Orientation video

The Raiders - Senior Design 1

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Problem:

- Concussions frequently occur on the field in football
- 80% of concussions go unreported (Vox.com)
- **High School Football Athletes:**
  - Average concussive head impact = 95 g
  - Lowest acceleration resulting in concussive impact = 74 g (Broglio et al, 2012)
- **Youth athletes (aged 9-14):**
  - Average concussive head impact = 62.4 g
  - Lowest acceleration resulting in concussive impact = 25.9 g (Campolettano et al, 2019)

Solution:

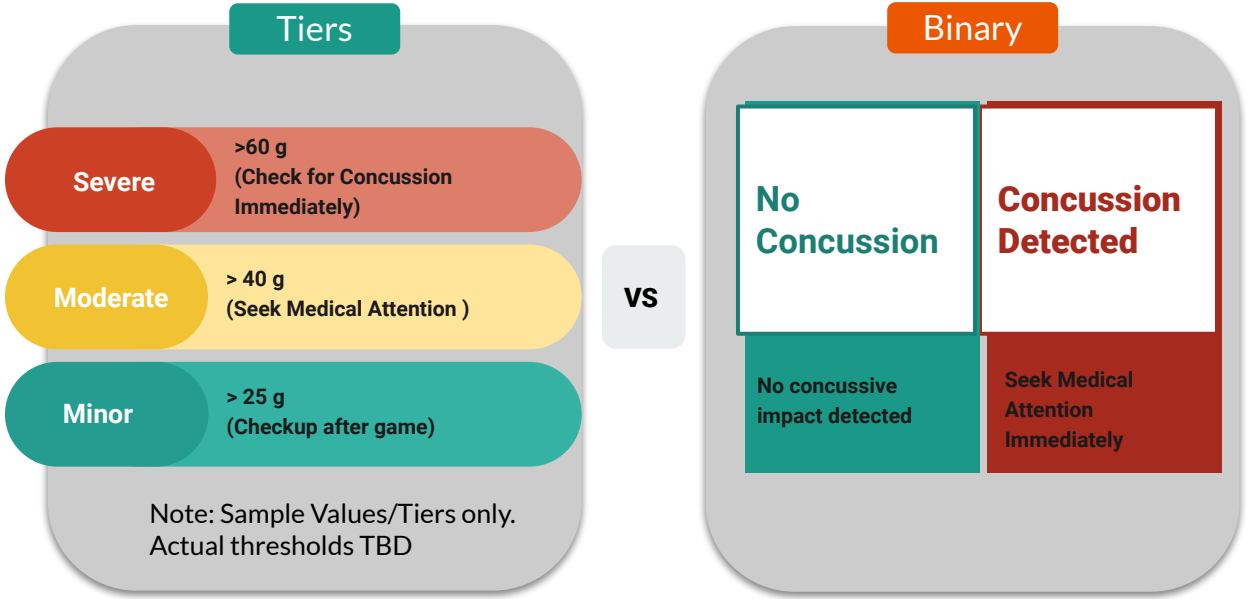
- Collision Detection Helmet:
  - Provides acceleration experienced by player to appropriate staff
  - Potentially detect concussive impacts that would go undetected
- Implementation:
  - Device attached to the helmet with accelerometer that would transmit data to end devices
  - Accelerometer detects acceleration and microcontroller calculates the resultant acceleration and transmits the information

Problem

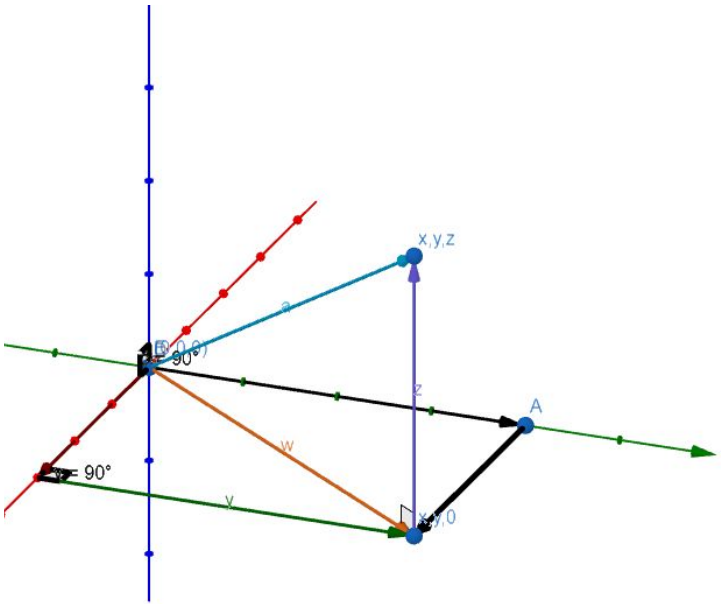
How can we differentiate severity of concussive impact?

