

Secure Mobile Health Care Monitoring Using Smart Shoes

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BlackRidge
TECHNOLOGY



MARIST

June 10, 2018



Google
Mesh
Wifi



Internet



Zeblok
BioInfor-
matics
Cloud

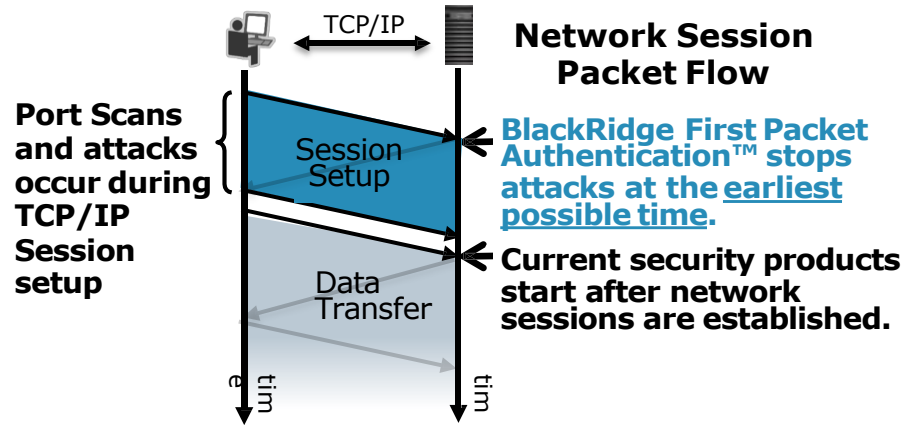
IMU+Plantar data for 3D
Motion Capture
WiFi; Streaming into AI-
BioInformatics Cloud. No
additional device needed.
Rechargeable; Motion
activated
OTA Updates
Powerful CPU for edge
algorithms

BlackRidge
Branch
Gateways



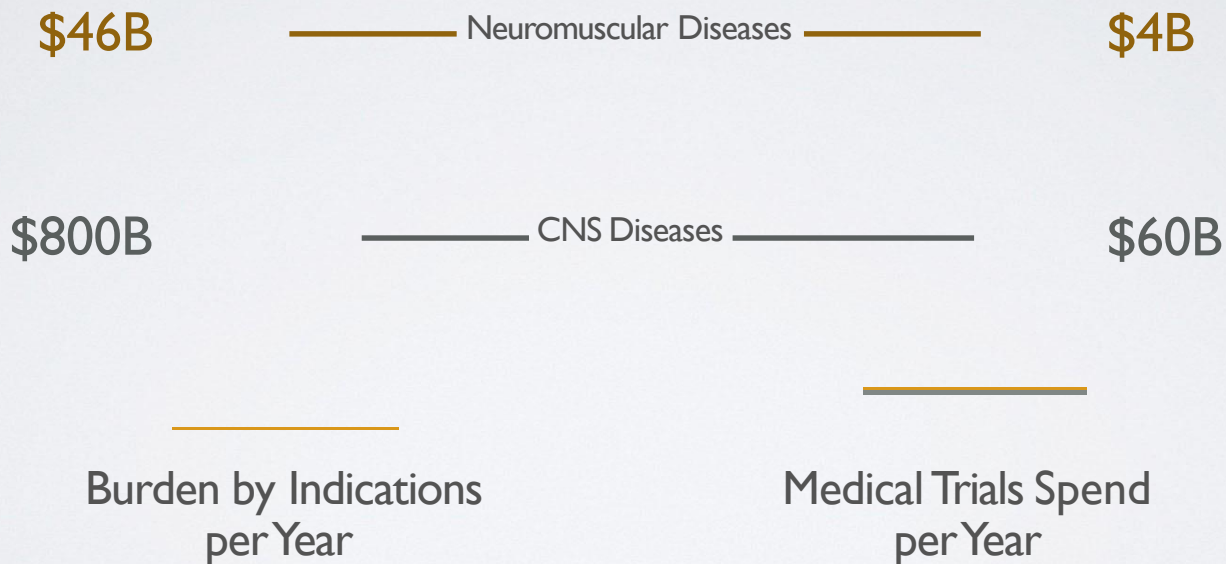
BlackRidge Stops Network-based Attacks and Addresses Network Compliance

