# Smart Tennis Racquet Design Review

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ELECTRICAL [+] COMPUTER

ENGINEERING

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# Overview

- Review of Project Description and Goals
- Physical Product Design
- Software Design Architecture
- User Interface Architecture
- Current Status

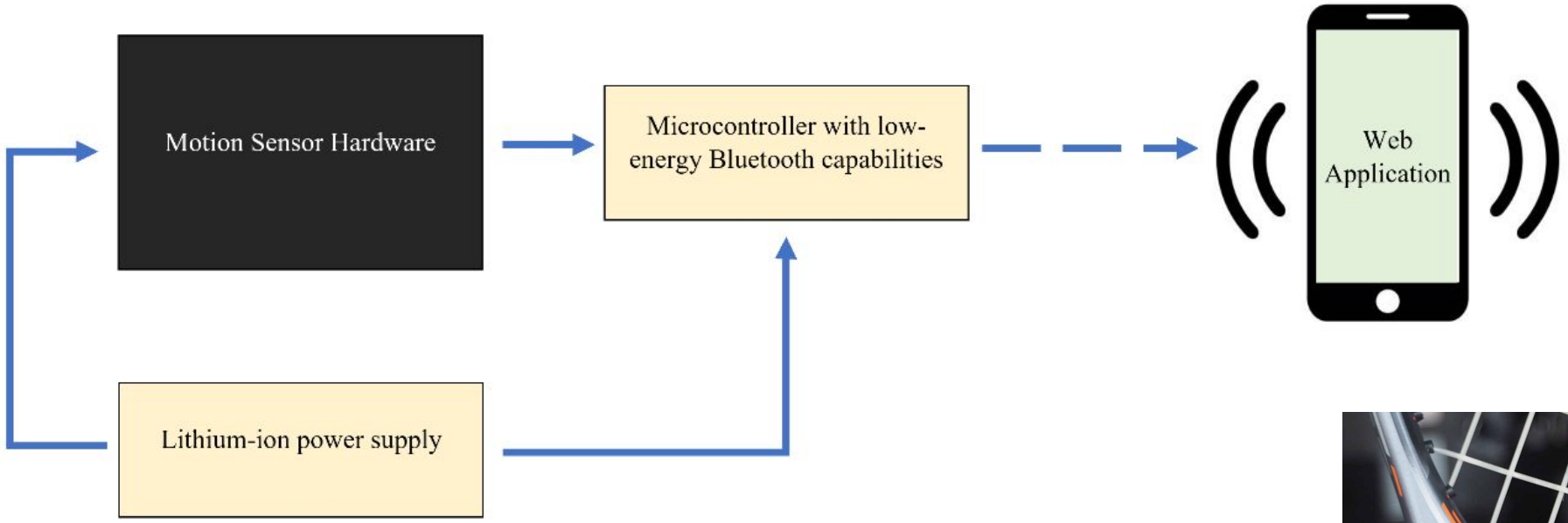
# Project Goals Review

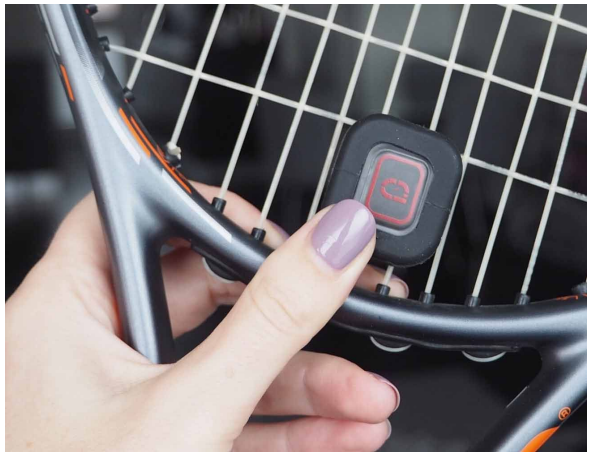
*Our goal is to increase access to high quality tennis analysis.*

- Create a device that attaches to *any* tennis racquet that classifies and logs metrics including:
  - Swing Type
  - Swing speed
  - Ball impact location

- Our device will classify and run analysis on-device and send data to our web app for visualization.

