Free Throw Form Analytics

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Introduction - Adam/Edison

~15% of points scored in NBA Games are Free Throws

Average Free Throw Percentages

- NBA - 75%
- NCAA - 69%
- Highschool - 55%

Studies show that the best free throw shooters, are those with the most consistent form.

Without a coach present, there is no way for these players to practice their free throws with consistent, good form.

Introduction

How can we give feedback to users in order to train more intelligently?

The system must be

- Portable
- Easy to use
- Low-cost
- Non-intrusive

One solution is cameras but...

Introduction

- Cameras are
  - Expensive
  - Not easily portable
- Noah Select is a basketball system that utilizes cameras to measure shot angle and shot depth
  - Costs several thousand dollars with a $100 monthly fee
  - Only measures ball movement, not shooting form
- We want a product that is affordable to players and easy to use anywhere

Noah Select from Noah Basketball

Introduction

Proposed Solution -

- Create a wearable device that will track the motion of a shooter’s free throw shots and provide feedback on their form
- This will allow the players to receive feedback on their form without the need for a coach to be there
- Target Audience - High school Basketball Players
- Cost - affordable for the serious high school basketball player

Design Considerations

Technology needs to monitor free throw form during individual practice for reinforcement of positive motions

Current technologies for motion tracking commonly use external systems such as cameras and ultrasonic sensors to track motion

Applications of these technologies in sports are limited to professionals and organizations

Need a low-cost, mobile solution for individualized form analysis: Inertial Measurement Unit sensors on a wireless wearable sleeve

Qualitative Goals - Edison

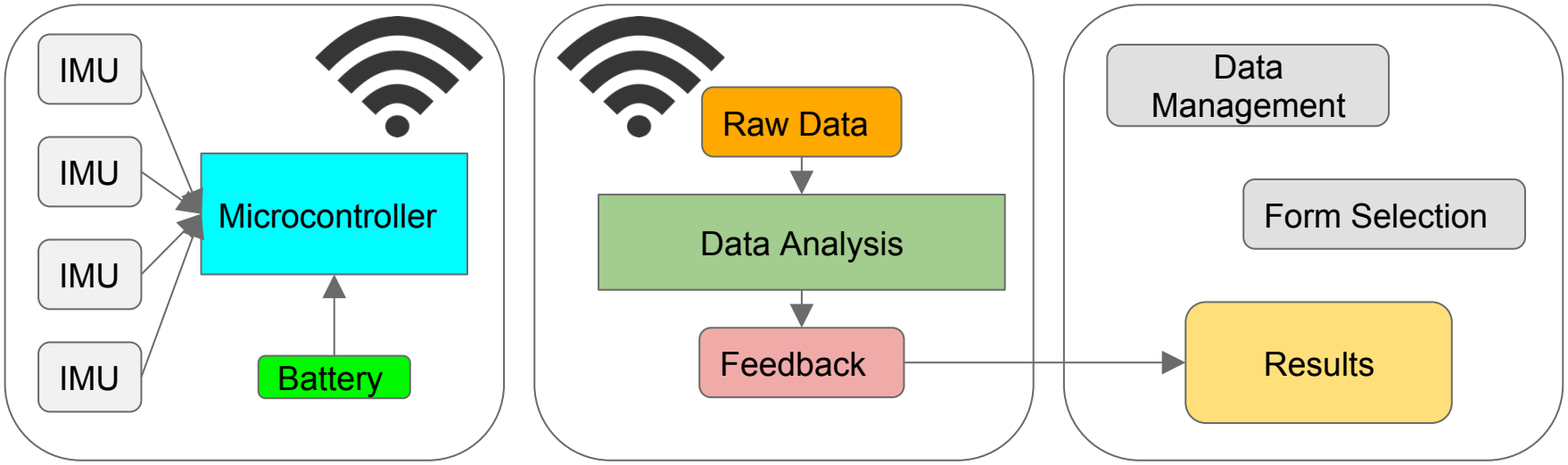
The system shall:

- be wearable and wireless,
- not restrict arm movement,
- fit a young adult male,
- be controlled by a button,
- display an RGB LED for status,
- be powered by a rechargeable battery,