- BlackRidge addresses the TCP/IP network vulnerability that is exploited in 100% of cyber attacks
 - BlackRidge authenticates identity and enforces security policy on the first packet, before a network session is established
- BlackRidge isolates and protects servers and applications
 - Stops port scans and network attacks
 - Provides ROI and reduces risk
 - Addresses network segmentation compliance

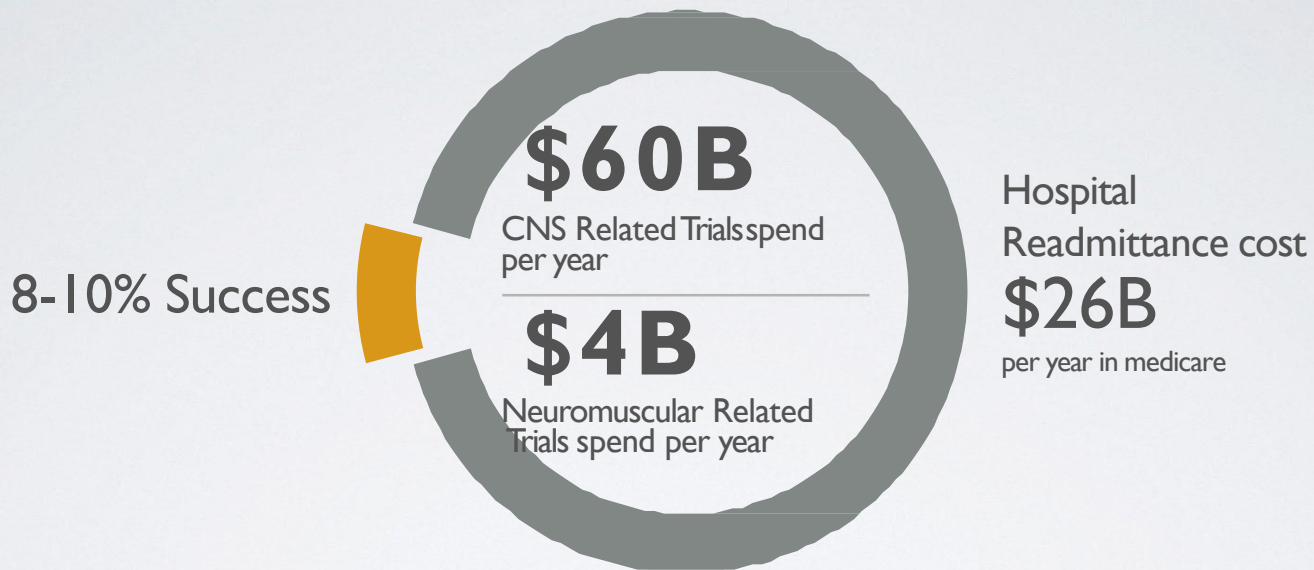


- Protects against DOS and DDOS attacks
- Unauthorized access because of compromised keys is eliminated
- Protects against Insider Threats
- Eliminate Bleichenbacher-style attacks and attacks on TLS ports

