INDY-5 Helmet

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Concussions

A concussion can be defined as a temporary unconsciousness or confusion caused by blow to the head

According to the University of Michigan a concussion occurs at roughly 90-100 grams of force

219 concussions in the NFL in 2023 alone

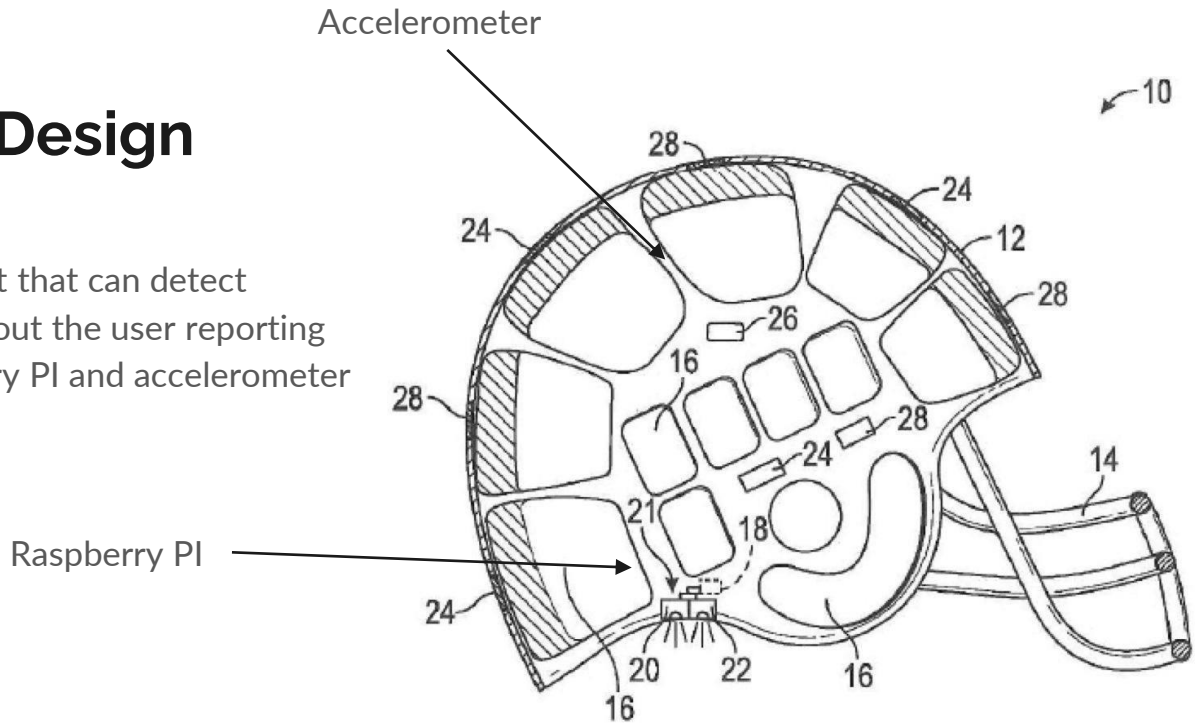
If concussions are not treated, patients are at a greater risk of reinjury which can increase symptoms

Concussions can have long term effects such as CTE (Chronic traumatic encephalopathy)

Technology Used

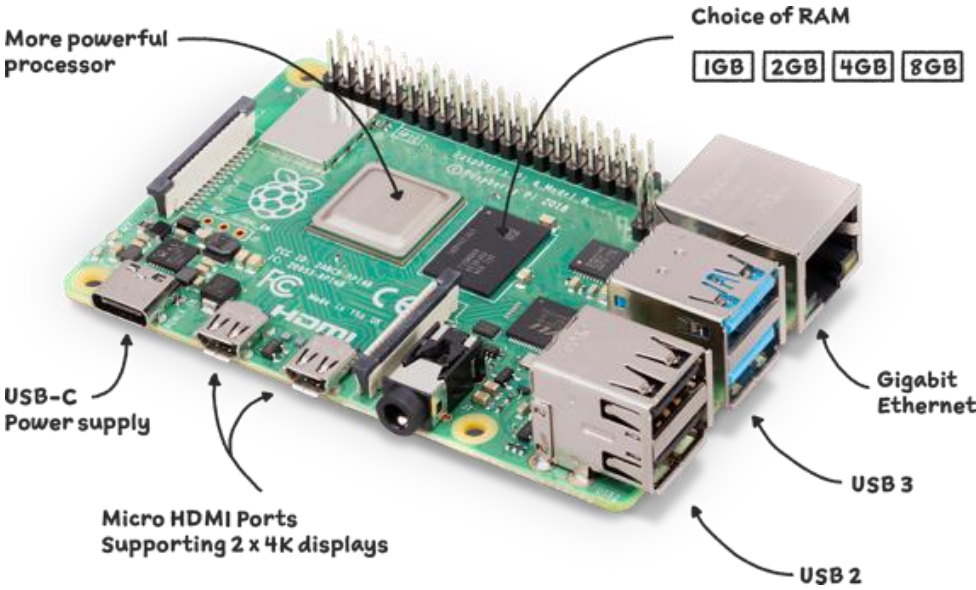
Our Helmet Design

- Creating a Helmet that can detect concussions without the user reporting
- Placing a raspberry PI and accelerometer inside



