

MUSICAL REHABILITATION ASSISTANCE SYSTEM



April 17th, 2015

OVERVIEW



- Who is Harmony Innovation?
- What is the origin of the MRAS?
- What does the MRAS do?
- How does the MRAS work?
- How did we complete the MRAS?
- Who should buy an MRAS?
- What did the MRAS teach us?

HARMONY INNOVATION



James Thomson

- Project Management, Documentation

Sam Chu

- Software Design, Software Integration

Ryan Colter

- Electronics design, Software Integration

Elnaz Heidari

- Kit Design, Kit Integration

Adam Prochazka

- Electronics Integration, Software Integration

THE ORIGIN STORY

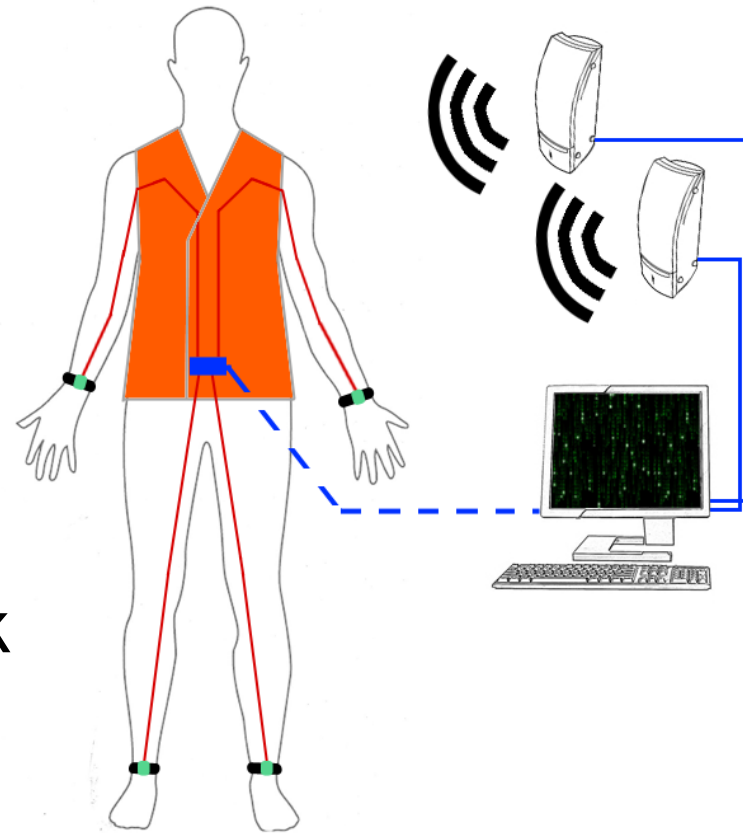


- » Musical and medical background
- » Synchronous motion
- » How do you know if you're doing it right?
- » Progressive improvement

OVERVIEW OF THE MRAS



- Worn by the patient
- MSU (green) sends data to the Controller (blue)
- Controller transmits data to Software
- Software analyzes data and generates feedback
- Continuous feedback is modified in real time