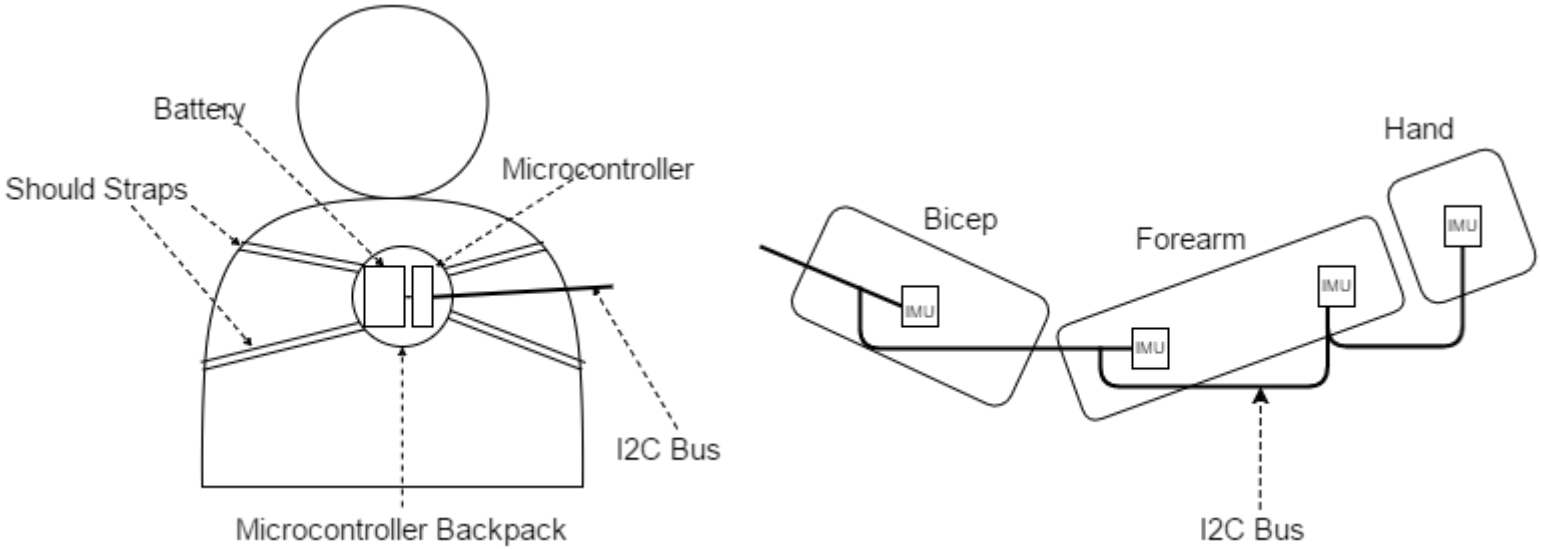
The system will:

- allow visual comparison of data,
- operate in real time,
- be accessible from any browser.

Design Approach - Overview



Design Approach - Hardware



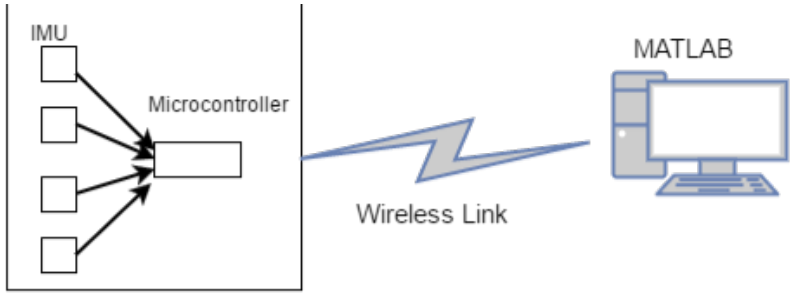
Lightweight battery and microcontroller - wireless enabled

IMUs spaced to focus on joints/arm segmentation

Will develop a testing rig for calibration of hardware using predictable data

Design Approach - Hardware Integration

Device Language	Lua
Comm Link	Wireless (wired development possible)



Develop software to interface and control the sensors, push buttons, and the RGB LED.

Local pushbutton for start/stop data collection and RGB LED for status (ready, recording, low battery)

Data communication method developed: starting wired, developing wireless.

Design Approach - Data Analysis

Primary focus is providing a platform for comparing multiple sets of “form data”

Provided arm dimensions and sensor locations create a framework for sensors in reference to each other

Analysis will calculate elbow position, joint velocities, release speed, time of shot, etc. for comparison parameters

Coaches/players can look at the shot as a whole or focus on specific shooting parameters

Long term goal of calculating positional data and developing model for visual representation

Design Approach - User Interface

- Web app interface for managing previous data and viewing current feedback
- Look and feel of UI will depend heavily on results of data analysis package
  - Comparison of parameters
  - Use of historical data for statistics
  - Visual display using parameters to estimate
  - Full model for visual playback of form
- Incoming data will automatically be compared to a user-selected “ideal” data set for fastest availability

Schedule - Mickeal

Included in project folder

Status - Mickeal

- Currently working on getting our proposal approved so we can be released to buy parts
  - The group has already identified the IMU's and microcontrollers for purchase and included them in the proposal
- Researching data transmission and storage solutions for sensor data
  - Considering JSON, HTTP, and Firebase as a possible solution for data storage and transmission
- Researching software solutions for data analytics and graphics
  - Considering Matlab for possible modeling
- Discussing component placement options, taking into consideration sample rate

Current Concerns - Mickeal

Concerns around component placement are currently being addressed. The group is worried that wire distance and wire capacitance may hinder collection of data in certain circumstances

Battery placement for non-invasive use is another concern. This also determines style of battery used

There are concerns that possible latency variations may hinder data collection speeds. Research into human movement modeling and sampling is currently being done.

References

https://www.teamrankings.com/nba/stat/percent-of-points-from-free-throws

http://www.noahbasketball.com/blog/basketball-shooting-percentages-and-statistics