

ECE 445

Senior Design Laboratory

Project Proposal

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**Footballytics**

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## **Introduction**

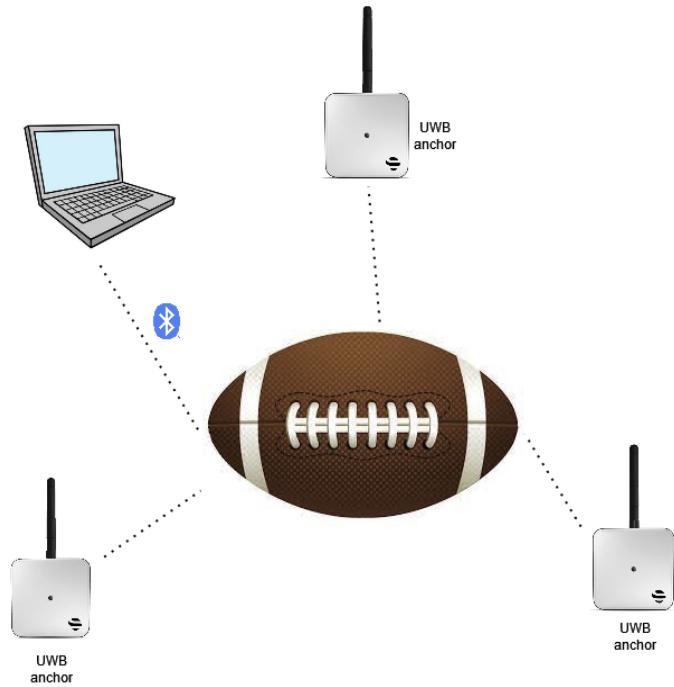
### **Problem:**

American football is a sport comprising two teams of eleven played on a field of 120 yds by 53 and  $\frac{1}{3}$  yards. One team attempts to either score touchdowns or field goals by either passing or running the football, an oval ball. The offense, or the team attempting to score the ball, has four downs to move ten yards from where they started. If they accomplish this goal, they get a new set of downs based on where they were stopped. This is decided by the referees, specifically the line judge, and is done through sight. This has some obvious issues, such as the accuracy of the referee in question. In this day and age, when other sports are able to do away with much of the inaccuracy in deciding scoring, we believe that there should be a solution to the most important part of football and the subjectivity surrounding it.

### **Solution:**

Smart Football: Sensors in the football will be able to provide real-time data and will have the ability to publish the data to remote servers. The data will include 4 key data measurements including geolocation, pressure, acceleration and gyroscope sensors which will allow us to track free-fall and impact during game play, as well as its precise location. We also want to measure the speed of throws, grip strength of the person throwing and catching. The final part is using some sort of indicator to make sure without a doubt that the requirements have been met for either a new set of downs, or touchdown.

**Visual Aid:**



**High Level Requirement List**

**Criterion For Success**

Checkpoint 1: We want the tracking system enabled to check positioning on the football field

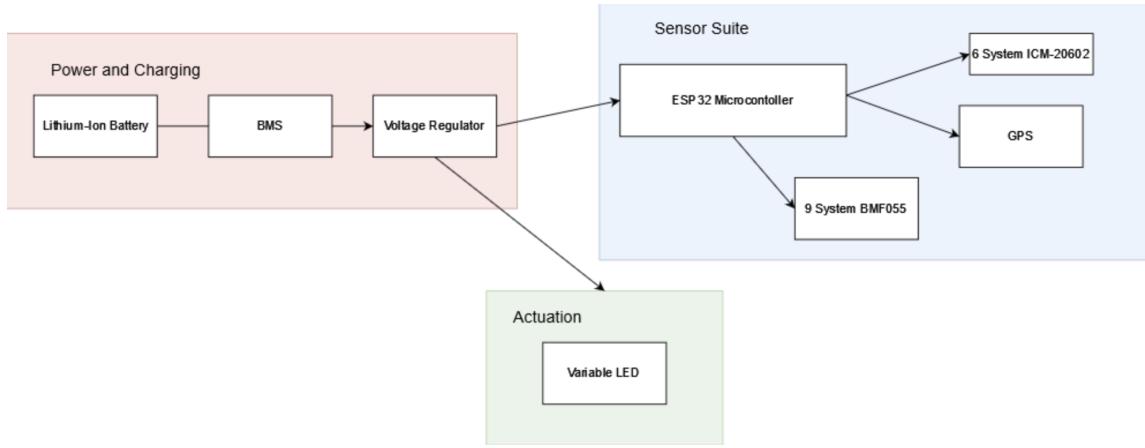
Checkpoint 2: include the accelerometer and gyroscope tracker

Checkpoint 3: air-pressure sensor to track pressure of the space within the ball

Checkpoint 4: Ensure general weight and size parameters conform with NFL standards

## Design

### Block Diagram:



### Subsystem Overview:

#### Subsystem 1

##### *Sensor suite:*

This subsystem consists of a 9 axis motion sensor(accelerometer, gyroscope, magnetometer), GPS, and pressure so that we can track metrics of different plays and throws while simultaneously always knowing where the ball is. The requirements for this subsystem is accurate measurement and storage of the different data taken by our sensors. We want to quickly upload our data to a remote server.

##### Components:

ESP32 Microcontroller

6 system ICM-20602

9 system BMF055

GPS system using ESP32 UltraWideband technology with 3 anchor points to track location down to the centimeter. (DW1000)

## **Subsystem 2**

### *Power and Charging*

Lithium ion battery that we can charge using a power strip

Components: PRT-13851 Lithium Ion Battery and Charger

The requirements for this subsystem is to supply 500 mA at 5 volts.

## **Subsystem 3**

### *Actuation*

Variable leds that light up depending on downs, out of bounds or touchdowns

Components: LEDS Grove - Variable Color LED

Green for touchdown

Blue is for passing the down marker.

Red is for out of bounds

This subsystem must light up accurately when the football passes certain thresholds, such as ten yard downs, out of bounds, and touchdowns

### **Tolerance Analysis:**

Some tolerances we need to take into account is the weight of our football. We need to make sure it is within the NFL required weight regulation for a competitive football. We also want to ensure that the system that holds our sensor equipment is perfectly centered within the ball to ensure proper weight distribution. In addition, charging our device inside the football and keeping it safe from damage in regular play will also be two concerns to keep in mind in our design.

## **Ethics & Safety:**

The successful analysis of data in sports can help us prevent injury to players and allow us to improve the fitness of our teams. This in turn also allows us to build relationships with fans by letting them see the process.

While our product does not pose many issues in terms of physical safety, there are considerations we must take into account regarding the ethics surrounding this product. Data privacy is of utmost importance to our company. We believe that the data taken by this product should not benefit one team over another in a competitive setting. Furthermore, we must make sure that the data collected is not used in a way that harms other players. We must protect the user's privacy. This aligns with the IEEE and ACM Code of Ethics, which call for promoting and upholding the dignity, privacy, and rights of all people, as well as avoiding harmful consequences.

## References

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