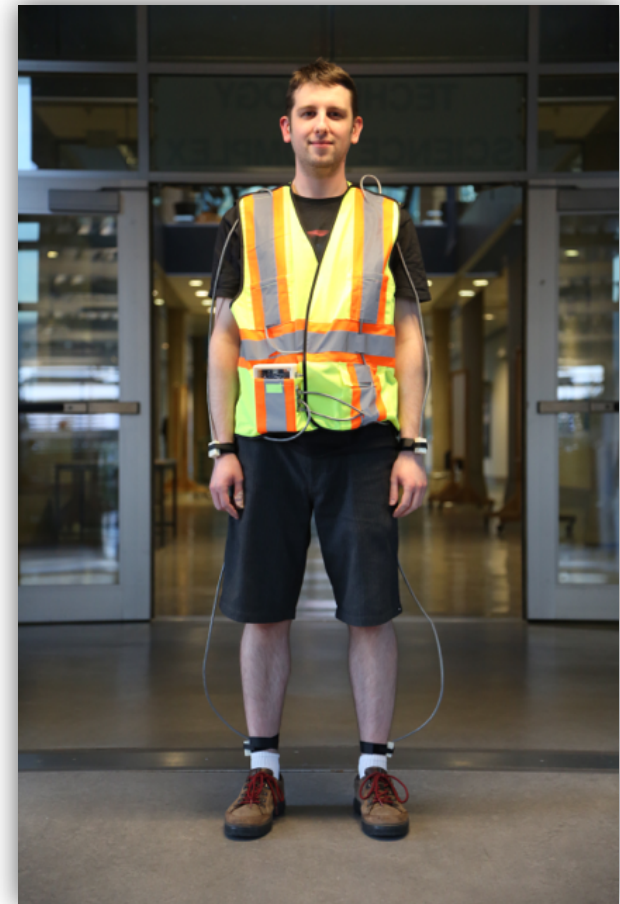
SYSTEM OVERVIEW



- » **Kit Design**
- » Integration of Electronics & Software
- » Electronics Design
- » Software: Data Processing
- » Software: Data Analysis
- » Software: Music Player

KIT DESIGN

- ⌋ Mechanical components
- ⌋ Wearables
 - Straps
 - Vest
- ⌋ Enclosures
 - Controller
 - MSUs
- ⌋ Safety & Comfort



SYSTEM OVERVIEW



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E/S INTEGRATION

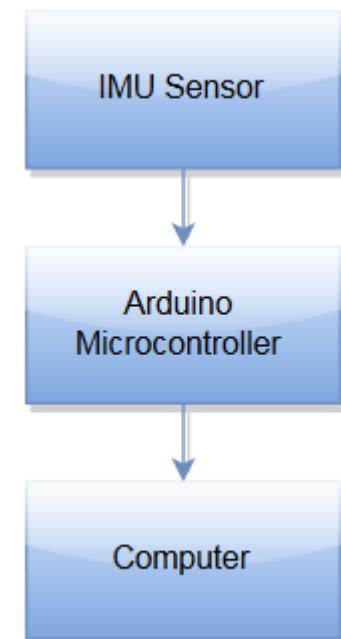


» Data from limbs to Software

- Sensors capture motion data
- Sent to Controller
- Transmitted to Software

» Wired serial connection via USB

- Bluetooth considered as alternative



SYSTEM OVERVIEW



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- » **Electronics Design**
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ELECTRONICS DESIGN



Required Specifications

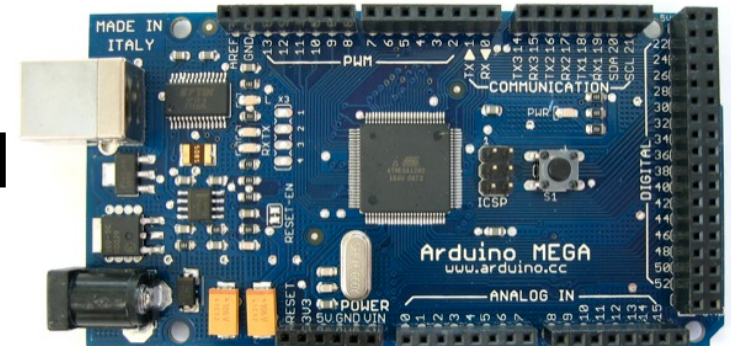
- Low voltage
- Comfortably wearable
- All electronics must integrate
- Must track motion with certain accuracy

ELECTRONICS DESIGN



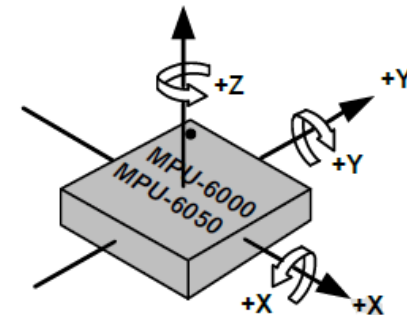
Controller

- Arduino Platform (instead of Raspberry Pi or others)



Sensors

- Accelerometer + Gyroscope IMU vs 9-axis magnetometer



ELECTRONICS DESIGN



- » Arduino code architecture
 - Initialization
 - Run State
- » Arduino code design process
- » Integration of different Arduino code

SYSTEM OVERVIEW



- » Kit Design
- » Integration of Electronics & Software
- » Electronics Design
- » **Software: Data Processing**
- » Software: Data Analysis
- » Software: Music Player

DATA PROCESSING



- » We looked at 3 major avenues for comparing data
 1. Position
 2. Acceleration
 3. Orientation

SYSTEM OVERVIEW



- » Kit Design
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- » Software: Data Processing
- » **Software: Data Analysis**
- » Software: Music Player

DATA ANALYSIS



» Comparison Algorithm

- System can capture preset data
- Compare patient data against preset data
- 3D envelope is built around preset data
- Generates a score based on that comparison
- That score affects the feedback

