BIO-Helmet

EEL 4914 Senior Design I

Group # 3

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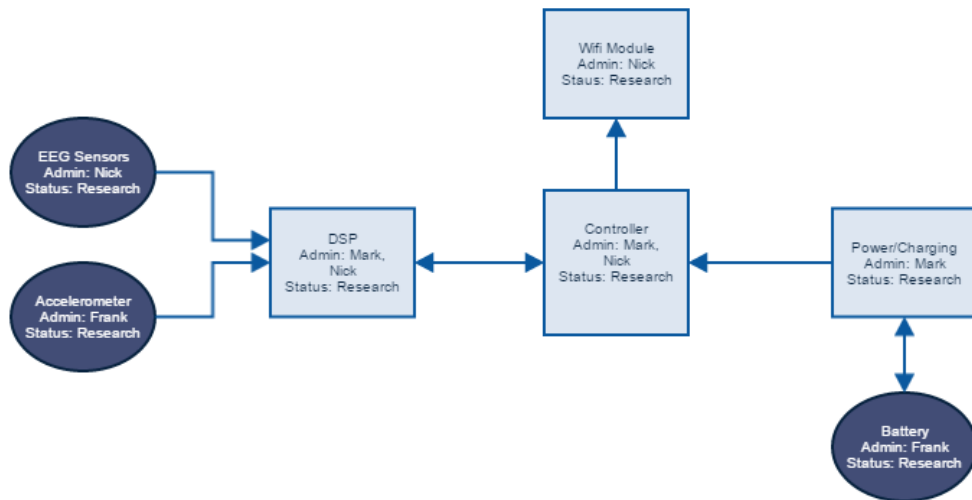**Project Description and Motivation**

The goal of this project is to create and integrate a system that would be able to detect with a high level of accuracy the event of a traumatic brain injury, more commonly known as a concussion. The system will be integrated into helmets used by athletes in contact sports. In this application, a football helmet will house this system. The system will be able to monitor brain wave activities of athletes wearing the helmet in real time. This, in turn, will hopefully reveal to us after further research how concussions can be seen through brain waves. There will also be sensors in the helmet that will detect the level of G-forces experienced by the players. The collection and processing of the data can help detect the event of a concussion with more accuracy. Our motivation is that we will provide a solution to a major problem plaguing today's NFL and college football players. This system would reduce the risk that athletes experience during heavy impact plays, by informing the medical staff if they can continue to play. Athletes that continue to play when they may have a concussion is part of the reason why the NFL is battling legal issues with the NFL Players Association. This system will monitor balance, force of impact, and brain wave activities all in real time via a Wi-Fi connection to a cloud server which will then display this information on any device on the sidelines. We will also be adding in a microphone and headphone in order to obtain verbal testing of the player's status. With all these sensors in place, it will give us accurate information in real time if a player has a concussion and should be removed from the game. The system should be lightweight in order to be used by the players without affecting their performance in a real game. Along with the hardware aspect, we will also be working on a desktop and mobile friendly website that will display all relevant statistics from the helmet in a user friendly and easy to read format. The system will also allow for the medical staff to build player profiles and historical data for each player. This system will consist of Amazon Web Services Elastic Computing 2 cloud server which will receive and process all sensor data from the helmet. This cloud server will also directly host the website. This will decrease latency times between sending data from the helmet to displaying on the website.
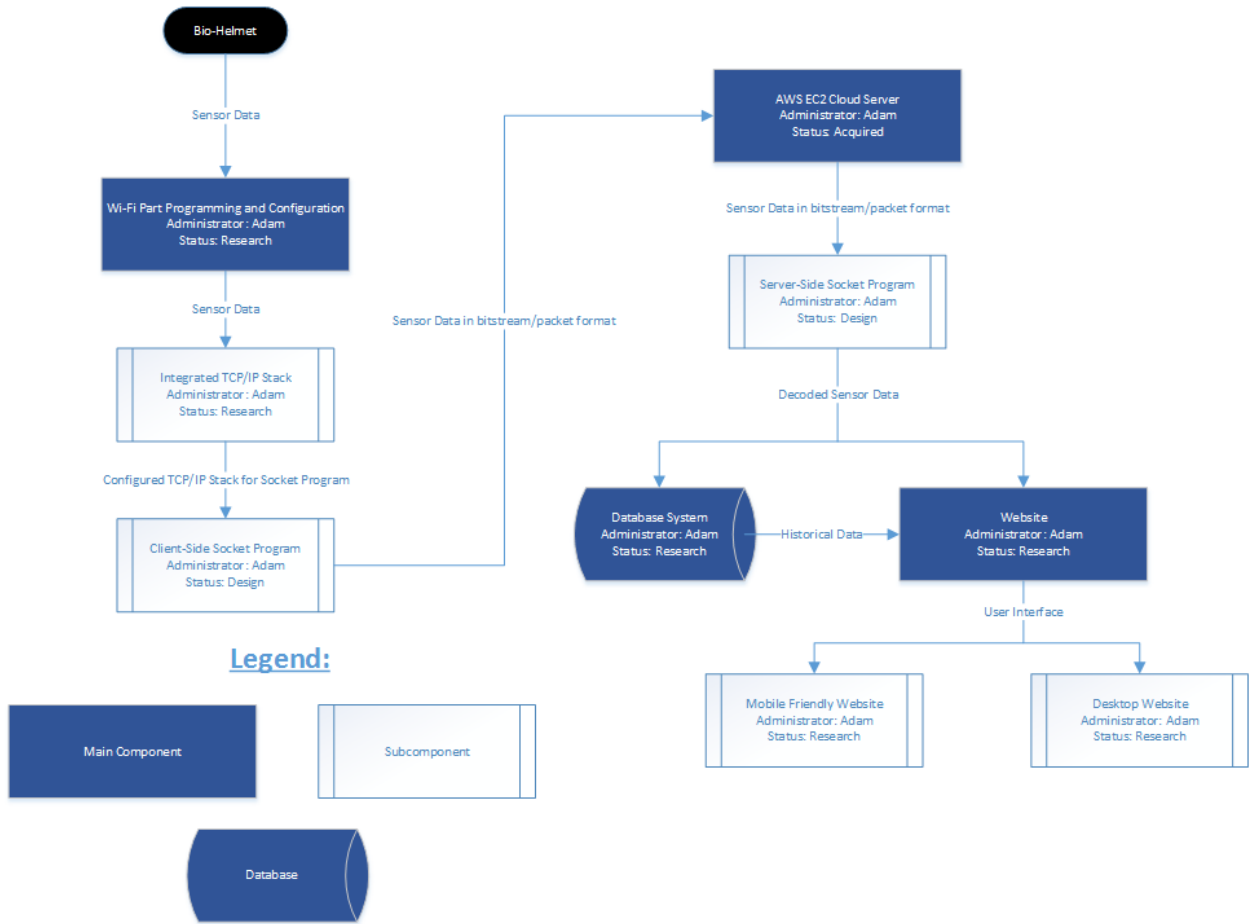
Specifications and Requirements