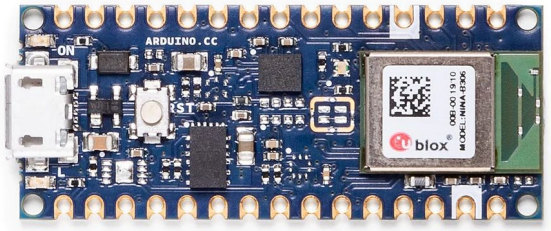
# System Design Review



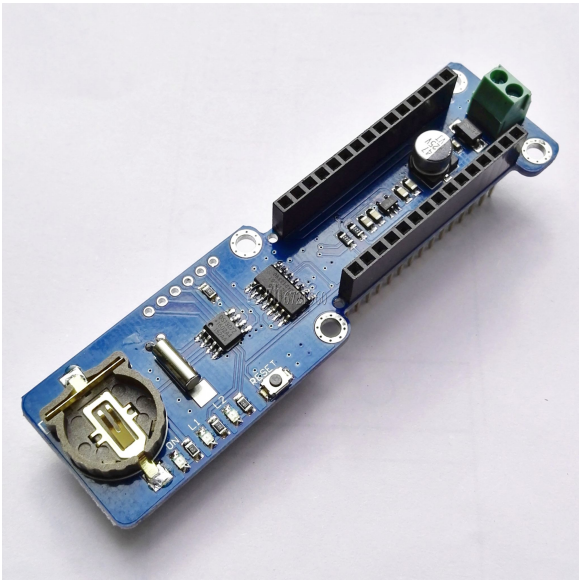
# Physical Product Design

- Hardware Stack
  - Arduino Nano 33 BLE
  - LiCB CR2032 3V Lithium Battery
  - Arduino Nano Data Logger Shield
  - Analog Devices 200g accelerometer
    - 1.6kHz maximum sampling frequency
  - Laptop computer
- Hardware Assembly
  - Protoboard
  - 3D printed case designed to fit in Wilson Adult Tennis Racket



# Physical Product Design

- Hardware Strategy
  - Record data for fixed time interval on Data Shield
  - Use software stack to detect and classify events
  - Bluetooth only used to send results
    - Past reliability issues found with bluetooth communications at distance
    - Computer must send an acknowledgment of receipt
  - Display results on web application