SYSTEM OVERVIEW



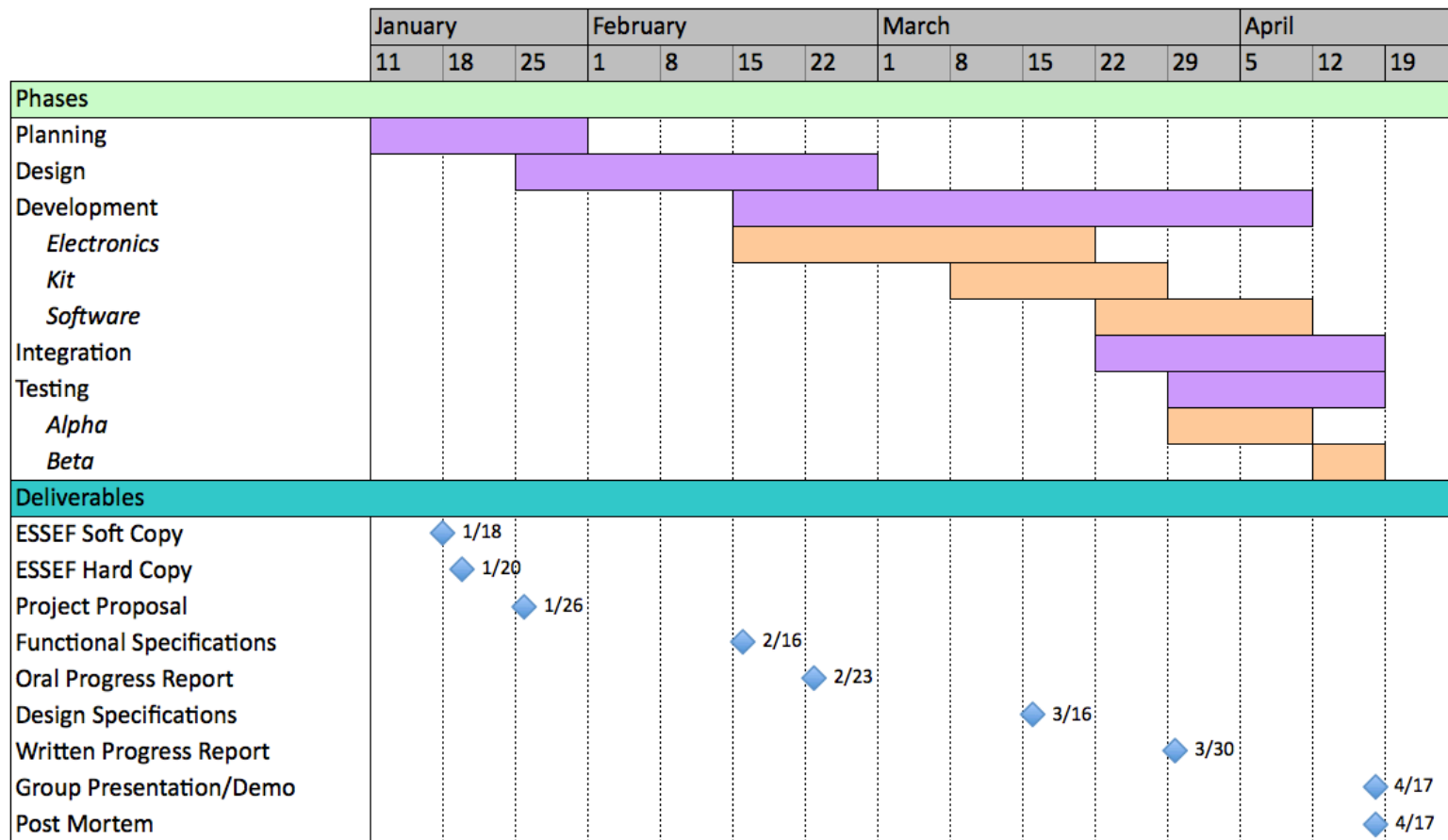
- » Kit Design
- » Integration of Electronics & Software
- » Electronics Design
- » Software: Data Processing
- » Software: Data Analysis
- » **Software: Music Player**

MUSIC PLAYER



- » Music provides the feedback
- » Each limb controls a different musical note
- » The number of correct XYZ values are directly correlated to volume

