JointSync: Biomechanics Wearable Devices

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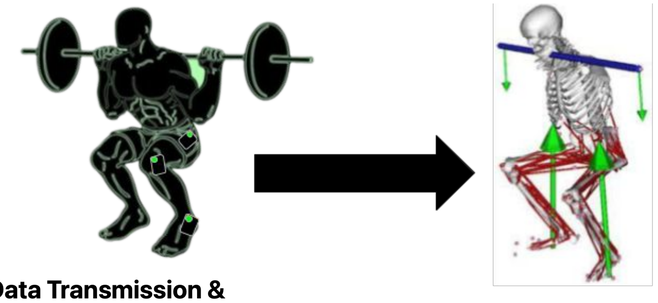
Objective

- To create an IMU based wearable to assess quality of biomechanics
  - Focus on lower body, i.e. squat, lunge, gait, hinge
- To aid individuals in understanding and optimizing their movement patterns during day to day life
  - Optimal joint health
  - Pain-free movement.

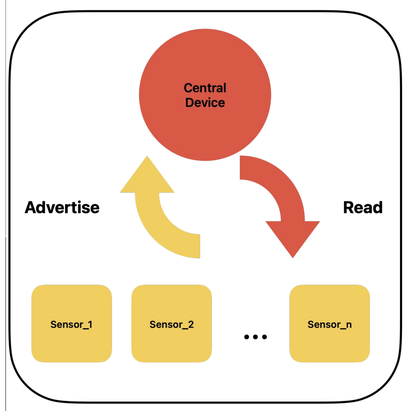
Methods and Materials

- Software and Software Tools: C++, Bosch Sensor Fusion algorithm, Fusion 360
- 3D Printing: Secure enclosure to house sensor+battery and attach to subject.
- OpenSim: Used to load anatomical model and simulate movement

Design & Implementation



Data Transmission & Acquisition via BLE



Middleware Layer

Push data to OpenSim, visualization updates (via CLI - shellscript)

Transform data to OpenSim compatible format .sto file

Associate IMU data from each mapped sensor to corresponding body joint for correct visualization

OpenSim Integration

Runs simulation to visualize measured movement pattern!

Accomplishments

- Reliable and consistent connection with multiple IMUs
- Single joint simulation
- Learned how to utilize BLE and new open source software
- An enjoyable project that we would like to continue further!

Future Work

- Establishing reliable central connection for all 11 peripherals
- Streamlining pipeline for automated visualization in OpenSim (middleware layer above; currently manual done)
- Qualifying the quality of movement patterns → make use of the data
- TinyML for activity recognition and tracking
- Decrease footprint with custom PCB & LiPo battery
- Refine enclosure design