CNS MEDICAL COST



INSUFFICIENT INSIGHTS



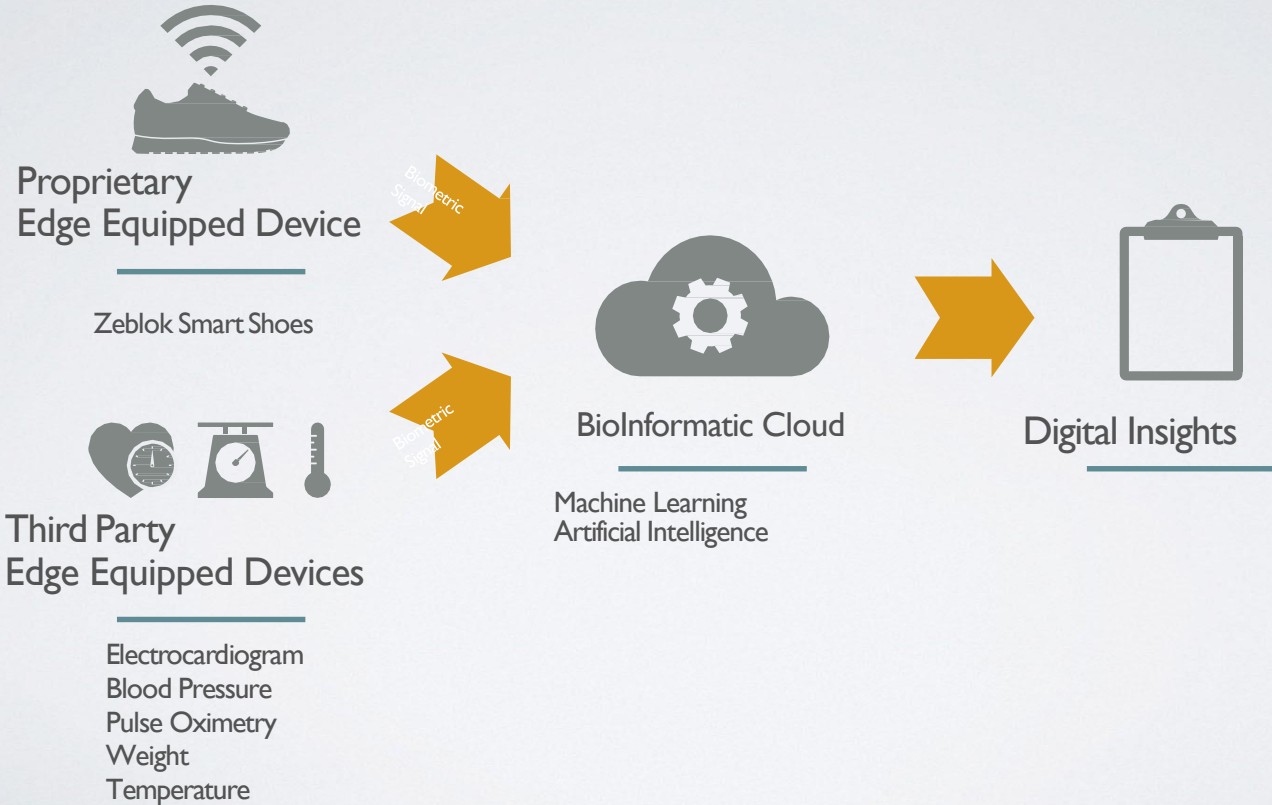
Measurement Challenges

Subjective, Episodic, Inconsistent,
Physical site constrained,
Non-personalized

Care Challenges

Insurance coverage, Patient education,
Patient enrollment, Early Screening,
Personalization

ZEBLOK PLATFORM



THE FIRST STEP

MOTION BIOSIGNAL: SMART SHOES



ZEBLOK & REHABILITATION



Orthopedic Impairments

Total Hip Replacement, Total Knee Replacement, Poor function, Flexibility or mobility of limb