PROJECT SCHEDULE



PROJECT BUDGET



EXPENDITURES	\$290.78
Arduino Mega 2560 Kit	68.87
Arduino Wireless Bluetooth Transceiver Module	12.97
9V Batteries	11.16
Kootek Arduino GY-521 MPU-6050 Module x 8	60.54
Manufacturing of Controller and MPU Enclosures	82.85
CAT5 Connectors	38.08
Fabric & Materials	16.31
FUNDING SOURCES	\$650.00
ESSEF Funding	650.00
TOTAL REMAINING	\$359.22

MARKET ANALYSIS



- » Intent is to port software to Smartphone
- » Expected retail price under \$500
- » Financing for final product from venture capital
- » No direct competitors
 - Other products could benefit from integrating with MRAS (exoskeletons)

PROJECT LEARNING



- » The rehabilitation process
- » Planning for development
- » Electronics/software integration
- » Developing in MATLAB
- » The value of a good team

FUTURE PLANS



- » MDDC Award for Excellence in Biomedical Engineering Student Design & Innovation
- » Calling card & resume for future employers
- » No plans to develop the project further

ACKNOWLEDGEMENTS



- » Dr. Ian Denison
 - Physiotherapist, Equipment Evaluation, GF Strong Rehab Centre
- » Dr. Jamie Borisoff
 - Canadian Research Chair, Rehabilitation Engineering Design, BCIT
- » Dr. Stephen Robinovitch
 - Professor, School of Engineering Science, SFU
- » Dr. John Jones
 - Associate Professor, School of Engineering Science, SFU
- » Dr. Faisal Beg
 - Professor, School of Engineering Science, SFU
- » Mike Hegedus
 - Doctoral Candidate, School of Engineering Science, SFU
- » Dr. Andrew Rawicz
 - Professor, School of Engineering Science, SFU

THE MRAS IS...



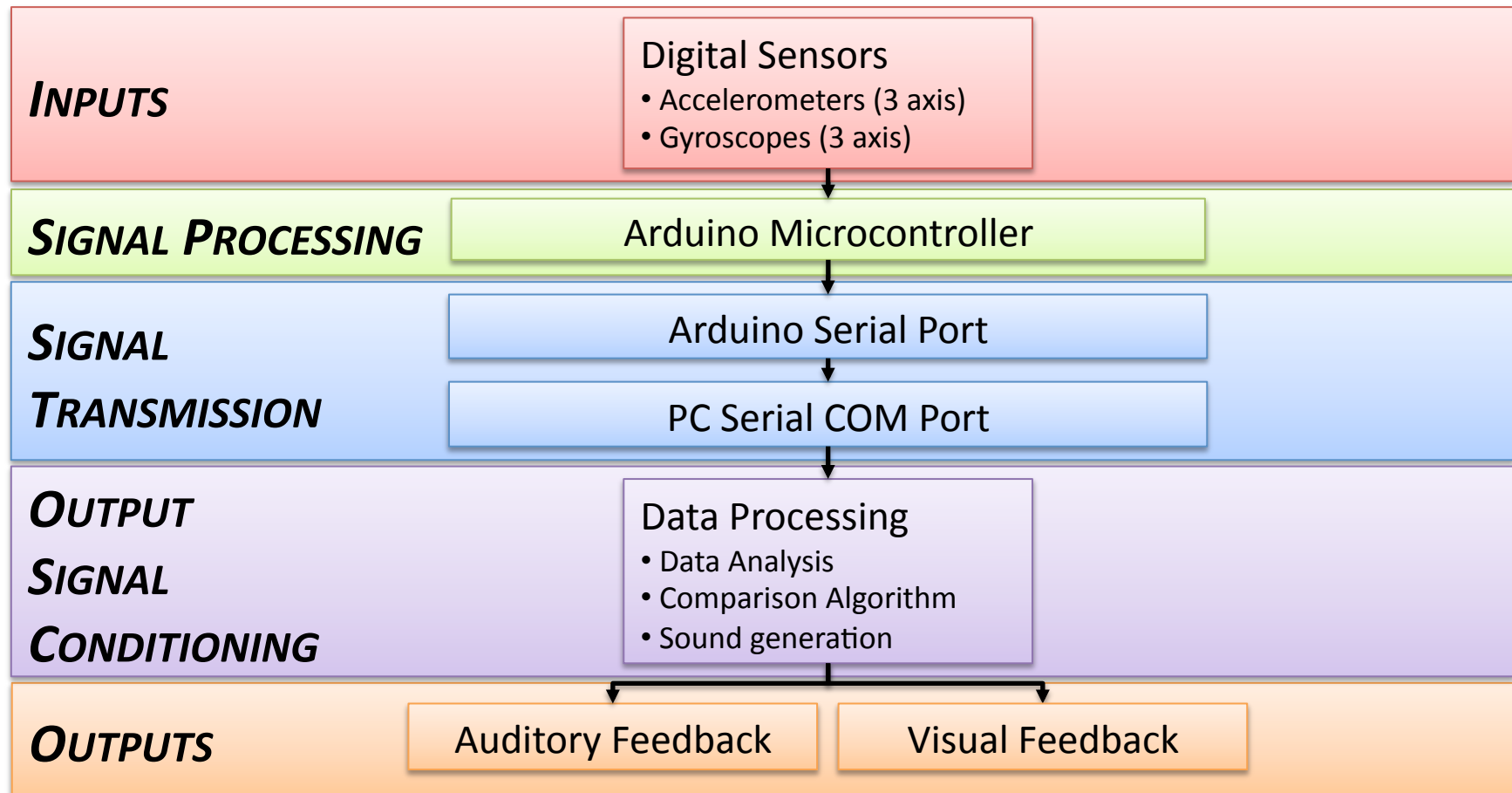
- » ... a sensor/software package.
- » ... for ambulatory rehabilitation.
- » ... continuous real-time feedback system.
- » ... seamlessly integrated.
- » ... designed to enhance rehabilitation.