Solution: Creating ‘tiers’ and tier thresholds

- By separating the magnitude into different tiers, we can more effectively gauge the severity of impact instead of having a binary of ‘concussion or no concussion’



Calculating magnitude of acceleration



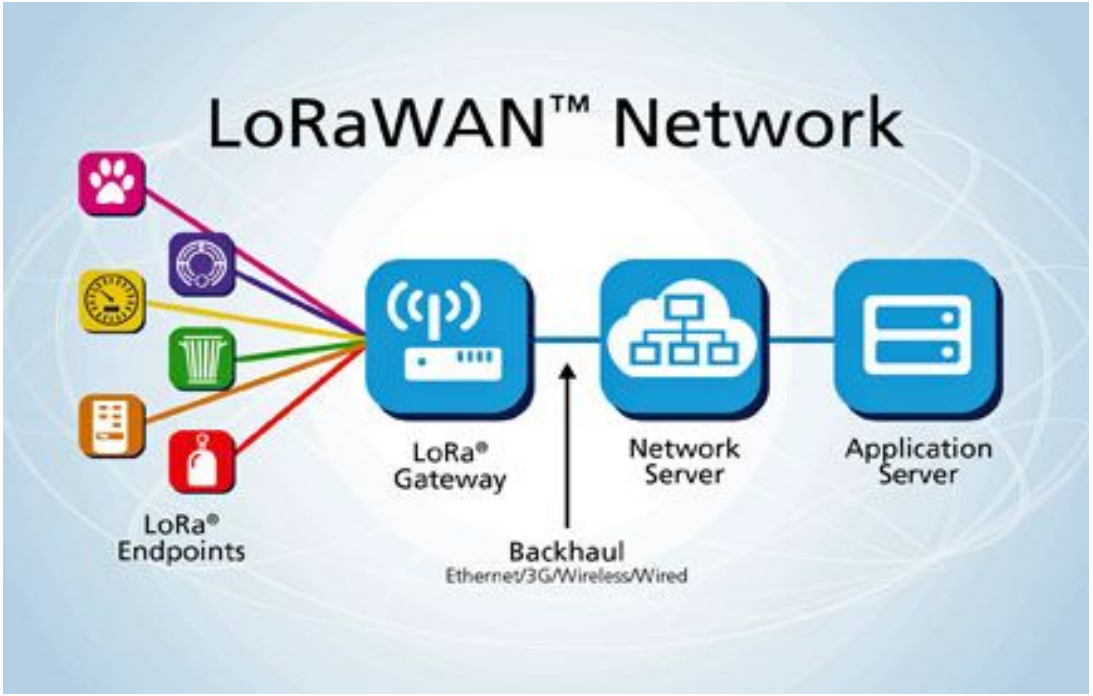
From the accelerometer, we obtain x, y, z in terms of m/s^2

To obtain the magnitude of a, the pythagorean theorem is used to obtain g-force as a directionless measurement as proven below:

$$x^2+y^2=w^2$$
$$w^2+z^2=a^2$$
$$|a|=\sqrt{(x^2+y^2+z^2)}$$
$|a|/9.81\ (m/s^2)$ = magnitude of acceleration in g's

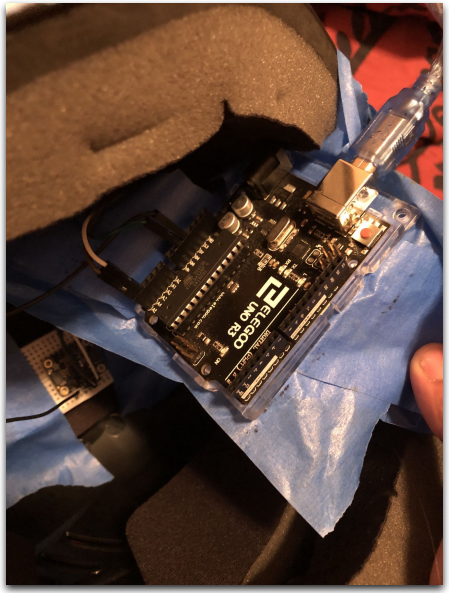
Data Transmission

- Impact data will be transferred through the LoRaWAN Network
- Transmission will be controlled using ChirpStack



Progress

- Device that consists of Microcontroller and accelerometer that tracks acceleration for x, y and z axis



Not all impacts are the same:

Collision on the top of the helmet

- High Peaks
- Short Wavelengths

Collision to the Side of the Helmet

- Lower Peaks
- Longer Wavelengths

Improvements:

- Smaller circuitry/components
- Independent power source
- Potentially add sensors (EEGs) to more accurately detect concussive impacts