Neurological Impairments

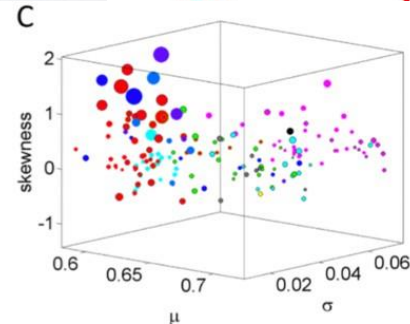
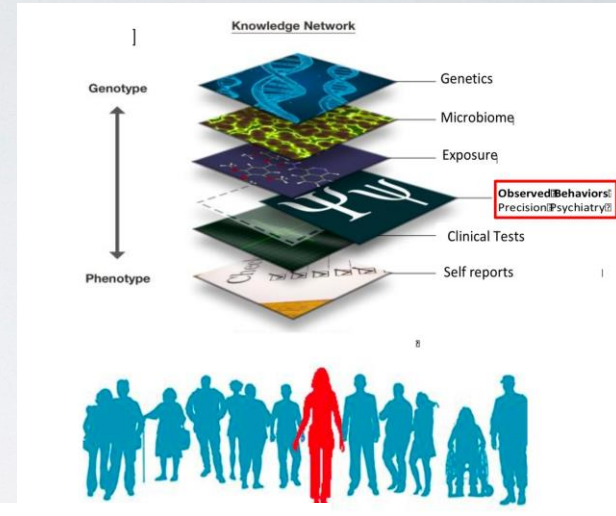
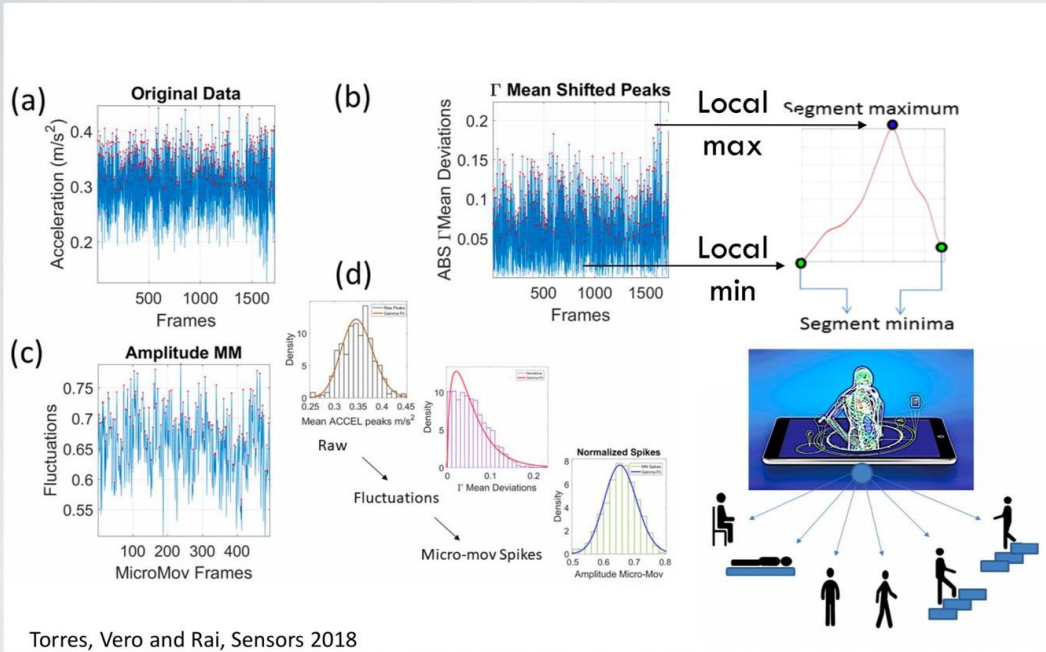
Stroke, Traumatic Brain Injury, Cerebral Palsy, Parkinson's Disease, Foot drop



Balance & Gait

Vertigo/dizziness, Gait difficulty, Frequent falls, Spinal cord injury, Cardiovascular impairments (including endurance and post-surgery needs), Posture improvement, Strengthening with reduced weight bearing, Patients with prosthesis