HEAR YOUR SUCCESS WITH EVERY STEP!

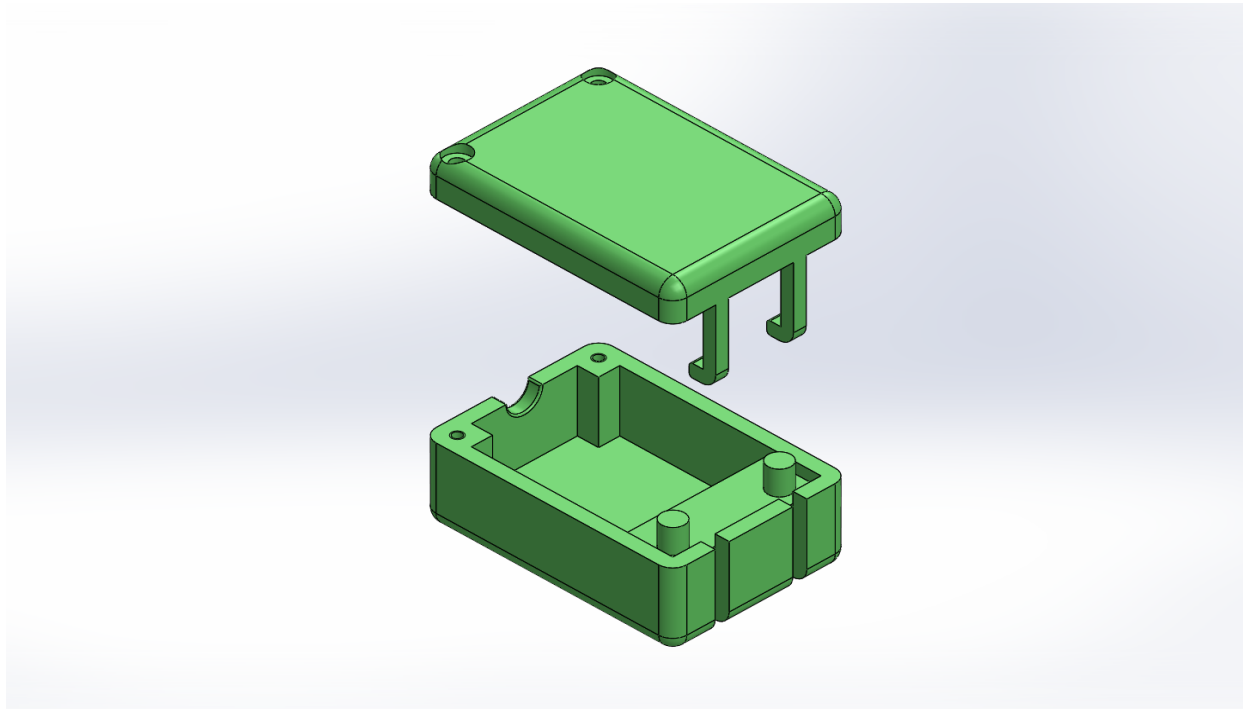
QUESTIONS?



OVERVIEW OF THE MRAS



KIT DESIGN



KIT DESIGN

