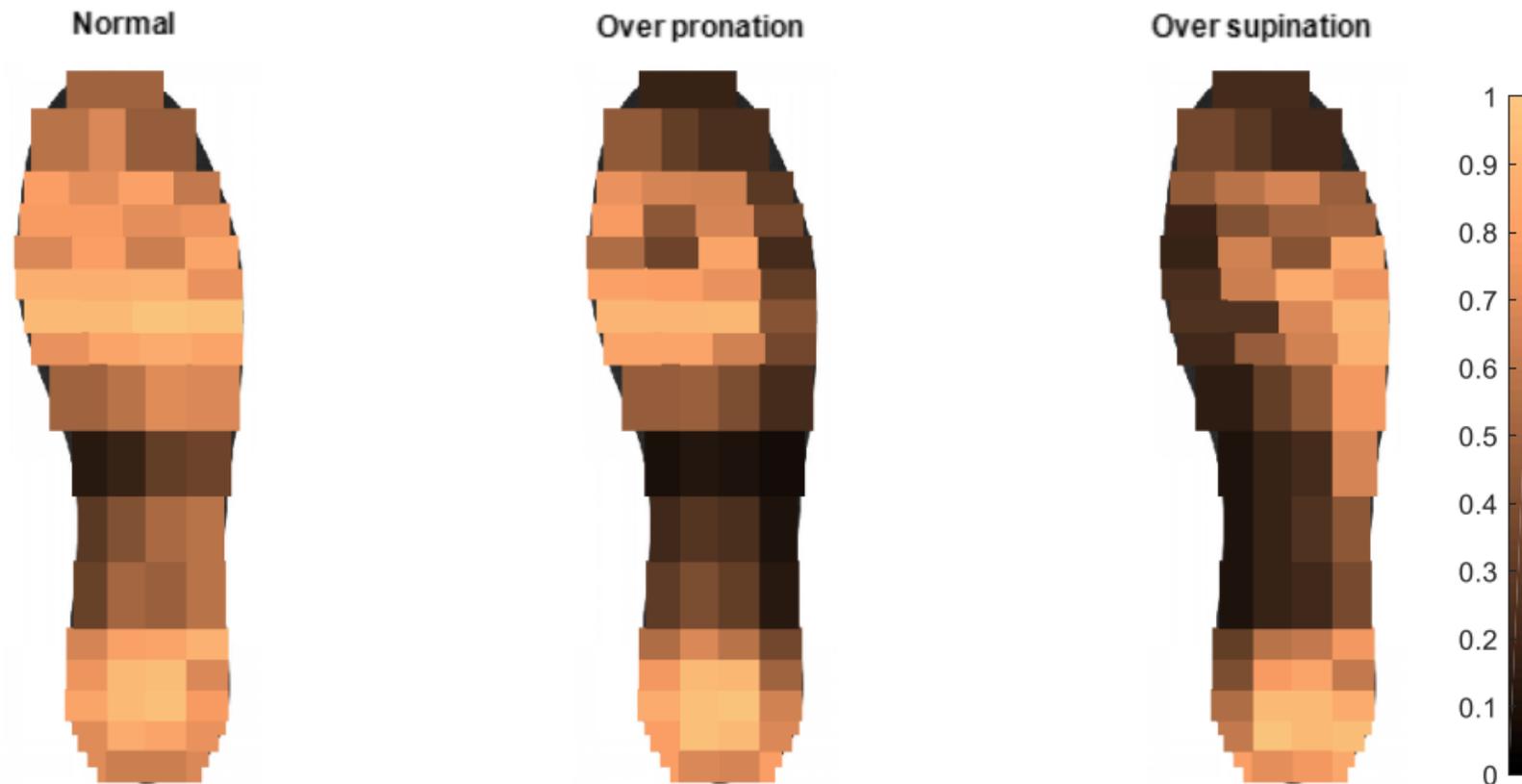- Mid-stance
- Terminal stance

[12]