INSIGHT #1 PERSONALIZED SCORECARDS



Use-Case Patents In-License From Rutgers University



METHODS FOR THE DIAGNOSIS AND TREATMENT OF
NEUROLOGICAL DISORDERS



OBJECTIVE AND PERSONALIZED LONGITUDINAL
ASSESSMENT OF POST SEVERE TRAUMATIC BRAIN INJURY

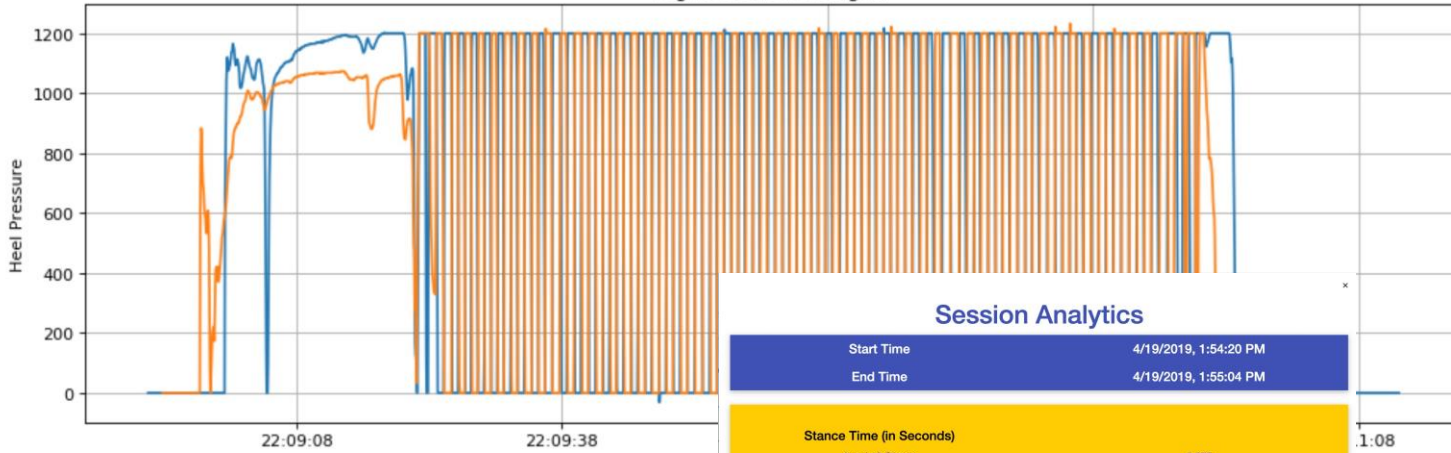


METHODS FOR MEASURING
PHYSIOLOGICALLY RELEVANT MOTION



INSIGHT #2 Real-World Locomotion and Gait

Right & Left Foot Signal



Session Analytics

Start Time 4/19/2019, 1:54:20 PM
End Time 4/19/2019, 1:55:04 PM

Stance Time (in Seconds)

Avg. Left Stance 0.877
Max. Left Stance 1.047
Minimum Left Stance 0.742
Standard Deviation of Left Stance 0.071
Average Right Stance 0.802
Maximum Right Stance 0.993
Minimum Right Stance 0.694
Standard Deviation of Right Stance 0.077

Total Strides

24

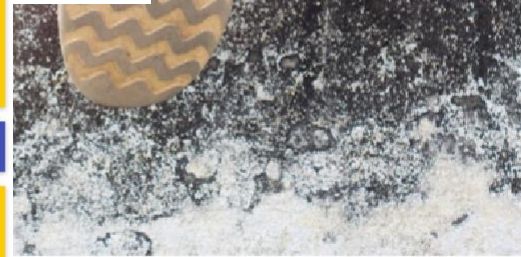
Swing Time (in Seconds)

Average Left Swing 0.807
Maximum Left Swing 0.859
Minimum Left Swing 0.71
Standard Deviation of Left Swing 0.041
Average Right Swing 0.879
Maximum Right Swing 0.958
Minimum Right Swing 0.752
Standard Deviation of Right Swing 0.054

Swing Velocity (m/s)