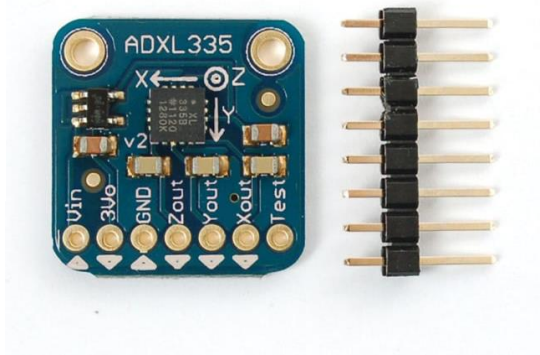
Raspberry Pi 4b

- Raspberry Pi's are micro computers
- Aluminum case also ensures the protection of the device



```
i2c = busio.I2C(board.SCL, board.SDA)
accelerometer = adafruit_adxl34x.ADXL345(i2c)


# Adjust tap detection threshold to 100 m/s^2
accelerometer.enable_tap_detection(threshold=500,duration=300)
accelerometer.range = adafruit_adxl34x.Range.RANGE_8_G
```



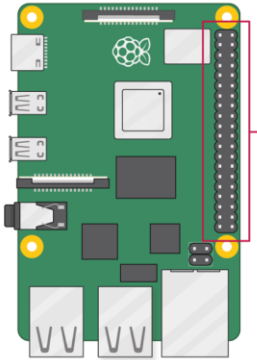
Adafruit Accelerometer

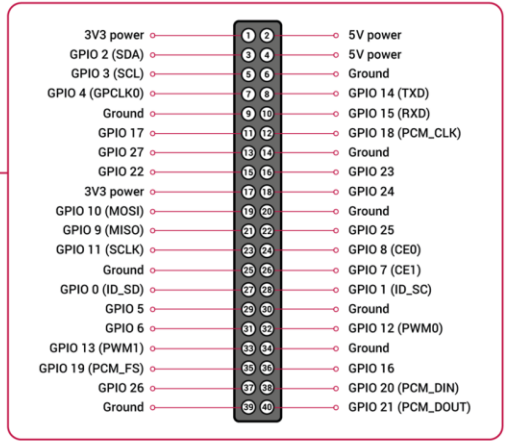
$$m = \frac{W}{g}$$

F=ma

- An accelerometer is a device that measures the vibration, or acceleration of motion, of a structure. The force caused by vibration or a change in motion (acceleration) causes the mass to “squeeze” the piezoelectric material which produces an electrical charge that is proportional to the force exerted upon it.

- This allows us to track force exerted on a players head





Adafruit Library

The tap detection parameters.

:param int tap_count: 1 to detect only single taps, and 2 to detect only double taps.

:param int threshold: A threshold for the tap detection. The scale factor is 62.5 mg/LSB\

The higher the value the less sensitive the detection.

:param int duration: This caps the duration of the impulse above ``threshold``.\

Anything above ``duration`` won't register as a tap. The scale factor is 625 µs/LSB

:param int latency: (double tap only) The length of time after the initial impulse\

falls below ``threshold`` to start the window looking for a second impulse.\

The scale factor is 1.25 ms/LSB.

:param int window: (double tap only) The length of the window in which to look for a\

second tap. The scale factor is 1.25 ms/LSB

What happens during hit

```
while True:
    x, y, z = accelerometer.acceleration
    print("Acceleration: %.2f m/s^2, %.2f m/s^2, %.2f m/s^2" % (x, y, z))

    tap_detected = accelerometer.events.get("tap", False)
    print("Tap event:", tap_detected)
    if tap_detected:
        print("Tap detected")
        # Sending the mail
        s.sendmail("indyfive2024@gmail.com", "poconnell20055@gmail.com", messa

    # Sleep for a while to prevent high CPU usage
    time.sleep(1)
```

Twilio

- Provides a messaging software tool
- Able to connect to API in order to send a message to alert the coach of a hit
- By using Twilio makes it simple for the user, no need for an app or other interface to connect to device

send_sms.py — Open with IDLE

```
from twilio.rest import Client
#Be sure to update the account_sid, auth_token, and from_ phone number with
values from your Twilio account. The to phone number will be your own mobile
phone.
# Your Account SID and Auth Token from console.twilio.com
account_sid = "ACXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"
auth_token  = "your_auth_token"

client = Client(account_sid, auth_token)

message = client.messages.create(
    to="+15558675309",
    from_="+15017250604",
    body="Hello from Python!")

print(message.sid)
```

SMTP

```
# Create SMTP session
s = smtplib.SMTP('smtp.gmail.com', 587)
# Start TLS for security
s.starttls()
# Authentication
s.login("indyfive2024@gmail.com", '                    ')
```

- Simple Mail Transfer Protocol
- Sets up connection to a google email account
- Allows for email to be sent containing a message

```
if tap_detected:
    print("Tap detected")
    # Sending the mail
    s.sendmail("indyfive2024@gmail.com", "poconnell20055@gmail.com", message)
```

Ideas for the future:

- Some sort of database that tracks the force and calculates somehow to accumulate the force that could add up to a concussion (not realistic need billions of dollars and larger team)
- Implement some sort of feedback system that allows real users to send feedback to us about how to make it better (from coaches/players)
- Somehow make it smaller so we don’t need to remove padding
- Implement texting feature for a quicker response for coaches

Demonstration