Processing steps - Heel

Processing Steps - Ball

Pedobarograph

Normal　　　　Over pronation　　　　Over supination

Video Demonstration

Application
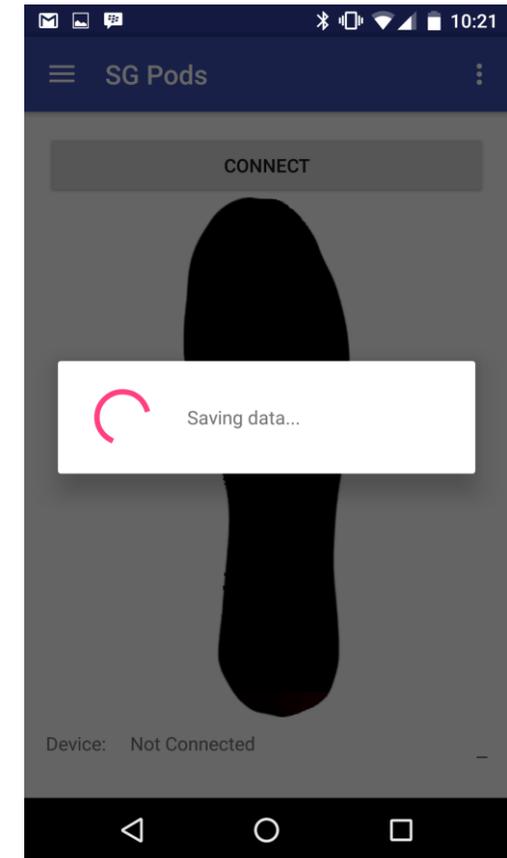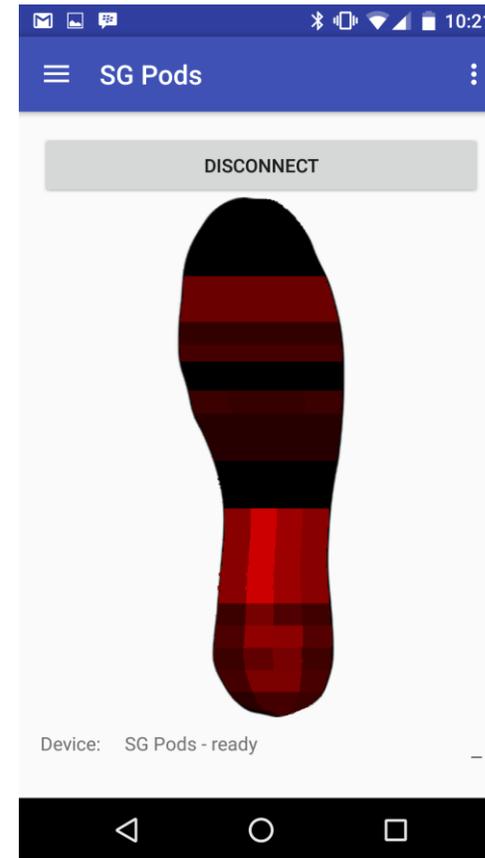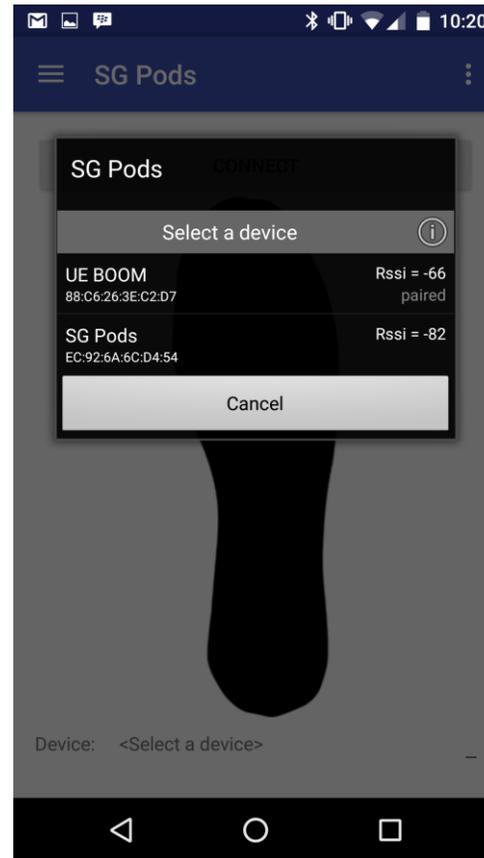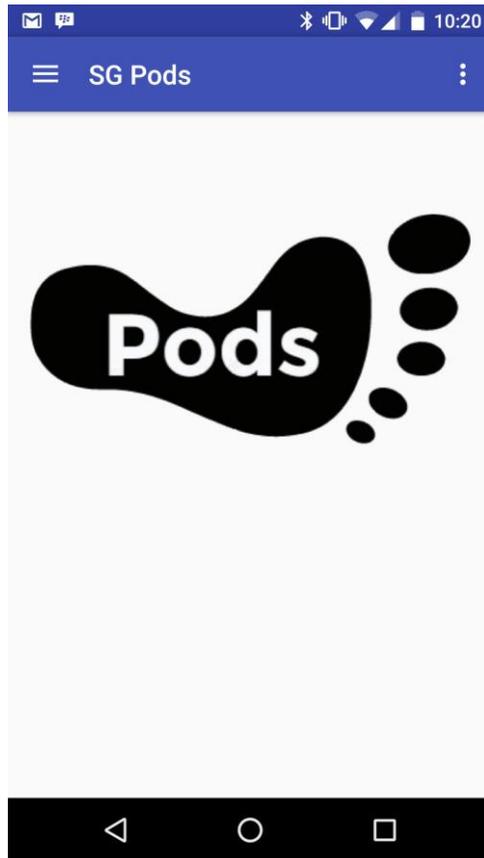
Cost/Financing