Right Swing Velocity 1.016
Left Swing Velocity 1.016

| S.No | Age | Weight (lbs) | Left Sensor Id | Right Sensor Id | Protocol | Start Time | End Time | Context | Analytics | Replay | Download | Delete |
|------|-----|--------------|----------------|-----------------|------------------------------|--------------------|-------------------|---------|-----------|--------|----------|--------|
| 1 | 29 | 145 | 1585755 | 1585741 | short_walk4/19/19 1:54:19 PM | 4/19/19 1:55:04 PM | PMNot Provided | | | | | |
| 2 | 29 | 145 | 1585755 | 1585741 | short_walk4/19/19 2:51:28 PM | 4/19/19 2:53:06 PM | PMNot Provided | | | | | |
| 3 | 29 | 145 | 1585755 | 1585741 | short_walk4/19/19 4:48:53 PM | 4/19/19 4:52:20 PM | PMNot Provided | | | | | |
| 4 | 29 | 145 | 1585755 | 1585741 | short_walk4/23/19 6:53:38 PM | 4/23/19 6:57:08 PM | PMNot Provided | | | | | |
| 5 | 22 | 172 | 1272211 | 1272212 | short_walk4/10/19 5:39:52 PM | 4/10/19 5:40:51 PM | PMNot Provided | | | | | |
| 6 | 30 | 170 | 1585741 | 1585755 | short_walk4/19/19 4:49:57 PM | 4/19/19 4:50:01 PM | PMNot Provided | | | | | |
| 7 | 46 | 180 | 1272212 | 1272211 | short_walk4/10/19 5:38:17 PM | 4/10/19 5:41:49 PM | Mon gait rite | | | | | |
| 8 | 57 | 168 | 1585727 | 1272211 | short_walk4/25/19 7:47:30 AM | 5/6/19 6:31:08 PM | zenos - just left | | | | | |



GAIT INSIGHT COMPARISON



First joint data capture with Protokinetics Zenos Walkway

The following is a result of data captured between Zeno Walkway and Zeblok Shoes at the same time. Subjects carried on walking beyond the end of the mat to simulate “unconstrained real-world” walk. By visual inspection, we trimmed the Zeblok shoes data to make sure the steps measured is limited to Zeno Walkway’s measured steps.

Zeblok Shoes can thus complement, and act as an extension of capturing valuable gait data beyond the Walkway and making the results @Site more @Real-World

| Session | PKMAS Step Count | Zeblok Step Count | Error % | Mean Step Duration | Error Percentage |
|---------|------------------|--------------------------|---------|-----------------------------|------------------|
| 0 | 53 | 52 | 1.9 | 1.497 | 12 |
| 1 | 43 | 42 | 2.3 | 1.626 | 5 |
| 2 | 65 | 65 | 0 | 1.921 | 13 |
| 3 | 44 | 43 | 2.3 | 1.811 | 6 |
| 4 | 30 | 33 | -10 | 1.6 | 10 |
| 5 | 50 | 50 | 0 | 1.392 | 4 |
| | | Average Step Count Error | 0.58 % | Average Step Duration Error | 8.3 % |



Terrific first results. No algorithms were modified. Very limited IMU Calibration

ACKNOWLEDGEMENT

Tony Sager and Dr.Casimer DeCusatis for allowing the use of facilities, mesh network at Marist College and thoughtful product feedback. We look forward to more active data collection and future research collaborations. Chris Anderson, Blackridge, for making the introductions and initiating this collaboration.

Dr.Tejasvi Parupudi, Senior Engineer, Zeblok

Vignesha Bhamidi, Senior Engineer,Zeblok

Dominick Lee, Software & Embedded Systems Architect, Zeblok

Akash Sengar, Software Engineer Bio-informatics, Zeblok

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Dr. Elizabeth Torres, Sensory Motor Integration Lab, Rutgers University with whom Zeblok has an option to licensing the biometric algorithms for early diagnosis in CNS indications.

AWARDS & RECOGNITION



Amazon Activate Award
\$10,000
January 2018

Manufacturing and Technology
Resource Consortium (MTRC)

 AT STONY BROOK UNIVERSITY

NY State MTRC Award
\$20,000
March 2018



RUTGERS

Rutgers TechAdvance Award
\$100,000
August 2018



Innovation Showcase Presenter,
CNSSummit
November 2018



Industry Member, NSF Center for Visual &
Decision Informatics (CVDI)
\$20,000
January 2018



NSF CVDI CONSORTIUM

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Next Steps/Future Research

- Compare Zeblok capability to legacy Gait analysis methods
- Feed other Vital Signs into Zeblok Bio-Informatics Cloud
- Stage Cyber Attacks against BlackRidge Zeblok solution to validate protection
- Investigate being able to predict diseases like MS and Parkinson's
- Publish papers with our findings in IEEE and other Journals

- Panel: Bridging Modern DevOps and the Mainframe