

P18071: Dazed and Confused

A Wireless Concussion Detection Helmet System

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Introduction

In nearly all contact sports, the player runs the risk of obtaining a concussion. Widely popular sports such as football have been under intense scrutiny for years in regards to retired players mental health due to all of the blows to the head they had endured. While modern day precautions aid in mitigating the risk of a concussion and assessing whether to treat the player, there is no real-time safety precaution to assist the players. The wireless concussion detection helmet is meant to solve just that issue.

Mechanical & Electrical Overview



Fig 1: Inside View of Helmet



Fig 2: Controller Board

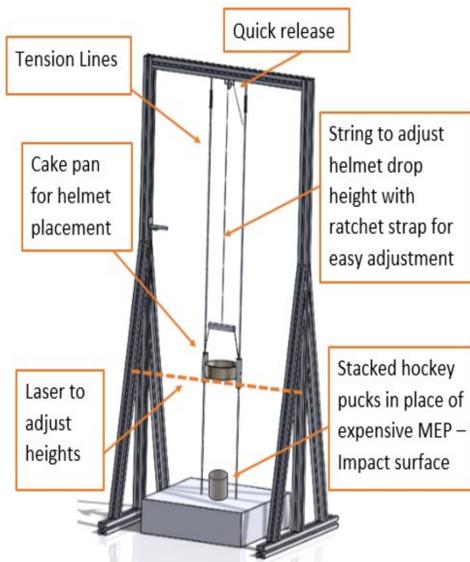


Fig 3: Drop Test Rig

An accelerometer was placed at the crown with a combination of epoxy and four small screws. The controller board has a protective casing to prevent harm. There are three batteries that are secured using epoxy along with the corresponding charging circuitry.

Features

- Real-time Monitoring and Alerts
- Ability to Track a Whole Team at Once
- 400 ft Range
- Impact Data History
- User Friendly Web App
- Prototype Design, Lower cost Than Market Average
- Rechargeable, with 300 Hours of Operation on One Charge

Software Overview

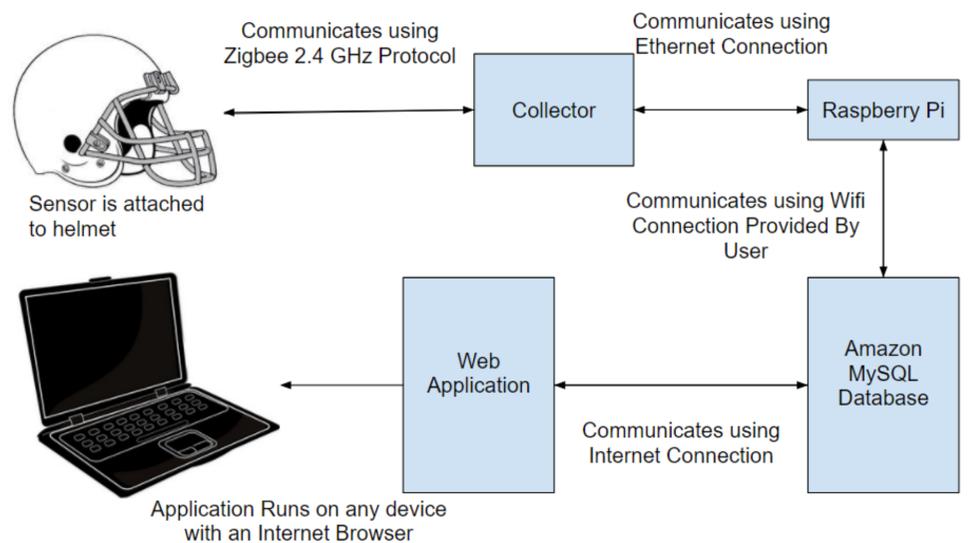


Fig 4: Data Flow—Helmet to Sidelines

All applications are designed to require minimal user input as possible to make the user experience seamless. Once initial set up is complete, the system simply needs to be powered on to operate. This allows the parents/coaches to have real time monitoring for what the players helmet feels.

Conclusions



Fig 5: Impact Testing Data

If a player receives a concussive impact, the web application will be updated with the information within a second. Additionally, the impact information for each player will be able to be stored indefinitely so that they are able to look back and know when a player received a concussive impact.

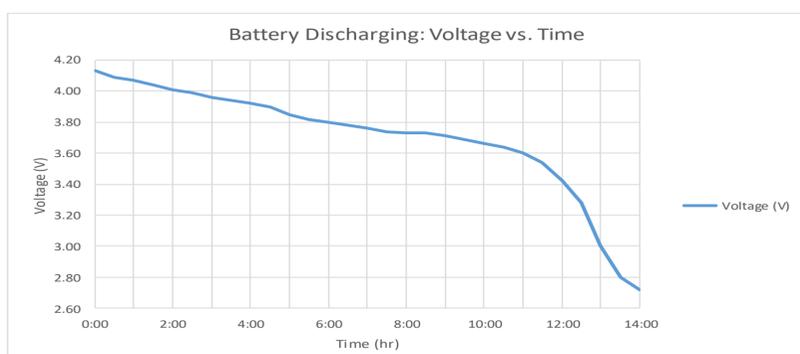


Fig 7: Battery Discharge Over Time

The accelerometer was tested at different locations and mounting methods. The most accurate results came from a screw mounted accelerometer located on the crown of the head. The higher end of the data, near the accelerometer's maximum limit results became scattered. The linear relationship could be extrapolated from the drop testing system with a 95% linear trendline when the data at or above physical sensor limit was removed.

Team Details

Players on Team

UserName	Sensor ID	G Felt	Battery mV	Time	Link
Jimmy	428	19.42	2452	4/18/2018 8:09:22 PM	Details
Josh	3088	10.01972	2709	4/18/2018 8:12:04 PM	Details
Robbie	6543	44.43	3211	4/18/2018 8:12:04 PM	Details

Fig 6: User View—Team

The battery life was estimated using a 100mA load to drain the batteries from their max voltage of 4.2V, until they reached their full depletion limit of 2.75V. The known expected current usage of the device is approximately 8mA, therefore the expected operating duration of the device could be estimated. Assuming the device was constantly transmitting gave the minimum run-time of the device, which was found to be 180 hours. In a practical application setting, the device will be transmitting in short intervals, so its expected to have an operating duration of up to 300 hours.

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