Our goal		Reality	
Insole Design	$110	Insole Design	$15
Black Box Design	$70	Black Box Design	$61
Total Device= $180		Total Device= $76	

Initial insole design was 10 FSR sensors at $10 each

Actual design has 64 FSR sensors. PROBLEM!!! That would cost $640 and we spent only $15.

So how did we do it?

Cost/Financing Continued

Conductive sheets are used to ship electronics for static protection

Let's make our own force sensitive resistors

Explored different conductive sheets and found LINQSTAT™ MVCF-Series

[14]

We purchased 11' square piece for $3.56 which was used for our insole

If we were to mass produce and make 1500 insoles, the price for conductive sheet in each insole would reduce to $0.02

[15]

[16]
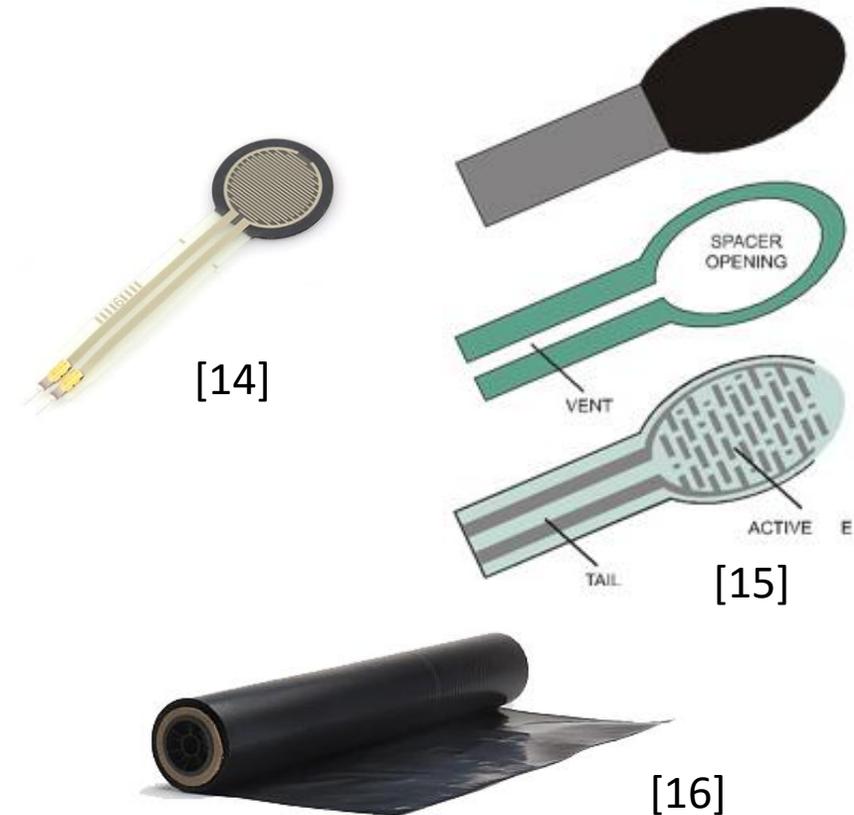
Future Development

Having a working application, our product is ready for mass production

Optimize insole and black box manufacturing

Estimated cost of materials in mass production of 1500 units

Insole $0.66/unit

Black Box $8.50/unit (battery not included)

Conclusion Professional Quotes

"This sounds like a very interesting product that can be useful to a wide array of people" - Carl. G, Hodgson Orthotics

"After an injury, the first thing we check is their gait, and correct any asymmetries. I would definitely use and recommend a device like this for anyone with abnormalities"
- Michelle. A, Physical Therapist, Eagle Ridge Physio

Conclusion User Quotes

Solegait

"OMG it actually works"
-Joel Bradsen

"Being a personal trainer, I would use this product to ensure proper form in training" -Tania Rodgeman

"This could revolutionize the shoe industry"
-Jacob Nunn

"This product would have sped up my recovery of my Achilles injury"
-Traian Talpalaru