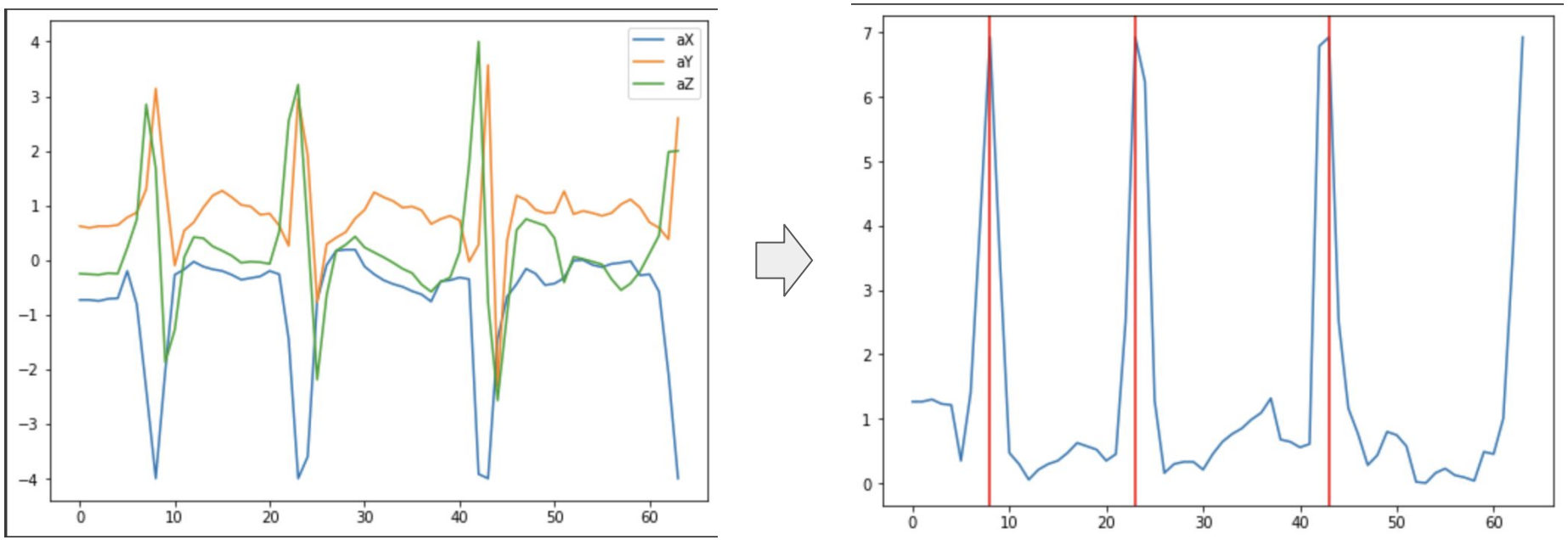


# Software Design: Training Data Collection

1. Data Collection
    a. Various kinds of swings in real game-play
        i. Multiple people with different skill levels
        ii. Perhaps have an additional class for Other/Bad form swings
    b. Ground Truth of swing speeds
        i. Baseball radar gun
    c. Ground Truth of location of ball collision
        i. Divide into 4 quadrants + center (sweet spot)
2. Metrics
    a. 3 acceleration axes and 3 gyroscope axes
    b. 2 scales: 16 G and 200 G

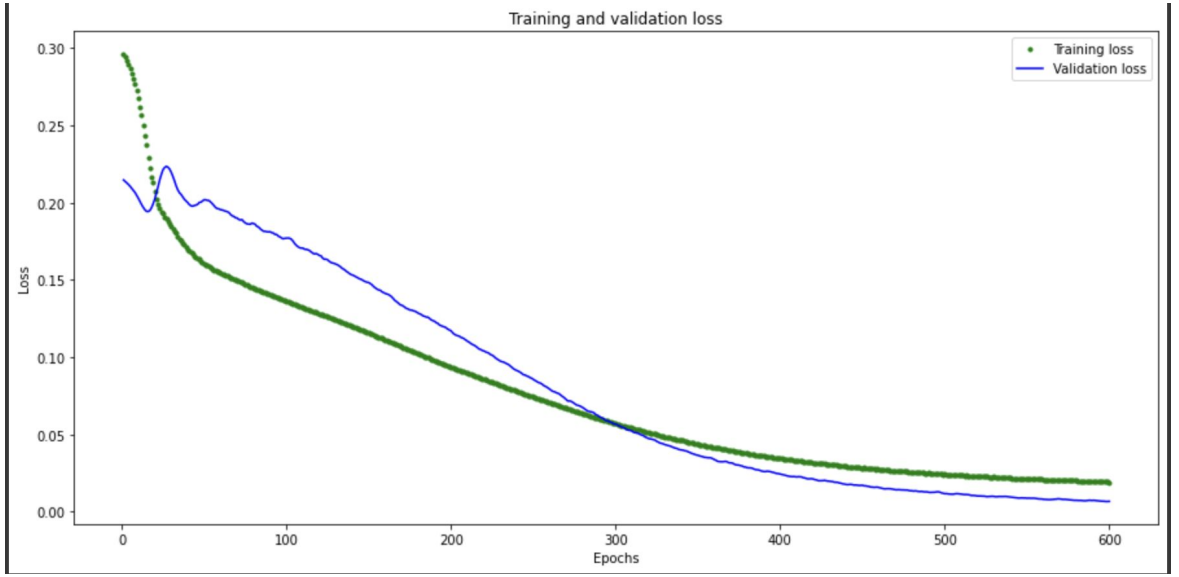
# On-Chip Software Architecture Design

- Event detection
  - Sum of squares taken for X, Y, and Z acceleration values
  - Threshold detection
  - Data taken from a fixed time before threshold event



# On-Chip Software Architecture Design

- Swing Detection
  - 2 Layer Neural Network
    - 1st layer: 20 neurons
    - 2nd layer: 15 neurons
  - Mean and STD of acceleration and gyroscopic sensors (3 axes each)
- Prediction
  - Serve
  - Forehand
  - Backhand
- Ground truth
  - User observation (swing type)
  - Radar gun (serve speed)



# User Interface

- Initial user interface site is located at https://anubop.github.io/tennis-sensor/
- Anubhav and Lycia have begun development on their user branches

# Project Information Website

- Initial information and presentation site is located at http://eceseniordesign2022spring.ece.gatech.edu/sd22p36/
- Will update with presentations, technical reviews, etc.

# Current Status

- Data Logger still hasn’t arrived
  - Start anyways on new accelerometer integration
  - Record with a long USB cable
    - Help verify software infrastructure with higher sampling rate
    - Record new data once data logger comes
- Project information and user interface sites have been created
- Software goals achieved thus far via 2 layer neural network
- Plan to collect shot speed data using radar gun and train new model

# Questions?