- EGG mesh (4-6 Sensors) (Between 45 to 130 depending on type)
- Processor ($ 10 to 50 considering low power, real time processing)
- Power system (5-12 V) ($ 10 to 20)
- Accelerometers (6 axis) ($ 15 to 30 each)
- Signal Processing Chip (Sampling rate of at least 1ms)
- Must be able to fit comfortably in standard helmet (NFL regulations: 12 ½" L - 9" W - 9 ½" H) ($ 200 to 300)
- 2.4/5 GHz dual band Wi-Fi part ($ 40 to 50)
- Integrated development environment for the chosen processor
- Amazon Linux AMI running on AWS EC2 t2.micro instance (1 Intel Xeon 2.5 GHz CPU, 1 GB RAM, SSD based EBS Storage)

- mySQL based database on above EC2 instance
- Various open source programming environments and languages for server side processing (C, Python, PHP, etc.)
- Existing 2.4GHz or 5 GHz Wi-Fi network at implementation location
- Drupal website content management platform
- Mobile or desktop device running a modern operating system
- Any modern desktop or mobile web browser which supports CSS, JavaScript, jQuery, and HTML5

Hardware Block Diagram

Software Block Diagram

Bio-Helmet

Sensor Data ↓

Wi-Fi Part Programming and Configuration
Administrator : Adam
Status: Research

Sensor Data ↓

Integrated TCP/IP Stack
Administrator : Adam
Status: Research

Configured TCP/IP Stack for Socket Program ↓

Client-Side Socket Program
Administrator : Adam
Status: Design

Sensor Data in bitstream/packet format →

AWS EC2 Cloud Server
Administrator: Adam
Status: Acquired

Sensor Data in bitstream/packet format ↓

Server-Side Socket Program
Administrator: Adam
Status: Design

Decoded Sensor Data ↓

Database System
Administrator: Adam
Status: Research

— Historical Data →

Website
Administrator: Adam
Status: Research

User Interface ↓

Mobile Friendly Website
Administrator: Adam
Status: Research

Desktop Website
Administrator: Adam
Status: Research

Legend:

Main Component

Subcomponent

Database

Project Budget and Financing

Currently, we plan on keeping this project below an estimated $1500 . The detail budget items are included below:

Part	Cost
EGG mesh (6 Sensors)	$780 (at $130 each)
Processor	$50
Power System	$20
Accelerometers (4 Sensors)	$120 (at $30 each)
Printed Circuit Board	$65
2.4/5GHz dual band Wi-Fi	$50
NFL Regulation Size Helmet	$300
Domain Name and Web Hosting	$15
Total	**$1400**

Project Milestones for both Semesters

Within Senior Design I, the design aspect of the prototype will be finished. We also hope to secure some other method of funding in order to help with us financially. We should have our controller chosen and tested for efficiency and all aspects of the hardware finalized so that it can be guaranteed that the hardware will be available and ready to be ordered for senior design II. By Senior design II we will hit the ground running in order to get every little kink worked out and everything running as it should.