"As a nurse I'm on my feet all day. Finding areas of high pressure would be useful when buying orthotics to minimize foot pain"
-Zahra Creighton

Questions

Acknowledgements

Andrew Rawicz

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Jamal Bahari

Lucas-Karim Merhi

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Appendix

D.V. Rai, L.M. Aggarwal "The Study of Plantar Pressure Distribution in Normal and Pathological Foot"
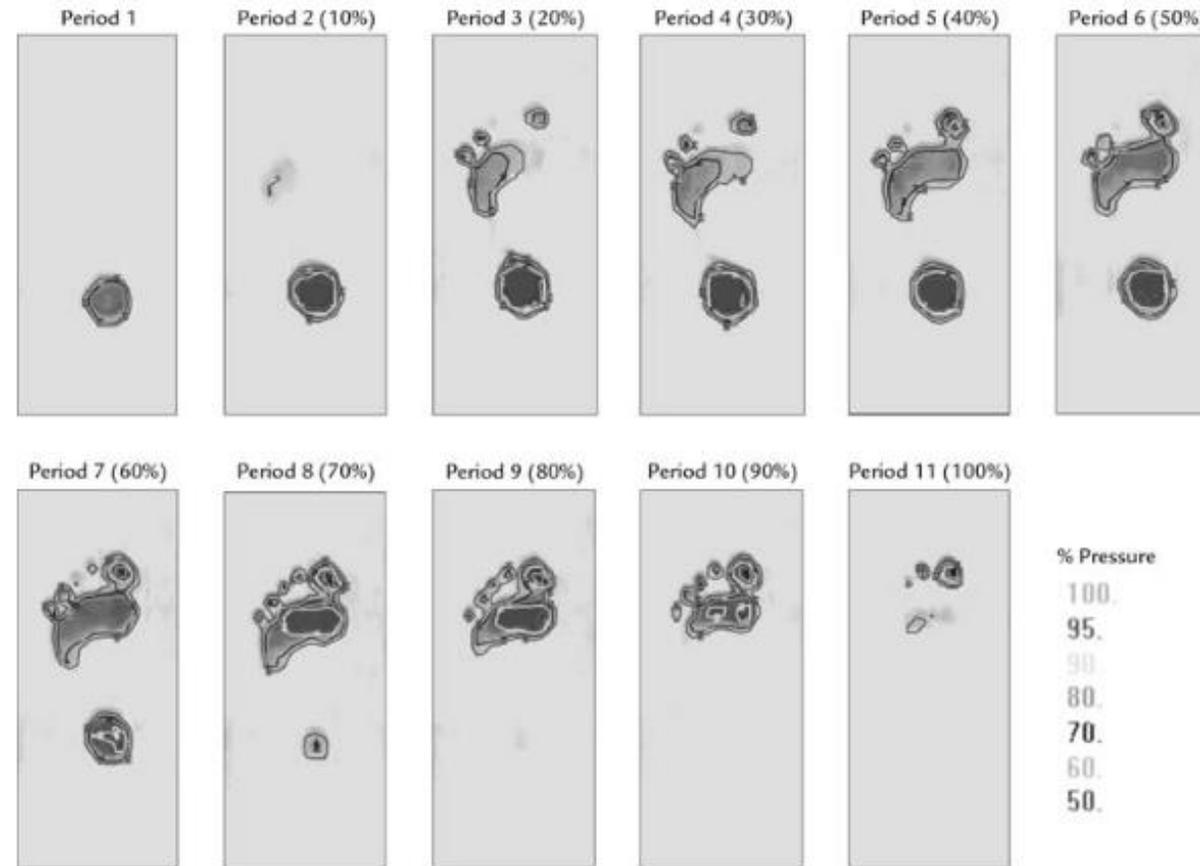
Estimated/Actual Cost of Materials

Item	Estimated Price ($CAD)	Actual Price ($CAD)
Bluetooth Breakout	19.95	19.95
Arduino	70.00	43.98
Force Sensitive Resistors	100.00	0
Force Sensitive Resistor Sheet	59.50	35.60
Wire/Conductive Thread	6.95	25.95
Fabric	10.00	N/A*
Shoe Insoles	20.00	7.00
Batteries	20.00	13.99
Additional Items		
Laminate Material	0.00	22.00
Enclosure	0.00	5.13
Prototyping Board	0.00	3.61
Miscellaneous	90.00	79.44
Shipping and import fees	60.00	46.78
Total	456.40	284.43

Foot pressure distribution during walking

[20]